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# MANUAL OF THERAPY

W. S. STRAU  
European Theater of Operations

5 MAY 1944



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# INTRODUCTION

The practice of medicine and surgery in the Army differs from that in civil life in that procedures and techniques frequently are prescribed instead of each practitioner being permitted to employ methods of his own choice. This is necessary for two reasons. A considerable proportion of patients are treated by several medical officers in different units in the chain of evacuation. It is highly essential that treatment be continuous and conform to one plan rather than to be altered with each change of medical officers. And, finally, in the ultimate analysis it is the Chief Surgeon who is responsible for the care of every patient; and he must, therefore, dictate the professional policies of the Theater.

This manual sets forth principles of treatment which have been tested in active operations by both our own forces and those of our Allies. In it are incorporated many of the professional policies of the medical service of ETO. These policies will be followed habitually. Any one of them may, and should, be disregarded in an individual case where there is sound reason for departing from policy. Personal preference for other methods of treatment as a routine is not a "sound reason." Departures from policies will be made because of special circumstances associated with individual cases.

The material has been divided into three parts:

Section A, which deals with the primary surgical treatment of the soldier and which will be useful for medical officers of divisions.

Section B, which deals with definitive surgical treatment as may be applied in hospitals.

Section C, which deals with the treatment in medical emergencies.

This Manual will be amended from time to time as experience indicates.

PAUL R. HAWLEY  
Major General, USA  
Chief Surgeon.

395573

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# SURGICAL EMERGENCIES. SECTION A

## PRIMARY SURGICAL TREATMENT

### I. WOUNDS OF THE SKIN, SUBCUTANEOUS FAT, FASCIA, MUSCLES AND TENDONS

#### I. General Considerations.

1. Remove only enough clothing to determine the extent of wounding, but be certain that large wounds of the back, buttocks and thighs are not overlooked. If clothing is removed, great care must be taken to ensure that patient is adequately protected from exposure during evacuation.

2. Primary care of wounds is not concerned with debridement of wounds, and is directed toward:—

- a. Prevention of infection.
- b. Control of hemorrhage.
- c. Relief of pain.
- d. Adequate immobilization.
- e. Prevention or treatment of shock.

#### 3. Prevention of infection.

a. Do not increase contamination by needless probing or manipulation of wound.

b. Remove only large superficial foreign bodies.

c. Do not introduce antiseptics such as ether, alcohol, or iodine into the wound.

d. Frost lightly with sulfanilamide.

e. Apply a large sterile dressing, fixed securely in place to prevent further contamination during evacuation.

f. Give tetanus toxoid.

#### 4. Control of hemorrhage.

a. Elevation of the part and an accurate and firmly applied pressure dressing controls most bleeding.

b. Active arterial hemorrhage from a vessel which is visible in the wound should be checked by clamp and ligation.

c. Uncontrollable deep hemorrhage requires the temporary use of a tourniquet, but in general the use of tourniquets should be avoided. When used a notation to that effect must be put on the EMT tag, and directions given for its periodic release.

d. Do not evacuate until bleeding is controlled.

5. Relief of pain. In all cases adequate sedation should be provided during examination, treatment and evacuation.

6. All large wounds, even without associated fracture, should be immobilized during evacuation.

7. Shock should be combated by:—

- a. Control of pain. (Beware overdosage of morphine, etc.)
- b. Immobilization of injured part.
- c. Plasma—in general one or two units of plasma may be given to all patients with extensive wounds, regardless of the circulatory state.
- d. If there is circulatory collapse, plasma and blood, in amounts of 1000 cc., or more, may be necessary (see Shock chapter).

e. Patients in shock should not be evacuated.

8. It is of primary importance to record on the EMT tag the date and hour of injury, the missile producing the wound, and where the wound was sustained.

9. In wounds of the extremity, a note describing the presence or absence of paralysis or evidence of interference with the vascular supply of the extremity is of vital importance to those who will be concerned with the subsequent care of the patient.

10. Patients with vascular impairment or extensive damage to the muscles of the calf, thigh or buttocks, should have priority evacuation because of danger of gas gangrene.

## II. WOUNDS OF THE CENTRAL AND PERIPHERAL NERVOUS SYSTEM

### a. CRANIO-CEREBRAL INJURIES

#### 1. *Diagnosis:*

a. Signs of critical brain injury.

- (1) Profound unconsciousness with failure to respond to deep supraorbital pressure.
- (2) Rapid or irregular respirations.
- (3) Rapid pulse with a rising blood pressure.
- (4) Decerebrate rigidity.
- (5) Dilated fixed pupils.

b. Intra-cranial hemorrhage is a potential factor in every case of head injury. The common signs of acute localized intra-cranial hemorrhage are:—

- (1) Deterioration in condition of patient.
- (2) Convulsive seizures, particularly when localized to one side of body.
- (3) Hemiplegia or hemiparesis.
- (4) Unilateral dilated fixed pupil, particularly after a lucid interval of consciousness.
- (5) Signs of increasing intra-cranial pressure (slowing of the pulse, elevation of blood pressure, changes in the respiratory rate and deepening unconsciousness).



c. Small lacerations of the scalp may be associated with penetrating wounds of the skull and extensive intra-cranial injury. *All scalp wounds should have serious implications until proved otherwise.*

## 2. Treatment:

a. Early evacuation to field or evacuation hospital where a neurosurgical team is available. The sole objective of emergency treatment should be to improve the condition of the patient sufficiently to permit transportation.

b. Treatment of cerebral concussion and edema by spinal fluid drainage and intravenous hypertonic solution are of questionable value and should only be used in exceptional cases.

c. The wound should be treated as follows:—

- (1) Clip hair for several inches about lacerations.
- (2) Control bleeding from scalp wounds with pressure dressings. If bleeding cannot be controlled with pressure, use through-and-through mattress suture.
- (3) Scalp wounds should not be irrigated, debrided or sutured.
- (4) Dust sulfanilamide crystals into the wound, care being taken to distribute them uniformly. More than 5 gms. is seldom required.
- (5) Do not place sulfathiazole or sulfadiazine directly into the wound, particularly if there is brain tissue exposed.
- (6) Once the dressing is placed, do not change it until the patient reaches a hospital where definitive treatment can be given. The dressing may be reinforced as necessary.

d. Blood loss from scalp wounds is seldom severe enough to require early transfusion.

e. Bleeding from the ear should be treated only with a dressing over the external ear. Do not attempt to stop the bleeding. Do not explore, cleanse or irrigate the auditory canal.

f. Shock rarely results from uncomplicated cranial injuries. If the patient is in shock, search carefully for associated injuries, particularly chest and abdominal wounds, or extensive injury to the long bones. *When shock is present, the usual treatment of this state takes precedence over all other considerations.*

g. An unconscious patient should not be placed on his back or in an upright position. Aspiration of secretions from the nose and throat into the bronchial tree is promoted in these positions and the patient may literally drown in his own secretions. He should be placed on his side, the foot of the litter or bed elevated so that secretions run from his mouth by gravity (postural drainage).



**h. Medication.** Morphine suppresses the state of consciousness, and depresses the respiratory centers, and its use should be discouraged in cranio-cerebral trauma. Head wounds accompanied by painful wounds of other parts may require morphine, but it must be used judiciously.

**i.** Early recording of the following data is important for the most efficient future treatment of the patient:—

- (1) Time of injury.
- (2) State of consciousness when first seen.
- (3) Paralysis of one or more extremities.
- (4) Pulse rate counted for one half minute.
- (5) Respiratory rate and rhythm.
- (6) Blood pressure.

### **3. Evacuation:**

**a.** Head injury patients without serious associated injuries stand transportation well. The usual dictums of good first aid care should be followed whether evacuation is by air, ambulance, boat or hospital train. High priority evacuation is always indicated.

## **b. FRACTURES OF THE SPINE WITH NEUROLOGICAL INVOLVEMENT**

### **Cervical.**

#### **1. Diagnosis:**

**a.** When an injured man complains of severe pain in his neck, suspect a fracture or fracture-dislocation of the cervical spine; if his arms and legs are paralyzed the diagnosis is certain.

**b.** Cervical spine fractures are usually associated with forward dislocation and anterior angulation at the level of the lesion. Determination of the exact level of the fracture is unimportant for emergency treatment.

*Do not manipulate the head in an attempt to establish the level of the injury.*

#### **2. Treatment:**

**a.** The most important principle of treatment is to prevent an increase in the bony deformity. Do not move the patient until the conditions are favorable. *Make every move count.* Do not raise the head under any circumstances. Do not put a rolled blanket or pillow beneath the head.

**b.** With the patient on his back, place a folded blanket (not more than 3 in. thick) beneath the shoulders, thus permitting the head to fall backward and downward. Place and fix folded blankets or articles of clothing on either side of the head to reduce lateral movement.

**c.** When patient is picked up to transfer to a litter or solid support, maintain strong traction at both the head and feet in the longitudinal axis of the body.

d. Keep pressure off the sacrum and heels, and where possible transfer patient to soft mattress to minimise danger of pressure sores.

e. An indwelling catheter should be introduced before distention of the bladder occurs, especially before evacuation of patient to distant points. *Never clamp the catheter.*

f. Give morphine cautiously to cervical injuries for fear of respiratory paralysis; in many cases the diaphragm will have been paralysed by the damage to the cervical spinal cord.

### 3. Evacuation:

a. High priority evacuation to General or Evacuation hospital is indicated.

## Lumbar.

### 1. Diagnosis:

a. If an injured patient complains of severe local pain in the lumbar region, fracture of the spine in this area should be suspected. Paralysis of the legs below the knees makes the diagnosis certain.

### 2. Treatment:

a. Again the fundamental principle in handling fractures or fracture-dislocations of the lumbar spine is to prevent an increase in the bony deformity, thus avoiding further injury to the spinal cord.

b. There are two acceptable positions for transportation of patients with lumbar spinal fractures:—

(1) With the patient on his back, make a roll with folded blankets, about 12 to 18 ins. in circumference, and place beneath the mattress near the site of the injury. This position produces hypertension of the spine.

(2) With the patient face down, some extension of the spine is automatically produced; in all circumstances further flexing is prevented.

c. When transferring patient from ground to litter traction should be maintained at the feet and axilla and he should be slid or rotated to the litter and not lifted.

d. Keep pressure off sacrum and heels and wherever possible transfer to a soft mattress

e. An indwelling catheter should be introduced but it should not be clamped.

f. Do not attempt to reduce the fracture in the field or in the intermediate dressing stations.

### 3. Evacuation:

a. High priority to a Field, Evacuation or General hospital is indicated.

### c. INJURY TO PERIPHERAL NERVES

#### 1. *Diagnosis:*

a. Fifteen percent of extremity wounds are complicated by injury to one or more major nerve trunks. Simple tests for motor and sensory function will usually indicate accurately which nerve is involved.

b. At the primary inspection of the wound, observe carefully the exposed nerves and record their condition on the EMT tag or on the cast. This information greatly facilitates later treatment.

#### 2. *Treatment.*

a. Extremity wounds with nerve injuries should receive exactly the same treatment as soft tissue wounds elsewhere (see page 4). Most patients with nerve injury will have injuries to one or more of the long bones, so splinting will be a preliminary requirement for transportation. In those cases with bone injury, the extremity should be immobilized in the most favorable position, to prevent deformity. This can usually be accomplished with bandages or rolls of clothing and blankets. Casts or elaborate splints will usually not be required for satisfactory evacuation. Remember to protect from pressure a part that has been deprived of sensation.

#### 3. *Evacuation.*

a. Low priority evacuation is usually indicated.

### III. WOUNDS AND INJURIES OF THE EYE

1. Look for an ocular injury in all cases, particularly in the unconscious patient. Separate the lids gently, avoiding pressure on the eyeball. Overcome lid spasm by the use of lid hooks, or a U-shaped piece of strong wire, suitably bent, or the handles of two teaspoons.

2. Look for and remove superficial loose foreign material, metallic bodies, dirt. Do not mistake prolapsed iris or dark bloody vitreous for foreign bodies. Do not excise prolapsed tissue. Do not probe. Make a diagnosis.

3. Instil 2 drops of 1 or 2% solution of atropine.

4. Follow with 5% sulfanilamide, 5% sulfathiazole, or 1-2% yellow oxide of mercury ointments, whichever is at hand. Do not use sulfadiazine ointment in the eye; it is most injurious.

5. Close the eyelids with a folded eye pad, a piece of cotton the size of a hen's egg or an eyepad made by folding over and over a 2-inch gauze bandage, forming a 2-inch square of about  $\frac{1}{4}$ -inch thickness. Moisten any of these in boric acid or saline solution, or sterile water, and apply damp. Cover with a dry eye pad or 2-inch gauze square and fasten with adhesive tapes.

Cover the sound eye with a piece of gauze and apply a binocular bandage. Evacuate as a litter patient, lying down. In the event that the lids are badly damaged, or in the unconscious patient, close the lids with sutures through the skin and subcutaneous tissue of the upper and lower lids, next to the lash edge, and tie together.

A simpler method is to pass a silk stitch through the skin of the upper lid, to draw the eyelid down, and to anchor the free ends of the stitch to the cheek with a piece of adhesive plaster. If the upper lid is gone, reverse the process.

If the lids are torn or split, the same first aid treatment can be applied with a few key sutures placed exactly in the intermarginal lid area.

If the lids are hopelessly destroyed and the eyeball in reasonable condition, perform a complete purse string, conjunctival flap, as described in Section B.

If for some reason the patient cannot be evacuated as a litter case, leave the sound eye covered only by a cardboard or stiff paper peep-hole (2-3 mm.), screen or eyeshade to prevent ocular movements. This helps to splint the injured eye.

#### IV. WOUNDS AND INJURIES OF EAR, NOSE, THROAT, SINUSES AND LARYNX

##### Specific Considerations.

##### 1. *Stop Hemorrhage.*

a. Pressure is chief method of control and can be applied by bandaging over gauze pads or rolls.

b. Use hemostats and ties on vessels easily available.

c. Bleeding from external auditory canal is usually slight and packing should be used only in extreme cases.

d. Bandage over the ear is preferable to intra-canal packing.

e. Nasal bleeding is stopped with vaseline gauze packing, occasionally requiring a post-nasal plug placed through the mouth and held in place with a cord through the nose.

f. Pharyngeal hemorrhage, if severe enough, requires external carotid ligation or packing the wound after tracheotomy.

##### 2. *Maintain Airway.*

a. The airway is dangerously obstructed when respiration is audible at rest when the observer is about 3 feet from the patient.

b. At that time, unless the patient can be constantly watched, tracheotomy should be seriously considered and performed if there is noticeable progression of the obstruction within one hour.

c. Laryngeal edema recedes much more rapidly with tracheotomy tube in place, and patients travel better with adequate airway.



### 3. *Preserve Tissue.*

a. Every piece of tissue which has any chance of survival should be retained for later plastic repair.

b. Debridement should not be done, and even pieces of bone and loose teeth should be preserved unless completely detached.

### 4. *Avoid Syringing the Auditory Canal.*

a. The possibility of introducing infection into the external auditory canal makes syringing dangerous.

b. Hemorrhage and cerebrospinal fluid leak from this orifice is usually not serious and the fluid should be encouraged to come out.

c. A sterile gauze or cotton wick lightly packed in the canal usually suffices, and should also be used in cases of suspected blast injury or ruptured drum.

### 5. *Wound Syringing in general.*

a. Wounds about the face and sinuses will frequently communicate with the throat.

b. Syringing should therefore be avoided because of the possibility of aspiration of foreign material into the lower air passages.

### 6. *Cautious use of Sedatives and Narcotics.*

a. In oozing wounds of the nose and throat, the danger of aspiration of blood, and involuntary swallowing of blood, make it imperative to keep the patient in a condition so he can expectorate.

b. Deep sedation is, therefore, contra-indicated to avoid unnoticed hemorrhage.

c. Sudden deafness, unilateral or bilateral, partial or complete, after exposure to excessive noise, is due to injury of the internal ear. The deafness may be accompanied by nystagmus, tinnitus and vertigo. If deafness does not improve in 2 or 3 days, evacuate the patient for care by an otologist.

## V. TREATMENT OF MAXILLOFACIAL INJURIES

### I. *General Considerations.*

1. A correlated plan of treatment, if carried out from the time the wound is incurred until definitive treatment is available, will greatly shorten the period of disability of patients with face and jaw injuries, and a larger number will be restored to approximately normal function and appearance than if haphazard methods are followed. Certain things should be done and others should not be done. Hence, attention to these points will save many lives and facilitate later treatment.

2. The use of local and systemic chemotherapy is indicated as for wounds of other parts of the body. This is particularly important in the treatment of massive wounds involving the

floor of the mouth and those associated with compound fractures.

3. Primary care, points demanding special attention.

- a. Control of hemorrhage.
- b. Provision of adequate respiratory airway.
- c. Temporary approximate reduction and fixation of maxillofacial fractures and adjustment of parts to anatomical position. (Relief of pain, treatment of shock, and other emergency measures as indicated.)
- d. Early evacuation to a hospital for definitive treatment.

## II. Specific Considerations.

### 1. *Control of Hemorrhage.*

a. Control moderate hemorrhage by pressure from gauze compress and bandage.

b. Hemorrhage not controlled by pack and pressure will require clamps and ligature of the bleeding vessels. In case ligature is not available and clamp is left on, it should be included in the bandage and marked.

c. In severe hemorrhage, life may be saved by application of digital pressure to a bleeding vessel at a control point in its course, until a clamp and ligature can be applied.

d. **DO NOT** increase respiratory difficulty by the application of gauze compress and bandage. Bandages *should not* create backward pressure or traction distally on fractures of the mandible.

### 2. *Provision of adequate respiratory airway.*

a. Clear mouth and throat of tooth fragments, detached bone fragments, broken or dislodged dentures, and all foreign matter.

b. Insufficient respiratory airway can be improved by the insertion of a rubber tube through the nose or mouth to the nasopharynx.

c. Critical cases may require intra-tracheal tube.

d. Tracheotomy should be done *promptly* if more simple measures fail to provide an adequate airway. In some cases of massive injury about the jaw and pharynx tracheotomy will be necessary as an emergency life saving measure.

e. In case of collapse of pharynx and floor of the mouth, or loss of control of the tongue, an airway can be maintained by holding the tongue forward. This can be accomplished by passing a suture through the tip for holding it forward. (In extreme emergency cases safety pins have been used to transfix the tip of the tongue.) Fractures of the superior maxillae frequently displace the loose structures downward and backward and definitely interfere with respiration. Bilateral comminuted fractures of the posterior part of the mandible may cause the chin segment to drop downward and backward, likewise causing respiratory interference. In either



case the front of the jaw may be held forward by a simple emergency splint. (Fig. 1.)

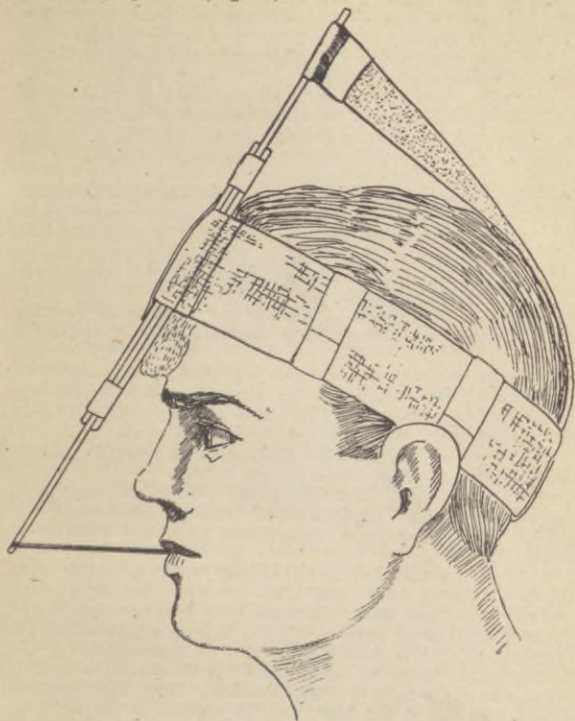


FIG. 1. .

(1) *Material.*

Wooden tongue depressors, 4.

Adhesive tape.

Bandage, 2-inch.

Ligature wire.

(2) *Construction.*

Two tongue depressors are placed end to end and are held by two others overlapping them in the middle, all being bound together with adhesive tape.

(3) *Application.*

- (a) This unit is secured vertically in the frontal region with a circular bandage so that the lower end is projected in front of the mouth. The upper end is attached to the bandage in the occipital region with a piece of tape.
- (b) A wire ligature is attached to the lower teeth or passed around the chin segment of the mandible, and the ends of the wire fastened to the lower end of the tongue depressor piece, either directly or with a rubber band.
- (c) The spring of the tongue depressor piece or elastic traction effectively keeps the anterior segment of the mandible forward. Likewise in cases of backward displacement of the maxillae, forward traction can be obtained by attachment of the upper teeth to the apparatus.

3. *Temporary approximate reduction and fixation of maxillo-facial fractures and adjustment of displaced parts to anatomical position.*

a. Institute adequate measures for relief of pain and prevention of shock. Morphine should be administered cautiously to patients with respiratory difficulty and is contra-indicated for patients with associated cranial injuries.

b. Cleanse wound superficially, removing tooth fragments, detached bone particles and foreign matter.

c. Displaced parts should be gently adjusted to anatomical position and gauze compress and bandage applied. *Avoid* collapsing bone segments and prevent backward traction on the mandible.

d. Maxillary fractures and fractures of the adjacent facial bones should be gently supported by stable bandaging. In primary treatment this stabilization can be improved by the application of gauze compresses and bandages used to control hemorrhage. It is essential to aim at re-establishing the former occlusion of the teeth, therefore all bandages applied should be supportive in this direction. Wire ligatures and suture material, if available, can be applied to the teeth of the same jaw across the line of fracture, to assist in stabilization of parts during evacuation. Multiple loop wiring, with intermaxillary elastic traction for reduction and stabilization of certain fractures, should be accomplished as early as time and facilities permit. Rigid intermaxillary fixation with wire is definitely contra-indicated in primary treatment for any case that might become nauseated or develop respiratory interference during evacuation. Edentulous cases require bandages that gently support the parts and avoid the tendency to collapse the segments. Dentures should be located, if pos-

sible, for use with adjustment and splinting of alveolar parts. These should always be transferred with the patient (even if broken).

e. Stabilization of parts is essential to avoid recurrent hemorrhage, reduce pain and prevent shock.

f. A stimulating dose of tetanus toxoid is indicated as for wounds of other parts of the body.

4. *Evacuate patients to a hospital or station where definitive treatment can be provided early.*

a. Ambulant or semi-ambulant patients with oral or pharyngeal wounds should travel sitting up, if possible.

b. Litter patients should be placed in a comfortable position and prone (face down) so that there is no possibility of interference with respiratory airway or aspiration of fluids.

## VI. THORACIC WOUNDS

1. There are three (3) main types of thoracic injuries:

a. Those in which there is only a wound of the chest wall, in which case treatment is directed as in any wound.

b. Those in which there are perforating, or penetrating, wounds of the pleural cavity, or lung, without cardio-respiratory embarrassment. No specific treatment in forward areas is necessary other than proper care to the external wounds, but priority evacuation must be arranged for the prompt treatment of complications which may develop.

c. Those with cardio-respiratory embarrassment, the recognition of which is essential because correct treatment is life-saving and often must be carried out in forward areas.

2. *Diagnosis:*

a. *Open Pneumothorax ("Sucking Wound"):* In this condition there is a free communication between the pleural space and the outside air. With each respiration, air is sucked into the pleural cavity, there is a swing-motion of the mediastinum and interference with the venous return to the heart. The marked respiratory distress, the visible wound in the chest wall, and the audible sucking of air into it, make the diagnosis obvious to the most inexperienced observer.

b. *Tension Pneumothorax (Pressure Pneumothorax):* In this condition, air escapes through a valve-like wound in the lung into the pleural space. With each breath air is forced into the pleural space, causing collapse and compression of the injured lung, displacement of the mediastinum to the opposite side, and progressive reduction in the volume of the opposite lung. The diagnosis is made by the finding of hyper-resonance and absent breath sounds on the affected side, with displacement of the heart, trachea, and mediastinum toward the opposite side in a patient with progressively increasing respiratory distress. It is important to recognize

that this condition may develop after an air-tight closure of an open pneumothorax.

c. *Crush Injury ("Stove-in-Chest")*: In this condition due to fracture of many ribs, there is complete mobility of a portion of the chest wall with paradoxical movement on respiration, severe pain, and dyspnea. The condition is obvious on palpation of the involved portion of the chest wall.

d. *Hemorrhage*: This will be either obvious externally from a wound of the chest wall, or will be intra-thoracic. There are four sources of intra-thoracic hemorrhage—(1) the internal mammary vessels; (2) the intercostal vessels; (3) the great vessels at the root of the lung; (4) the lung itself. Bleeding from the lung parenchyma is rarely fatal because the low arterial pressure in the pulmonary circuit nearly always allows for spontaneous cessation of bleeding. Wounds of the great vessels at the hilus of the lung are nearly always fatal. This leaves only two common sources of hemorrhage which should concern the surgeon in forward areas, and for which he may be able to do something. The location of the wound, 1 cm. lateral to the sternum, in the case of the internal mammary vessels, and beneath a rib margin, in the case of the intercostal vessels, is the key to the diagnosis.

e. *Subcutaneous Emphysema*: This may occur in any wound in which a small opening in the pleura occurs. It is recognized by progressive non-tender swelling of subcutaneous tissue, with palpable crepitation around the wound, or at the base of the neck. This condition may develop after an attempt to close an open pneumothorax by suture of the skin alone.

f. *Blast Injuries*: In this condition there is rupture of many small vessels of the lung with pulmonary edema due to the concussion effect of the blast. The diagnosis is made on the basis of the history, the presence of hemoptysis, cyanosis, and diffuse rales throughout both lungs.

### 3. *Treatment.*

a. *Open Pneumothorax*: The primary consideration is to close the hole in the chest wall. This is best done by a large, sterile vaseline-gauze pad supported by a bulky dressing, and held firmly in place with adhesive tape. Because of the danger of tension pneumothorax it is better if this dressing is not sealed absolutely air-tight but it should be nearly so. In the presence of large gaping wounds it may be necessary to suture the gauze pad in place so that it is not lost in the pleural cavity. In an emergency, anything to close the hole—a large, sterile pad held over the opening by one's hand—is sufficient to save life until a more adequate dressing is applied. The patient should lie on the affected side.

b. *Pressure Pneumothorax*: Treatment consists of introducing a needle through the second interspace anteriorly,



on the involved side, and allowing the air to escape (Fig. 1a). As a precautionary measure against recurrence, or if the air continues to escape, the needle should be re-inserted through a cork, strapped in place and covered with a condom or finger cot in such a manner that a valve is produced (Fig. 1b). In place of the needle a small catheter may be introduced through an incision in the thoracic wall and attached to a closed drainage system (Fig. 1c).

## "Flutter Valve"

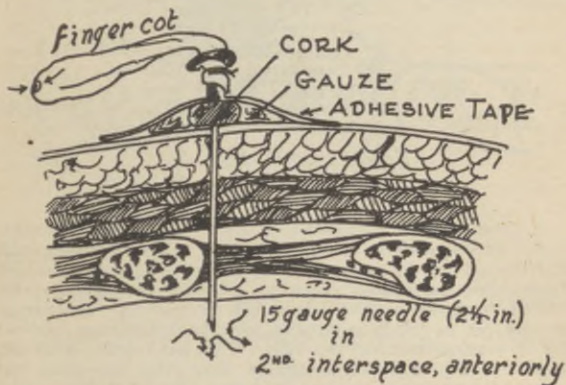


FIG. 1a.

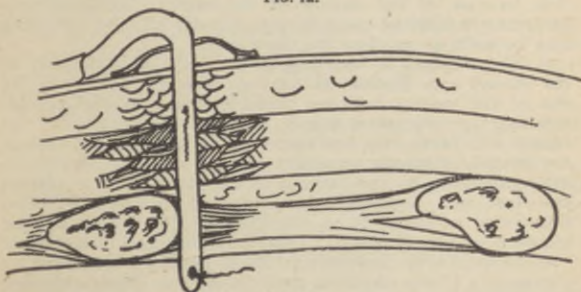


FIG. 1b.

## Intercostal Block

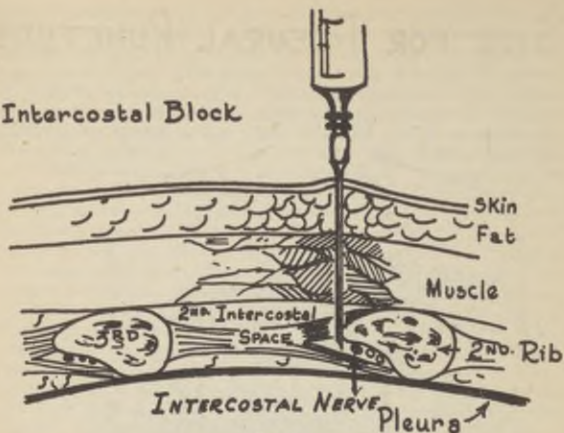


FIG. 1c.

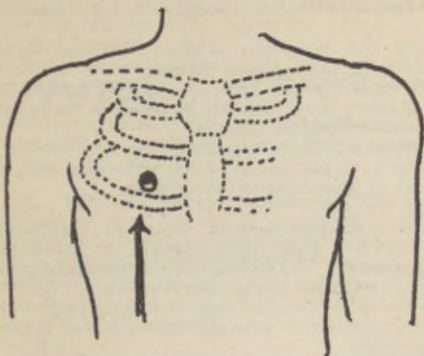
c. *Crush Injuries*: Relieve pain by anesthetizing the intercostal nerves with novocaine (Fig. 2). Control paradoxical movements of the chest wall by adhesive strapping which immobilizes the injured side only. If there is marked cyanosis there is probably associated bronchial obstruction. Encourage the patient to cough vigorously after pain has been relieved by novocainization of the ribs. The head-down position, together with vigorous coughing, may clear the bronchial tract. Patient must not be left alone in the head-down position because of the danger of respiratory embarrassment. In extensive bilateral crush injuries circular adhesive strapping may be tried to stabilize the chest wall.

d. *Hemorrhage*: If bleeding is external, an inspection of the wound may disclose an obvious bleeding point. If the site of the wound indicates possible injury to the internal mammary or intercostal vessels, try to secure the ends of the vessels with hemostats, and ligate. Failing to do this, enlarge the wound sufficiently to permit a finger to control the bleeding temporarily by compression of the bleeding point against the chest wall, and then try to stop the bleeding by deep transfixing sutures. If no bleeding point is found, combat the ooze by firm packing. Treat for shock and hemorrhage.

e. *Subcutaneous Emphysema*: As a rule, no treatment is necessary. If this condition develops after an air-tight closure of an open pneumothorax, there will be an associated tension-



# SITE FOR PLEURAL PUNCTURE



1 INCH AWAY FROM STERNUM  
IN 2<sup>ND</sup>. INTERCOSTAL SPACE

FIG. 2.

pneumothorax which requires treatment in the same way as described above.

f. *Blast Injuries*: Absolute rest is more important than immediate evacuation. Oxygen is of the greatest value. The associated collapse is not benefited by plasma or whole-blood transfusion.

#### 4. *Evacuation*:

a. Chest cases have the same high priority as abdominal cases.

b. It should be remembered that patients with thoracic injuries are often more comfortable and breathe better sitting up than lying down. Arrange evacuation in the position best tolerated by the individual patient.

## VII. ABDOMINAL WOUNDS

### 1. *Diagnosis*:

a. The most minute perforation of the skin of the abdominal

wall must be suspected as a possible wound of entrance. If accompanied by gastro-intestinal symptoms or physical findings of peritoneal irritation, a presumptive diagnosis of intra-abdominal injury should be made at once.

b. Projectiles entering the chest, buttocks, thighs, sacral or perineal areas must be regarded as possible causes of abdominal injuries.

c. The signs and symptoms of intra-peritoneal damage vary, and often do not indicate the gravity of the injury. Rigidity is a very misleading sign. It may be present from abdominal wall injury alone, and may be absent in the presence of extensive intra-abdominal wounds.

d. Intra-abdominal injuries may occur from non-penetrating injuries without a visible wound of the abdominal wall, and also from crush or blast injuries (air or water).

### 2. Treatment:

a. The most vital factor is *time*. Therefore, there should be no time wasted in unnecessary changing of dressings or prolonged examination. As soon as the diagnosis is suspected, arrange priority evacuation to the nearest unit where operation can be done and post-operative care of 8-10 days provided.

b. Disturb the patient as little as possible during examination and evacuation.

c. Morphine sufficient to control pain is permissible as soon as the diagnosis is evident. The absorption of morphine is delayed in the presence of shock; give repeated doses of morphine with great caution.

d. Nothing should be given by mouth.

e. Shock must be treated by infusions of plasma and whole blood if available. This must be maintained if evacuation is delayed or prolonged. If hemorrhage is suspected, *slow* continuous infusions are preferable to rapid, short ones. Mortality of abdominal wounds is more directly related to the amount of hemorrhage than to any other single factor.

g. Evisceration—do not replace but frost with sulfanilamide and cover with a moist sterile dressing, reinforced by abdominal dressing.

### 3. Evacuation:

a. Abdominal injuries have highest priority rating. Operation should be done as soon as possible.

## VIII. WOUNDS OF THE GENITO-URINARY SYSTEM

1. In wounds of the kidney region, where hemorrhage is profuse, blood vessels should be ligated if possible. If this is impossible, the wounds should be dusted with sulfanilamide powder and packed securely with gauze. A firm binder should be used.

2. In wounds of the bladder region, dust with sulfanilamide powder and apply sterile dressing. In cases of pelvic fracture, the pelvis and lower limbs should be splinted for transportation.
3. In wounds of the external genitalia, dust with sulfanilamide and apply sterile dressing. Do not remove any tissue.
4. Do not catheterize a patient for diagnostic purposes at First Aid stations.
5. Treat shock as indicated and, excluding cases of hemorrhage, give evacuation priority to cases of possible ruptured bladder and bowel.
6. A catheter should be passed and left inlying in all cases of severe injury to nervous system when a neurogenic bladder will result.

## IX. WOUNDS OF LARGE BLOOD VESSELS

### *Diagnosis:*

1. Diagnosis is made by bright blood escaping from wound or an increasingly tense hematoma.
2. Remember that the skin need not be broken in order for an injury to an artery from a contusion, a fracture or a dislocation to be present.

### *Treatment:*

1. *Control hemorrhage* in cases in which blood is escaping from the wound by any of the following methods:—

- a. Elevation of the part. This should be done with due care of associated fractures, regardless of the local methods used.

- b. Direct pressure on the wound with a bulky dressing.

- c. Secure the bleeding vessel with a clamp and ligature, and ligate the companion vein. This is only to be done when the open vessel can be easily seen in the wound, lest blind clamping in the depths of the wound cause nerve injury.

- d. Direct control of the artery by digital pressure at the root of the limb.

- e. Ligation of the artery and companion vein at a distance from the wound.

- f. The use of a tourniquet is to be discouraged except as a temporary emergency measure to facilitate control by other means, i.e., ligature, packing and pressure dressing. Evacuation with a tourniquet in place means the almost certain loss of the extremity distal to the tourniquet. However, during evacuation, an unapplied tourniquet should accompany patients with injuries to major blood vessels.

2. In cases in which the bleeding is chiefly subcutaneous, local pressure over the hematoma is the only emergency local measure indicated.

3. Cases with severe bleeding into fascia planes of the extremity have a greater chance of gangrene than those in

whom the blood can escape. Priority evacuation is indicated in these cases.

4. Replace lost blood, whether external or into tissues, with plasma and blood transfusion.

5. For transport, keep the body warm but apply no artificial heat to the limb.

6. *Surgical technique for the ligation of important arteries.* The following technical steps should be employed in approaching individual blood vessels. The incisions depicted are those suitable for reaching the vessels at a point where they are undamaged. Where the approach is through a wound directly onto the lesion in the vessel, incisions should be much larger than those here shown, in order to give enough exposure for adequate control of hemorrhage. The decision as to the site for ligation is best made by constriction of the artery in the wound with observation of the color, pulse and temperature in the hand or foot during constriction. This is safer than relying on a constant pattern of collateral circulation in a system so subject to anomalies as the arterial tree (see diagrammatic sketches of arterial tree, pages 147 to 156).

## X. CONTUSIONS, STRAINS, AND SPRAINS

### 1. Definitions:

a. A *contusion* is a crushing injury of soft tissue without a break in the skin.

b. A *strain* is an incomplete rupture or avulsion of a muscle or tendon from its attachments or in its substance.

c. A *sprain* is an incomplete rupture or avulsion of a ligament.

### 2. Diagnosis:

Great care must be taken to exclude the possibility of fracture by consideration of the forces involved in the injury and careful examination. *If there is any doubt, treatment should be instituted for fracture and the patient evacuated.* Sharply localized tenderness over bone, rather than ligament, muscle, or tendon and pain at the site of injury on manipulation of bones at a distance from the injury are more characteristic of fracture than sprain. Stress fractures in the metatarsals tibia, and even the femur may easily be confused with muscle strains. Sprains of the wrist are very rare and fractures of the scaphoid very common.

### 3. Treatment and Evacuation:

The objects of treatment are to:

a. Prevent edema and hematoma formation.

b. Disseminate for more rapid absorption any hematoma which has formed.

c. Promote healing by fibroblast proliferation.

This is accomplished by the application of cold (when possible) to the fresh injury, by compression, and by resting the injured part.



Ice cold wet compresses, where available, should be applied to any contusion, strain, or sprain where seen immediately after injury. Heat in any form as a primary treatment is illogical and harmful. The injured part should then be firmly bandaged with an elastic ("Ace") bandage with a generous felt, cotton, or if available, sponge rubber pad directly over the site of injury beneath the bandage. The bandage should be firmly anchored to prevent slipping and the injured part put at rest. The great majority of strains and sprains of the back and lower extremity will require evacuation. However, many mild ankle sprains exhibit pain and disability out of proportion to the degree of damage to the ligaments. In these the vicious cycle of pain—edema—tissue anoxia—pain—can be interrupted by infiltration of the areas of greatest tenderness with 10-20 c.c. 1% novocaine. The ankle is strapped with adhesive tape after shaving and the patient returned to duty. A second infiltration may be required. Strapping should be of the basket weave type and should prevent lateral motion at the ankle joint. This is the only contusion, strain or sprain for which adhesive strapping is recommended as a primary treatment.

## XI. BONE AND JOINT INJURIES

The following suggestions are made for the initial handling of patients with bone and joint injuries, covering examination, splinting and evacuation from forward areas to hospitals where definitive treatment can be provided.

### 1. Examination:

A rapid but careful examination of the patient should be made to determine the site of injury, so that proper splinting can be applied. It is not advisable to remove all of the clothing from the patient for this examination but to examine him extremity by extremity, and then make a careful check of his thorax and back.

*It is important to splint early to minimize shock and soft tissue damage.*

At the time the initial examination is made, priority evacuation should be arranged so that proper definitive treatment can be instituted.

### 2. Treatment:

a. *Local Wound.* Sulfonamide powder should be lightly dusted over the wound and the wound covered with a dry, sterile dressing.

b. *Hemorrhage.* Hemorrhage should be controlled. The most desirable method is by a simple pressure dressing. If it is necessary to use a tourniquet, arrangements should be made to loosen the tourniquet from time to time, such as once each hour, so that additional harm will not result from

its use. Patients with tourniquets should be evacuated immediately so that this hemorrhage can be controlled by other means.

c. *Morphine*. Morphine should be administered in sufficient quantities to control pain.

d. *Shock*. When this is present it should be treated by transfusions of plasma or whole blood. The control of hemorrhage and application of proper splinting will also do much to minimize shock.

e. *Tetanus toxoid*. Tetanus toxoid for U.S. troops, or anti-tetanus serum for British or other troops, and chemotherapeutic prophylactic agents should be administered.

f. The following splints for initial transportation are suggested:

- (1) *Femur, knee and leg*. Apply the hinged, half-ring leg splint with effective traction. Traction may be made by using the webbing strap and buckle, gauze bandage and clove hitch, or by adhesive tape traction to the skin.
- (2) *Foot and ankle*. Apply a well-padded wire ladder splint or two padded board coaptation splints to the sides of the foot and ankle.
- (3) *Shoulder, arm or elbow*. Bind the injured extremity to the chest wall with triangular bandages or with a velpeau dressing made from gauze bandages.
- (4) *Elbow, forearm and wrist*. Splint with a well-padded wire ladder splint or two padded board coaptation splints and bind to the trunk with triangular bandages or a velpeau dressing.
- (5) *Lumbar and dorsal spine*. The patient should be put prone on a litter without any padding, or supine on a litter with a small pad or blanket roll under the site of injury. Patients may also be transported in a blanket lift, if there are sufficient personnel to make this form of transportation practicable.
- (6) *Cervical spine*. Improvise a collar-type immobilization by using the patient's canvas leggings, with the hooks of each legging facing so as to leave a smooth outer surface. Then fit the ankle notch snugly under the chin, tie the leggings with the laces and wrap tightly in place with a bandage.
- (7) *Pelvis*. Make a snug swathe about the pelvis using triangular bandages or the patient's own clothing. Additional comfort in transportation will be obtained by binding the patient's legs together.
- (8) Cover the patient well with blankets, coats, etc., to retain body heat.

### 3. *Evacuation:*

- a. *All compound fractures should have the highest priority in*



evacuation to the most forward hospital or surgical unit where debridement can be performed.

b. Simple fractures should be transported to the hospital as soon after splinting as conditions of evacuation will permit, but in general these cases may be retained for lower priority evacuation. *If, however, there is evidence of progressive, concealed hemorrhage, which might produce shock, gangrene or ischemic paralysis, such patients with these simple fractures should have the highest priority in evacuation.*

## **XII. GENERAL PRINCIPLES IN THE TREATMENT OF TRAUMATIC SHOCK**

1. Traumatic shock may be defined as circulatory failure due to a marked reduction in the circulating blood volume.

2. Early recognition of impending shock is vitally important from the point of view of effective therapy. The loss of blood volume is usually much greater than is apparent from the early signs and symptoms. This fact must be constantly borne in mind, for shock, once manifest, becomes increasingly difficult to treat, less and less responsive to therapy, and self-perpetuating to a point where treatment is no longer effective.

3. Treatment of impending shock must be initiated as soon as the situation is recognized. The essential therapy reduces itself to:—

(a) Measures taken to prevent further loss of fluid from the circulation (*hemostasis*).

(b) Restoration of the deficient blood volume to a safe level (*transfusion*).

(c) Alleviation of severe pain and restlessness.

(a) *Hemostasis.*

Measures taken to check further losses in the circulating blood volume are of primary importance. Hemostasis must be accomplished immediately, by the most effective and the simplest possible means. External hemorrhages are controlled with pressure dressings—not, if it can be avoided, by tourniquets which increase the tissue damage peripheral to the point of application and hence favor further fluid loss after their removal, into the traumatized extremity. Patients with abdominal and chest injuries are moved as little as possible. Fractures must be promptly and securely immobilized to prevent further laceration of blood vessels by the jagged ends of bone. Until the blood volume is restored, operative procedures, other than those necessary to accomplish hemostasis, are deferred.

(b) *Transfusion.*

The deficiency in the circulating blood volume must be restored, as soon as possible, by transfusion. It is essential

that this replacement be *early* and *adequate*. Plasma will be the most constantly available material for transfusions in the forward combat areas. In the preliminary stages of shock therapy the transfusion of plasma in adequate amounts is a satisfactory method of restoring the circulating blood volume (minimal of 500-1000 cc. (2-4 units) are necessary). Burn cases require plasma primarily. Casualties suffering from massive hemorrhage respond satisfactorily to plasma transfusions, but only up to a certain point. If hemorrhage continues, or if operative procedures are to be undertaken, the plasma should be supplemented as soon as possible by whole blood, in the proportion of at least one part whole blood to two parts of plasma.

The source of whole blood transfusions will be, for the most part, non-combatant personnel, medical personnel or lightly-wounded casualties. The necessary equipment for performing fresh blood transfusions is available for all medical installations, as far forward as the clearing station. Donors are selected on the basis of their identification tags. Because of errors in the latter, the blood group must be re-checked in each case. When Group O blood is used it is unnecessary to cross-match. When other types are used, cross-matching must not be omitted. Whenever time permits, the double precaution afforded by the cross-match should never be neglected.

This source of whole blood will be supplemented, wherever possible, by stored Group O blood distributed by plane and truck, in refrigerator containers. Fresh blood should be given within 6-8 hours after it has been obtained from a donor; stored blood within 8-10 hours after its removal from cold storage.

The volume of blood and plasma to be administered must be estimated in each case on the basis of the clinical evaluation, and particularly upon the patient's response to therapy. It can be stated, in general, that the minimum transfusion requirements of any casualty with signs of shock are 1000 to 1500 cc.

Transfusions are not to be done indiscriminately, but must be reserved for cases presenting definite indications of significant blood loss. Casualties with perforating abdominal wounds and extremity wounds, especially compound fractures of the lower extremities, require transfusion more consistently and in greater volume than other groups of cases. Chest wounds associated with hemorrhage require adequate transfusions.

(c) *Relief of Pain.*

If pain is not controlled by the immobilization and dressing of the injured part, the judicious administration of morphine

is indicated. Morphine, in shock cases, should be given, not subcutaneously or intramuscularly, but intravenously, for, because of the peripheral vasoconstriction, absorption of the drug from the injection site is retarded and variable. Unless given by the intravenous route, estimation of its effect and, consequently, regulation of its dosage, is difficult.

Morphine in syrettes is not suitable for intravenous administration. The maximal single dose of intravenous morphine sulphate is 16 mg. ( $\frac{1}{4}$  gr.). Its administration can be repeated at intervals of two to three hours, should pain and excitement require further control, and provided there is no evidence of respiratory depression. If, for any reason, the morphine must be administered subcutaneously, the retarded absorption must be taken into account in estimating its effect and the interval between doses. No dose should exceed 16 mg. ( $\frac{1}{4}$  gr.), and a minimum of four hours should elapse between doses. If the respiratory rate decreases to less than twelve per minute, the respiratory center should be stimulated with one or two cc. of caffeine-sodium-benzoate injected intravenously.

(d) *Supportive Therapy.*

*Protection against chilling* of the patient is accomplished by the proper use of blankets under and on the patient, as well as protective clothing.

*Avoidance of overheating* the patient is equally important.

*Intravenous injection of saline solution* is indicated, in addition to plasma or whole blood, when there has been vomiting, prolonged excessive sweating or dehydration from any cause other than plasma or blood loss.

*The use of oxygen* is often a useful adjunct to shock therapy; it is especially indicated if there is cyanosis or associated chest injuries.

*Respiratory and cardiovascular stimulants*, such as caffeine, coramine, adrenalin and strychnine, are ineffective in the treatment of shock. Caffeine and coramine, however, are useful in combating respiratory depression brought about by morphine applied injudiciously in its treatment.

*The position of the patient* on the stretcher, provided he is quiet, comfortable and nearly horizontal, is relatively unimportant so far as the shock is concerned.

*Anesthetics of choice*, in the presence of shock, are local or block anesthesia with procaine.

4. No patient who has been in shock should be evacuated until, by means of intensive transfusion therapy, the blood pressure is restored and sustained at a safe level.

### XIII. AMPUTATIONS

1. Amputations should not be done unless the limb is almost completely detached.

2. Complete or incomplete traumatic amputations should be treated as any other open wound. Active arterial bleeding should be controlled. An unapplied tourniquet should accompany the patient during evacuation.

#### XIV. ANESTHESIA

Anesthesia is rarely indicated or required in battalion aid or division clearing stations. When anesthesia is required to ligate bleeding arteries not controlled by pressure, regional infiltration of procaine (not to exceed 200 cc. of 0.5% solution) will usually prove adequate.

General anesthesia in these forward areas is to be avoided if possible, but when required, is best obtained by the use of one of the short acting barbiturates.

#### DO'S AND DONT'S OF ANESTHESIA

##### I. DONT'S.

1. Do not administer morphine to walking wounded. They may become litter cases, may sleep by the wayside, may be captured, and may delay definitive treatment.

2. Do not administer morphine to patients with intracranial injuries.

3. In the presence of peripheral vascular constriction, due to shock and/or exposure to cold, do not give repeated doses of morphine by the subcutaneous or intramuscular routes. With impaired peripheral circulation the rate of absorption may be delayed, and evidence of overdose may not be exhibited until the patient is treated for shock.

4. Do not wire together the jaws of a patient to be evacuated by air. (Nausea and vomiting of air sickness.)

5. Do not use excessive doses of sedative drugs for preliminary medication. Previous doses of morphine may have been given and may not yet have taken effect.

6. Do not give pentothal sodium without first administering atropine sulfate, grains 1/150 or grains 1/100 subcutaneously, preferably 1 hour prior to induction of anesthesia. If the operation is emergent give the atropine intravenously 10 minutes before induction of anesthesia.

7. Do not give pentothal sodium to patients in shock, even for induction. (The first few cc. may cause a fatality.)

8. Do not give pentothal sodium to patients with respiratory depression, obstruction or dyspnea. Do not give pentothal with the intent of producing abdominal muscular relaxation.

9. Do not give a general anesthetic to patients suffering from anoxia. Treat the anoxia first.

10. Do not administer a spinal anesthetic to patients in shock.



11. Do not use excessive quantities of any agent for regional anesthesia.

(Upper limits for dosage of procaine:—

2% .. 40 cc.

1% .. 100 cc.

$\frac{1}{2}$ % .. 200 cc.)

12. Do not use excessive quantities of epinephrine in procaine solutions. (Desirable concentration of epinephrine in procaine:—

5 minims 1/1000 in 50 ccs. of 2% procaine.

5 minims 1/1000 in 100 ccs. of 1% procaine.

5 minims 1/1000 in 200 ccs. of  $\frac{1}{2}$ % procaine.)

13. Do not forget to maintain an adequate airway and a free respiratory exchange in all instances.

## II. DO'S.

1. For patients in shock give morphine in small doses (grains  $\frac{1}{4}$  or  $\frac{1}{2}$ ) by the intravenous route. Repeat as required, but beware of cumulative action. Dissolve the morphine in 2 ccs. of sterile water, inject 1 or 2 minims, pause and check for evidence of idiosyncrasy. If no evidence of untoward reaction, inject the required total dose over a period of 2 to 3 minutes, using barbitate.

2. Treat all patients suspected of blast injury of the lungs as litter cases.

3. In the presence of anoxia (shock, hemorrhage, cyanosis, livid or pallid) establish a clearway. Turn the patient on his side in head downward (10°) position, with head turned to side, to permit escape from the mouth of blood or vomitus. If he is unconscious draw his lower jaw forward. Grasp his tongue with dry gauze, sponge or bandage material, being careful to avoid being bitten. Pull the tongue forward, insert an artificial airway and if these manoeuvres are inadequate insert an endotracheal tube if available.

4. In the presence of cyanosis, maintain respiratory exchange. If the patient is breathing poorly, example, following intracranial injury, administer oxygen by intranasal catheter or B.L.B. mask. If the patient is not breathing, administer artificial respiration, or preferably apply intermittent positive pressure by means of a resuscitator mask and bag. Use only sufficient pressure to raise his chest wall. In the presence of an open thoracic wound, regulate the pressure to prevent herniation of the lung into the wound.

5. Be ever vigilant for evidence of untoward reaction to anesthetic agents.

6. Remember that sedatives and general anesthetic agents are respiratory depressants.

7. Remember that drugs of the barbituric acid series

(pentothal sodium) are peripheral vascular dilators and overdose may produce pulmonary edema.

8. Remember that volatile anesthetic agents, with the exception of chloroform and nitrous oxide, are inflammable, and in certain concentrations in oxygen or air may be explosive.

9. Remember that procaine and similar regional anesthetic agents, example, metycaine, may produce convulsions. Members of the barbituric acid series are physiologic antidotes. For the treatment of convulsions due to procaine, metycaine or pontocaine, administer pentothal sodium in small doses (2 to 3 ccs. of 5% solution) intravenously, using only sufficient of this agent to obtain control. The object is to provide relaxation that will permit adequate aeration. If respiration is insufficient, support it by artificial means. Similar treatment for convulsions may be employed, irrespective of their cause.

10. In order to avoid untoward reaction to regional anesthetic agents, employ dilute solutions (0.5% procaine) for all infiltrative procedures—200 ccs. total safe dose. 1% procaine for nerve blocks involving moderate sized nerves (sacral), 100 cc. total dose. 2% procaine for nerve blocks involving large sized nerves (brachial plexus), 40 cc. maximal dose. Small quantities of 2% solution may be employed for blocking branches of the 5th cranial nerve. In this instance it is desirable to avoid subsequent tissue reaction by the use of small quantities of solution, but as a general principle, employ dilute solutions in adequate quantity rather than more concentrated solutions in small doses.

11. Avoid intravenous injection of regional anesthetic agents. Inject only with the needle in motion, or, if the needle is stationary, inject  $\frac{1}{4}$  cc. to check its potency, aspirate to be sure that its point is not situated intravenously and then inject the required quantity observing the patient for evidence of untoward reaction.

12. *Gaseous content of any cylinder is to be ascertained by reading the label.* British systems of identification by means of color differs from that for American tanks. A green British cylinder contains carbon dioxide, whereas a green American cylinder contains oxygen. An all black cylinder may contain either nitrous oxide or oxygen or carbon dioxide.

## XV. TREATMENT OF BURNS

### I. General Considerations.

1. A high percentage of burns are received accidentally through carelessness and negligence. Efforts should be made to prevent burns by emphasizing the dangers associated with handling gasoline and other inflammable materials, and instituting suitable safety measures.

2. In the early management of a burn casualty, the primary considerations are :—

a. Prevention and control of shock.

b. Prevention of contamination of the burn surface during treatment and evacuation.

## II. Specific Considerations.

### *Initial Care.*

1. Control of pain by morphine administration. In extensive burns  $\frac{1}{2}$  grain doses of morphine may be necessary. If anoxia is present, large doses of morphine are dangerous, and under such circumstances the dose should not exceed  $\frac{1}{2}$  grain. If the patient is in shock, absorption of subcutaneous or intramuscular morphine may be delayed, in which case repeated doses of morphine should be given with caution. Relief of shock and improvement in peripheral circulation may lead to rapid absorption and over-dosage if morphine has been repeated in such cases. Careful administration of intravenous morphine has the advantage that pain is more promptly and certainly controlled, and the danger of over-dosage from repeated subcutaneous or intramuscular administration is nullified. Doses of  $\frac{1}{4}$  to  $\frac{1}{2}$  grain, given slowly in 10 cc. of sterile distilled water or saline, and repeated as necessary, is perhaps the safest method of intravenous morphine administration.

2. Early plasma replacement therapy should be instituted. If evacuation cannot be carried out quickly to a place for definitive therapy, plasma should be started as part of the first-aid measures. If one or two units of plasma can be given *early*, even in the first half-hour, lives may be saved. Quantities of plasma up to twelve units may be required in the first twenty-four hours for extensive burns. If the patient is in shock when plasma is started, the first two or three units should be given rapidly.

3. From the first, efforts should be made to prevent contamination of the burn surface by nose and throat organisms. Those handling the patient should always be masked. If masks are not available, they can be improvised. Aseptic technique, with gloves and instruments if possible, should be used at all times.

4. Casualties with 15% or over of body surface burned should be treated as litter patients immediately.

5. Clothing need not be removed unless too dirty, charred, contaminated or soaked with oil or chemicals.

6. No cleansing or debridement should be attempted in the field. This procedure should only be done in hospitals where complete facilities for definitive treatment are available.

7. Cover the wound with sterile dressings, triangular ban-

dages, or clean sheets. Evacuate to hospital for definitive treatment of the burned area as quickly as possible. Boric acid ointment or vaseline applied to a grossly contaminated burn complicates the later cleansing of the burn surface. If a local application is considered necessary, 5% sulfadiazine cream is preferred because of its bacteriostatic effect and its relative ease of removal later if cleansing and debridement are considered necessary.

8. Application of sulfadiazine cream, boric acid ointment or petrolatum to a grossly contaminated burn are *not* to be considered as definitive treatment.

9. Eyes should be gently irrigated with saline or boric solution, and a mild ointment (4% boric acid ointment), or oil instilled. Do not apply sulfadiazine cream to the eyes or lids, since it is extremely irritating to the conjunctiva. The lids should be closed with a pad of dampened gauze over them and a dry one held with adhesive, if possible, as the best dressing for the cornea is the lid. Cocaine or other anesthetics should not be used, as anesthesia of the cornea might lead to damage. If there is evidence of corneal injury, the case requires the attention of an ophthalmologist as early as possible.

10. Severe burns of the hands, or of one hand alone, should be considered as major burns and evacuated to a hospital for definitive treatment.

11. Tetanus toxoid is indicated for all patients with second or third degree burns.

12. Tannic acid, tannic acid jelly, triple dye, gentian-violet, gentian-violet jelly, and other membrane forming applications, should NOT be used.

13. RAPID EVACUATION TO DEFINITIVE TREATMENT SHOULD BE EFFECTED.

## **SURGICAL EMERGENCIES. SECTION B**

### **DEFINITIVE SURGICAL TREATMENT**

#### **I. WOUNDS OF THE SKIN, SUBCUTANEOUS FAT, FASCIA, MUSCLES AND TENDONS**

##### **I. General Considerations.**

1. Determine at once extent of injury, by examination of the patient, inspection of the wound and review of the E.M.T. tag. Great care should be taken to avoid further contamination by careless dressings or talking into the wound.

2. Roentgenographic or fluoroscopic examination should be done to localize foreign bodies preceding operation.

3. Delay debridement of large wounds until shock has been adequately treated by plasma or whole blood. The amount



of blood loss frequently exceeds the visible evidence of hemorrhage.

4. Avoid unnecessary manipulation of the wound, or transfer of patient from litter to bed, until operation completed.

5. Before removing the dressing preliminary to debridement, clean the soiled skin with soap and water. Keep wound protected from cleansing agents. Remove all hair from about margins of the wound by shaving. Pre-operative skin preparations should be simple; soap and water scrub, followed by the application of any standard antiseptic, is adequate. Do not introduce *antiseptics* into wound.

6. Debridement should always be done under strict aseptic precautions, even when the wound is small. Multiple wounds, due to very small metallic foreign bodies, do not require debridement. Simple cleansing with soap and water, frosting with sulfanilamide and a sterile dressing is adequate. Multiple small superficially embedded foreign bodies are often best removed by scrubbing with a brush.

7. Irrigate the wound gently, using sterile saline solution. Irrigation is best accomplished by a gravity apparatus. Place the nozzle of the tube into the deepest part of the wound, thus irrigating from within outward. Never irrigate in such a manner that the solution flows over skin before entering the wound.

8. The extent of underlying damage cannot be predicted from the appearance of the external wound. A small superficial wound may often lead into a larger wound of the deeper structures. In such cases incisions extending from the wound may be necessary to obtain adequate exposure (Fig. A).

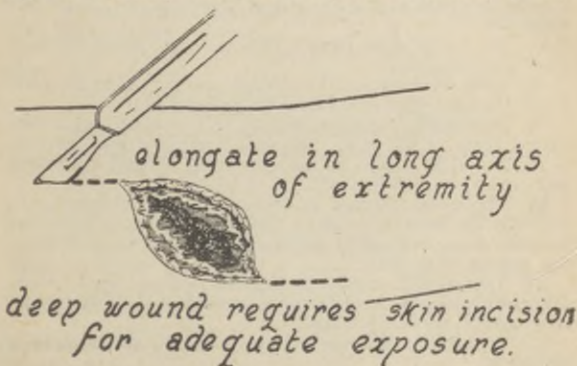


FIG. A.

Such extensions of the incision should be made in the long axis of the extremity. In the region of joints, the resultant scarring and possible contracture is decreased if the skin incision is made in the direction of the lines of skin cleavage (transversely).

9. Excise only a narrow margin of skin. It is rarely necessary to excise more than one-eighth of an inch margin.

10. Remove all hemorrhagic and soiled subcutaneous tissue. Fat has a low resistance to infection.

11. Excise all devitalized fascia. Fascia which has frayed or torn edges, which is shredded and otherwise not connected with living fascia, is not viable. Enlarge opening in the fascia to provide exposure of the deep portions of the wound. Transverse fascia incisions provide better drainage.

12. Remove readily accessible foreign bodies; especially important are pieces of clothing and other non-metallic materials. Prolonged search, involving extensive exploration for relatively small foreign bodies, is not indicated.

13. Excise all devitalized muscle. Non-viable muscle does not contract when stimulated, nor bleed when cut. Devitalized muscle is the potential source of gas bacillus infection.

14. Conservation is emphasized in removing bone fragments. Only bone which is detached from muscle, periosteum, or from a larger piece of viable bone, should be removed.

15. If the ligation of a major artery is necessary, the accompanying vein should be ligated.

16. Do not attempt primary suture of nerves. However, if two ends of a divided nerve are visible, they should be loosely approximated with two or three sutures to prevent retraction.

17. Do not attempt tendon repair, except under the most ideal circumstances.

18. After debridement, hemostasis and irrigation are complete, frost the wound lightly with sulfanilamide.

19. No wound, regardless of size, will be closed, primarily, except those of the face, scalp and synovia of joint cavities.

20. An effort should be made to cover delicate structures, such as nerves, tendons and blood vessels.

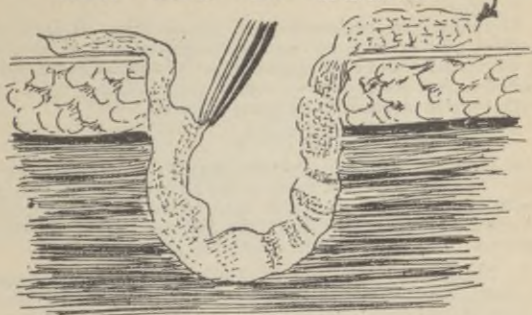
21. The wound should be packed loosely. Avoid tightly packing the wound. Afford drainage by gently inserting vaseline gauze with ends protruding beyond the margins of the wound (Fig. B).

22. The wound should be covered with a large, sterile, absorbent dressing, held in place by means of a firmly—but not tightly—applied bandage.

23. Immobilize all large wounds, even in the absence of fractures.

24. In the management of war wounds, the importance of

Let Gauze Strips extend  
well out of wound.



Place Gauze Loosely  
Do Not Pack

FIG. 8.

early secondary closure, or early skin grafting, cannot be over-emphasized.

25. Tetanus toxoid must be given, if not already received at forward station.

26. In the post-operative management of the wound, every effort must be made to prevent secondary contamination.

27. Treatment of gas gangrene.

(a) The most important factor in the prevention of gas gangrene is the thorough and complete debridement of devitalized muscle, and the early replacement of blood loss.

(b) The most important factor in treatment of established gas gangrene is early removal of all involved tissue. This frequently necessitates excision of entire muscle bellies or guillotine amputation.

(c) Chemotherapy should be maintained.

(d) Polyvalent gas gangrene antitoxin should be administered, preferably intravenously, after suitable precautions against anaphylactic shock have been taken. A minimum dose of three ampoules, repeated hourly at the discretion of the medical officer, until six doses have been administered, is recommended.

(e) Because in gas bacillus infection there is rapid destruction of erythrocytes, whole blood transfusions should be used.

## II. WOUNDS OF THE CENTRAL AND PERIPHERAL NERVOUS SYSTEM

### CRANIO-CEREBRAL INJURIES

The following statements are intended as a guide for medical officers who, by force of circumstances, are required to treat neurosurgical patients before they arrive at a hospital where trained neurosurgical teams are available. (See also section on Emergency Treatment, page 6.)

#### 1. *Care of the Unconscious Patient.*

a. Keep the patient in optimal position for postural drainage. Never permit him to lie on his back or be in an upright position. Place on side with face rotated forward and, if necessary, elevate the foot of the bed or litter to facilitate drainage of secretions from mouth by gravity.

b. Maintain fluid intake to 1500 cc. daily and increase proportionately during hot weather or in case of high fever. Fluids should never be put into the mouth of a stuporous or semi-conscious patient. They should be given per rectum, subcutaneously or intravenously. Never use more than 1000 cc. of physiological saline in 24 hours because of the danger of salt retention in the tissues of the brain. If unconsciousness persists after 24 hours feed nourishing liquids by nasal tube.

c. Turn the patient from side to side every three hours to prevent bed sores and hypostatic pneumonia.

d. Avoid morphine and other opium derivatives for restlessness. Paraldehyde, administered by nasal tube, rectum or intravenously is the safest and most satisfactory sedative for the patient with head trauma.

#### 2. *Intra-Cranial Hemorrhage.*

a. Extra Dural: The classic signs of extra-dural hemorrhage are:—

- (1) A lucid interval of consciousness.
- (2) Deepening stupor.
- (3) Unilateral dilation and fixation of the pupil on the side of the lesion.
- (4) Slowing of the pulse rate.
- (5) Rising blood pressure.
- (6) Focal convulsions or paralysis.



Extra dural hemorrhage requires immediate surgical evacuation with ligation of the main trunk of the middle meningeal artery. A straight incision extending from the mid portion of the zygoma upward into the temporal region should be used. The temporal bone exposed by separating the fibres of the temporal muscle is trephined. The bony opening may be enlarged as necessary to evacuate the clot and ligate the middle meningeal artery. The dura should not be opened, except when a sub-dural hemorrhage is suspected. If the main artery cannot be found and small bleeding points completely controlled with the facilities available, place a light gauze pack over the dura and compress until all bleeding has stopped. Dust sulfanilamide crystals throughout the wound and close the incision with the tip of the packing presenting through the lower angle. Fractional removal of the pack may be begun after 48 hours.

b. Sub-dural hemorrhage: Acute sub-dural hematomas of size sufficient to cause profound symptoms are frequently arterial in origin. They are usually associated with profound brain injury and prognosis is always grave. They are often clinically indistinguishable from extra-dural hematomas. The technical details for evacuating the clot are similar to those described for extra-dural hematomas.

Chronic sub-dural hematomas are of late occurrence and should always be suspected when recovery from a relatively minor closed head injury is retarded. These are not emergency lesions and can always await evacuation to hospitals where trained neurosurgeons are available.

c. Intra-cerebral bleeding, if arterial, is apt to be quickly fatal. If venous, localised intra-cerebral hematoma may form and stop spontaneously. The usual location is in the anterior half of the temporal lobe. These clots produce characteristic neurological symptoms and signs. They are seldom emergencies and will usually await evacuation to the rear.

In general, surgical exploration for intra-cranial hemorrhage should be carried out early only as a life-saving measure when the patient is deteriorating rapidly.

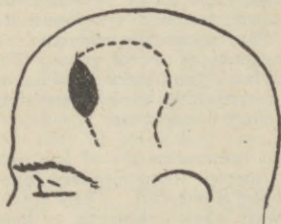
d. Scalp wounds: Carefully debride the scalp to conserve as much skin and subcutaneous tissues as possible, otherwise the wound cannot be closed. Sulfanilamide powder (not over 5 gms.) should be dusted into the wounds and the edges of the skin meticulously approximated. *Do not use drains.* If there is extensive loss of tissue and the edges of the scalp

cannot be approximated, a split thickness skin graft should be placed over the exposed bone. (Fig. 1.)

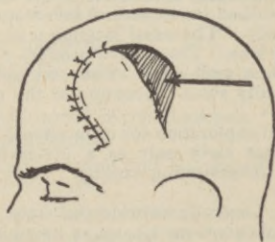
a.



b.



c.



Pericranium to be  
skin grafted.

FIG. 1.  
Method of closing defect in scalp.

### 3. *Fractures.*

a. Simple linear fractures require no treatment.

b. Compound linear fractures into the accessory nasal sinuses or external auditory canal are important, chiefly because they afford portals of entry for infection. In such cases sulfadiazine therapy (administered intravenously or by mouth) should be instituted at once.

c. Simple comminuted depressed fractures of bone should be removed and the edges of the defect smoothed with rongeurs. These defects can be most satisfactorily repaired with tantalum plate at a subsequent operation. In certain instances the bony fragments will be large and may be elevated into position, thus restoring the contour of the skull.

d. In compound comminuted fractures the wound should be thoroughly cleansed of dirt and foreign matter. If the bony fragments have torn the dura and damaged the brain, all devitalized tissue, including the brain, should be meticulously removed. Openings in the dura should be closed, if necessary by free transplants of fascia from the temporal muscle or fascia lata. Drains should never be used unless available facilities do not permit thorough control of hemorrhage. All tissues, including the brain, should be dusted with sulfanilamide crystals. Primary closure should be attempted up to 72 hours in wounds treated locally with sulfanilamide at time of injury. All compound skull fractures should receive adequate sulfadiazine therapy systematically.

In penetrating wounds of the brain it is important that all fragmented bone be removed. Small metallic fragments, unless producing symptoms, may be left, especially if their removal requires traversing relatively normal brain tissue.

### SPINAL INJURIES WITH NEUROLOGICAL INVOLVEMENT

(Refer to section on Emergency Treatment, page 7.)

#### 1. *Fracture-dislocation of the Cervical Spine.*

a. The best form of treatment is skeletal traction applied by Crutchfield tongs. If tongs are not available, skeletal traction may be applied by wires passed through two small burr holes made on either side of the skull, or by barbless fish hooks placed beneath the mid portions of the zygomatic arches. In the absence of all facilities for skeletal traction, halter traction is the method of choice. At least 15 lbs. of weight should be applied. Open or closed reduction by manipulation should never be attempted, for fear of further damaging the spinal cord.

## 2. Compression Fractures of the Lumbar Spine.

a. Reduction is best accomplished with the patient on his back and a blanket roll, approximately 12 ins. in diameter, placed beneath the mattress at the point of fracture. (Fig. 2.)

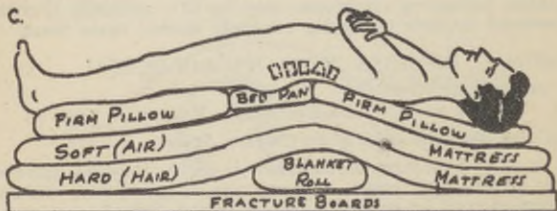
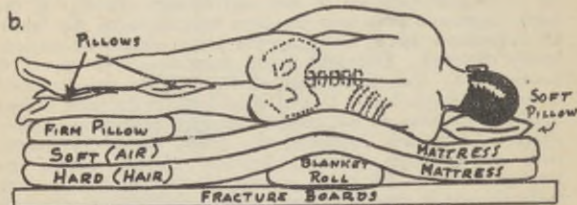
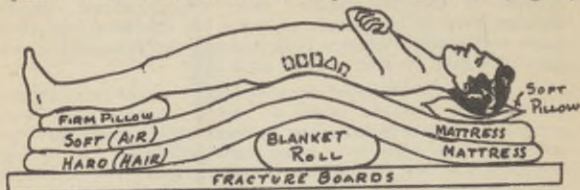


FIG. 2.

Proper position for patient with compression fracture of the lumbar spine.

b. *Care of the Bladder.* Treat the paralyzed bladder by tidal drainage as soon as practicable. (Fig. 3.) If after six weeks there is no evidence of recovery, a cystostomy should



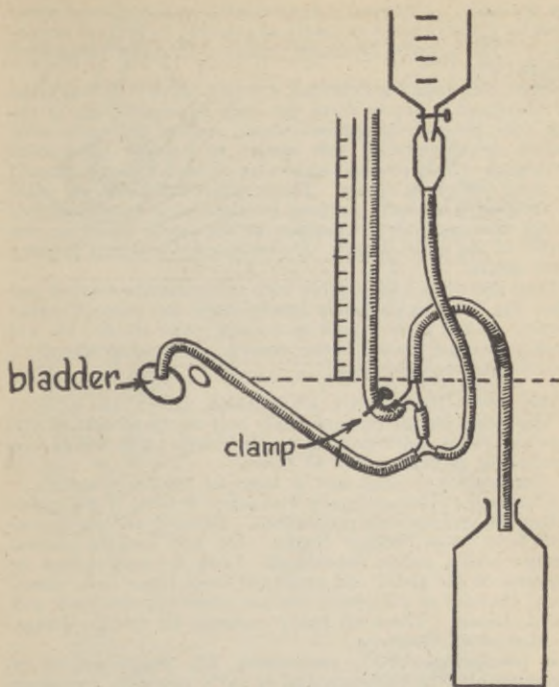


FIG. 3.

Simple type of tidal drainage. The essential point in successful operation is that the rubber tubing alongside the yard stick empty more slowly than the bladder. This is accomplished by means of a small screw clamp shown in the drawing.

be done. Keep urine acidulated with ammonium chloride or ammonium mandelate. Change catheter at least once a week.

### INJURY TO PERIPHERAL NERVES

In view of the irreparable degenerative changes that occur in the end plates of severed nerves, early surgical repair is essential for best results. Primary suture is theoretically desirable but experience has shown that in battle wounds where there is contusion of the nerve, immediate suture is

not desirable. However, it is essential that the severed nerve ends be approximated as nearly as possible to prevent retraction. This greatly facilitates early end-to-end secondary suture.

When the wound is debrided, exposed nerve ends will often be visualized. Approximate the ends if possible but if the gap does not permit approximation, anchor the nerve ends snugly to surrounding soft tissues to prevent subsequent retraction. Thin stainless steel wire or tantalum wire should be used for nerve repair. These suture materials are ideal as they serve a useful purpose in identifying by subsequent X-ray examinations the location of the nerve injury or the extent of the nerve defect. *Do not attempt elaborate primary nerve suture.*

Dust the wound thoroughly with sulfanilamide crystals and close the muscles or fascia loosely over the exposed nerve trunks. *Never place a pack on a minor nerve trunk.* Do not attempt primary closure of the wound. Delayed or secondary sutures are recommended.

### III. WOUNDS AND INJURIES OF THE EYE.

The following instructions apply only in the event that the patient cannot be evacuated to the hands of a competent ophthalmic surgeon within 48 hours.

1. *Examination* (a good spot or beam of light is essential).

Cleanse the open eye gently with saline or boric acid solution irrigations under sterile precautions. Remove obvious superficial and loose foreign bodies. Do not remove corneal foreign bodies unless superficial. Look for perforations or ruptures of the globe, and prolapsed uveal tissue (iris, ciliary body, choroid) or prolapsed vitreous which appears black and blood-stained. These are easily mistaken for foreign bodies.

2. *Methods of Anesthesia.*

a. Instillation of 2% pontocaine, 2% butyn (which is incompatible with sulfonamides) or 4-5% cocaine. One drop every 3-5 minutes for 4 times. Adequate for simple or surface ophthalmic surgery.

b. General anesthesia with pentothal. Very satisfactory for ophthalmic operations.

3. *Excision of iris prolapse and subsequent conjunctival flap.* (Perforating wound of the cornea.)

After performing 1 and 2 above, pick up the prolapsed iris with forceps and pull slightly out of the wound. Cut the iris prolapse off at the corneal surface. The elasticity of the iris stump should withdraw it back into the anterior chamber.

If the perforating wound is small and near or involves the limbus, a partial (apron) conjunctival flap may be all that is necessary.

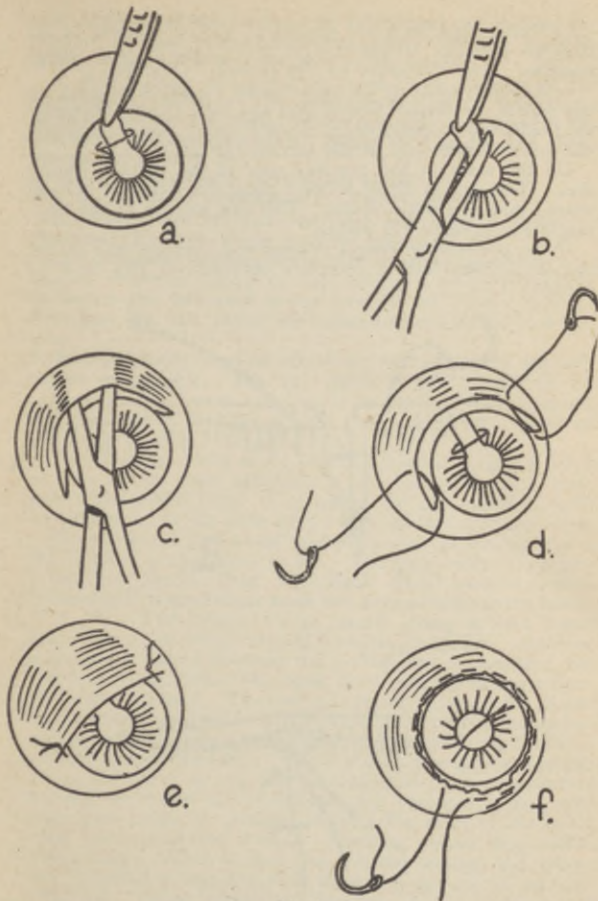


FIG. 1.

Excision of a prolapsed iris and the formation of a conjunctival apron flap. Fig. b represents the first step in a complete conjunctival flap with purse string suture.

a. Incise the conjunctiva at the limbus edge in the wound area and extend the incision on each side, hugging the corneal limbus, so that  $\frac{1}{2}$  to  $\frac{1}{3}$  of the corneal limbus is incised. (Fig. 1a & b.)

b. Undermine, by blunt dissection, the conjunctiva as far back as possible, taking care to avoid injuring the ocular muscles. Avoid pressure on the eyeball. (Fig. 1c.)

c. Apply a stitch in the undermined conjunctival edge on one side of the corneal wound area and bury the needle under the unaffected conjunctiva for about 5 mm. Bring the needle out to the surface and tie the thread. (Figs. 1d & e.)

Do the same to the opposite side of the corneal wound area. This brings an apron of conjunctiva over the corneal wound and acts like a splint. The raw surface of the conjunctiva is towards the cornea.

If the perforating wound is large and involves half of the cornea, a purse string complete conjunctival flap will be needed.

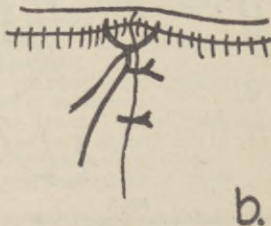
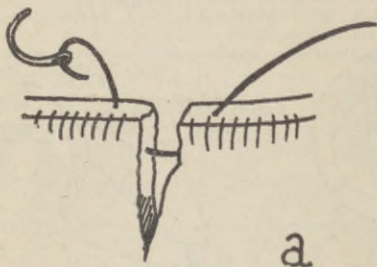


FIG. 2.  
Method of repair of the margin of a lacerated lid.



d. Do a complete peritomy of the conjunctiva around the corneal limbus. Undermine completely. Watch out for ocular muscles. Avoid pressure on the eyeball.

e. Pass a purse string suture around the cut edge of the conjunctiva and tie. This step should cover the cornea entirely. (The raw surface of the conjunctiva is towards the cornea.) Instil 2% atropine. Apply pads as directed above (Section A). (Fig. 1f.)

4. Repair of lacerated (perforated) sclera.

a. Excise the uvea prolapse close to the sclera.

b. Very gently lift each cut edge and insert a suture of fine silk. Apply no pressure to the eyeball itself.

c. Cover with conjunctiva pulled over the laceration and sutured (mattress suture) to the conjunctiva of the other side.

5. Suture the lacerated ocular muscles in proper position with fine silk, and repair the lacerated conjunctiva over the area.

6. Lid lacerations must be accurately and as exactly approximated as possible. The key stitch is that passed in the intermarginal lid area and should be the first one inserted, and tied firmly, forming a small elevation or teat. Save all the tissue possible. (Fig. 2a & b.)

7. Enucleation—there is no need of general surgeons doing an enucleation since sympathetic ophthalmia is exceedingly rare under 10-14 days. Enucleation should, therefore, only be performed in the base area, except in rare circumstances.

Enucleation is performed by peritomy of the conjunctiva at the limbus, as described in 3d. The conjunctiva is undermined completely. (Fig. 3a). Each ocular muscle is then isolated with a strabismus hook and excised close to the sclera. (Fig. 3b). The external rectus muscle stump is then firmly grasped and the eyeball rotated far to the nasal side. Excision scissors are passed between the eyeball and conjunctiva into the orbit. (Fig. 3c). The optic nerve can be felt as a firm, cord-like structure. The nerve is placed between the blades of the scissors and cut. At the same time pull out the eyeball and cut off the tags of restraining tissue (superior and inferior oblique muscle tendons). There will be a smart hemorrhage when the nerve is cut; this is controlled by a cone-shaped tampon of cotton placed beneath the conjunctiva and held with firm pressure, directed towards the apex of the orbit, after removal of the eyeball. Bleeding should stop within 10 minutes. When it does, remove the tampon and suture the conjunctiva together with three well-spaced silk sutures. (Fig. 3d). Put in ophthalmic ointment. Close the lids, apply eye pads as directed and a firm bandage.

8. Evisceration of the eye—In the event of panophthalmitis (eyeball full of pus), evisceration should be done. The

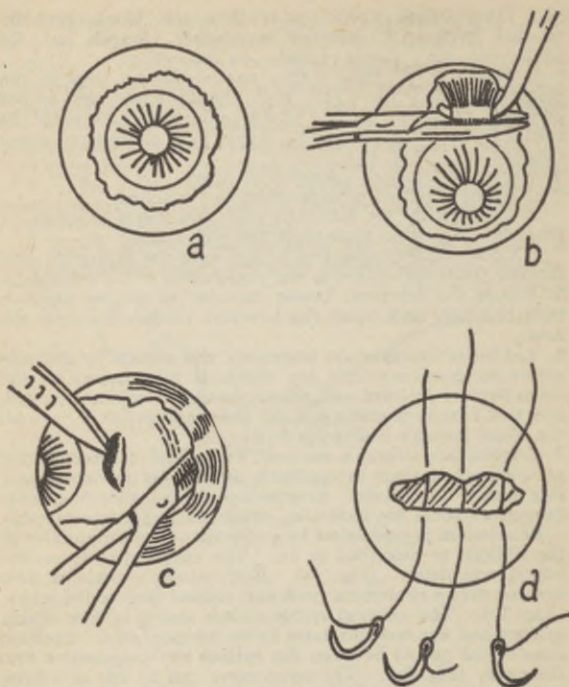


FIG. 3.  
Steps in the enucleation of an eyeball.

cornea is excised and the contents of the eye scooped out with a blunt curette. Care should be taken to remove all of the pigment tissue. The walls of the cavity (scleral) must be white everywhere. There will be little or no bleeding when the cavity is entirely clean. Insert some ophthalmic ointment, close the lids and cover with eyepads as directed, and apply a firm bandage.

9. When the eyeball is practically disintegrated, identify the eyeball tissue itself and remove. Do not remove ocular muscles or conjunctiva. Save all you can.

## IV. WOUNDS AND INJURIES OF EAR, NOSE, THROAT, SINUSES AND LARYNX

### I. General Considerations.

1. Control infection by using sulpha drugs and providing drainage of wounds which enter the para-nasal sinuses. Superficial wounds are closed for primary union.
2. Operate early for replacement of structures which maintain the contour of the head or those which are important for proper functioning of the various parts involved.
3. Save tissue of all types, even bone and teeth, so that every bit is available for future plastic repair.
4. Remove foreign bodies which are so situated that they provide a pathway for infection from the upper respiratory cavities to deep tissue.

### II. Specific Considerations.

#### A. Ear.

1. *Contusion of Auricle.* Blows on the auricle may cause a hematoma or subcutaneous collection of tissue fluid. If either becomes infected, progressive destruction of the cartilage, which results in a shrivelled ear, may ensue.

a. Evacuate the fluid early by incision.

b. Apply a pressure bandage. There should be an ample bed of gauze behind the auricle to help preserve its form.

2. *Lacerations of Auricle.*

a. Clean according to surgical principles. Replace *all* fragments as blood supply is usually adequate, even through small pedicles.

b. Suture lightly to allow drainage, taking care that the suture does not pass through the cartilage.

c. Embed the auricle in vaseline gauze, and apply a bandage.

3. *Bleeding from External Auditory Canal.* Bleeding from the external auditory canal, not caused by laceration of the soft structures of the canal or injury by a foreign body, usually follows a fracture of the temporal bone.

a. Clean the auricle only.

b. Do *not* syringe the canal.

c. Plug the canal superficially with sterile cotton or gauze.

d. Transfer patient to care of otologist.

4. *Wounds of Mastoid Process.*

a. Deep cleaning of an extensive mastoid wound should be done by an otologist, since in this procedure the inner ear and the facial nerve and lateral sinus may be involved.

b. Clean the wound superficially, using cleansing solutions so that they do *not* enter the tympanic cavity.

c. Leave the wound open, dust with sulfanilamide powder, pack with sterile gauze, and apply a bandage.

d. Transfer the patient to the care of an otologist.

## **B. Nose.**

### **1. Fracture.**

a. Replace contour at once by placing sturdy instrument into the concave side of nose and exerting pressure outward. At the same time mould the nose with fingers of other hand. This procedure easily forces the bones and cartilages into position and they will stay without splints.

b. Pack nasal cavity with vaseline gauze to control hemorrhage and hold fragments in place. Packs can stay in from 1 to 5 days.

c. Repair external lacerations.

### **2. Fractures accompanied by Skull Fractures.**

a. Following injury to the skull, with or without an external wound, an intermittent or continuous watery drip from one or both sides of the nose indicates a fracture which opens to the subarachnoid space into the nasal cavity through the cribriform plate or the frontal sinus.

b. Do not syringe the nose or wound.

c. Protect the nasal cavity by external sterile pad.

d. Caution patient *not* to blow the nose.

e. Transfer the patient to care of neuro surgeon.

f. Institute chemotherapy.

g. X-rays are always indicated before final repair.

## **C. Throat.**

### **1. Hemorrhage.**

a. If bleeding does not stop spontaneously, and actual location is obscure, slow blood loss, which is frequently swallowed, and danger of aspiration all make external carotid ligation imperative.

b. If airway is obstructed, perform low tracheotomy.

c. If dysphagia is severe, feed patient through a nasal or pharyngeal tube, but do *not* leave the tube in the esophagus if sore throat ensues, as damage to larynx may result.

### **D. Larynx.**

1. *Obstruction.* Voice changes and audible respiration when patient is at rest indicate obstruction which may be progressing to danger stage.

a. Watch patient carefully.

b. Perform low tracheotomy if there is any question about the airway. The larynx heals faster after tracheotomy.

c. Prevent aspiration of blood or foreign material.

d. Transfer patient to care of a laryngologist.

### **E. Foreign Bodies.**

1. Small embedded foreign bodies, completely surrounded by tissues, which do not interfere with proper functioning of any part involved, are usually well tolerated.

2. Foreign bodies lying on nerves, resulting in pain, localized or referred, should be removed.



3. Those which lie in the walls of the upper respiratory cavities should be removed because of the possible avenue of infection which they can provide. Later possibilities of infection must be considered.

#### H. Hints on Tracheotomy.

1. Preliminary intubation with an intra-tracheal tube or bronchoscope makes the operation much easier.

2. The lower the tracheal opening, the better the airway heals when the tube is removed. If the tube is accidentally inserted too high in an emergency (first tracheal ring or higher), replace it later to the low position.

3. Make skin incision through all layers down to trachea. Stop the bleeding before making vertical incision through second and third ring.

4. Suction is a great help, but a good cough will remove blood and mucous, especially when the tracheal stoma is held open with a hemostat.

5. Obstructive lesions in the throat and larynx heal faster in tracheotomized patients.

### V. TREATMENT OF MAXILLOFACIAL INJURIES

#### I. General Considerations.

1. Superficial wounds are classified as those wounds of the face in which there is no evidence of fracture of facial bones, or deep penetration. These wounds, when seen early, may be closed by primary suturing, *provided* they are relatively clean and can be thoroughly cleansed and *carefully* debrided. Severe maxillofacial wounds with loss of tissue, especially those resulting from gunshot, should not be closed by primary suturing. Specialized care should be instituted as early as personnel, time and facilities permit.

2. Anesthesia is seldom required for the initial care of maxillofacial injuries before evacuation to an installation where definitive surgical treatment can be accomplished. When an anesthetic is indicated, first consideration should be given to regional infiltration or nerve block anesthesia for surgical treatment of severe traumatic lesions about the face. General anesthesia may be necessary if trauma involves structures in the nose, mouth or pharynx. Maintenance of an airway and prevention of seepage of blood into the trachea is essential. The use of pentothal is hazardous and is contra-indicated in presence of shock. Inhalation anesthesia is indicated. Introduction of an endotracheal tube, either through the mouth or nose, as conditions dictate, is highly desirable. Maintenance of Trendelenburg position ( $10^{\circ}$ ) will protect against seepage into the lung by promoting drainage of blood and secretions into the pharynx where they can easily be removed

by suction. Insertion of wet packs into the pharynx is also indicated to establish a closed system. If extensive trauma within the mouth or pharynx is likely to be followed by edema or emphysema, it may be necessary to establish a tracheal stoma prior to surgical treatment of the primary lesion, and to use this avenue of approach for administration of the anesthetic by inhalation and subsequently for aspiration of excess secretions.

## II. Specific Considerations.

1. *Reduction and fixation of fractures and adjustment of parts to anatomical position.*

a. Secure consultation and aid of dental surgeon if available.

b. *Do not* manipulate fractured fragments of maxillae in the presence of fractures of the base of the skull and accompanying injury of the brain until drainage of fluid has ceased and patient's condition approximates normal.

c. Final control of hemorrhage. Use small hemostats and fine ligatures. Ligate locally and not in course of the vessel and maintain maximum blood supply to the parts.

d. The wound should be cleansed thoroughly under the best surgical conditions. Remove all tooth fragments, foreign matter, detached particles of bone and dislodged teeth in line of fracture, since these are elements that invite infection. Do conservative debridement of soft tissues. Excise only tissue that is completely devitalized and tissue which obviously has no chance of survival. Protect nerves, vessels, ducts and glands. The use of small cutting needles and fine sutures placed near approximating skin edges will aid in prevention of suture scars. Skin sutures should be removed early.

e. *Bone particles that still possess periosteal attachment should never be removed, since these small vital attachments may make all the difference between consolidation and new bone formation with restored function, and collapsed fragments with the attendant complications; even comminuted viable bone should be saved.*

f. In cases of massive loss of substance, adjust soft tissue and restore torn flaps to normal position. Suture mucous membrane to skin edges to cover raw surfaces and to preserve skin and mucous membrane. Avoid closures under tension that produce overlapping of fractured ends of bone or collapse of bone fragments. Provide adequate dependent drainage to deep penetrating wounds, and especially those communicating with the mouth. Immediate suture is only advisable in superficial wounds and wounds that can receive proper care within a few hours after injury.

g. Fractures of maxillae and mandible.

(1) Complete roentgenographic studies should be an integral part of definitive treatment.

(2) Aim at re-establishing the former occlusal relationship of the teeth, and ultimate restoration of dental function. Collapse of bone segments should be avoided in cases with loss of structure.

(4) The use of labial arch bars or wiring of the teeth of the same jaw across the line of fracture may be indicated for stabilization during evacuation.

(5) Rigid intermaxillary fixation of the lower teeth to the upper *should not* be used prior to unattended travel. Intermaxillary elastic traction may be used safely for this stabilization since the mouth can be opened in case of nausea and the elastic bands easily removed or tension regulated as indicated.

(6) Immobilization of fractures can be accomplished by the application of intra-maxillary multiple loop wires and intermaxillary *elastics*, for reduction and fixation, when sufficient teeth remain in each jaw (Figs. 1 & 2). The application

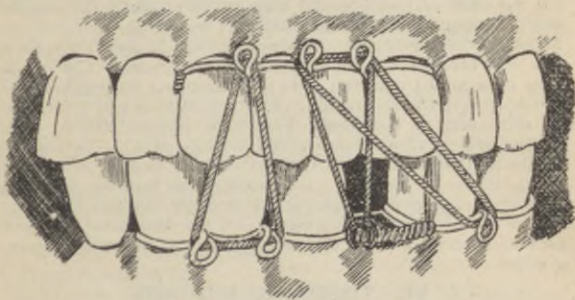


FIG. 1.

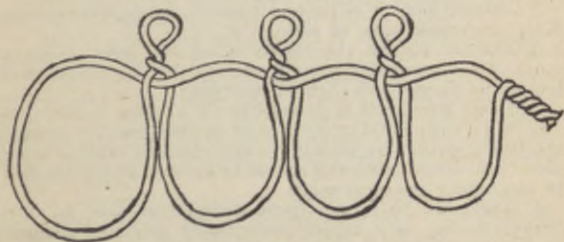


FIG. 2.

of a vertical circular bandage with mild buccal elastic traction may be indicated for auxiliary support of maxillary fractures. (This bandage, made of plastic material, will eliminate the collapsing tendency of ordinary bandage.)

(7) Sectional dental splints of proper design and construction may be used to advantage in the treatment of complicated cases for immobilization when limited function is desirable.

(8) Edentulous fractures require the skilful application of supporting bandages to maintain the parts in proper position, without causing collapse of segments or interference with airway. Dentures are particularly important as they can often be used in connection with supporting bandages or circumferential wiring.

(9) Another method of reduction and retention of edentulous cases, or those with displaced edentulous fragments, is afforded by the application of the extra-oral skeletal pin and bar fracture appliance.

2. Every effort should be made to provide trained personnel for the care of maxillofacial injuries throughout the combat area. Adequate life-saving measures and early treatment are necessary to insure the casualties getting to the hospitals of the next echelon for more definitive treatment. The execution of a well-correlated plan of treatment throughout will not only save life but result in many casualties being returned to duty after a minimum period of hospitalization. End results are of great concern and usually said to be directly proportionate to the nature and character of the early treatment received. Patients with maxillofacial injuries, requiring extended care and reconstructive surgery, should be transferred to the Zone of Interior when the treatment has progressed to such a stage that evacuation can be safely accomplished.

## VI. THORACIC WOUNDS

### I. General Considerations.

1. Disturb patient as little as possible during examination. Keep on injured side, or sitting up.

2. Do not abolish the cough reflex by large doses of morphine. Intractable pain is often far better controlled by intercostal nerve block than by morphine.

3. Local anesthesia is preferable for injuries to the chest wall, but if the pleural cavity is to be entered, positive pressure anesthesia (preferably through an endotracheal tube) is essential. Intravenous pentothal should be avoided in the presence of respiratory embarrassment.

4. There are no more urgent emergencies than an open pneumothorax, or a rapidly progressing pressure pneumothorax, but once temporary treatment has been instituted



there is time for deliberation and careful consideration to determine the indications for further treatment.

5. Suspect associated injuries to the chest in wounds of the upper arm, cervical region, and the abdomen.

6. X-rays are essential, in all actual or suspected injuries to the chest.

7. Acute gastric dilatation is a common complication of thoracic injury, and often accounts for dyspnea which is out of proportion to the degree of thoracic injury. Since this condition is potentially lethal, but simple to treat, it should be specifically looked for in all X-rays of the chest. The greatly dilated stomach is easily recognized below the diaphragm. Introduce a Levine tube.

8. Hemorrhage requires as adequate replacement of blood as in other types of injuries.

9. Untreated effusion of serum and blood are the commonest avoidable causes of late complications. The pleural space must be kept empty.

10. An avoidable cause of late complication is drainage tubes which have been lost in the pleural cavity during evacuation. All tubes must be securely anchored to the chest wall.

11. Attention is called to the inestimable value of bronchoscopy whenever the bronchi or trachea are obstructed by mucous or excessive secretions. It may prove life-saving either as a pre-operative measure, or in the post-operative period.

12. Early active breathing exercises shorten convalescence and are of value in preventing deformities of the chest wall.

## II. Specific Considerations.

### 1. *Open Pneumothorax:*

a. Do not disturb dressings until patient is fully prepared for operation.

b. A general anesthetic with positive pressure provided preferably through an endotracheal tube is essential.

c. Remove dressings, debride wound, and carry out necessary intrapleural procedure.

d. Air-tight closure of the thoracic wall and re-inflation of the collapsed lung is essential. A large defect may be repaired by the combined use of the diaphragm and large muscle of the chest wall, such as the latissimus dorsi or pectoralis major. Rarely, it may be necessary to suture the lung to the margin of the wound.

e. If indicated, because of contamination of the pleural cavity and the dangers of sepsis, intercostal closed catheter drainage should be instituted through a separate incision in a dependent position.

f. Following air-tight closure without catheter drainage, patients should be watched carefully for subcutaneous emphysema or pressure pneumothorax.

## 2. Hemorrhage:

It must be remembered that a patient can bleed to death into the pleural cavity without producing mechanical embarrassment to the cardio-respiratory system.

The commonest sources of bleeding are the intercostal, and internal mammary vessels. These should be suspected from the location of the wound, and are readily controlled under suitable operating conditions.

Hemorrhage from the lung itself usually ceases spontaneously, but occasionally a wound of the lung close to the root of a lobe may be the source of major bleeding which can be controlled by suture or partial resection and suture of damaged pulmonary tissues.

Wounds involving the great vessels at the hilus are usually rapidly fatal. Rarely, early intervention and heroic surgery may save life.

## 3. Foreign Bodies:

In general, a conservative attitude should be adopted toward the removal of foreign bodies. Smooth foreign bodies less than 2.5 cm. in diameter rarely require urgent removal. Large, irregular foreign bodies should be removed because of the high incidence of serious infection.

Usually, the problem will solve itself in individual cases. The large, irregular foreign bodies almost invariably are associated with wounds which require careful debridement down to the pleural cavity. Under such circumstances, it is essential to enlarge the opening sufficiently to permit complete inspection of the pleural cavity, repair of damaged lung, and removal of foreign bodies.

Small foreign bodies produce simple penetrating wounds, often without complication, and treatment may be entirely conservative.

A shattered rib on entry side, regardless of the condition of the external wound, and size or retention of missile, is a clear indication for thorough exploration of both, the wound of entrance, and pleural space. Such explosive rib injuries are often associated with extensive damage to the lung, and rib fragments prove to be troublesome foreign bodies.

Before operating in any case of retained foreign body, precise localization by X-ray is necessary. Always suspect a foreign body to be subcutaneous, or in the parietes, until its position is unequivocally proven in the lung.

## 4. Abdomino-thoracic Injuries:

These require a thoracic approach only when there are injuries to the thorax which threaten life and require urgent surgery.

In penetrating wounds of the chest in which a missile cannot be demonstrated by X-ray, the abdomen should always be X-rayed. If the thoracic approach is used, the diaphragmatic wound may be enlarged radically and abdominal exploration performed trans-diaphragmatically. Wounds of the stomach and spleen are often readily handled through this approach.

If abdominal exploration is unsatisfactory, a secondary abdominal incision should be planned after repair of the diaphragm and chest injury. Close the diaphragm by overlapping macerated margins with non-absorbable sutures, and place at rest by low phrenic crush. Keep the abdominal and pleural cavities separated by diaphragmatic repair. Repair of lung damage and closed intercostal drainage may be indicated.

In the presence of liver laceration, pack sub-diaphragmatic space and drain posteriorly below the diaphragm.

Observe for empyema and intra-abdominal complications, especially subphrenic abscess.

#### 5. *Pressure Pneumothorax:*

Recognized by labored respiration, hyper-resonance, absence of breath sounds, and deviation of the trachea, mediastinum and heart to the opposite side.

Immediate treatment consists of relieving tension by aspirating air from the involved side through the second interspace, anteriorly. As a precautionary measure against recurrence, a "flutter valve" should be inserted, or closed catheter drainage instituted.

#### 6. *Hemothorax:*

Should be evacuated probably within 48 hours in order to—

- a. Reduce the incidence of infection.
- b. Prevent loss of pulmonary function by fused chest.
- c. Prevent deformity.
- d. Shorten convalescence.

The tradition that a hemothorax is hemostatic and that it does not clot, should be abandoned.

- (1) If the blood has not clotted, aspirate without introduction of air.
- (2) If the blood has not clotted, but is infected, treat as empyema.
- (3) If blood has clotted, but is uninfected, break up and remove through cannula, if possible; it may be necessary to make an intercostal incision in order to evacuate the clot. Close chest and aspirate air.
- (4) If blood has clotted and is infected (recognized by characteristic X-ray appearance of air-mottled lower zone shadow), treat as empyema, but attempt to remove clot without risking contamination of adjacent walled-off uninfected pleural space.

7. *Crush Injuries* (Extensive mobilization of the chest wall by rib fractures—"Stove-in" chest):

Serious respiratory embarrassment may result, due to the paradoxical movement of the mobilized chest wall and shifting of the mediastinum. Repeated injections of the corresponding intercostal nerves with local anesthesia may be indicated to relieve pain and relieve respiratory embarrassment.

In some instances, circular adhesive strapping is sufficient for fixation of the chest wall. In some unilateral and most bilateral injuries, the thoracic wall should be stabilized and elevated by perichondrial wire sutures or towel clips attached to the mobile section of fractured ribs. The wires or towel clips are used to provide traction. Continual mobilization until chest is stable (at least three (3) weeks).

8. *Blast Injuries.*

Impact of blast wave on chest may cause hemorrhage in subpleural area, especially in intercostal spaces. Peripheral portions of lung show hemorrhagic infiltration, or in more severe cases, extensive extravasations of blood may occur throughout both lungs.

Diagnosis depends on:

- a. History.
- b. Signs, often progressive, include hemoptysis, dyspnea, cyanosis, and rales.
- c. X-ray showing more or less diffuse mottling of lung fields or blackout shadows representing hematoma of the lungs (differentiate from an under-exposed X-ray film).

Most important aspects of treatment are:

- a. Oxygen. Nasal catheter or BLB mask.
- b. Absolute rest of patient.
- c. Chemotherapy to prevent subsequent infection.
- d. Avoid inhalation anesthesia.

9. *Acute Gastric Dilatation:*

This has been frequently found as a complicating and/or principle feature after chest injury. The classical picture (without distended abdomen), including dark gastric contents, has been encountered as early as 2½ hours after an injury. As this condition is not uncommon, potentially lethal and simple to treat, it should be specifically looked for in all chest plates.

10. In the post-operative care of chest injuries, oxygen is life-saving and should be used as a routine. Repeated aspiration of the pleural space is necessary if effusion occurs. This may have to be continued for some weeks and failure to do so is a potential source of late complications.

11. Bronchial aspiration in the care of post-operative cases of atelectasis or collapse of the uninjured lung, may be life-saving.



## EMERGENCY BRONCHOSCOPY

Bronchoscopic removal of blood, secretions, and debris from trachea and bronchi may be life-saving, when coughing and catheter aspiration are ineffective. The scope can loosen clots and cough or suction will remove them. Irrigate with 10-20 cc. physiologic saline solution to assist in moving the debris.

Low bronchoscopy through a tracheotomy opening is indicated for the same purpose if the per-oral method is not possible because of high lesions and difficulty in introducing the instrument. A wide tracheal stoma will permit expulsion of debris that will not pass through the larynx. A laryngoscope is good to use for this purpose.

Use local analgesia only. Barbiturate sedation, followed by 5-10% cocaine or 1% pontocaine application to pyriform sinuses and vocal cords, or injection of 0.5 to 1.0% procaine in region of superior laryngeal nerves at thyro-hyoid membrane will control the larynx.

Watch for laryngeal obstruction as indicated by noisy respiration following any manipulation of larynx.

## VII. ABDOMINAL WOUNDS

### Specific Considerations.

1. In determining probable prognosis and priority for care, the following data should be assayed:—

a. *Time interval since injury.* Under six hours the prognosis is good; every hour lost after six hours increases the risk. After 24 hours, especially if there are signs of peritonitis, conservative therapy may offer more hope than operation.

b. *Nature of missile producing wound.* Clean, perforating bullet wounds are much more favorable than explosive wounds, or those due to large, irregular shell fragments. Small shell fragments more closely simulate bullet wounds.

c. *Position of patient when injured; location of wounds of entrance and exit; location of foreign bodies by X-ray.* An analysis of this data will indicate the probable course of the missile and the organs most likely to be injured. Upper abdominal wounds are more favorable than lower abdominal. Suspected wounds of the liver alone are not sufficient cause for laparotomy unless there is evidence of continued hemorrhage. Injuries involving the colon or rectum, especially in the retro-peritoneal portion, have a grave prognosis.

d. *Symptoms and physical findings.* Marked gastro-intestinal symptoms occurring shortly after wounding are suggestive of intra-peritoneal damage. The more severely shocked patient has priority for treatment, but the less shocked has priority for operation. Wounds of entrance and exit with prolapsed omentum or viscera should be given priority. The presence

of associated injuries will influence the decision. Other things being equal, the finding of associated injuries of the G.U. tract are grounds for priority.

2. As much of the above data as possible should be obtained without disturbing the patient. At times, an evaluation of the EMT, and a very brief inspection of the patient, will determine the immediate priority for further and more detailed examination. A chart of the pulse, respiration and blood pressure should be started in every case. Changes in this chart form one of the most reliable means of determining the efficacy of treatment of shock and priority for operation.

### 3. *Examination:*

a. A careful physical examination of the chest and abdomen (including rectal examination) is essential. The buttocks, back, perineum and thighs must be inspected for possible wounds of entrance or exit. Very small openings in the skin must be considered as possible wounds of entrance. Rigidity is often a late sign, and if there is shock it may not be found even in peritonitis. Repeated examination for signs of increasing peritoneal irritation may be necessary to distinguish between wounds of the abdominal wall and intra-peritoneal wounds. In cases of doubt, exploratory laparotomy may be the wisest choice.

b. All abdominal wounds should be X-rayed to determine the location of foreign bodies and the presence of free gas.

c. It must be remembered that intra-abdominal injuries can occur from non-penetrating injuries without a visible wound of the abdominal wall, i.e., severe blows to the abdomen, crush or blast (water or air).

d. If the patient cannot void, catheterization should be done. This excludes injuries of the G.U. tract and assures an empty bladder at operation.

### 4. *Pre-operative Preparation:*

a. Shock. Shock therapy must be instituted promptly and no patient should be operated on until he has reacted from shock; on the other hand, if there is continued hemorrhage, shock therapy must not delay essential surgery. Shock should be treated while the patient is being prepared for operation and as soon as a satisfactory circulatory state is obtained, operation should be done, but shock therapy must be continued during the operation. The mortality in abdominal wounds is more directly related to the amount of hemorrhage than to any other single factor. Whole blood must be used in addition to plasma in treating shock due to hemorrhage, especially if anesthesia and a prolonged operation are necessary. If available, it is preferable to plasma.

b. Preparation of the skin. Soap and water cleansing and

a careful shaving of the abdomen is the most important part of the skin preparation.

c. A Levine tube should be passed into the stomach; this is essential if there is evidence of distention or gastric dilatation.

#### 5. *Anesthesia.*

The anesthetic must provide adequate relaxation. In general, ether is preferable to spinal; pentothal may be used only to provide a rapid and smooth induction. This is especially useful if there is partial evisceration, and little evidence of shock.

#### 6. *Operation.*

a. *Choice of Incision.* Wounds of entrance and exit should be debrided after the abdominal operation is completed. Exceptions to this rule are wounds of the buttocks and back, which, if the patient's condition warrants, should be debrided first. This avoids the necessity of turning the patient on his face after the abdominal operation—a maneuver which contributes considerably to shock. A long para-median incision to the right or left, of the midline, as the indications warrant, makes the best approach. A T-shaped extension into either flank can be used for injuries of the spleen, liver, kidney or colon not accessible through this incision. An approach to upper abdominal injuries through the chest is discussed under abdomino-thoracic wounds.

b. *Exploration.* The control of active hemorrhage is the first consideration. Fluid and blood should be removed by suction or sponged away and the following sources of hemorrhage investigated:

(1) Abdominal wall, i.e., superficial or deep epigastric vessels (should be suspected from site of wound); (2) spleen; (3) liver; (4) mesenteric vessels; (5) retro-peritoneal bleeding.

A systematic exploration of the abdomen must be done, but the order is governed, to some extent, by the location of the wound and the probable viscera injured.

Except in tangential wounds, if a hollow organ has a wound of entrance, there must be one of exit, or the missile will be found in the lumen. When there is one hole in the bowel, a careful search must be made for a second wound; if the second wound is not obvious a careful search should be made along the mesenteric attachments. Time should not be lost in a futile search for foreign bodies.

#### c. *Surgical Repair.*

(1) In general, the less extensive the procedure, the better the prognosis. Utilize simple purse-string closure of small defects whenever possible. Larger wounds should be sutured in a manner to avoid obstruction of the lumen. The small bowel should never be exteriorized.

(2) In large bowel injuries, the damaged segment will be

exteriorized. In order to facilitate subsequent closure the two limbs of the loop should be approximated by suture for a distance of about  $2\frac{1}{2}$  inches and then returned to the abdomen, leaving the apex exteriorized with a short length of rubber tubing or other material beneath it. If the segment cannot be mobilized the injury should be repaired and a proximal colostomy done.

(3) The abundant blood supply of the stomach makes resection rarely necessary, even in injuries involving the major blood vessels. The posterior aspect of the stomach should be inspected by dividing the gastro-colic ligament. Wounds of the duodenum must not be overlooked; the duodenum should be investigated in all cases, and special attention must be given to the retro-peritoneal portions whenever a perforation has not been found to account for an obvious peritonitis.

(4) All wounds of the rectum, both intra- and extra-peritoneal, require diversion of the fecal stream by colostomy, closure of any intra-abdominal openings and local perineal drainage.

(5) The indications for resection of any segment of the gastro-intestinal tract are: (a) Infarction due to damaged blood supply; (b) extensive separation of bowel from mesentery; (c) huge gaping wounds impossible to repair locally; (d) many wounds in one segment making individual suture impossible.

(6) Perforating wounds of the bladder require repair and drainage of the urine by a high suprapubic cystotomy. The space of Retzius should always be drained.

(7) Penetrating wounds of the spleen may involve the stomach, diaphragm, colon, pancreas or kidneys. In general, splenectomy is preferable to suture.

(8) In wounds of the liver no attempt should be made to remove foreign bodies unless they are easily located and readily accessible. Detached, or nearly detached, fragments of liver should be removed. Bleeding from raw surfaces of the liver can be controlled by suture. Extensive, deep lacerations may require packing.

d. *Local chemotherapy.* In all cases, approximately 5-10 gms. of sulfanilamide should be frosted over suture lines and areas of maximal contamination. In wounds involving both peritoneal and retroperitoneal tissues, somewhat larger amounts (12-15 gms.) may be used, dividing the dosage in accordance with the extent of the tissues involved. Care should be taken to avoid caking of the powder by as uniform distribution as possible.

e. *Drainage.* Gauze and rigid rubber tubing should not be used for drainage. Drains must never be placed directly



adjacent to intestinal suture lines, traumatized bowel, or major blood vessels.

f. *Closure of the abdomen.* In all cases, the laparotomy wound will be supported by through and through retention sutures of heavy silk, steel wire, or silkworm gut. Wounds of entrance and exit should be debrided and the peritoneum and fascia closed after dusting with sulfanilamide.

#### 7. *Post-operative Care.*

a. *Shock.* Continue therapy with blood and/or plasma, as indicated. Encourage deep breathing.

b. *Gastro-duodenal drainage* by means of a Levin tube should be continued, and the usual means of putting the gastro-intestinal tract at rest instituted, i.e., morphine in liberal doses, heat to the abdomen, restriction of fluids by mouth.

c. *Systemic chemotherapy.* This should be started parenterally, and continued until the oral route is available. Sodium sulfathiazole or sulfadiazine, in amounts of 6 gms. daily, is recommended. Several important precautions must be observed:—

(1) Do not start chemotherapy until the patient has recovered from shock.

(2) Hydration must be adequate. Always give the initial intravenous sulfonamide immediately after an infusion of saline.

(3) The daily urinary output should approximate 1500 cc.

(4) Alkalis should be given orally as soon as fluids by mouth are started. Sodium bicarbonate, 1 teaspoonful every 4 hours, is satisfactory.

(5) The sulfa drugs are easily administered parenterally, as follows:—

(a) Dissolve the 5 gm. ampoule in 125 cc. of distilled water.

(b) Give the entire ampoule as an initial dose, preceded by a saline infusion of at least 1000 cc.

(c) Subsequently give 50 cc. (2 gms.) every 8 hours, or 25 cc. (1 gm.) every 4 hours.

(6) The urine must be examined daily for red blood cells.

(7) If possible, blood levels are desirable. A level of 6-8 mg. for sulfathiazole, or 8-12 mg. for sulfadiazine, should be maintained if serious infection develops.

#### d. *Parenteral fluids.*

(1) The total fluid intake should equal 2000 cc. (for insensible fluid loss) plus 1500 cc. (for urinary output) plus volume replacement of fluids lost by vomiting, gastric suction, intestinal fistulae, etc. The total requirement usually will vary between 3500 and 6000 cc.

(2) The seriously ill patient should receive 1000 cc. of plasma daily as part of the total fluid requirement. This

maintains nitrogen balance, prevents hypoproteinemia, and is of vital importance if recovery is prolonged.

(3) Normal saline should be used to replace fluid lost by vomiting, gastric suction, etc., and an additional 500 cc. of normal saline should be given to maintain electrolyte requirements.

(4) The balance of the total fluid intake should be given as 5% dextrose in distilled water.

#### 8. *Abdomino-thoracic wounds.*

a. The basic principles emphasized in the surgery and post-operative care of both abdominal and thoracic wounds are applicable.

b. A cardinal principle is that all penetrating wounds of the abdomen necessitate a thorough exploration of the gastrointestinal tract, whereas many wounds of the chest are best treated conservatively except for aspiration of a hemothorax, or relief of tension pneumothorax.

c. In general, the wound which constitutes the most immediate threat to life should be given primary attention.

### VIII. WOUNDS OF THE GENITO-URINARY SYSTEM

#### I. General Considerations.

1. Trauma to the genito-urinary system should be suspected in all cases of abdominal, lower thoracic or perineal injury.

#### 2. *Diagnosis:*

a. Pain and tenderness over the flank or suprapubic region after trauma is suggestive of injury to the kidney or bladder.

b. Hematuria is the most important sign of genito-urinary trauma, and a urine specimen should be obtained on all suspected cases. If the patient cannot void, urethral catheterization should be performed, unless the urethra is damaged. A catheter should not be passed unless facilities for operation are available.

c. Cystoscopy and pyelography should be used as indicated.

#### 3. *Treatment.*

a. Cardinal principles in the treatment of trauma to the genito-urinary system are:—

(1) Control of hemorrhage.

(2) Adequate free urinary drainage.

(3) Control and prevention of infection by chemotherapy and adequate soft tissue drainage if extravasation of urine has occurred.

#### II. Specific Considerations.

##### A. KIDNEY.

1. Always obtain a urine specimen in all suspected injuries of kidney.

2. Repeated physical examinations for increasing tenderness or mass in the flank due to hemorrhage or urinary extravasation are necessary to properly follow a traumatic kidney case and to evaluate the necessity for surgery.

3. Successive urine specimens should be saved to give a picture of the improvement or lack of improvement of intra-urinary tract bleeding.

4. Intravenous or retrograde urograms should be obtained, if possible, in all cases of suspected renal injury unless severe shock is present.

5. Trauma to the kidney, unassociated with an open wound, can usually be treated conservatively, although the principles of hemorrhage control and urinary drainage must be constantly adhered to.

6. Except in the presence of massive hemorrhage, surgical intervention should be delayed until the period of shock is over.

7. In all abdominal wounds associated with hematuria, the condition of the kidneys should be investigated at the time of the abdominal operation, also when free fluid is found in the peritoneal cavity at operation, the kidney, ureter and bladder should be inspected.

8. Gunshot wounds of the kidney usually require nephrectomy, and are usually associated with other severe visceral injuries which should be investigated at the same operation.

9. Never remove an injured kidney without ascertaining the presence of a functioning kidney on the opposite side. If patient's condition does not warrant study of opposite kidney, use conservative measures of treatment, namely, ligation and packing.

10. Patients who have suffered a proved renal injury should be kept in bed at least 10 days.

## **B. URETER.**

1. Wounds of the ureter, although rare, demand early operation.

2. Increasing mass in the flank, or increasing free fluid in the abdomen, may be the first symptoms of ureteral injury.

3. Intravenous or retrograde pyelo-ureterograms should be made in all cases of suspected ureteral injury.

4. Pass a ureteral catheter prior to operations in all cases of suspected ureteral injury, when the condition of the patient warrants.

5. As an emergency measure, provide extraperitoneal drainage for extravasated urine.

6. Partial tears of the ureter will usually heal if drainage is sufficient and no extravasation present. If extravasation is present, partial tears should be repaired and adequate drainage provided.

7. If the repair of a completely severed ureter is attempted, urinary drainage above the site of the anastomosis should always be provided.

8. Chemotherapy to prevent and control infections should be instituted in all cases of ureteral injury.

9. Nephrectomy is usually indicated in a case with a completely severed ureter if there is loss of tissue, or complicating infection or peritonitis.

10. Dilated ureters should not be transplanted into the bowel.

## C. BLADDER.

1. Ruptured bladder should be suspected in all cases of lower abdominal wounds and in cases of pelvic fracture.

2. Suprapubic, or groin, tenderness is the most important sign of bladder injury. Patients with this sign deserve further prompt investigation.

3. A patient with suspected bladder injury should not be catheterized unless facilities for operation are available.

4. The presence or absence of bladder rupture should be verified by cystography or cystoscopy if the necessary facilities are available.

5. If the bladder is ruptured, early operation is imperative, as the mortality rises rapidly with delay.

6. For extraperitoneal rupture, adequate prevesical and perivesical drainage, and local sulfanilamide, should be provided, and cystostomy done.

7. For intraperitoneal rupture, sutures of the opening and suprapubic cystostomy, with drainage and local sulfanilamide, are indicated. The peritoneal cavity should not be drained.

8. A cystostomy is indicated in cases with massive intravesical hemorrhage in which the clots cannot be evacuated with an instrument passed through the urethra.

9. All cases of bladder injury should be given chemotherapy to control or prevent urinary infections.

10. Neurogenic bladder. In acute urinary retention due to nerve lesions, a urethral catheter should be inserted and left inlying. Tidal drainage should be started as soon as possible. Do not use intermittent catheterization. Do not permit over-distention of bladder.

At end of 4 weeks do a high suprapubic cystostomy, provided patient does not show signs of bladder improvement, and does show a reasonable life expectancy. A high suprapubic cystostomy should be done immediately if catheter drainage is not satisfactory because of recurrent ascending infection, virulent urethritis, acute prostatitis or seminal vesiculitis and massive hemorrhage from bladder.



## D. URETHRA.

1. Injuries to the urethra are divided into two classes—those above and those below the urogenital diaphragm, and should be diagnosed accordingly.

2. Bleeding from the urethra, inability to void, or painful urinary extravasation, may be the presenting symptom.

3. Passing a urethral catheter on a patient suspected of urethral injury should not be attempted until facilities for operation are present.

4. Penile and scrotal injuries should be treated according to the principles of general surgery. Adequate urinary drainage should always be provided. Extreme conservatism should govern debridement of wounds of the external genitalia.

5. Urinary extravasation demands immediate radical incision and drainage, with adequate diversion of the urinary stream by cystostomy or external urethrotomy.

6. Cystostomy is necessary for drainage if the injury is above the urogenital diaphragm. Often catheterization of the urethra from inside the bladder is helpful in urethral reconstruction. The optimum time for reconstructing a urethra is at the time of the original operation.

7. Chemotherapy should be instituted to help control infection.

## IX. WOUNDS OF LARGE BLOOD VESSELS

### I. General Considerations.

1. Cases of large increasing hematoma not controlled by pressure should be explored. Evacuate the hematoma and ligate the involved vessel.

2. Divide the artery between two ligatures and, for additional security, transfix both stumps with a ligature. Division of the artery permits more accurate and secure ligation as well as providing the beneficial effects of periarterial sympathectomy to the extremity. When ligation of a major artery is required, the companion vein should be ligated as well, since this decreases the likelihood of gangrene.

3. If the artery has not been opened, but is contused, and thrombosis has taken place, it should be ligated and divided, and the exposed, thrombosed portion excised, and the same procedure performed on the companion vein.

4. When approach to the artery through the wound appears too difficult, expose the artery believed to have been injured so far proximal to the point of injury as to secure a clean, dry field. For temporary arrest of the hemorrhage, pass a small rubber tubing or tape around the vessel.

5. A pulsating hematoma increasing in size and progressively interfering with the circulation of the extremity distal to the hematoma, requires surgical intervention.

6. Cases of arteriovenous fistulae are rarely detected in the first day or two after wounding. They are not *per se* an indication for operation and are better left until a later date unless there is a complication, such as leakage or deterioration of the arterial supply to the limb.

7. Supportive treatment for the patient in whom there is anxiety about the circulation to a limb should be as follows:—

a. Heat the individual's body and the root of the injured limb, protect the limb from heat loss by woolen coverings, if possible, but never heat the injured limb itself.

b. Treat shock according to recommendations given elsewhere.

c. Perform paravertebral novocaine block, if feasible, to overcome spasm of the collateral blood supply. This procedure to be repeated every 12 to 24 hours if a beneficial response is obtained.

d. If gangrene threatens, keep limb wrapped in sterile towel and observe closely for the possible development of gas gangrene.

## X. CONTUSIONS, STRAINS, AND SPRAINS

### 1. General.

a. The object of definitive treatment is to assist the reparative processes of the body in restoring the injured part to as near normal as possible in as short a time as possible. This is accomplished by rest or immobilization, by the removal of large collections of blood or fluid, by heat, massage, and increasing active exercise up to the point of pain. Compression bandages as a rule have accomplished their purpose in 48-72 hours and should be removed.

### 2. Specific.

a. *Contusions.* Extensive contusions in well-muscled areas, notably the buttock, may present an area of fluctuation at the point of injury after 48-72 hours. These should be aspirated and occasionally incised, evacuated, and firmly closed without drainage. Contusions of joints very often result in effusions which should be aspirated. These procedures should not be done in the presence of overlying skin injury or sepsis, or if there is any doubt about the sterility of operating room facilities. Heat and massage are valuable adjuncts after 72 hours. Massage should be centripetal and should not include the site of injury.

b. *Strains.* Acute strains as a rule will respond rapidly to rest. The commonest strain is probably that of the lumbosacral muscles. Absolute rest for three to five days, or until all tenderness and spasm has subsided is recommended. The patient should lie supine with a single rolled blanket under the knees on a firm mattress supported by boards.

The back is then strapped and light duty resumed. Strapping is carried out with the patient prone. After shaving, two layers of 3-inch adhesive tape are applied between the 12th rib and the sacro-coccygeal joint and from anterior axillary line to anterior axillary line. If symptoms persist after strapping and return to light duty, the patient should be evacuated for further study and treatment. Heat and massage are valuable in the treatment of back strain but for psychological reasons should not be emphasized.

Strain of the calf muscles is common and can often be relieved by a  $\frac{1}{2}$ - $\frac{1}{4}$  inch felt pad beneath the heel.

c. *Sprains.* Immobilization as well as rest is usually required in the definitive treatment of sprains. Sprains are rare in the upper extremity, and with the exception of the wrist usually of little importance. An injured wrist should never be treated for sprain until fracture of the carpal scaphoid has been absolutely excluded by X-rays taken in 3 planes. Even if no fracture line is seen in the first X-rays, a clear-cut history of fall on the outstretched hand with tenderness in the "anatomical snuff box" is usually sufficient to justify immobilization in plaster for 10 days when sufficient absorption will have occurred to make the fracture line visible in a second X-ray.

The knee and the ankle are the most commonly and seriously sprained joints. The following programs of definitive treatment are recommended:

(1) *Knee.*

- (a) Aspirate if effusion is present.
- (b) If no abnormal lateral or anterior-posterior mobility as compared with uninjured knee, replace compression bandage and institute active non-weight bearing exercise. Discard crutches when tenderness has subsided and range of motion is normal, usually in 7-10 days.
- (c) If abnormal laxity is present in either collateral or cruciate ligaments, immobilize for 3 weeks in a padded split plaster of Paris cylinder from the greater trochanter to the malleoli. If the cruciate ligaments are intact the joint is immobilized in full extension, if injured, in 30 degrees flexion. Vigorous quadriceps and ankle exercises are carried out for 5 minutes every hour on the hour. These should not be the patient's responsibility but should be supervised. Activity on crutches is encouraged, but weight-bearing prohibited until removal of the cast.

(2) *Ankle.*

(a) *Moderate Sprains.*

- (1) After swelling has subsided, shave leg, strap with 1 in. adhesive tape and begin active motion. Strapping should be of the basket-weave type, should reach to the mid-point of the lower leg and should prevent lateral motion at the ankle. Tape can safely be carried completely around the ankle. Crutches may be required for a day or so. Canes are not recommended.
- (2) On return to light duty, ankle wraps may be substituted for strapping. These are applied by the patient, after instruction, and consist of unyielding 2-inch muslin bandages, carried in circular and figure-eight fashion around the malleoli, foot, and os calcis behind the malleoli and anchored with adhesive tape. Properly applied, ankle wraps limit lateral motion at the ankle, but leave anterior-posterior motion relatively free.

(b) *Severe Sprains.*

- (1) Continue elevation and compression until edema has subsided.
- (2) Manipulate under fluoroscopic screen under pentothal or spinal anesthesia to determine presence or absence of:
  - (a) Abnormal tilting of astragalus on tibia from severe damage to lateral collateral ligament.
  - (b) Widening of joint mortise from severe damage to tibio-fibular ligaments.If tilting of more than 15 degrees or widening of more than 0.3 cm is found, X-ray films should be taken of both ankles in the position producing the greatest deformity.

- (3) If neither lateral collateral or tibio-fibular ligaments are severely damaged, treat as a moderate sprain.
- (4) If lateral collateral ligament is severely damaged immobilise for 8 weeks in a snug plaster boot from the tibial tubercle to the metatarsal-phalangeal joints. Replace boot as often as it becomes loose. Weight bearing may be allowed after 4 weeks. Institute regular exercise of leg and toes for 5 minutes every hour.
- (5) If tibio-fibular ligaments are severely damaged, either immobilize in a plaster boot for 8 weeks



as in (4) or fix fibula to tibia with a bolt, screw, or strong wire loop. If plaster immobilization is used, check X-rays should be taken through the plaster every 10 days and weight bearing not allowed. If internal fixation is employed, weight bearing can be permitted 3 weeks after operation.

## XI. BONE AND JOINT INJURIES

### DEBRIDEMENT OF COMPOUND FRACTURES

#### Specific Considerations.

1. *All compound fractures must be considered as dirty cases and will require debridement.* If the cases are received early, in from 4 to 6 hours after injury, one may hope to limit the spread of infection by adequate operation. Operation should be performed as soon after the wound is received as is possible.

2. Clean appearing perforating wounds may be caused by high velocity bullets or small shell fragments, and may, in many instances, do minimal damage to soft parts. Large irregular shell fragments, on the other hand, may cause extensive soft part damage, while doing minimal damage to bone structures.

3. *Pre-operative X-ray examination is of value,* not alone from the standpoint of determining bone damage, but also as providing a source of information for non-opaque foreign body location. A large shell fragment may have carried bits of clothing or other non-opaque material into the wound with it, and this non-opaque material may be more detrimental to the patient than the shell fragment itself. *Information regarding gas infection* and damage to nerves, blood vessels, etc., may also be gained by X-ray examination as well as revealing the presence of shell fragments.

#### 4. Procedures.

a. A rapid, careful physical examination is essential. This examination should be conducted regionally and operation or operations then planned.

b. Shock therapy should be instituted promptly and may have to be continued during the operation. If possible, the patient should react from shock before operation. Plasma and whole blood may be used, depending upon their availability.

c. A tourniquet may be applied if desired.

c. Shaving, followed by soap and water cleansing of the area to be operated upon is the preferred type of skin preparation. However, if water is not available in sufficient quantities, shaving of the skin followed by painting with tincture of iodine may be used.

- e. *All skin possible should be saved.*
- f. Crushed, macerated muscle and fascia, and bone fragments that are completely detached from periosteum or soft parts should be removed, but if bone fragments have much soft tissue attachments, these should be left in place.
- g. *Fascial structures such as the fascia lata should be cross-cut, so that adequate drainage will be afforded.*
- h. All large, easily accessible foreign bodies, opaque or non-opaque, should be removed.
- i. The fracture should be reduced and reduction maintained manually if possible. *Do not attempt internal fixation by any foreign material.* The reduction of the fracture is desirable at this time if it can be maintained by external splinting but *it is not of prime importance.* The control of infection is of major concern at this time and no methods of fracture reduction should be employed which may cause infection to be disseminated in the fracture fragments.
- j. *Remove the tourniquet.*
- k. Sulfonamides should be applied locally.
- l. *Vaseline gauze drainage should be employed, loosely inserted in the wound. No wound closure is to be done.*
- m. A dry gauze external dressing over the wound and a transportation cast should be applied.

## TRANSPORTATION CASTS

1. Transportation casts are those plasters which are applied at the most forward surgical unit where debridement or other definitive treatment is instituted.
2. It is desirable to use a plaster cast for transportation which immobilizes the injured extremity safely. The salient features of such a plaster should be therefore:
  - a. As adequate immobilization as possible.
  - b. Sufficient padding of the extremity involved to ensure comfort, prevent pressure sores, etc.
  - c. Splitting of the cast and underlying dressings or padding to allow for swelling of the extremity.
  - d. The inscription on the cast of a line diagram of the fracture and such other pertinent information as may be indicated, such as time of injury, time of debridement, medical unit rendering care, and any other special notes on the care rendered.
3. For transportation immobilization, the following plaster casts are suggested:
  - a. Fracture of the leg or ankle: A full leg padded cast with the foot at right angles and the knee at 10° flexion.
  - b. Fractures of the femur or knee:
    - (1) Double spica to the lower thigh on the well side.  
This can be cut down over the abdomen and below

the rib margins on the sides. A strut extends from the one thigh across to the other. (40 rolls of 6 in. plaster, 10 rolls of 6 in. sheet wadding.)

- (2) A single spica of the affected leg which will necessarily have to extend higher on the thorax for proper immobilization but should be windowed or cut down as low as is possible over the abdomen.
- (3) The half ring Army leg splint applied with traction, with two plaster cuffs, one around the thigh and one around the calf, which may be used where it is not practicable to use the plaster spica. (2 rolls of sheet wadding and 2 rolls of plaster.)
- (4) The half ring Army leg splint applied with traction which will give fairly good immobilization where the evacuation period is not great.

c. Fractures of the forearm and elbow: A full length plaster cast extending down to the tips of the fingers, bound to the thorax with triangular bandages or a few rolls of plaster (velpeau).

d. Fractures of the humerus or shoulder: A short shoulder spica with the arm placed across the chest in about 45° shoulder and 90° elbow flexion, or a U-shaped plaster held to the thorax with a velpeau dressing of cloth or plaster bandage. The short spica so applied will extend down to about the 12th rib and if the arm is placed in this position it will not extend beyond the side of the stretcher or the patient's thorax since it is not put up in abduction.

4. Fractures of the spine: If the patient is not suffering from abdominal distention and is free from other complicating conditions, such as cord damage, it will probably be advisable to place him in a body jacket. This jacket should be well padded over the thorax and iliac crests and applied in as much hyper-extension as can be obtained without the use of an anesthetic. It should extend on its anterior aspect from the sternoclavicular joints to the symphysis pubis. Posteriorly, it should be trimmed to allow freedom of the axillae and scapulae and high enough to permit free use of the bedpan. After the cast has dried thoroughly a large window may be cut over the abdomen to relieve abdominal pressure.

5. Fracture of the pelvis: A full, double leg spica well padded about the pelvis, trimmed high in the back to permit use of the bedpan and extending rather well up on the thorax and windowed generously to relieve abdominal distention, will provide good immobilization for transportation.

6. It is obvious that plaster spicas applied as suggested above in paragraph 3, will provide greater immobilization than will the other types of casts mentioned. If, however,

for any reason, such as shortage of material, or lack of skill in applying the spicas, or for any other reason, these cannot be used, the other methods mentioned above will provide reasonably satisfactory immobilization for this transportation phase.

7. It is felt that padding beneath the plaster is important as a general principle. Undoubtedly some surgeons who are skilled in the use of plaster-of-paris can apply unpadded casts with safety, and can secure better immobilization with these unpadded casts than with padded ones. However, since the majority of medical officers are not skilled in the use of plaster, it is felt that additional safety will be provided the injured extremity by the rather generous use of sheet wadding or cotton beneath the cast.

8. *All transportation plasters of the extremities must be split throughout all layers of the plaster and the underlying padding down to the skin immediately after their application.* This is an axiom and cannot be disregarded in any instance. If a plaster is split clear through to the skin, cutting the underlying padding and dressings as well, the cast may be spread easily if swelling occurs or circulatory interference is noted, and further damage to the extremity minimized.

9. It is imperative that a line diagram of the fracture, a short note indicating the date of injury, the date of treatment, the type of treatment provided, and the unit rendering this treatment, be inscribed on each plaster in indelible pencil. This will aid in the followup medical care on each patient, and since in a high percentage of cases the medical records are lost, this information will serve as a substitute record.

10. Some individual ingenuity in the application of transportation plasters will be necessary. Elaborate orthopaedic or fracture tables will probably not be available where these casts are applied. Makeshift devices will have to be employed. *It is suggested that all plasters be applied on the stretcher or at least that the patient's extremities not be put in abduction beyond the limits of the stretcher.* In this way wide abduction casts which might interfere with his transportation will be avoided.

## GENERAL INFORMATION IN THE APPLICATION OF ALL PLASTERS

a. Maintain position of the fragments by manual traction until the plaster is set.

b. In leg casts, keep the foot at a right angle.

c. In arm casts used for forearm or wrist injuries, always trim the cast back to the proximal palmar crease, so that full metacarpal-phalangeal flexion can be maintained.

d. Watch carefully so that indentations from fingers, hands, etc., are not made in the plaster while the plaster is setting.



e. *Never use circular gauze dressings or adhesive tape around the extremity beneath the plaster cast.*

f. *Split all plaster casts through the plaster and the underlying padding after a manipulation or surgical procedure.*

g. Spread the cast if swelling occurs.

h. A legend in indelible pencil should be inscribed on all casts, consisting of a line, diagram of the procedure, date of operation, medical unit, number and surgical procedure carried out.

## XII. AMPUTATIONS

1. Indications for amputation of a limb are:—

a. Complete destruction of its blood supply. This means loss of the main and the majority of the collateral blood supply.

b. Fulminating gas bacillus infection.

2. Indications for amputation of the upper extremity should be more rigid than those for the lower, because:—

a. Circulatory gangrene is less frequent.

b. Gas gangrene is less frequent.

c. A small remnant of a hand is of far greater functional importance than a small remnant of a foot.

3. Level of amputation. Regardless of any consideration of future prosthetics, the limb should be amputated as low as the nature and situation of the wound permits.

4. Amputations are not to be sutured.

5. Only two types of amputation are permissible:—

a. The guillotine amputation, in which the skin, soft tissue and bone are all divided at identically the same level.

b. Circular or irregular short flap amputation, in which the skin and soft tissues are left slightly longer than the bone.

6. The guillotine amputation is used in cases where the amputation level is well below the site of election. This is done with the intention that re-amputation will be necessary at a later date.

7. The circular or irregular flap amputation is used when the point of bone division must be at or close to the point of election. As much skin as possible is thereby saved to pull over the end of the stump and later re-amputation will not be necessary.

8. If the bone must be divided at the site of election, and skin beyond this cannot be saved, a guillotine amputation is then indicated.

9. The main artery and nerve are divided at the same level as the bone. The artery is secured with a ligature and a transfixion stitch ligature distal to it. The nerve stump is not treated in any way by ligation, crushing or alcohol injection.

10. Careful hemostasis of the small vessels in the stump is essential lest later elevation of a shocked patient's blood

pressure cause vessels, which were not recognized at operation, to bleed.

11. Following either type of amputation frost with sulfanilamide, apply a small dressing of vaseline gauze over the open stump and, if possible, place the skin on traction with adhesive tape and a Thomas splint. Apply additional dressings after the stump is in the splint.

12. A plaster spica may be applied for splinting and the incorporation of distal traction.

13. Skin traction should be maintained indefinitely or until healing takes place. Exceptions are cases of circular or irregular flap amputations with cleanly granulating wounds without discharge or edema, or systemic febrile reaction. These may have secondary closure with a few loose retention sutures at a later date.

14. It is advisable to procure, wherever possible, a written statement in the patient's record by a second medical officer, signifying his agreement with the decision to amputate.

### XIII. ANESTHESIA

1. Before administering any anesthetic, check the equipment for completeness. Be sure that cylinders are properly attached, remove empty tanks and replace with full ones. Positive identification of gases in cylinders must be done by reading the label. Color markings are not to be relied upon, and used only to corroborate the label.

2. Treat patients adequately for shock before administering the anesthetic unless shock is due to continuing hemorrhage or cardiac dysfunction associated with a sucking wound of the chest.

3. Selection of anesthetic agent and method of administration. The following questions should be answered in reference to each patient and by the process of elimination the proper selection of agent and method may be reached.

a. Is the patient in shock or likely to develop shock?

In the case of a positive answer consider local or regional anesthesia. If muscular relaxation is essential, ether anesthesia preferably with nitrous oxide and oxygen may be employed. Use high concentrations of oxygen. Take the utmost care to provide an adequate airway and insert an endotracheal tube if necessary. Administer suitable intravenous fluid before administering the anesthetic.

b. Is analgesia adequate for the purpose?

In the case of a positive answer local or regional anesthesia should be employed.

c. Is relaxation necessary?

Ether anesthesia provides the maximal relaxation with the greatest margin of safety.

Spinal anesthesia in the absence of shock may be employed to produce muscular relaxation for operative procedures below the diaphragm. Pentothal sodium may be indicated if major degrees of relaxation are not necessary.

d. Is controlled respiration necessary?

If so, it can best be obtained by using the endotracheal method and a closed technique with breathing bag for passive respiration and a canister of soda lime for carbon dioxide absorption.

e. Is quick recovery of reflexes essential?

If so, regional anesthesia is advisable. For operations about the nose, pharynx and mouth, where hemorrhage within the mouth is a feature, avoid the use of pentothal. In skilled hands the insertion of an endotracheal tube and packing of the pharynx with moist or vaseline gauze will provide adequacy of airway.

f. Does the presence of injury to a vital organ preclude the use of certain anesthetics?

Failing function of the kidney is likely to occur after severe crushing injury. Use of ether or chloroform is to be avoided. The presence of pneumonia or pulmonary edema contraindicates the use of irritating volatile anesthetics. Use pentothal with extreme caution. Administer oxygen by inhalation if possible. In the presence of jaundice with possible hepatic dysfunction, use pentothal cautiously. Its destruction and excretion may be delayed. Infection of the peritoneal cavity with associated vomiting makes the administration of anesthetics hazardous. Insert a Levine tube in the stomach and aspirate the fluid content before administration by inhalation is begun. Leave the tube in place during the surgical procedure.

g. Is post-operative nausea and vomiting to be avoided?

Fluid loss through vomiting adds to shock. Regional or intravenous anesthetics are desirable where post-operative vomiting must be curtailed. Wiring of a fractured jaw is best undertaken under regional anesthesia. Use of pentothal in the presence of dehydration associated with severe burns is frequently desirable.

**THE INEXPERIENCED ANESTHETIST SHOULD EMPLOY ONLY THOSE AGENTS AND METHODS WITH WHICH HE IS THOROUGHLY FAMILIAR.**

#### 4. Preparing the patient for operation.

a. First treat shock adequately, employing the Trendelenberg position ( $10^{\circ}$ ), application of warmth but not excessive heat, administration of oxygen and plasma or blood intravenously. In the presence of crush injury alkalinize the urine.

b. If the patient has been injured shortly after ingesting a meal, consider that his stomach will be full, irrespective of the time interval before operation, unless he has emptied it by vomiting. Undigested food may be evacuated from the stomach, inducing vomiting by irritation non-traumatically within the pharynx, or partial induction of anesthesia by the administration of ether followed by irritation of the pharynx. During this manouver keep the patient in Trendelenberg position, preferably lying on his side in order to facilitate the evacuation of the vomitus from the mouth and pharynx. In the presence of intestinal obstruction insert a Levine tube and withdraw all fluid contents from the stomach. In the presence of upper abdominal trauma where the likelihood that the pleura has been punctured is so real, plan on using endotracheal anesthesia, in order to provide an efficient airway that permits the use of intermittent positive pressure.

#### 5. Preliminary medication.

a. Check the record for evidence of administration of morphine prior to admission. If the morphine has been given within 4 hours do not give more. Give atropine, grains 1/150 or 1/100, one hour prior to the operation. In case of emergency, give atropine intravenously 10 minutes prior to operation. Prior to the employment of local, regional or spinal anesthesia, administer a barbiturate nembutal  $1\frac{1}{2}$  or 3, either by mouth or per rectum. Absorption will be hastened if the contents of the capsule are dissolved in water.

#### 6. Precautions immediately preceding operation.

a. Empty bladder by catheter if necessary. Note presence or absence of occult blood.

b. Protect nerve trunks by padding, particularly elbows, knees and around the wrists. Pad shoulder braces well, loosen clothing about the neck and chest, protect patient against loss of heat, examine mouth for loose teeth or foreign bodies, remove foreign bodies and extract loose teeth if they are likely to be dislodged and aspirated under anesthesia. Remove partial plates. Protect patient's eyes. Avoid psychic trauma. This can be accomplished by inducing anesthesia with pentothal sodium.

#### 7. Anesthetic agents.

a. Ether. Ether may be employed alone or in combination with other agents. Its greatest value lies in the production



of muscular relaxation, and it is applicable to most types of operation. It is inflammable and explosive. Contra-indications: Acute and chronic respiratory infections, particularly with excessive production of mucus. Toxic states with hyperpyrexia, hepatic disease, nephritic dysfunction, in the presence of open flame or cautery or other open electrical devices.

b. Chloroform. Non-explosive and non-inflammable, but heated vapor burns with a green flame. Must be stored in colored bottles, preferably in a location where direct sunlight may not influence it. This agent is extremely potent and may produce primary cardiac failure during induction and delayed poisoning involving the liver following operation. Adequate oxygenation during its administration is absolutely essential.

Indications: Where no other suitable anesthetic is available, and where flame, cautery or other open electric apparatus creates the hazard of explosion with other volatile agents.

Contra-indications: Shock, toxic states, hepatic or cardiac dysfunction. Do not administer to a patient who is extremely excited. Do not employ epinephrine should untoward reaction occur. Method of administration by the open drop method with the patient preferably breathing an oxygen enriched atmosphere. Observe the patient for all known signs of depth of anesthesia, and consider a pulse rate under 80, cardiac irregularities, depression of respiration, occurrence of pallor and dilation of the pupils as significant signs indicating immediate withdrawal of the agent.

#### IF CHLOROFORM IS USED FOR INDUCTION,

change the mask before administering ether. Do not mix chloroform and ether in a single container because ether evaporates more quickly, and the ultimate solution contains a high percentage of chloroform.

c. Ethyl Chloride. Ethyl chloride is highly inflammable and explosive in air or in oxygen, possesses properties similar to chloroform. Induction is rapid, quiet and pleasant. It is indicated for induction of anesthesia in muscular individuals. Its administration may be associated with the production of masseter spasm and generalized seizures. In asthenic individuals, bradycardia followed by primary cardiac failure may be exhibited. Some tendency to nausea and vomiting on recovery may be noted. Discontinue administration if pulse rate is below 74.

**Contra-indications:** As for chloroform. For long operative procedures. Where open flame, cautery or improperly protected electrical devices are to be used.

**Indications:** Use only for short minor procedures or as an induction agent, preliminary to the administration of ether. Using ethyl chloride spray for the production of local anesthesia by freezing is seldom warranted.

d. Nitrous oxide. It is relatively inert and possesses no toxic property for tissue unless anoxia is present. Rapid induction with rapid recovery is possible with minimal irritation of the mucous membranes. Untoward effects are due to oxygen want. Degeneration of the cerebral cortex and basal ganglia may occur.

**Indications:** Short operative procedures where relaxation is not necessary. Where cautery, X-ray and electrical apparatus is to be employed. With oxygen as a vehicle for administration of ether vapor. (For this purpose always employ concentrations of oxygen above 20%.) Administration of nitrous oxide and oxygen in equal volumes during the administration of pentothal sodium minimizes the dose of pentothal that will be required.

**Contra-indications:** For operations requiring relaxation, unless ether vapor is added. A patient in shock suffering from hemorrhage where anoxia may occur without cyanosis being evident.

**Comment:** The administration of nitrous oxide and oxygen requires a high degree of skill and apparatus of modern approved model. In order to make possible the use of a high concentration of oxygen, preliminary medication with morphine should be adequate.

e. Pentothal sodium. Is a sulphur homologue of pentobarbital sodium (nembutal). Evipal soluble is a sulphur-free barbiturate but is less potent.

**Indications:** In anesthesia in which inflammable and explosive anesthetic agents might be a hazard. For the debridement of wounds where shock is not in evidence and maximal degrees of relaxation are not required. For induction of anesthesia prior to administration of anesthetics by inhalation. For cystoscopy, ureteral catheterizations, incisions of abscesses. For immediate relief of convulsions due to tetanus or overdosage of cocaine or procaine. For subsequent control of tetanic seizure employ a barbiturate which is longer acting. Where pentothal sodium is administered simultaneously with nitrous oxide and oxygen in equal volume, the dose of pentothal will be minimized. It may be employed as a supplement to

local, regional or spinal anesthesia. In the presence of spinal anesthesia, depression of respiration should not be accentuated and the administration of oxygen is advocated. Because pentothal produces peripheral vascular dilatation it may be employed for testing for adequacy of circulation in an extremity. Such test should be undertaken in an atmosphere which is between 65° and 72°, thus ensuring the presence of less than maximal peripheral vascular dilatation. An increase in the temperature of the extremity will indicate a loss of vascular spasm or the presence of collateral circulation.

**Contra-indications:** Pentothal is contra-indicated in the presence of shock, but is thought by some to be useful in minimizing the onset of shock provided that it is administered early before shock has become severe. Patients suffering from respiratory embarrassment due to partial upper respiratory obstruction, intrathoracic foreign bodies, tension pneumothorax, empyema, mediastinal shift with cardiac decompensation, productive bronchitis, asthmatic reaction, emphysema in the presence of foreign bodies or inflammatory masses involving lateral structures of the neck, particularly in the presence of encroachment on the patency of the airway. For the production of abdominal relaxation unless supplemented by other agents given by inhalation. Among civilian casualties, children under 12 years of age.

**Precaution:** Adequate preliminary sedation will minimize the dose of pentothal required. Administer atropine either subcutaneously or intravenously if necessary prior to the use of pentothal. Maintain adequate respiratory exchange and administer oxygen if available, or oxygen and nitrous oxide in equal volumes if it is essential that the dose of pentothal be minimized. Avoid intra-arterial injection.

Use solutions that contain pentothal in 5 per cent concentrations or less. Administration must be intravenously. For tissue reaction due to extraveneous spilling, apply warm moist applications. Avoid the use of cold applications which will tend to produce peripheral vascular constriction and thus reduce the blood supply to the part. Ambulant patients must be kept under control for several hours because of the production of amnesia which might be present in spite of a condition of apparent lucidity of mind.

# SPINAL ANESTHESIA

OPERATION	PONTOCAINE & PROCAINE COMBINED Use Pontocaine 1.0% (10 mgm/cc) and Procaine 10% (100 mgm/cc) (Duration 50 to 150 mins.)				PROCAINE CRYSTALS Dissolved in Spinal Fluid Conc'ns 10% (100 mgm/cc) (Duration 30 to 90 mins.)			METYCAINE Conc'ns 10% (100 mgm/cc) (Duration 50 to 150 mins.)		
	Inject Between	Vol. of 1.0% Pon- to- caine	Vol. of 10% Pro- caine	Total volume after Sp. fluid added	Inject Between	Dosage of 100 mgm/cc Procaine	Total volume after Sp. fluid added	Inject Between	Volume of 10% Metycaine	Total volume after Sp. fluid added
Repair Perin. Lac.	..	cc. 0.5 + 0.5	cc. 0.5 + 0.5	cc. 2.0	L3 & L4	cc. 0.5 - 1.0	cc. 2.0	L3 & L4	cc. 0.5 - 0.7	cc. 2.0
Trauma to Testis	..	0.7 + 0.3	0.7 + 0.3	2.5	L3 & L4	0.75 - 1.0	3.0	L3 & L4	0.6 - 0.8	2.5
Cystoscopy	..	0.7 + 0.3	0.7 + 0.3	2.5	L2 & L3	0.75 - 1.0	3.5	L3 & L4	0.6 - 0.9	2.5
Cystostomy	..	0.7 + 0.3	0.7 + 0.3	3.0	L2 & L3	1.0 - 1.2	3.5	L3 & L4	0.8 - 1.0	3.0
Inguinal Hernia	..	1.0 + 0.5	1.0 + 0.5	3.0	L2 & L3	1.2 - 1.5	3.0	L2 & L3	1.1 - 1.3	3.0
Resect. Bladder	..	1.2 + 0.5	1.2 + 0.5	3.5	L2 & L3	1.2 - 1.5	4.0	L2 & L3	1.2 - 1.4	3.0
Appendectomy	..	1.0 + 0.5	1.0 + 0.5	3.5	L2 & L3	1.2 - 1.5	4.0	L2 & L3	1.1 - 1.3	3.5
Nephrectomy	..	1.2 + 0.5	1.2 + 0.5	4.0	L2 & L3	1.5 - 2.0	4.5	L2 & L3	1.2 - 1.4	3.5
Explore Stomach	..	1.2 + 0.5	1.2 + 0.5	4.5	L2 & L3	1.5 - 2.0	5.0	L2 & L3	(Max.)*	

Spinal needle gauge 20 or 22.

Rate of injection—0.5 cc. per sec.  
No barbitage.

NOTE: Patients must be kept level for 15 to 20 minutes after injection of spinal anesthetic.  
*Trendelenberg contraindicated during this interval.* Administer anesthetic with patient on operating table.

\*Metycaine—maximal dose 140 mg. or 1.4 cc. of 10% solution.  
Not to be used for upper abdominal procedures.



## OXYGEN THERAPY

1. Blood saturation with oxygen may be 10-15% below normal before cyanosis is perceptible. If cyanosis is evident administration of oxygen is warranted. Anoxemia may be present without the appearance of cyanosis in individuals who are in shock, particularly if hemorrhage has been excessive. A slight deficiency results in increased respiratory and pulse rates with evidence of slight cyanosis. Moderate deficiency of insidious onset produces symptoms comparable to alcoholic intoxication. The patient's judgment is warped, he may be suffering from headache, nausea, vomiting, as well as visual and respiratory disturbances. Severe oxygen want results in acute deficiency, development of marked cyanosis with rapid pulse and respiratory rates, unconsciousness and death if unrelieved. During the late phase in this syndrome, the pulse may be slow, full and bounding. It precedes by a very short interval of time the appearance of a rapid thready pulse and the development of an irreversible stage in the reaction.

### 2. Evidence of oxygen deficiency and treatment.

a. With patient breathing adequately but obviously in shock, give oxygen by intranasal catheter. Use catheter F12 or 14. Measure distance from ala of nose to tragus of ear and subtract  $\frac{1}{2}$  in. Mark this length from the tip of the catheter by means of adhesive, lubricate with vaseline and insert catheter along the floor of the nose. Fix it firmly in position by means of adhesive over the bridge of the nose. Administer 5 liters per minute. If the patient gags or swallows withdraw the catheter  $\frac{1}{2}$  in. or more, to a point at which this reaction ceases. If the patient is unconscious observe for gastric distension, withdraw the catheter to a point where the tip can be readily seen in the pharynx.

b. With chest wall moving inadequately, differentiate between mechanical obstruction, intracranial damage, atelectasis, intrapulmonic disruption, pulmonary edema, pneumothorax with or without increased intrapleural pressure.

(1) With obstruction, respiration is labored, it is frequently stertorous with suprasternal and supraclavicular retraction occurring on inspiration. Change the position of the head and body to improve airway and permit drainage and escape of blood and mucus secretion. Maintain 10 Trendelenberg with patient lying on his side. Search for foreign bodies in the mouth and pharynx, remove same. Draw the lower jaw and tongue forward, insert an airway. Administer oxygen by mask and bag with intermittent manual pressure on the bag, and use pressure just sufficient to expand the chest. If obstruction is due to severe trauma within the mouth or penetrating through to the pharynx, consider the advisability of undertaking the establishment of a tracheal opening which

will be prophylactic against a complete obstruction that is likely to occur with increasing edema or development of subcutaneous emphysema. If obstruction is due to epiglottic edema it may be possible to insert an endotracheal tube and give oxygen by mask or bag or through a catheter inserted in the tube. Provide against the patient biting down on the tube and thus occluding the airway. If the patient is nauseated and is likely to vomit, this method is less safe than tracheotomy. In any case it is preferable to establish a tracheal opening within 12 hours rather than leaving the endotracheal tube in situ beyond this time.

(2) With intracranial damage involving respiratory center either directly or secondarily, breathing may be rapid or slow and irregular in rhythm. Obstructive symptoms may be due to muscular relaxation of the tongue, pharynx and larynx. Treat as indicated above. Reduction of intracranial pressure by the withdrawal of spinal fluid should be considered and may improve the character of respiration. Oxygen may be administered through a catheter inserted into the artificial airway.

(3) With atelectasis there is unilateral lag in the movement of the chest. Other classic signs may be elicited. Administer oxygen by intranasal catheter, B.L.B. mask or mask and bag. Encourage coughing by forcibly percussing the involved area. Change the position of the patient every hour while awake and aspirate material from the pharynx. If the condition is associated with fracture of the ribs, accomplish an intercostal block of each rib involved. Relief of pain will make coughing possible. If these measures are not successful insert an endotracheal tube, insert an aspirating catheter through it and remove mucoid material. Oxygen may be given through a catheter inserted in the endotracheal tube. If the condition is unrelieved bronchoscopy is indicated but is seldom necessary.

(4) In the presence of blast injury of the lung active methods of assisting respiration are contraindicated. Quiet unobstructed breathing is the ideal, provided an atmosphere high in oxygen content is available. This may be supplied through an intranasal catheter or B.L.B. mask. The hazards of continuing slow intrapulmonic hemorrhage necessitates hospitalization and bed rest longer than might at first seem warranted.

(5) With pulmonary edema, frothy mucus will be in evidence, and signs of varying degrees of obstruction noted. Facilitate expectoration of mucus by Trendelenberg position with patient lying on his side. Administer oxygen by intranasal catheter or B.L.B. mask. In the presence of excessive production of mucus an intranasal catheter is much to be preferred. The use of positive pressure is not indicated

unless edema is cardiac in origin rather than due to alveolar irritation.

(6) With pneumothorax, unilateral respiration may be in evidence without serious symptoms unless increase in intrapleural pressure causes mediastinal shift. Administer oxygen by intranasal catheter or B.L.B. mask. Remove air from pleural space by means of intrapleural puncture. For transportation of patient fix needle in situ and attach a thin walled rubber tube (finger from a surgical glove or piece of Penrose drain). If glove finger is employed effect a small opening in the distal end to permit egress of air. This valve system will prevent ingress.

If mediastinal shift is associated with a sucking wound of the thorax, make every attempt to stop the opening. Beware of increasing intrapleural pressure. To be assured against this a needle may be inserted as described above.

c. With no movement of the chest wall maintain artificial respiration with the patient in the prone position. Remove loose or foreign bodies from the mouth or pharynx. Establish an airway, using mouth to mouth breathing if mask and bag and a supply of oxygen is not available for maintenance of intermittent positive pressure and attempt to eliminate the fundamental cause of the condition. If available insert an endotracheal tube. If the condition is prolonged place the patient in a respirator supplying intermittent negative pressure ( $-10$  mm Hg).

### 3. Improvised equipment for oxygen therapy.

The regulation gas mask can be used to administer oxygen and its use is indicated for giving oxygen in an atmosphere contaminated with poison gas. The gas mask is worn in the normal fashion and a transfusion needle (preferably 15 or 17 gauge) is inserted through the corrugated tubing. The needle is connected by rubber tubing to a flowmeter and thence to a cylinder of oxygen. Deliver at the rate of 5 to 7 liters per minute.

In order to obtain a higher concentration of oxygen the canister may be removed from the corrugated tubing of the gas mask and a rebreathing bag such as is used for anesthetic work may be substituted in its place to act as a reservoir. The inlet for oxygen may be through the needle inserted as described above. The flow of oxygen should always be sufficient to prevent total collapse of the bag upon inspiration. With this arrangement positive pressure sufficient to perform artificial respiration may be produced by intermittently compressing the expiratory valve and preventing the escape of gas and simultaneously placing manual pressure on the bag. For this maneuver it is essential that the mask be fitted firmly in place by means of headstraps, otherwise gas escapes between

the mask and face before the chest is raised. A freely open airway is an absolute essential to successful treatment.

#### 4. Oxygen therapy for medical conditions.

Administration of oxygen through intranasal catheter is indicated for patients suffering from pneumonia, asthma or pulmonary embolism. In the presence of pneumonia start treatment early, preferably before cyanosis appears and continue over a sufficient period to be assured that extension of the disease and relapse will not occur. For asthma administration may be combined with rectal administration of ether in oil. Employ ether  $2\frac{1}{2}$  ozs. mixed with 3 ozs. of either mineral or olive oil. In many instances the bronchial spasm will be relieved. The production of mucus will be temporarily increased, and suction should be available to aid its removal. Subsequently the mucus will tend to be less tenacious and the patient will be improved.

In the presence of cardiac disease, cardiac insufficiency occurring as a sequel to pulmonary disease, acute coronary thrombosis or associated with mediastinal shift, administration of oxygen by intranasal catheter is the simplest method. For reduction of abdominal distension administration of oxygen in high concentration is necessary. A B.L.B. oronasal mask should be employed. There is produced an increase in the gradient of diffusion between the nitrogen existing in the intestinal canal and that in the blood, consequently there is an increased rate of removal of nitrogen through the tissues into the blood and thence through the lungs to the open air.

Oxygen administration is of questionable value in the presence of migraine or gas gangrene.

Comment: The most reliable guide to effective treatment is the reduction of pulse rate and reduction in temperature, the absence of cyanosis, the character of respiration and level of blood pressure all influence decision regarding the desirability of terminating treatment. Note the maximal reduction in pulse rate. If this rate is maintained after oxygen therapy is terminated, the patient probably no longer requires an oxygen enriched atmosphere.

5. Safeguards: Be thoroughly familiar with the equipment supplied (Items 36108, 37126, 93640, 93643, Arcus quick coupling pipeline), check for completeness and efficiency of operation.

During the insertion of an intranasal catheter the oxygen should flow at 5 liters. If the patient swallows a bolus of gas the catheter must be withdrawn until swallowing no longer occurs. Excessive withdrawal of the catheter will reduce the oxygen concentration within the trachea. The catheter should be withdrawn every four hours, cleansed and reinserted in the opposite nostril unless a septal deflection



prevents insertion. Oxygen administered through an intranasal catheter should be thoroughly humidified to prevent excessive drying of the throat. If the patient is unconscious observe the degree of distension of the stomach. Insert the catheter and observe the stomach for developing distension. Withdraw the catheter to a point where delivery of the oxygen down the esophagus no longer occurs. Insertion of a Levine tube into the stomach will provide a safeguard against overdistension.

Smoking by the patient, attendants or visitors during the administration of oxygen is to be prohibited. Do not administer oxygen unless the patient and apparatus is at least 8 feet from an open fire. Because the volume of inclosed oxygen is relatively great in an oxygen tent, this type of apparatus should not be employed within 15 feet of an open fire.

Cylinders contain oxygen compressed to a pressure of 2,200 pounds. They therefore should be treated with care and respect. Do not oil the valve. Do not connect any apparatus to the cylinder valve while hands are greasy or while greasy gloves are worn. Preliminary to attaching a regulator to the cylinder valve allow a small quantity of oxygen to escape, thus clearing the valve of dust. If the regulator is the variable pressure type before allowing the oxygen under high pressure to enter it, turn the control to the zero point. If the regulator has a manometer attached, whether it be of the aneroid type or the gravity type, before allowing the oxygen under high pressure to reach it, completely check the flow. Any regulator which becomes hot during the time that oxygen under high pressure is flowing into it is defective. The flow of oxygen from the cylinder should be turned off at once, the regulator detached and sent for repair. The hazard of fire within a defective regulator and disintegration of it is very real. A regulator which becomes covered with frost is being used beyond its capacity and the flow of oxygen should be decreased.

Mixtures of carbon dioxide and oxygen will not be available for issue in this Theater of Operations. In no instance is a cylinder of pure carbon dioxide to be attached to any apparatus designed for inhalation therapy or for production of anesthesia.

#### XIV. TREATMENT OF BURNS

##### I. General Considerations.

1. Each hospital should be prepared at all times with a burn team and a plan for admission, sorting and treatment of multiple burn casualties.

2. In the very early stages the treatment of shock and

hemoconcentration takes precedence over local treatment of the burn.

3. Definitive treatment of the burned area is given at the first opportunity presented by the condition of the patient and the presence of adequate hospital facilities. It is aimed at obtaining and maintaining a wound free of contamination and infection.

## II. Specific Considerations.

### 1. Systemic Treatment.

a. Plasma must be given to maintain blood volume. A simple method of estimating the amount of plasma necessary is that of adding 100 cc. of plasma for every point the hematocrit determination exceeds the normal of 45. Another rough method is that of administering 500 cc. of plasma for each 10% of the body surface burned. The adequacy of plasma administration can be determined by frequent red blood cell, hemoglobin, and hematocrit determinations. An effort should be made to keep the red blood cell count at 5.5 million or below, the hematocrit reading below 50, and the hemoglobin down to 100%. The general condition of the patient, the pulse and blood pressure, are other invaluable guides.

Continued plasma therapy for three or four days may be necessary, and following this, plasma should be given at intervals to maintain the blood proteins at a normal level.

b. A standard method of estimating body surface burned is by use of the Berkow formula, as follows:—

Head .. .. .	6%
Upper Extremities:	
Both arms and forearms ..	13%
Both hands .. .. .	5%
Total .. .. .	18%
Trunk and Neck:	
Anterior Surface .. ..	20%
Posterior surface .. ..	18%
Total .. .. .	38%
Lower Extremities:	
Both thighs .. .. .	19%
Both legs .. .. .	13%
Both feet .. .. .	6%
Total .. .. .	38%

c. The need for whole blood transfusion will develop in some cases as early as 2-3 days after the burn is incurred. Plasma is not a substitute for whole blood if secondary anemia is present.

d. A urinary output of 1000 cc. to 1500 cc. daily must be established as soon as possible. In the first 24 hours after an extensive burn it is more important to effect adequate

plasma replacement than to give parenteral crystalloids. During this period it is believed that the salt requirements are met by the salt content of the plasma administered. The daily fluid intake should be maintained at 3000 cc. to 4000 cc., and if parenteral fluids are necessary to reach this level, chief reliance should be placed on 5% glucose in distilled water. Saline should be given sparingly, usually only if there is vomiting or some other cause for salt depletion. As a general rule, not over 1000 cc. of normal saline should be given over a 24-hour period.

e. During the critical phase (which may last up to 72 hours or longer), the patient must be closely observed for the development of pulmonary edema, shock, morphine overdosage, or the development of cerebral manifestations. Oxygen therapy is often indicated during this period.

f. From the first, the importance of maintaining the nutritional state of the patient should be kept in mind. Every effort should be made to give adequate food and liquids with a high content of carbohydrate, protein and vitamins.

g. A prophylactic dose of polyvalent gas bacillus antitoxin may be given for deep burns at the discretion of the medical officer.

## 2. *Cleansing and Debridement.*

a. No attempt will be made to clean or debride the burn surface until shock is adequately controlled.

b. The wound will always be treated under standard operating room technique with patient and attendants fully masked.

c. Morphine sedation will be adequate to allow debridement and cleansing of the wound in the majority of cases. Intravenous morphine may be indicated in some instances. If general anesthesia is necessary, first consideration should be given to light intravenous pentothal sodium. Inhalation anesthesia is contra-indicated if an associated blast injury is present or suspected.

d. In some cases, if the patient is received a short time after the burn is incurred, and if the wound is free of gross contamination, cleansing and debridement may be considered unnecessary.

e. Those burns showing gross contamination should be cleansed with neutral soap and water, and irrigated with saline. Lard, mineral oil or ether, in small amounts, may be used for removal of grease and heavy oil. The cleansing should be done gently with gauze or cotton swabs. Green soap and brushes will not be used. The cleansing should include the skin surrounding the burn.

f. Removal of loose shreds of epidermis and large blisters should be done after thorough cleansing. Small blisters may be left undisturbed, or removed, depending on the extent of the procedure necessary and the condition of the patient.

g. Immediate excision and grafting of burns has such limited application that it is not recommended.

h. Debridement should not include excision of loose skin from the *eyelids, ears, or fingers*. Blisters in these areas may be incised after cleansing.

### 3. Dressing.

a. The burned area should be covered with single strips of fine mesh gauze (44-mesh gauze bandage), impregnated with 5% sulfadiazine cream, boric acid ointment or petrolatum. *Sulfadiazine cream is preferred* because of the early high local concentration of the drug obtained. It does not stand autoclaving and should be prepared at the operating table by spreading thinly on 44-mesh gauze bandage. Sulfanilamide powder may be used with boric acid ointment or petrolatum, but the total dose should not exceed 10 grams. Local sulfonamide therapy is only of value as a prophylactic against virulent infection in the early stages. It is useless after pus has developed from ordinary pyogenic infection of the deeply-burned areas. Ordinarily there will be no indication for continuation of local sulfonamide therapy after the first dressing, which, in a favorable case, can be postponed to between seven and fourteen days.

b. The remainder of the dressing will consist of gauze, absorbent cotton, cotton waste or cellulose. The dressing will be thickly applied over all the burn and will be bandaged on snugly with even pressure throughout. Stockinette or some form of elastic bandage may be used if available, to maintain pressure. Care should be taken to prevent the pressure dressing from forming an area of constriction. In the case of extremities the pressure dressing should include the entire extremity distal to the burn.

c. Immobilization of the part by plaster splints placed over the dressing should be effected when possible. Skin-tight plaster casts should not be used. If a complete plaster casing is applied, it should be split to allow for swelling.

d. Burned hands should be carefully dressed with pressure to, and including, the tips of the fingers. The hand should be in the position of function with fingers separated and flexed. Edema is further prevented by elevation, which is best accomplished by overhead suspension attached to plaster arm splints applied over the pressure dressings.

e. Pressure dressings are applied to the face as elsewhere, taking care to protect the eye, pad the ears, and leave an adequate respiratory airway.

f. Genitalia should be covered with 5% sulfadiazine cream and simple dressings. The dressings should be applied in such a manner that they can be changed separately as necessary.

g. Dressings should be changed infrequently in the early



stages of a burn and, if possible, the dressings should be done in the operating room with standard aseptic technique.

h. In some instances it may be necessary to change the dressing at four to five days on a clean and uninfected case, because of external soiling or soaking of the dressing by exudation of plasma. In such cases it is often satisfactory to change the bulky outer portion of the dressing and not disturb that immediately over the burn surface.

#### 4. *Sulfonamide Therapy.*

a. If a sulfonamide is used locally, oral or parenteral administration of the drug should be postponed until adequate kidney function is demonstrated by a daily urinary output of 1500 cc., and the blood sulfonamide has dropped to a low level. After this period, if evidence of sepsis develops, oral therapy should be instituted and continued as indicated.

b. All cases with moderate to severe burns, that have not had local sulfonamides applied, will be started on oral chemotherapy. Sulfadiazine is the drug of choice for oral administration (sulfanilamide may be substituted). It should be given with caution in the early stage of a burn, and the dose should not exceed 0.5 gram every four hours until the urinary output has reached a normal level. Frequent blood level determination should be done.

#### 5. *Further Care of Burned Surface.*

a. If virulent infection is prevented, healing of superficial burns will take place rapidly.

b. After a period of about two weeks, infection of deeply-burned areas by ordinary pyogenic organisms will make frequent dressings necessary in order to maintain cleanliness and promote separation of slough.

c. Wet dressings using saline, boric, Dakin's, or azochloramid solution for irrigation should be applied and changed daily.

d. Dressings should be wet before removal.

e. If possible, saline baths should be used for ease of removal of dressings, for cleanliness and to promote active exercises.

f. Unhealed areas should be prepared for grafting, and grafts applied as early as possible. It is often possible to begin grafting within three or four weeks after the burn is incurred.

g. Active motion should be instituted in severe hand burns not later than seven days following the injury. This can be facilitated by removing the dressing and placing the extremity in an arm basin filled with saline.

#### 6. *General Care.*

a. Whole blood transfusions may be necessary as early as three or four days after the burn, and at regular intervals thereafter until the case is healed or grafted.

- b. A diet high in calories, *protein*, carbohydrate and vitamins should be maintained.
- c. The blood protein level should be observed and kept at a normal level by plasma transfusions as necessary.
- d. Careful and sympathetic nursing care is an absolute essential.

## XV. RADIOLOGY

1. X-ray examination should be made only when the findings will affect treatment, or, more rarely, the disposal of the patient.

2. *Triage and Radiology.* Planning conferences should be arranged between the triage group and the radiologist to assure uniform policies as to what type of cases should have X-ray examination; priority and volume in which they should be sent to the X-ray department, and a system of brief exact requests for X-ray examination which will convey the specific purpose of each request. A similar system of requests should be formulated with ward medical officers.

3. *Patients in shock* or threatened shock should not have X-ray examinations except in rare emergency.

4. *Gunshot wounds of the upper thighs and buttocks* should have additional A.P. or P.A. radiographs of the pelvis and lower abdomen because complicating involvement is frequently found here.

5. *Gunshot wounds of the thorax* should have additional A.P. and lateral radiographs of the upper abdomen, because of frequency of trans-diaphragmatic involvement.

6. *Gunshot wounds of upper arm, shoulder and neck* should be considered for additional A.P. (or P.A.) radiographs of the thorax, to exclude upper lung involvement.

7. *All soft tissue wounds* of the extremities should have an A.P. and lateral X-ray examination of the injured part, including the nearest joint, prior to surgical treatment.

8. *Transportable cases* with wounds of the *face and skull* should generally not have X-ray examination until specialized treatment is available.

9. *Fluoroscopy* is seldom as satisfactory as radiography. It is most useful in thoracic cases as an adjunct to radiography, and in localization of foreign bodies in the pelvis where lateral views are impractical and stereoscopy is not available. It is used for other types of cases, mainly when facilities for radiography or film supplies are not adequate to keep abreast of the volume of patients. Fluoroscopy, when not expertly supervised, can be a menace to patients and operators. It should never be attempted until the eyes have been accommodated at least 15 minutes.

10. *Localization of foreign bodies in extremities* is generally best accomplished by A.P. and lateral radiographs. Fluoroscopic orientation by the table device is generally not as practical in extremities as A.P. and lateral radiographs, because bandages and wounds prevent marking the skin, and because the surgical approach to the foreign body may not be determined until *after* the X-ray study, and thus skin marking, even when possible, may not be placed on the proper aspect of the extremity. Lateral radiographs of extremities can, and should, be made with the patient supine, when turning the patient causes pain.

11. A procedure should be evolved whereby a patient about to be evacuated can be accompanied by his radiographs in the highest possible per cent of cases. This will conserve film, tubes, and save pain and disturbance of the patient by obviating many retakes.

12. Standardized radiography, using basic positioning, will encourage radiologists, in all hospitals to which the patient is sent, to interpret the films which accompany the patient.

*A Manual of Standardized Positioning for Forward Area Radiography*, divided into two parts, description text, and illustrations, is published separately for Army medical installations of ETO.

## MEDICAL EMERGENCIES. SECTION C

### I. GENERAL

In so broad a field merely the basic principles of the treatment of a few medical situations requiring prompt action may be outlined.

### II. ACUTE POISONINGS

#### a. *Acids.*

(1) Neutralize with weakly alkaline solutions, such as magnesia, chalk, white wall plaster, sodium bicarbonate (cooking soda), soapsuds, or lime water, if available.

(2) Give a demulcent, such as reconstituted milk or egg (from powder).

(3) Keep the patient warm.

(4) Give 0.015 gram ( $\frac{1}{4}$  grain) morphine sulfate for pain.

(5) Do not pass a stomach tube or give an emetic, because of the danger of perforation.

#### b. *Alcohol.*

(1) Acute alcoholism may be confused with a number of other conditions, notably spontaneous or insulin-induced hypoglycemia, cerebral concussion, and acute poisonings due to drugs, particularly barbiturates and cocaine (with acute

cocaine poisoning, treatment for acute alcoholism frequently results fatally).

(2) If the diagnosis of acute alcoholism is established, no specific medical treatment is required in most cases.

(a) Put the man to bed, cover him warmly enough to prevent chilling, and allow him to sleep until he recovers.

(b) The routine use of gastric lavage is not advisable.

(c) The patient should be watched until it is certain that the intoxication is not serious.

(d) On his awakening, give 1.0 gram (15 grains) sodium bicarbonate, and a saline laxative by mouth, if they can be retained; give 0.6 gram (10 grains) acetylsalicylic acid (aspirin) by mouth for relief of general distress; if vomiting persists, give nothing but crushed ice by mouth and administer 0.0006 gram (1/100 grain) atropine sulfate hypodermically, repeating once, or twice at 3-hour intervals, if necessary.

(3) If the man is noisy, violent, or combative, and if he is robust—

(a) Administer 0.006 gram (1/20 grain) apomorphine hydrochloride hypodermically; this will suffice to quiet the patient, and will usually induce vomiting (apomorphine should never be given to a drowsy or unconscious patient).

(b) If vomiting does not occur, a stomach tube should be passed and the stomach washed out with several quarts of warm water or of a 5 percent solution of sodium bicarbonate.

(c) Barbiturates and other hypnotics should be avoided as far as possible, and should never be given until it is certain that a serious degree of intoxication is not present. Paraldehyde is the safest, and may be given in doses up to 8-12 cc. (2-3 drams) by mouth in cold water or lemonade (synthetic) or rectally in mineral oil. Given intravenously paraldehyde gives excellent sedation in a few minutes. By this route the dose is 0.5 to 3 cc. and the drug does not require sterilization.

(d) In rare cases in which apomorphine is ineffective or inadvisable and hypodermic administration of a sedative is deemed necessary, inject 0.2 to 0.3 gram (3 to 5 grains) sodium luminal or sodium amytal. These drugs are too dangerous for general use, since the depressing effect is added to that of the alcohol, and since they occasionally excite rather than quiet the patient.

(4) If a very large amount of alcohol has been imbibed during a short interval, a serious degree of intoxication may develop, which can prove fatal from respiratory and circulatory failure, unless energetically treated. Such a condition is indicated by drowsiness increasing rapidly to coma, dilated pupils, slow, stertorous breathing; cyanosis, rapid, feeble pulse, loss of reflexes, incontinence, and convulsions. To combat coma, inhalations of oxygen may be useful. Warm



coffee by rectum may be helpful. Caffein sodium benzoate 0.3-0.5 grams (5-7.5 grains) intravenously is recommended as a central stimulant.

(a) Insert a stomach tube, taking care that it does not enter the trachea, and wash out the stomach thoroughly with a 5 percent solution of sodium bicarbonate in warm water. Introduce a teaspoonful of sodium bicarbonate and 30 grams (1 ounce) magnesium sulfate, dissolved in a glassful of water, into the stomach before withdrawing the tube.

(b) Avoid chilling by keeping the patient well covered with blankets and by using hot-water bottles, if necessary.

(c) The patient should be carefully watched to prevent the aspiration of vomitus and the resultant pneumonia.

(d) In certain cases, generalized convulsions occur. If mild, they can be controlled by 0.1 to 0.2 gram ( $1\frac{1}{2}$  to 3 grains) phenobarbital by mouth, or if severe by 0.5 gram ( $7\frac{1}{2}$  grains) or less of sodium amytal intravenously.

c. *Alkalies.*

(1) Neutralize with a weak acid, such as lemon powder or vinegar, if available.

(2) Keep the patient warm.

(3) Do not pass a stomach tube or give an emetic, because of the danger of perforation of the oesophagus or stomach.

d. *Barbiturates.* The following treatment, subject to the needs of the case and limitations of the surroundings, may be carried out:

(1) Pass a stomach tube and wash out the stomach.

(2) Purge with 30 grams (1 ounce) magnesium sulfate.

(3) Keep the patient warm.

(4) Give continuous oxygen therapy, in combination with carbondioxide, to stimulate the respiratory center, if necessary.

(5) Caffein sodium benzoate 0.3-0.5 grams (5-7.5 grains) intravenously.

(6) Hospitalize without delay if the depression be of such degree.

e. *Carbon Monoxide.*

(1) Treat at once and continuously.

(2) Supply fresh air and keep the patient quiet.

(3) Apply artificial respiration if necessary.

(4) Provide inhalation of 5 percent carbon dioxide and 95 percent oxygen, if possible, or use pure oxygen. Oxygen alone is indicated only since the combination is not available.

(5) Hospitalize as soon as possible.

f. *Iodine.*

(1) Give a starchy preparation, such as a heaping tablespoonful of flour stirred into a pint of boiling water and the mixture allowed to cool, at once.

(2) Remove the mixture with a stomach tube.

(3) Repeat these two procedures until the solution is no longer colored.

(4) Give 500 to 1500 cc. physiologic saline solution intravenously.

(5) Give morphine sulfate in amounts adequate to relieve pain.

g. *Mercury Salts* (chiefly *mercury bichloride*).

(1) Give large quantities of reconstituted milk and egg (from powder).

(2) Then pass a stomach tube and thoroughly wash out the stomach.

(3) Combat shock by appropriate methods, including plasma and blood transfusion.

(4) Hospitalize without delay.

h. *Opium* (Morphine).

(1) Pass a stomach tube and wash out the stomach with a 0.05 percent solution of potassium permanganate.

(2) Inject intravenously 0.5 gram ( $7\frac{1}{2}$  grains) caffeine sodium benzoate or theophylline.

(3) If stupor has not occurred make every effort to keep the patient awake and moving.

(4) Inhalation of 5 percent carbon dioxide and 95 percent oxygen may stimulate respiration, or use pure oxygen. Oxygen alone must be used since the combination is not available.

(5) Apply artificial respiration if necessary.

(6) Give a saline purge—30 grams (1 ounce) magnesium sulphate.

(7) If shock develops, treat as in shock due to other causes.

i. *Phenol* (Carbolic Acid).

(1) If taken by mouth, pass a stomach tube and wash out the stomach with mineral oils, or if oils are not available use ordinary tap water.

(2) If stomach tube is not available, inject 0.006 gram ( $\frac{1}{10}$  grain) apomorphine hydrochloride, hypodermically.

(3) Provide inhalation of 5 per cent carbon dioxide and 95 percent oxygen or apply artificial respiration, if necessary. Use pure oxygen in absence of the  $\text{CO}_2$ ,  $\text{O}_2$  mixture.

(4) If there is a surface burn, wash off the skin with 95 per cent alcohol.

(5) Hospitalize at once.

j. *Phosphorus* (in rat paste and matches).

(1) Pass a stomach tube and wash out the stomach with 500 cc. of a 0.5 percent solution of copper sulfate.

(2) Repeat at 15 minute intervals.

(3) Give a saline purge—30 grams (1 ounce) magnesium sulfate.

(4) The ingestion of organic oils should be avoided.

- (5) Give 0.015 gram ( $\frac{1}{4}$  grain) morphine sulfate for pain.
- (6) Eventually give a demulcent preparation, such as boiled starch solution, reconstituted milk and egg (from powder).
- (7) Hospitalize as soon as possible.
- k. *Silver Salts* (chiefly silver nitrate).
- (1) If swallowed, give orally 30 grams (1 ounce) sodium chloride dissolved in a glassful of water, pass a stomach tube and wash out the stomach.
- (2) If in the eye, irrigate freely with physiologic saline solution.

### III. ALLERGIC AND ANAPHYLACTIC REACTIONS

Before injecting any foreign serum the patient must be questioned regarding the personal or family occurrence of any form of allergic manifestation, viz., dermatologic, respiratory, gastro-intestinal, etc. No patient with a definite history of allergy should receive a foreign serum unless it becomes vitally necessary. In such conditions the administration should be extremely cautious. Intradermal and ophthalmic tests for sensitivity should be made wherever possible. Positive reactions contra-indicate the use of serum, except under unusual conditions.

In the chance of such reactions a syringe filled with 1 : 1000 epinephrine (adrenalin) should be kept in readiness. Should the reactions follow subcutaneous or intramuscular injection, absorption may be limited by the application of a tourniquet above the site of injection. The tourniquet should be released for a few seconds every few minutes over a period of 30-45 minutes, when it may be completely removed. 1 cc. of 1 : 1000 solution of epinephrine (adrenalin) is injected intramuscularly immediately. If a tourniquet has been applied to reduce absorption, the injection of adrenalin must be made proximal to the same. This injection of adrenalin may be repeated every 10 or 15 minutes as required. Complete rest and general body warmth are further indications.

#### a. *Allergic Asthma.*

(1) Treat as follows:

(a) Desensitization or removal of the offending allergen is the logical attack. If unable to attain this end the asthmatic episodes may be delayed or aborted by ephedrine sulfate 0.045 gram ( $\frac{1}{4}$  grain) every 3-4 hours according to indications.

(b) In the acute episodes epinephrine will be required. A trial dose of 0.1 cc. of 1 : 1000 solution of epinephrine to be given hypodermically. If no adverse reactions 0.5 cc. may be given in 15 minutes. This dosage may be repeated at half-hour intervals. Or in some instances the therapeutic advantages may be repeated merely by gentle massage at the site of the injection.

(c) Occasionally atropine sulfate 0.0005 gram (1/120 grain) hypodermically may be useful in this relation when epinephrine fails.

(d) Aminophylline 0.5 gram (7½ grains) intravenously is likewise recommended in the same relation.

b. *Edema of Larynx (angioneurotic edema).*

(1) Inject 0.5 cc. of a 1:1000 solution of epinephrine (adrenaline) hypodermically.

(2) Repeat two or three times at 15-minute intervals, if necessary.

(3) If tracheotomy is indicated, do not delay until deep cyanosis occurs or until the patient is exhausted.

c. *Serum Reactions.* Several types of reaction may follow the parenteral injection of foreign serum.

(1) Collapse or syncope may occur after any hypodermic medication.

(a) Treat as for syncope in general.

(b) If the blood pressure becomes dangerously low, inject 0.5 cc. of a 1:1000 solution of epinephrine (adrenalin) hypodermically.

(2) Atopic or anaphylactic reactions follow the injection of serum into susceptible persons. Itching, hives, asthma, and vomiting may be followed promptly by collapse or even death. These phenomena occur immediately in a naturally sensitive person or after 1 to 5 hours in those sensitized by the previous injection of serum.

d. *Serum Sickness.* Begins 5 to 10 days after the injection of the foreign protein. It is characterized by malaise, urticaria, fever, lymphadenopathy, arthralgia, alone or in combination. Epinephrine (adrenalin) will commonly relieve the urticaria. A test dose of 0.1 to 0.2 cc. of a 1:1000 solution of epinephrine should first be given hypodermically. If there is no adverse reaction 0.5 cc. may be injected subcutaneously. Acetylsalicylic acid 0.3 to 1 gram (5 to 15 grains) will suffice for the control of arthralgia.

#### IV. FOOD INTOXICATIONS AND POISONINGS

a. *Food Intoxications.* Acute simple diarrhea is usually due to irritating substances present in spoiled or contaminated (with certain paratyphoid bacilli or staphylococci) food, to poor kitchen sanitation, or to improper care of eating utensils. Bacterial contaminations of food stuffs explain most of the gastro-intestinal upsets previously attributed to food intoxication. Rigid supervision of the storage, preparation and distribution of food, and strict adherence to regulations relative to the care of mess kits greatly reduce the incidence of diarrheal disorders. It is imperative that regulations relative to these matters be adhered to if epidemics are to be avoided in



encampments and in the field. If acute simple diarrhea occurs

(1) If heat to the abdomen does not control pain, give 8 cc. (2 drams) paregoric or 0.03 gram ( $\frac{1}{4}$  to 1 grain) opium orally. In severe cases, morphine may be required.

(2) Limit food to a liquid or bland diet, even for several days after recovery.

(3) When the stools are watery, and contain but little fecal material, give 4 cc. (1 dram) paregoric in warm water with 1 gram (15 grains) bismuth subcarbonate every hour until the diarrhea is controlled.

(4) If shock is marked, the usual treatment should be given. Intravenous fluids, normal saline, 5% glucose solution and plasma, may be required.

(5) Unless improvement promptly occurs, hospitalization is indicated.

(6) Protect others from possible infection from vomitus or feces.

b. *Food Poisonings.*

(1) *Botulism.* The appearance, usually within 48 hours after ingestion of questionable food, of central nervous system symptoms, such as dizziness, disturbances of vision, speech and swallowing, weakness and incoordination, without fever, is suggestive of botulism, rarely of mussel poisoning. The possibility of encephalitis or poliomyelitis should be considered in differential diagnosis. If botulism is suspected, hospitalize without delay.

(2) *Mushroom Poisoning.* The symptoms may be immediate or delayed (48 hours). Vomiting, abdominal cramps, severe diarrhea, fixed contracted pupils, and mental confusion occur, and in certain cases, jaundice, anemia and hemoglobinuria. If the diagnosis of acute poisoning is made—

(a) Pass a stomach tube immediately and thoroughly wash out the stomach.

(b) Give repeated enemas.

(c) Give 30 grams (1 ounce) magnesium sulfate by mouth.

(d) Inject 0.0006 gram (1/100 grain) atropine sulfate subcutaneously and repeat if physiologic effects (dilation of the pupils and dryness of the mouth) are not obtained.

(e) Evacuate to a hospital as soon as feasible.

## INFECTIOUS DISEASES

### V. VIRUS DISEASES

a. *Common Cold.* This disease is caused by a virus. Previously indicted bacteria are incidental or complicating agents. No effective prophylaxis exists. Isolation, theoretically a sound procedure, is not generally practised.

(1) Bed rest during the first 48-72 hours of common cold would unquestionably contribute materially to the regular

and complete convalescence. Abundant fluids (citrus fruit juices if available) are recommended. One of the common saline laxatives may be given. A hot drink to afford diaphoresis is in order. Dover's powder 0.3 grams (5 grains) repeated in 1 or 2 hours is a valuable adjunct. In the matter of topical applications the mildest nasal douches and gargles as warm normal saline solution, are preferred over more active chemical agents.

(2) Serious prostration or protraction of the toxic constitutional symptoms should be considered indications for early evacuation. The sulfonamides have no place in the treatment of common cold; but bacterial complications, as sinusitis, respond well to these drugs.

b. *Influenza*. This disease is caused by one of several viruses. A leading cause of morbidity and death from disease in World War I, it is particularly feared by reason of the general susceptibility, the uncertainty of its control, and its grave complications. The importance of a clear definition of its clinical picture arises in military medicine. The incubation period is from 24-72 hours; the inception, very precipitous; prostration, profound. Catarrhal manifestations are frequently not as marked as in the common cold. Indeed, the subjective complaints do not parallel the degree of congestion in nose and throat. An unusual form of cyanosis (heliotrope) is commonly noted. The pulmonary complications are frequent and grave. Bradycardia is not infrequent. Leukopenia characterizes the hematopoietic reaction.

(1) The prophylaxis follows general hygienic rules directed toward droplet infection. A vaccine has been prepared and preliminary results are promising but not convincing.

(2) The active treatment includes the measures outlined for the common cold. Sulfonamides are without effect in influenza as in the common cold, but they will unquestionably find an important place in the control of the bacterial overlays of streptococci, pneumococci and the like.

c. *Primary Atypical Pneumonia*. Its etiology has not been definitely fixed but a virus origin is suspected. It is entirely probable that the pulmonary manifestations occur in only a minority of a large group of patients whose major manifestations are upper respiratory.

(1) Clinical course. The incubation period is 14-21 days. Catarrhal symptoms are mild to moderate. Hoarseness has been quite marked in certain epidemics. Cough, early, harassing, non-productive is noted. Later, glairy mucoid sputum is produced. Ultimately, it becomes abundant muco-purulent. Occasionally, frank hemoptysis may occur; but never is the sputum rusty. Constitutional symptoms are mild to moderate as a rule. Malaise, headache and general

aching are the rule. Prostration varies from inconsiderable to moderate. A febrile reaction of 1-2 degrees occurs for several days. The temperature may range from 102°-105° for 10 days to 2 weeks. Occasionally a fever of a low remittent type continues for several weeks to several months. Pleuritic pain is unusual. Occasional postinfectious asthenia occurs.

(2) Physical findings are extremely variable. Cyanosis and dyspnea are uncommon. Occasional asthmatic breathing is noted. Herpes labialis is unusual. There is congestion of nasal and pharyngeal mucosa of varying degree. A paucity of pulmonary signs has been conspicuous. Crackling and fine moist rales are the most common finding. Occasional sibilant and sonorous rales are heard. Signs of consolidation, atelectasis and emphysema may exist in adjacent areas. Evidence of massive consolidation is unusual. Pleural friction rubs are rarely encountered. Silent pleural effusions may occur. Bradycardia appears in a minority of patients. Splenomegaly is remarked at times.

(3) Laboratory. Common pulmonary pathogens are absent from the sputum. Blood and pleural fluid cultures are negative. The leukocytes average 6-11,000 total (monocytosis, 10-18%). Positive cold agglutinins occur in the blood. False positive Wassermann reactions becoming negative in convalescence have been reported. Inversion of albumin-globulin ratio has been noted in the serum proteins.

(4) X-ray findings are disproportional to the clinical and physical prediction. They include increase in the tracheobronchial lymph nodes, "ground-glass" haziness of the involved lung or area of same, reticulation of the pulmonary architecture, nodular areas of increased density, varying from miliary to massive proportions, extending from hilum toward the periphery, illusions of honeycombing or solitary excavation dependent upon transient emphysema, atelectasis of varying degrees and pleural effusions.

(5) Complications are infrequent, but the following have been noted, asthmatic bronchitis, bronchiectasis, pulmonary abscess, pulmonary infraction, spontaneous pneumothorax, serous pleural effusions, cough fractures of ribs, meningismus, encephalitis and toxic psychoses.

(6) In the absence of an established etiology the prophylaxis is still limited to general hygienic measures against droplet and contact infection.

(7) Aside from the general measures to meet the infectious toxemia, two major indications present themselves, namely, control of the harassing cough and of anoxia. For the former codeine sulfate in full doses 0.030 gram ( $\frac{1}{2}$  grain) every 2 or 3 hours is recommended; but it may be necessary to use morphine sulfate 0.015 ( $\frac{1}{4}$  grain) by mouth or hypodermically. Oxygen

is the antidote for anoxia. In detached units it may be necessary to improvise apparatus to administer the necessary oxygen. All the essentials required are: oxygen under pressure in a tank, reducing valve, wash bottle, rubber tubing and catheter. The efficacy and utilization of oxygen may be gauged by a slowing of the pulse, control of cyanosis and dyspnea, mental quiet and fall in temperature. The first named is the most accurate index. Should the pulse rate not fall after one hour of adequate oxygen, first, check apparatus. If no technical faults, it may be assumed that further trial of oxygen will be ineffective.

d. *Infectious Hepatitis (Catarrhal jaundice, catarrhal cholangitis)*. Recent studies have indicated a probable virus etiology for this condition which has a relatively high incidence in military practice. While these patients must be evacuated to the hospital, certain indications for treatment prior to this movement should be kept in mind.

(1) Catharsis, preferably with a saline laxative or calomel in divided doses followed by a saline laxative.

(2) The diet should be constituted as follows: 70% carbohydrate, 24% protein and 6% fat. This diet experimentally protects the liver against toxic injury and favors regeneration. Among the proteins the most important are those containing sulfur amino acids (methionine and cystine). Eggs, milks, and cheese are the most abundant natural sources of these elements.  $1\frac{1}{2}$  pints of skimmed milk (reconstituted) a day will suffice to meet the need.

## VI. ANIMAL PARASITISM

a. *Amebic Dysentery and Amebiasis*. The endamoeba histolytica, the cause of this condition, occurs widely throughout the world; but even in the tropics, contrary to general belief, this agent is responsible for only 10 percent of the dysenteries. Bacillary dysentery is overwhelmingly the most common etiology encountered. Of the two forms, amebic (trophozoite) and encysted, the latter is the one involved in the spread of the condition. The mechanism of spread is through the infected stools, either in the active or carrier stage of the disease. The specific diagnosis can only be made by demonstration of the parasite in the stools or tissues of the affected patient. The appearance of the rectum or sigmoid colon, upon direct inspection, may be helpful in this direction but appropriate specimens should always be taken for microscopic study and culture.

The prevention of this condition is defined by the lines as outlined under Bacillary Dysentery. Its active treatment must be carried out in hospital and should never be undertaken in the field.



b. *Helminth Infestation.* The suspicion or demonstration of any infestation of the intestine by helminths will lead to the evacuation of the patient to the hospital for appropriate treatment.

c. *Malaria.* Malaria is caused by one of several specific protozoa—namely, *plasmodium vivax*, *plasmodium falciparum*, *plasmodium malarial* and *plasmodium ovale*. These plasmodia have a sexual and asexual cycle. The sexual phase is spent in the female anopheline mosquito; the asexual, in the human subject. Necessary for the perpetuation of the disease are several elements therefore: malarial patient, anopheline mosquitoes, breeding place for the same and susceptible individuals. The train of continuity may be broken at any one of these points.

While malaria is not a problem in this Theater, anopheline mosquitoes are here and given ideal conditions the introduction of malarial patients might lead to the development of the disease. Particular importance attaches, therefore, to prevention in areas of known instances of malaria.

d. *Prevention.*

(1) The prevention of malaria may be accomplished either by the elimination of the vectors, by the protection of man from the bites of infected mosquitoes, or by the destruction of the plasmodia in man in order to prevent infection of the mosquito.

(2) The elimination of mosquito vectors is an important factor in the sanitation of permanent posts and camps, but obviously has a limited application in temporary camps occupied by troops on field service. Troops in the field are also unable to avoid areas inhabited by civilian carriers of malaria, who serve as reservoirs for the infection of the local anopheline vectors. Under such circumstances the prevention of malaria must depend mainly on procedures that protect the troops from the bites of infected mosquitoes.

(3) Whenever practicable, camp sites should be on elevated ground at least a mile from swampy or marshy areas and an equal distance from local population groups. The troops should be provided with bed nets made of 20-mesh bobbinet, and medical officers should instruct the personnel as to the use of nets to prevent the exposure of sleepers.

(4) The use of atabrine for prophylaxis is not recommended as a routine procedure, since the available information indicates that it does not prevent infection. It is, however, of definite military value in that it prevents the appearance of the clinical symptoms of malaria so long as it is taken, and thus affords a means for keeping troops fit during periods of emergency in the field. 0.1 gram ( $1\frac{1}{2}$  grains) atabrine four times a week is the recommended dose.

It is highly improbable that preventive measures in this Theater will include the use of atabrine.

Upon the suspicion or diagnosis of malaria, the patient will be transferred to a hospital for treatment. Quinine will not be administered in the field.

## VII. BACTERIAL DISEASES

a. *Pneumococcus Lobar Pneumonia*. Characteristically this condition differs from primary atypical pneumonia, in its rapid inception, with a frank chill, cough, production of rusty sputum, pleuritic pain, herpes, dyspnea, cyanosis, signs of massive consolidation, pleural friction, leucocytosis, pneumococci in the sputum and blood and X-ray evidence of massive consolidation. The treatment in the forward area or in detached units is obviously limited by the facilities and the conditions of evacuation, since such patients should be evacuated to a fixed hospital as soon as possible.

(1) Bed rest in the position most comfortable to the patient which will usually be on the affected side, with the head and shoulders somewhat elevated.

(2) Force fluids to 3000 cc. Fruit juices should be given if available.

(3) The diet should be light (or liquid) and easily assimilable.

(4) Codeine sulfate 0.030 gram ( $\frac{1}{2}$  grain) by mouth to control cough and morphine 0.015 ( $\frac{1}{4}$  grain) hypodermically, to control mental unrest, may be indicated.

(5) Sulfonamides are highly effective, regardless of the type of pneumococcus responsible. Hence no delay should be occasioned by awaiting returns from remote laboratories. *However, where possible, the sputum and blood should be collected for such studies before initiating sulfonamide therapy.*

Sulfadiazine is the preferred sulfonamide at the present time. The following routine is advised:

(a) An initial dose of 4 grams (60 grains) of sulfadiazine by mouth to be followed by—

(b) 1 gram (15 grains) every 4 hours day and night until the temperature falls to normal. Thereafter—

(c) 1 gram (15 grains) four times a day for a further period of 3 or 4 days.

(d) 1 gram (15 grains) twice a day for an added week.

(6) Serum therapy is not available in the forward area but should be used in fixed hospital installations for the following indications:

(a) Profound toxemia.

(b) Failure of improvement in the clinical picture and fever after 48 hours of sulfonamide therapy.

(c) Repeated positive blood culture.

(7) Oxygen therapy may early be indicated under conditions described in "Primary Atypical Pneumonia."

b. *Bacterial Pneumonia secondary to Influenza, Measles and other diseases.* This form of pneumonia may be caused by a variety of organisms including pneumococci, streptococci, staphylococci and others. The necessity for bacteriologic studies to control therapy is obvious but the sulfonamides are efficacious in a majority of instances. In general the indications closely follow those of pneumococcus lobar pneumonia.

c. *Meningococcal Infections.* An increasing number of patients with meningococcemia without meningeal manifestations have appeared in this Theater. In the interest of the earlier and more effective treatment of this group of patients their reaction becomes increasingly important.

(1) Sulfadiazine is the sulfonamide of current choice. Sodium sulfadiazine should be given intravenously to all patients with meningococcal infections as follows:

(a) Initial dose of 5 grams in 1000 cc. normal saline solution, intravenously.

(b) Subsequent route and dosage to be determined by the reaction of the patient. If the condition remain grave, the 5 gram dose may be repeated twice (total 15 grams) in 24 hours.

(c) Begin oral administration as soon as conditions warrant. Maintenance doses of 1-2 grams (15-30 grains) every 4 hours, day and night, until the temperature has been normal for seven days. (See caution regarding hematuria.)

(2) Hospitalization of patients with meningococcal infection without delay. However, in the interest of the expeditious and early treatment facilities for the intravenous administration of sodium sulfadiazine have been placed at a series of centers, remote from fixed hospital installations. Instructions have been issued to initiate intravenous sulfonamide therapy whenever the diagnosis of meningococcus infection is suspected or established. The medical officer will carefully weigh the differential in time between obtaining and administering the drug and transporting the patient to the nearest hospital.

(3) Recent experience has established the remarkable efficacy of sulfadiazine in control of meningococcus carriers. Although smaller doses have been recommended, it is advised that the following schedule be followed: 3 grams, 2 grams and 2 grams on 3 successive days.

d. *Bacillary Dysentery.* Several types of dysentery (Sonne, Kruse, Flexner and Shiga) bacilli are responsible etiologic agents. Among these the Shiga type, producing an exotoxin as well as an endotoxin, is the most virulent. It is a threat to military as well as civilian populations throughout the world. In North Africa two epidemic periods are remarked—Spring, and August to November. The source of infection is the

infected stool and its spread is through food, flies and fingers. Since recovery is attended by the persistence of a carrier state in 3% of individuals, the occurrence of minor epidemics should be carefully controlled with this aspect of the problem in mind. Major epidemics obviously depend upon mass contamination of food and water supplies. The characteristic clinical picture includes fever, cramps, diarrhea, tenesmus and dehydration. The feces contain pus, mucus and blood. The identification of the etiologic agent in the stool is required for definitive diagnosis.

Discipline is essential for the maintenance of the highest level of sanitary control in a given unit. The occurrence of dysentery represents a collapse, more or less serious, of such control. Measures must be immediately taken to check all possible defections in this system.

These patients with dysentery segment themselves naturally into two major groups—those with and without severe toxemia. The latter will be evacuated without delay to fixed hospitals. The former will be treated as follows:

- (1) Complete rest in bed.
- (2) A fluid or low residue diet.
- (3) Adequate fluid indicated to combat dehydration and toxemia. If fluids in excess of 3000 cc. a day be not taken, intravenous salt solution or 5% glucose solution should be administered in sufficient quantities to make up the deficit.
- (4) Sulfaguanidine is the preferred sulfonamide. Its administration follows this pattern:
  - (a) Initial dose 3.5 gram ( $52\frac{1}{2}$  grains).
  - (b) Maintenance dose 3.5 gram ( $52\frac{1}{2}$  grains) every four hours day and night, until the stools number 5 or less a day.
  - (c) 3.5 gram every 8 hours until the stools have been normal for 4 days.
- (5) Anti-dysenteric serum will be reserved for hospital use where indicated.

## VIII. GENERAL PRINCIPLES OF SULFONAMIDE THERAPY

Progress in the field of sulfonamide chemistry and therapy has been so rapid that generalizations are difficult, if not impossible. With increasing experience the range of application and the limitations of the many modifications will be more closely defined. As a natural consequence of this process the replacement of preferred sulfonamides by new preparations may be anticipated from time to time. Indeed, the entire field of the chemotherapy of bacterial infections is in its formative phase.

The sulfonamides are not panaceas. Yet they are indiscriminately used for all manner of infections, bacterial and



otherwise. In the interest of scientific accuracy it might be held that bacteriological studies of the etiology of infectious diseases should control the use of these drugs. Since such strictures obviously run counter to the best interests of the patient at times, an intelligent compromise will be effected in the field. Under all circumstances certain precautions must be observed.

(a) *Recent Sulfonamide Medication.* Either by self-medication or upon the prescription of another medical officer sulfonamides may have been taken before the patient presents himself for treatment. In the absence of facilities for establishing sulfonamide levels in the blood an estimation of the prior dosage should be attempted and the subsequent administration should in a measure be adjusted thereto.

(b) *Sensitivity.* The idiosyncrasy to this group of drugs is largely qualitative. In most instances it is independent of the total dosage and the levels of the sulfonamides in the blood. There are exceptions to this rule. If a history of deleterious by-effects be elicited or if sensitivity be suspected, a test dose (0.1 to 0.3 grams) and observation for 12 hours may disclose substantiating evidence. Regardless of this control, the subsequent administration of the same sulfonamide must be very cautious or another sulfonamide may be substituted.

(c) *Parenteral Solutions.*

(1) Intravenous solutions, except in the case of sulfanilamide, are made up only with the sodium salts of sulfonamides. There is no sodium salt of sulfanilamide and the drug is rarely given intravenously. The sodium salts are prepared in 5 percent solutions. To make a 5 percent solution of sodium salts measure 5 grams (75 grains) of the salt, transfer it from the bottle with a sterile spatula and weigh it out in a sterile container, then add to 100 cc. of sterile freshly distilled water. These solutions cannot be boiled or autoclaved. They are alkaline, the alkalinity being sufficient to kill all bacteria except spores. Because of alkalinity, these solutions must be given intravenously slowly (15 minutes), care being taken not to get the material outside the vein because if this occurs it may cause a slough. For this reason, administration by the subcutaneous or the intrathecal route should be avoided. These solutions should never be added to blood for transfusion, to saline, glucose or other fluids for intravenous use.

(2) To prepare a 1 percent solution of sulfanilamide, 1 gram of crystalline sulfanilamide should be measured, using sterile precautions as in (c) (1) above, and transferred to 100 cc. of freshly prepared sterile normal saline solution which has been brought to a boil. This solution is practically always given by the subcutaneous route, rarely by the intravenous route.

MANIFESTATIONS OF DRUG TOXICITY NOTED IN ADULTS TREATED WITH  
SULFANILAMIDE SULFAPYRIDINE, SULFATHIAZOLE, SULFAGUANIDINE<sup>1</sup> OR  
SULFADIAZINE

REACTION	SULFANILAMIDE	SULFAPYRIDINE	SULFATHIAZOLE	SULFADIAZINE
Nausea, vomiting Dizziness Psychoses* Neuritis** Cyanosis Acidoses* Fever*	Fairly common Common 0.6 percent occur early Very rare Very common early and late 1.9 percent occurs any time 10 percent generally 5th to 9th day; may occur 1st to 30th day 1.9 percent; may take any form, generally 5th to 9th day; may occur 1st to 30th day. 0.6 percent, early or late 0.3 percent, early or late	Frequent Common 0.3 percent occur early Not reported Faint, common, early & late None 4 percent; generally 5th to 9th day; may occur 1st to 30th day 2 percent; may take any form, 5th to 9th day, may occur 1st to 30th day. Not seen, but reported 0.6 percent; early or late	Uncommon Uncommon Rare Rare Uncommon None 10 percent; generally 5th to 9th day 5 percent; nodular type, common, may take any form 5th to 9th day. Rare 1.6 percent early or late Reported Rare Very rare	Uncommon Uncommon Questionable Not reported Rare None Uncommon; 1 percent Uncommon; 2 percent Not reported Rare Reported Rare Very rare
Hepatitis** Leukopenia with granulocytopenia** Acute agranulo- cytosis**	0.1 percent; occurs 14th to 40th day; common 17th to 25th day 3 percent; early or late	0.3 percent; occurs 14th to 40th day; common 17th to 25th day Rare	Reported	Reported
Mild hemolytic anemia Acute hemolytic anemia** Hematuria*	1.8 percent; occurs 1st to 5th day Not reported	0.6 per cent occurs 1st to 5th day 8 percent; generally early	Rare Very rare	Rare Very rare
Anuria with azotemia**	Not reported	0.3 percent; generally 1st 10 days	2.5 percent generally early 0.7 percent generally 1st 10 days	Not infrequent Rare

REACTION	SULFANILAMIDE	SULFAPYRIDINE	SULPATHIAZOLE	SULFADIAZINE
Hyperleukocytosis	Generally in presence of acute hemolytic anemia	Generally in presence of acute hemolytic anemia	Not reported	Not reported
Injection of sclerae and conjunctivae**	Not reported	Not reported	4 percent; may occur with rash and fever 5th to 9th day	Rare; 0.3 percent
Purpura hemorrhagica	Not seen, but reported	Not seen, but reported	Not reported	Not reported
Ocular and auditory disturbances**	Rare	Rare	Very rare	Not reported
Jaundice**	With acute hemolytic anemia or hepatitis	With acute hemolytic anemia or hepatitis	With acute hemolytic anemia or hepatitis	Not reported
Painful joints*	Reported	Not reported	Reported with rash, etc.	Not reported
Stomatitis*	Rare	Not reported	Not reported	Not reported
Gastro intestinal tract disturbances	Bleeding, rare, diarrhea uncommon	Rare	Very rare	Not reported

<sup>1</sup>Sulfaquianidine has shown little toxicity to date. Drug rash and fever have been noted.

\*Best to stop drug and force fluids.

\*\*Imperative to stop drug and force fluids.

(d) *Toxic Reactions.* While determinations of the levels of sulfonamides in the blood are very important in evaluations of the efficacy of sulfonamides, they are essentially quantitative guides. The reaction of the host to the invading bacteria may bear no direct relation to the level of the sulfonamide in the blood; but no judgment of its adequacy is final without this information. Patients receiving sulfonamide compounds should be seen daily. Headache and malaise may be early toxic symptoms. Hematuria, microscopic and macroscopic, should be noted. Pallor, jaundice and skin eruptions are important evidences of toxicity. The recurrence of fever after the subsidence of the infectious reaction, and in the absence of a demonstrable complication, should raise the question of sulfonamide responsibility. The delayed leukopenic reaction may only be anticipated by routine numerical and differential leukocyte determinations after the tenth day.

In the lesser toxic reactions the sulfonamides may be continued under cautious control. Should the clinical indication persist, for example, it may be decided that the toxic skin eruption is not an adequate reason for withdrawing the vitally important sulfonamide. Again, the substitution of another drug of the group may meet the situation. For instance, sulfathiazole may replace sulfapyridine, if nausea and vomiting deny the availability of the latter. The more serious reactions affecting the central or peripheral nervous system, liver, kidney and hematopoietic system, brook no palliation. Immediate withdrawal of the sulfonamide and forcing of fluids constitute primary measures of control. Sufficient fluids should be taken to insure a urinary output of 1500 cc. per day. Recent reports indicate that hematuria from acetylation may be prevented by adequate alkaline (sodium bicarbonate, 6 grams a day). The routine use of alkalis with sulfadiazine is not generally recommended. If renal obstruction has advanced to the stage of anuria and uremia, ureteral catheterization and pelvic lavage may be necessary. Repeated transfusions are required to control the acute hemolytic anemia. The leukopenic reaction may be averted in most instances if the sulfonamides be discontinued, before the critical levels of 4,000 total leukocytes and 50 percent neutrophils are reached. Concentrated liver extract 6 cc. daily intramuscularly and pentnucleotide 30 cc. daily intramuscularly are recommended to combat the leukopenia.

Leukopenia, early in the course of an infectious disease, does not constitute a contraindication to the sulfonamides. Great caution will, however, be observed in the use of sulfonamides in patients with such counts. The same policy obtains in subacute or chronic glomerular nephritis with an acute relighting on a streptococcal basis. Even in the presence



of hematuria such patients frequently do very well under sulfanilamide.

## IX. RICKETTSIAL DISEASES

### 1. TYPHUS FEVER.

a. *Etiologic Agents*. There are two epidemiological types of typhus fever determined by two arthropoid vectors: epidemic or louse-borne and endemic or rat-flea-borne.

(1) *Epidemic Typhus* (synonyms-exanthematous typhus, classical, European or Old World typhus, fleckfieber, ship, jail, or camp fever). This type is caused by rickettsia prowazeki.

(2) *Endemic typhus* (synonyms-murine, American or flea typhus, Brill's disease). This type is caused by rickettsia mooseri.

#### b. *Geographic Distribution*.

(1) *Epidemic typhus* is found chiefly in Europe, North Africa, Asia, and in the higher altitudes of Central and South America. It is not present in the United States or insular possessions.

(2) *Endemic typhus* is found in Southern United States, including southern California and seaports of the Atlantic coast and insular possessions of the United States, Mexico, and probably coastal South America. It is widespread over Europe, Asia, and Africa, especially in countries bordering the Mediterranean, and in Malaysia, China and South Africa. About 4,000 cases are reported annually in the United States.

#### c. *Transmission*.

(1) *Epidemic Typhus*. The reservoir of the disease is man, and it is transmitted from man to man by the body louse, *Pediculus vestimenti*. Epidemic typhus is chiefly a disease of winter and spring, and affects impoverished, overcrowded, and dirty peoples. Once established, it spreads rapidly from person to person through the agency of the body louse. The large epidemics of history have invariably followed, or been associated with war, famine, or civil revolution.

(2) *Endemic Typhus*. The reservoir of the disease is the rat and the disease is transmitted to man by the rat flea, particularly *Xenopsylla cheopis*. Endemic typhus is chiefly present in late summer and fall and cases are associated with contact with rats or on premises maintaining rat harbors, for example, grocery stores, food warehouses, restaurants. The disease does not spread from person to person in absence of body lice and is not necessarily associated with lousiness or poverty.

#### d. *Specific Diagnosis*.

(1) *Epidemic Typhus*. The incubation period is from 6 to 14 days. The onset is variable, usually sudden with chills, fevers, general pains, and headache. The fever continues

for about 2 weeks. A macular eruption appears on the fourth to sixth day and rapidly becomes petechial. Typically, the rash appears on the chest or abdomen first, spreads to back, arms, legs, and only in severe cases to palms, soles, and face. Mental symptoms are common in severe cases, especially during the second week. One attack confers immunity which is not always permanent. Agglutination of *B. proteus* OX-19 (Weil-Felix) is positive in the second week, usually in titers above 1:320. Complement fixation with typhus rickettsias is positive in the first week. The case fatality rate is 20 to 50 percent.

(2) *Endemic Typhus*. The incubation period is from 6 to 14 days. It is clinically and immunologically identical with epidemic typhus, except the rash may be more sparse and fleeting and the clinical course milder than epidemic typhus. The Weil-Felix is positive in the second week as in epidemic typhus. The case fatality is about 3 percent. The chief differential diagnosis is from Rocky Mountain spotted fever. Spotted fever is usually a more severe infection than endemic typhus. The rash appears earlier, usually on the third or fourth day, but occasionally may be delayed. Typically, the rash is first seen on wrists and ankles, later spreading to the body. The macules show more tendency to coalesce in spotted fever, but spotted fever is negative for complement fixation with typhus antigen.

*e. Treatment.*

(1) *Epidemic Typhus*. No specific treatment of proven value has been developed. A hyperimmune serum is under study but is not yet available. The new sulfonamide drugs have been tried without benefit. The treatment is entirely symptomatic. Absolute rest in bed with good nursing care should be provided. Fluids should be maintained preferably by mouth, rectum or hypodermoclysis. Constipation may be relieved by enemas or mild laxatives. Tepid sponges should be employed for the control of fever. Headache may be relieved by aspirin or codeine; morphine may prove necessary.

(2) *Endemic Typhus*. The treatment is the same as for epidemic typhus.

*f. Prevention.*

(1) *Epidemic Typhus*. Prevention depends on the protection of susceptible individuals against infective lice or their immunization with effective vaccines.

(a) *Protection against Lice.*

1. *Delousing of Clothing*. Infected articles of clothing can be deloused by (1) fumigation methods for field operation, (2) powders for individual use in delousing clothing. Methyl bromide gas is extremely penetrating.

Short periods only are necessary, and this chemical kills both eggs and adults. A demountable plywood box with forced air circulation and an impervious bag to be used with ampules for breaking inside the bag are available. Material may be kept in the duffle bag of the soldier. Instructions given to soldiers are for weekly dusting of seams of clothing. Powders will destroy lice and eggs if there is any contact with the eggs. The activity continues from 7 to 14 days which provides for eliminating the young which hatch from such eggs as failed to come in contact with the powder itself.

2. *Delousing of Troops.* This may be accomplished by the use of chemicals and bathing. Acetic acid (vinegar) 10 percent solution, kerosene, or gasoline (pure or 50 percent suspension in water) will loosen the eggs attached to hairs and facilitate their subsequent removal by bathing, brushing, and combing. Clipping of the hair is a valuable adjunct to this treatment. Thorough bathing with soap and water is an indispensable part of the delousing process.

(b) *Immunization with Vaccine.* (Instructions may be found in Circular Letter No. 162, Office of the Surgeon General, 28 November 1942). At the present time typhus vaccination is required for all military personnel stationed in or travelling through Asia, Africa, Europe (including the British Isles), and the mountainous regions of Central and South America (including Mexico) but excepting Panama.

It should be recognized that vaccination alone is not adequate for the prevention of typhus. Accordingly, vaccination should be considered merely an adjunct to, and never a substitute for, the control measures prescribed in AR 40-205 and in Section VI, AR 40-210, and such other special control measures as may be recommended by the surgeon of the force concerned.

1. *Type of Typhus Vaccine.* The vaccine approved at this time consists of a suspension of killed epidemic typhus rickettsiae prepared by the yolk-sac culture method.

2. *Method of Vaccination.* (a) The initial vaccination will consist of three injections of the vaccine 1 cc. each, administered subcutaneously, with intervals of from seven to ten days between injections.

(b) A stimulating dose of 1 cc. of typhus vaccine should be administered every four to six months as long as serious danger of infection is present. Other 1 cc. doses of typhus vaccine may be given whenever in the opinion of the surgeon this additional stimulation of immunity is indicated.

(c) *Care of Cases and Contacts.* Isolation in vermin-free rooms should be provided. All lice and louse eggs on the clothing and on the patient should be destroyed. Exposed susceptibles should be deloused and quarantined for 14 days after the lice have been removed. The isolation of contacts is not necessary in the absence of body lice.

(2) *Endemic Typhus.* The prevention of endemic typhus is based on the elimination of rats by rat-proofing, trapping, and poisoning. Special care should be directed to the proper protection and disposal of garbage to prevent access to rats. The use of vaccine in endemic typhus is debatable as the incidence of the disease is too low to warrant general vaccination. This procedure is not to be considered in places where the rat population can be controlled.

## 2. TRENCH FEVER. Synonyms (Wolhynian fever, five-day fever).

a. *Etiologic Agent*—*Rickettsia quintana*.

b. *Geographic Distribution.* Trench fever appeared during the First World War. At that time the disease became epidemic in nearly all the armies of Europe and later spread to Mesopotamia. Only a few cases have been recognized since the last war but there is some evidence that the disease has retained an endemic foothold in Russia and Poland.

c. *Transmission.* The etiologic agent is transmitted by the body louse. Recovered cases of trench fever may remain infective to lice for months. After a louse has fed upon an infected person, a period of 7 to 10 days passes before this louse can transmit the infection. *R. quintana* in the dried louse excreta remains virulent for at least four months. It also retains its virulence in the dried urine of patients.

d. *Diagnosis.* The incubation period is from 2 to 3 weeks. The onset is sudden, with prostration, severe pain in the muscles and bones, particularly the tibia, the radius, and ulna. Frontal headache may be severe. Congestion of the conjunctivae is of common occurrence. The spleen is enlarged. In 70 to 80 percent of the cases a rash consisting of small macules develops, usually on the first or second day of fever. It is stated that this rash does not become petechial as in typhus and spotted fever. The rash is most pronounced over the lower thorax, abdomen and back. Sweats are common. The leucocyte count is usually between 10,000 and 12,000. The initial bout of fever lasts about five days. Relapses occur at intervals of 5 to 6 days or even longer. Three to five relapses may occur. Prostration is pronounced and convalescence prolonged. The disease is not fatal but is important on account of lengthened disability. Apparently, immunity is not established by one attack. The production



of agglutinins for *B. proteus* X-19 (Weil-Felix reaction) is inconstant.

e. *Treatment.* The treatment is entirely symptomatic, as in the other rickettsial infections.

f. *Prevention.* Delousing measures. Since the rickettsia of trench fever is present in the urine and saliva of patients, precautions should be taken to guard attendants against contraction of infection by contact. Care should be exercised in disposing of body discharges. Clothing and bedding should be disinfected with steam at 160 degrees F. or above, or by 2 to 3 percent cresylic acid disinfectant.

## X. VENEREAL DISEASES

### 1. GENERAL.

This section on the diagnosis and treatment of venereal diseases is based on the opinions and recommendations of the Committee on Medicine and its Subcommittee on Venereal Diseases, Division of Medical Sciences, as published in Circular Letter No. 74, Office of the Surgeon General, July 25, 1942, revised on the basis of clinical experience which has been gained under conditions obtaining in E.T.O. Because of the rapid development of chemotherapeutic agents, and because the optimum time-dose relationship of arsenoxide in the treatment of syphilis is undergoing marked revision, it is likely that some of these recommendations will be changed from time to time. In particular, it is pointed out that intensive treatment for syphilis has been adopted as the method of choice in E.T.O. There is as yet insufficient evidence concerning the final effectiveness of Pencillin in the treatment of syphilis to justify its use for this purpose. It is not intended that the recommendations contained herein will be used to the exclusion or neglect of other indicated therapeutic or nursing procedures.

### 2. GONORRHEA.

#### 1. *Diagnosis:*

a. A diagnosis of gonorrhea will be made on the basis of history, symptoms, and physical signs. Confirmation by bacteriologic examination will be employed wherever practicable, but is *not* required.

b. A diagnosis of urethritis, non-specific, or a similar diagnosis other than gonorrhea will not be made:—

- (1) In the presence of a recent history of gonorrhea.
- (2) In patients who have had treatment, local or systemic, subsequent to the development of symptoms and prior to examination.

- (3) Without the exclusion of gonorrhea by a minimum of three successive cultures taken from the inflamed area at intervals of not less than 24 hours and certified by a medical officer to contain no growth of *N. gonorrhea* after cultivation by an accepted technique for demonstration of this organism.

## 2. *Treatment of Acute Gonorrhea.*

- a. Local treatment is harmful and *should not be used.*
- b. Chemotherapy.

- (1) Acute gonorrhea may be satisfactorily treated with the patient on a duty status in a large proportion of cases, and this is recommended whenever local conditions permit. Every precaution should be taken to insure that the patient receives the prescribed treatment.
- (2) Sulfathiazole. Administration should be started as soon as the disease is detected. Give 2 grams initial dose and 1 gram four times daily thereafter. Give the first dose half an hour before breakfast and the last dose before the patient retires. The daily urine output should be maintained at a minimum of 1200 cc. It is advisable to continue the treatment three days after the urine is clear (two glass test on rising in the morning) and the discharge has ceased. If there is no response within ten days, discontinue sulfonamide therapy and transfer the patient to a hospital. *Continuance of further sulfonamide therapy beyond this time is quite useless.*
- (3) On demonstration that the gonorrheal infection is resistant to sulfonamide therapy, treatment with penicillin should be given promptly *in a hospital.* The details of technique will not be included here.

## 3. *Determination of Cure.*

Cure is determined by the disappearance of symptoms and physical signs. Confirmation of cure by bacteriologic examination will be employed wherever practicable but is not required.

## 4. *Serologic Follow-up of Patients with Gonorrhea.*

All patients who acquire acute gonorrhea should have a serologic test for syphilis done on admission and at least one follow-up test to rule out a symptomless infection with the latter disease. If only one such test is done, it should be performed 3 months after the onset of gonorrhea.

### 3. SYPHILIS.

#### a. *Diagnosis of Syphilis.*

(1) It is of the utmost importance that the diagnosis in early syphilis (primary and secondary stages) be established at the earliest practicable moment and that treatment be instituted as soon as the diagnosis is made.

(2) All ulcerative genital lesions, extragenital lesions characterized by indolence, induration, and regional lymphadenopathy, and cases of urethritis accompanied by indolent enlargement of related lymph glands are to be regarded as probable cases of syphilitic infection until this possibility has been excluded by repeated darkfield examinations and repeated serologic tests. In these cases routine serologic tests will be done not less often than:

On admission to sick report.

Second week.

About the end of the first month.

About the end of the second month.

(3) Routine serologic tests will also be made in all cases of gonorrhea at least as often as follows:

On admission to sick report.

Before return to a duty status.

About the end of the second month.

(4) *Antisymphilitic treatment will not be started until the diagnosis of syphilis is definitely established.* The demonstration of the *Treponema pallidum* by darkfield examination is conclusive as to the necessity for the immediate institution of treatment. However, it is essential that darkfield examinations be performed only by personnel experienced with the method. The source of the material for darkfield examination must be suitable; for instance, it is not possible to be certain that spirochetes seen in material taken from the mouth are *Sp. pallida*, and a diagnosis based on material from any dirty or grossly contaminated lesion may be unwarranted. Relatively clean penile lesions, enlarged lymph nodes, or dry lesions on the glabrous skin are excellent sources of material for darkfield examination. Description of all the details of technique and of the morphologic characteristics of the *Sp. pallida* are beyond the scope of this Manual; it is sufficient to point out that the diagnosis of syphilis on the basis of darkfield examination, while of great value, is crucial, and must be made with due care. Such examinations *must always be verified* by a medical officer.

Patients with open lesions of the skin or mucous membranes suspected or proven to be due to syphilis and/or chancroid

will be admitted to hospitals for determination or confirmation of the diagnosis.

## FALSE POSITIVE SEROLOGIC REACTIONS DUE TO NONSYPHILITIC DISEASES

Circular Letter No. 97, Office of the Chief Surgeon E.T.O.  
30 May 1943:

"1. It has been clearly established that the usual serologic tests for syphilis may be temporarily positive as a result of diseases other than syphilis. Reports have indicated that false positive reactions among soldiers, though relatively infrequent, are of sufficient importance to warrant consideration in order that the unjustified diagnosis of syphilis may be avoided.

2. Accumulated evidence indicates that most biologic false positive reactions will be encountered under the following circumstances:

a. Vaccination for smallpox within the three preceding months, especially with "take."

b. Certain febrile diseases. From the standpoint of the Army the more important of these diseases in this connection are malaria, infectious mononucleosis, severe respiratory tract infection including virus pneumonia and influenza, and mumps. Many other diseases are known to be capable of producing biologic false positive serologic reactions, but are of less importance because of (1) the uncommonness of the disease itself or (2) a small incidence of false positive reactions resulting therefrom. Included in this latter group are typhus fever, leprosy, chancroid, lymphogranuloma venereum, Weil's disease, relapsing fever, rat-bite fever, Rocky Mountain spotted fever, disseminated lupus erythematosus and septicemia.

3. Conflicting serologic reports are the rule in such cases. It is not unusual to see both Kahn and Wassermann doubtful, or either test positive and the other doubtful or negative. However, such conflicting serology cannot be used as the sole index for arousing suspicion of a biologic false positive, since in a small proportion of the cases the "reagin" titre will be of sufficient height that all tests will be positive.

4. It has been observed that ordinarily the blood tests do not become positive during the febrile stage of the disease, but rather one or two weeks after the temperature has dropped. Furthermore, the false positive reactions usually subside within three to six weeks, though occasionally they may



persist longer. It can be definitely stated that at least 90 percent of false reactions will have reversed within three months of onset, and in the majority of those remaining the "reagin" titre will be subsiding.

5. The accidental finding of positive or doubtful serologic reactions in individuals being treated or examined for recent infections referred to in par. 2, or following vaccination procedures, should not be considered indicative of syphilis. If the individual gives a definite history of previous treatment for syphilis or if he presents clinical evidence of syphilis, a confirmed positive test may be regarded as presumptive evidence of the disease. If, however, upon careful physical examination the individual presents no clinical evidence of syphilis he should be followed serologically *and without treatment* for a period of three months, serologic tests being performed each two to four weeks. At the end of this time the patient should be completely reappraised to ascertain whether or not syphilis may be present. In this reappraisal the following considerations will apply:

a. Those in whom the serology has reversed to negative will be discharged as nonsyphilitic.

b. Those individuals having a persistently positive reaction to tests on successive specimens will be diagnosed as syphilis and treated.

c. Those still having a conflicting serology with no clinical evidence of syphilis may be subjected to further serologic and clinical follow-up. This group represents one of the most difficult problems in syphilology, and wherever possible consultation should be obtained prior to final disposition.

b. *Treatment of Syphilis.*

(1) *General Principles of Treatment.*

(a) No treatment is to be given for suspected early syphilis until the diagnosis is made either by darkfield examination or confirmed serologic tests. No therapeutic tests are to be used.

(b) Arsenoxide (mapharsen) will be used as the standard arsenical. Neoarsphenamine or other arsenicals *cannot* be substituted in the treatment schedule outlined in pars. 3 and 4.

(c) If it is necessary to use neoarsphenamine, because of the nonavailability of arsenoxide, the former drug should be given only at weekly intervals in courses of not more than eight consecutive *weekly* doses.

(d) Tryparsamide and fever therapy are not to be used outside of a hospital.

(e) Each treatment is to be recorded on the syphilis register of the patient: A Supplementary Treatment Record (ETOUSA MD 313) is available for recording treatments given to patients whose Syphilis Record is not at hand. This record is retained by the patient, and should be filled out in all cases of syphilis treated in E.T.O. It is to be emphasized that Form ETOUSA MD 313 is an entirely supplementary record and in no wise replaces the Syphilis Register, nor does it relieve the medical officer of responsibility for maintaining the Syphilis Register.

(f) *It cannot be too strongly emphasized* that regularity of treatment schedule without long or short time variations or lapses is critically important to both infection control and cure. Every effort must be made to impress this fact on enlisted men and officers as well as medical personnel.

(g) *Emphasis should also be placed* on the completion by each patient of the full schedule of treatment in the time called for regardless of early serologic reversal.

## *(2) Treatment of Early and Latent Syphilis.*

(a) Early (primary and secondary) and latent syphilis of any duration should be treated by an identical treatment system. Intensive therapy, in which the treatment of early syphilis is compressed into a period of 20 days, has been used in E.T.O. since April 1943, and has proven satisfactory. Under expert supervision the inherent risk of serious treatment reactions due to intensive therapy is small, and it offers the patient with syphilis assurance of completion of treatment which will protect him adequately from the danger of serious relapse or progression of his infection. In prolonged treatment systems, lapses in treatment will occur, especially in combat troops. Directions in regard to intensive therapy are contained in Circular Letter No. 138, Office of the Chief Surgeon, E.T.O., 10 Sept. 1943, as follows:

## 4. INTENSIVE TREATMENT OF EARLY SYPHILIS

1. Intensive therapy is the method of choice for the treatment of early syphilis, when suitable facilities are available.

2. Individuals under 40 years of age whose syphilitic infection is of less than one year's duration, and who are otherwise healthy, will be given this type of treatment. Although intensive therapy is particularly applicable to

syphilitic patients who have received no previous treatment, patients who have received up to 10 injections of an arsenical drug without untoward reaction may be shifted from standard prolonged therapy to intensive therapy.

3. Intensive therapy for syphilis will be administered only in General Hospitals, and such other hospitals as the Chief Surgeon may designate. In the designated hospitals the Chief of the Medical Service will be responsible for the proper administration of intensive therapy which will follow the schedule of treatment prescribed by the Chief Surgeon.

4. Patients with early syphilis who are considered suitable for intensive therapy will be transferred to a hospital designated in paragraph 3 above, with the least possible delay.

5. Patients will be returned to duty on completion of intensive therapy. For any patient in whom further treatment is indicated, the Medical Officer giving intensive therapy will outline the course of further treatment required in the Syphilis Register and in the Supplementary Record of treatment (ETOUSA MD Form 313). Unit Surgeons will follow this outline in administering further treatment.

6. On completion of intensive therapy, patients will have quantitative blood Kahn tests performed at intervals of 2 months for the first six months. The Medical Officer giving intensive therapy will indicate the time for the taking of quantitative Kahn blood tests and spinal fluid tests in each case on the Syphilis Register and Supplementary Records of treatment. Even though the Kahn test remains positive during this period, no further treatment for syphilis will be given except in those cases where the Medical Officer responsible for the intensive therapy has indicated. However, should the Kahn test show a significant increase in titre (i.e., of the order of an increase from a reading of 10 units to 80 units) followed by a confirmatory test, the patient will be referred to a hospital for examination.

7. Providing there is no clinical evidence of syphilis, and if the spinal fluid is negative when examined 6 months after completion of intensive treatment, the Syphilis Register will be sent to the Medical Records Division, Office of the Chief Surgeon, for review as required by Circular Letter No. 106, Office of the Chief Surgeon, 25 June, 1943.

b. Patients with syphilis, early or latent, should be hospitalized initially to the end that a careful examination may

be made and antisyphilitic treatment started. In the event that intensive therapy is not feasible because of lack of facilities, or other considerations, the schedule of treatment should be as follows:

5. "STANDARD" TREATMENT SCHEDULE, early and latent syphilis.

TABLE I

<i>Week</i>		
1	Arsenoxide (mapharsen) intravenously twice weekly, total 20 injections	Bismuth subsalicylate intramuscularly once weekly, 5 doses
2		
3		
4		
5		
6		Omit bismuth—5 weeks
7		
8		
9		
10		
11	Omit arsenoxide (mapharsen)—6 weeks	Bismuth subsalicylate intramuscularly Once weekly—6 doses
12		
13		
14		
15		
16		
17	Arsenoxide (mapharsen) as in first course, twice weekly total 20 injections	Omit bismuth—5 weeks
18		
19		
20		
21		
22		Bismuth subsalicylate intramuscularly once weekly, 15 doses
23		
24		
25		
26		

*Arsenoxide (mapharsen) dosage:* Adjusted approximately to body weight; average dose 60 mg., minimum dose 50 mg., maximum 70 mg.

*Bismuth subsalicylate in oil dosage:* The standard dose is 0.2 gm. of bismuth subsalicylate intramuscularly (not 0.2 gm. of elemental bismuth metal).



(3) *Technical Suggestions.*

(a) Discard discolored drugs and solutions and damaged ampules.

(b) Dissolve arsenoxide in sterile distilled water in the proportion of 10 mg. of drug per 2 cc. of water; a dose of 60 mg. will then be contained in 12 cc. of solution, 50 mg. in 10 cc. and 70 mg. in 14 cc.

(c) Shake and aerate arsenoxide; do not shake or aerate the other arsenicals.

(d) Inject arsenoxide rapidly to avoid thrombosis; there is little danger of speed shock or nitritoid crisis. Other arsenicals should be injected slowly to avoid speed shock or nitritoid crisis.

(e) Thoroughly shake oil suspensions.

(f) Attempt aspiration after insertion of needle before making any injection, especially intramuscularly.

(g) Inject bismuth intramuscularly into upper outer quadrant of buttock. Alternate sides.

(h) Massage firmly after withdrawing needle from buttock and have patient prolong massage to three minutes.

(i) Advise rest if practicable after arsenicals.

(j) Warn patient to report his reactions.

(k) Watch mouth and gums for bismuth stomatitis.

(4) Treatment is to be stopped and the patient hospitalized if the following appear:

(a) An itchy dermatitis of the face or flexures.

(b) Jaundice.

(c) Petechial or other hemorrhagic lesions.

(d) Evidence of cerebral injury, even though slight.

(5) General antireaction therapy.

(a) Epinephrine solution 1:1000.  $\frac{1}{2}$ -1 cc. subcutaneously for speed shock or nitritoid crisis.

(b) Glucose 500 cc. 5 percent solution intravenously supplemented with thiamine chloride 5 mgms. for jaundice. (See Notes on the treatment of jaundice. S.G.O. Circular Letter No. 55 June 11, 1942.)

(c) Vitamin B complex is recommended in suspected liver damage.

(d) In cerebral vascular accident measures to be considered are venesection, and hypertonic saline solution intravenously (500 cc. of a 1.5 percent solution).

(e) In blood dyscrasias, transfusions.

(f) Sodium thiosulphate for any type of treatment reaction is considered valueless.

(g) BAL has recently been found to be of great value in the treatment of reactions to trivalent arsenical compounds, particularly arsphenamine dermatitis.

(6) *Serologic Control of Treatment.* In patients with early syphilis a serologic test will be done at the beginning and end of the schedule of treatment outlined in Table I; but treatment may be stopped whether the serologic test for syphilis (STS) is positive or negative, and the Register sent to the Office of the Chief Surgeon E.T.O. for review and safe keeping. After the completion of treatment the STS should be repeated three and six months later. If the test is negative after six months, the case may be classified as "Result Satisfactory" and the Syphilis Register will be closed. If the test is positive after six months, the patient should be referred to a station or general hospital.

In patients with latent syphilis the STS should be repeated at the completion of treatment outlined in Table I, but the Syphilis Register may be closed when this treatment is completed, regardless of the result of serologic test.

(7) *Spinal fluid examination* should be performed in a hospital in patients with early syphilis at the end of the course of treatment outlined in Table I, or as soon as possible thereafter; but in any event before the Syphilis Register is closed. In apparent latent syphilis, spinal puncture should be performed in a hospital before treatment or as soon as possible thereafter, but in any event before the Syphilis Register is closed.

(8) *Control of relapse and infectiousness.*

(a) Early syphilis is to be regarded as infectious until the second injection of arsenoxide has been given.

(b) Physical inspection of skin (including palms and soles), mucosa, anus, and genitalia should be performed as often as circumstances permit during treatment and at each probationary inspection.

(c) The involution of the chancre or secondaries should be watched to detect treatment-resistant cases.

(d) Patients should be warned to look for and report mouth, skin, and genital lesions. Darkfield examination is of great help in recognizing relapsing lesions of the skin and genitalia.

(9) *Complications or Relapse.* In the event of any complication of treatment (serious treatment reactions) or any evidence of relapse, clinical or serologic, the patient should be at once transferred to a station or general hospital.

(10) *Cardiovascular, visceral, and neurosyphilis* require special treatment in hospital. For additional details see standard texts.

## 6. CHANCROIDAL INFECTION.

a. *Definition.* Chancroid is a venereal disease transmitted only by direct contact and characterized by single or multiple

genital ulcers. The latter possess irregular crater-form margins, are usually not indurated, and exhibit a tendency toward the formation of complicating suppurating inguinal adenitis. The incubation period is usually three to fourteen days.

b. *Diagnosis.* It is important to rule out the presence of mixed syphilitic and chancroidal infection. For this purpose at least three darkfield examinations should be made on successive days; a blood serologic test for syphilis should be made on admission to the hospital, during the second week, and at monthly intervals for two months following healing of the chancroidal lesions. Laboratory tests for the diagnosis of chancroid (Ito Reestierna skin test or the staining or cultural isolation of the Ducrey bacillus) are not recommended.

c. *Treatment.*

(1) *Chemotherapy.*

(a) *Local.* Accessible lesions should be cleansed with soap and water and dried. They should then be completely covered with powdered sulfanilamide and a loose, dry dressing applied. This should be repeated at daily intervals until the lesion heals. Other local medication is not recommended. In patients with tight phimosis and underlying ulcerative lesions, the phimotic preputial cavity should be irrigated twice daily with 1-5000 potassium permanganate solution.

(b) *Systemic.* Administer sulfathiazole or sulfadiazine 1 gram (15 grains) four times a day for five days. Sulfanilamide 1 gram (15 grains) three times a day for five days, may be utilized instead of sulfathiazole or sulfadiazine, but is less well tolerated.

Practically all chancroidal infections will respond to the above routine. In fact, if the lesion does not heal, doubt is cast on the correctness of the diagnosis of chancroid, and the patient should be restudied from the diagnostic standpoint, and, if necessary, treated surgically.

(2) *Surgical Therapy.*

(a) Surgical procedure designed to relieve phimosis or paraphimosis should be resorted to only on the basis of sound clinical judgment.

(b) *Chancroidal Bubo.* Most of these will subside with systemic sulfonamide therapy. If extensive suppuration is present, the bubo may be opened by a small incision, the pus aspirated and the cavity packed with sulfanilamide powder.

## 7. LYMPHOGRANULOMA VENEREUM.

a. *Definition.* This disease concept includes the conditions formerly known as lymphogranuloma inguinale, lymphopathia venereum, climatic bubo, esthiomene, and inflammatory rectal stricture.

b. *Etiology.* A filtrable virus, probably multiple strains.

c. *Geographic Distribution.* World-wide.

d. *Clinical Picture.* A systemic disease of the lymphatic system, usually originating in a trivial and transitory lesion of the penis, vulva, vagina, or rectum, which frequently escapes the patient's notice.

The invasion of the lymphatic glands usually occurs from ten to thirty days after infection, occasionally is delayed months. Inguinal adenitis is often bilateral and occasionally subsides without suppuration. During this stage, constitutional symptoms may be observed. Lymph nodes may fuse to skin, resulting in multiple areas of softening, followed by numerous fistulae. Extensive scarring accompanies healing. The anorectal syndrome usually is found only in the female, and is characterized by rectal pain, discharge of blood and pus from the anus, a tendency toward extreme chronicity, and the production of rectal stricture.

e. *Differential Diagnosis.* Differentiate from malignant tumors, Hodgkin's disease, tularemia, tuberculosis, pyogenic infections, chancroidal bubo, and syphilis. Mixed venereal infections should be ruled out by the darkfield examination of material from genital lesions for the causative organism of syphilis. Frequent serologic examinations should be continued for at least two months after the disappearance of the lymphatic symptoms.

(1) Only one diagnostic procedure for lymphogranuloma venereum, the intradermal test of Frei, has as yet come into general use. Other methods used in confirming the diagnosis are either impractical (animal inoculation, artificial cultivation of the virus), non-specific (alterations in serum protein), or their value not yet established (complement fixation).

#### *Treatment.*

(1) *Local.* Patients with acute inguinal adenitis should be hospitalized whenever possible. The fluctuant nodes may be aspirated but incision and drainage should be delayed until the effect of chemotherapy has been observed. Radical excision is inadvisable because of the risk of elephantiasis of the scrotum or vulva.

#### (2) *Chemotherapy.*

(a) The value of the sulfonamide compounds in lymphogranuloma venereum has not been definitely established, but preliminary reports indicate that they may be effective. Sulfathiazole and sulfadiazine are probably the drugs of choice, although sulfanilamide may be used.

1. Sulfathiazole or sulfadiazine should be administered in doses of 1 gram (15 grains) four times daily for five days. It may be necessary to prolong this medication to



ten to fourteen days, in which case the dose should be reduced to 0.5 grams four times a day.

2. Sulfanilamide, if used, should be administered in doses of 1 gram (15 grains) three times a day for five days, followed by a reduction to 0.5-0.75 grams three times daily for an additional five to seven days.

(b) The acute anorectal syndrome should be treated in the same manner as the inguinal manifestations. Stricture or other late complications should receive special consideration.

## 8. GRANULOMA INGUINALE.

a. *Definition.* Granuloma inguinale is a chronic disease due to infection with a leishmania-like organism. It involves primarily skin and mucous membranes, rarely with coincident adenopathy; it is characterized by vivid-hued, shining verrucous, vegetating nodules of granulating tissue with a hemorrhagic surface surrounded by a thin, easily exoriated epidermis. The condition spreads by peripheral extension and auto-infection, often involving the entire genital area. It may involve large adjacent areas of the lower abdomen and thighs. The lesions show little or no tendency to spontaneous healing and may persist for months or years.

## XI. NEUROPSYCHIATRIC DISABILITIES

### a. *General.*

(1) Neuropsychiatric disabilities are vital medico-military problems because of their incidence and because their presence endangers the morale and discipline of troops.

(2) The treatment objective is twofold: to return to duty as many men as possible, and to minimize the consequence of disability.

### b. *Diagnosis.*

(1) The diagnosis of the underlying condition is rarely obvious. The widest variety of symptoms and signs occurs, but allowing for many combinations, the outstanding symptomatic segments are—

(a) Physical reactions ranging from convulsions, paralyses, deafness, blindness, aphonia, or stammering and severe headaches, to tremors, tics, areas of anesthesia, cardiac and gastrointestinal functional disturbances, shortness of breath, encuresis and vaso-motor symptoms. Organic neurological signs may be present.

(b) Mental symptoms such as coma, confusion, disorientation, amnesia or other memory impairment may predominate. There may be hallucinations and delusions, or obsessive thoughts and compulsive acts. Mental retardation may be apparent.

(c) Emotional reactions, including depression with desire to commit suicide, apathy or loss of interest, elation and excitement, resentment, suspicion, irritability, fear, panic, battle dreams, feelings of unreality, anger, rage, and homicidal tendencies, with various admixtures.

(d) Military misbehaviour, embracing suspected fifth-column activities, or spying, arousing and spreading discontent, inciting insubordination, striking an officer, drunkenness, neglect of duty, cowardice, self infliction of wounds, sulkiness, quarrelsomeness and petty stealing.

(2) Examination should be extensive enough to answer the following questions:

(a) Is there definite evidence of underlying structural lesion or disease?

(b) If so, is it due to disease or injury within the nervous system, or due to more general causes (uremic convulsions, sinus headache or organic disturbance in other organs)?

(c) Is it psychogenic in origin?

(d) If psychogenic, is it psychosis or psychoneurosis?

(e) If psychoneurosis, is it one of the usual types of war neuroses (anxiety neurosis or conversion hysteria) or a less frequent neurosis (neurasthenia or psychiasthenia)?

(f) Can the disabling symptoms be speedily removed?

(g) Is it malingering?

(3) Elaborate histories cannot be expected, but reliable sources of information are the sick soldier's officers, his non-commissioned officers, and other soldiers who are his intimates. As much information as possible concerning the previous personality traits should be gathered. Prognosis depends in large part on the existence or absence of constitutional psychopathic tendencies or behavior, especially in early life. Details of injuries, particularly head trauma, and unusual illnesses, are important.

(4) A brief neurological examination, including pupillary responses, eye movements, tendon reflexes, abdominal and plantar reflexes, motor and sensory responses, Romberg test, posture and gait, often furnishes valuable diagnostic leads. When possible, laboratory studies should be used as indicated. The general physical condition should be checked in order to rule out causal or contributing factors outside the nervous system.

(5) The mental examination is largely dependent on careful observation—general appearance, state of body, clothing, facial expression, attitudes, motor activity (increased or decreased, purposeful or aimless, related or unrelated to environment), mannerisms, catalepsy, stupor, negativism, suggestibility, and other manifestations.

(6) The soldier should be discriminatingly questioned in order to confirm impressions of observational data and to determine the presence of decided mood alterations, overactivity or underactivity of thought and speech, obsessive thoughts, compulsive acts, ideas of reference, delusions, hallucinations, lack of orientation, and disturbances of memory.

(7) An estimate of the emotional state and of consciousness is a necessary condition of diagnosis and treatment. In manic depressive states the emotional display is likely to be fairly clear-cut, depressed, often with self blame and suicidal trends, or exhilarated with quick shifts to other emotional reactions, including rage leading to dangerous violence; in schizophrenia, the surface emotional expressions tend to be inadequate to the verbally expressed thinking or even at odds with it. In anxiety conditions many of the usual physiological accompaniments may be present.

(8) In the recoverable war neuroses, particularly those occurring in combat, there is often an initial befogged state, perhaps actively precipitated by concussion, fatigue or food deprivation, or there may be an acute panic reaction. Even more favorable are acute psychoses with delirium dependent upon physical exhaustion. Hysterical symptoms coming on acutely during combat may respond to strong suggestive therapy if treated early.

(9) Malingering is a deliberately planned attempt to evade military duty to secure a discharge by feigning illness; while not easy to detect yet usually the simulation is overdone or incomplete with the absence of fundamental signs and symptoms. Practically all malingerers show other evidence of psychopathic instability.

(10) Military misbehavior is frequently incipient evidence of psychosis, psychoneurosis, mental defect, or even organic neurologic diseases; if it has a psychogenic basis, successful treatment depends on uncovering the underlying condition dealing with it.

(11) The common war neuroses are anxiety neurosis and conversion hysteria—the former being much more frequent. Anxiety arising from insecurity (or even threat to life) is a factor common to all neuroses. In anxiety neurosis the recognition of the true cause of the anxiety is repressed while the psychological and physiological accompaniments of a state of anxiety predominate in the symptomatology. Among the symptoms are headache, dizziness, dryness of mouth and throat, shortness of breath, palpitation and irregularity of the heart, gastro-intestinal disturbances and vasomotor instability. The feeling of anxiety becomes attached to certain symptoms that can in any way justify such an emotion. Fear of heart disease or of peptic ulcer are common focuses. Fear of

insanity or of losing control or of showing anxiety in some way may characterize the mental state. Not all symptoms may be present, but the most common ones are those arising from the gastro-intestinal and cardio-vascular systems. An anxiety neurosis may develop gradually under prolonged stress or there may be a sudden acute panic reaction, especially under combat conditions. In the latter a striking feature is the over-action to any sound, sudden movement, or the sound of motors. In combat these men may leave safe cover and run blindly into danger. There is a variable degree of mental confusion, tachycardia, and tremor. In addition they have night terrors, insomnia irritability and an inability to concentrate.

(12) Among the more common conversion hysteria symptoms are amnesia, blindness, deafness, aphonia, paralyses, areas of anesthesia (glove or stocking type) and convulsions. Generally only one symptom predominates and that symptom serves the purpose of solving a conflict, through the mental mechanism of conversion. For example, the soldier who cannot bring himself to continue shooting men may develop (unconsciously) a paralysis of the right arm, or the soldier who cannot bear the sight of maiming may resolve (unconsciously) his conflict by blindness. Under combat conditions rhythmical reflex tremors, repetitive dodging and avoiding movements, amnesias and stupor reactions are the most common symptoms.

(13) A third type of war neurosis is the reactive depression. It is characterized by a depressed mood, loss of interest, apathy, diminished strength, insomnia, and loss of appetite. The onset is gradual and comes after prolonged periods of stress.

(14) In all war neuroses there is an underlying unconscious conflict—the demands of the instinct of self-preservation, strongly activated by moving emotions, fear, horror and revulsions versus the ideals of soldierly duty, patriotism, honor, tradition, training, discipline, and the "fear of being afraid." Under the added burdens of conscious worry, stress, loneliness, boredom, home troubles, deprivation, fatigue, or physical concussion, the conflict may be converted into protective symptoms (conversion hysteria); the emotional state may predominate (anxiety neurosis); or there may be a general withdrawal (reactive depression). The development of a neurosis, as well as the type of neurosis manifested, depends on the fundamental personality characteristics.

(15) "Blast Syndrome" should be clearly differentiated from neurosis by a history of definite loss of consciousness, having the breath knocked out, coughing up bloody sputum, or bleeding from ears or nose, and finding fissuring of the



skin, flash burn, perforated or hemorrhagic ear drums, conjunctival hemorrhage, signs of intrathoracic or intraabdominal injury, focal or general signs of organic damage to the central nervous system. Without at least one of these points being present the possibility of organic blast injury is remote. This must be kept clearly in mind because many psychiatric patients date the onset of symptoms to a time when they were in close proximity to explosive bursts.

*c. Treatment.*

(1) At the front during combat the medical officer should differentiate the neuropsychiatric patients from the other casualties as quickly as possible. All neuropsychiatric casualties should be diagnosed "Exhaustion" on the Emergency Medical Tag.

(a) Heavy sedation should be started by the first medical officer who examines the patient. Sodium amytal, 6 or even 9 grains by the mouth, can be given with safety and without converting the patient into one requiring a litter for transport. Phenobarbital, 4½ grains, is the drug of second choice. Morphine should not be used.

(b) Give each patient a sweet drink, hot or cold, depending on the season, and some food. Each patient should have three full meals a day, unless otherwise ordered.

(c) In many instances this sedation with 18 to 24 hours of rest, good nourishment, reassurance and suggestion may be all that is required before the soldier is able to return to duty. Under some circumstances this can be accomplished at aid or clearing stations. The majority, however, will have to be sent to the evacuation hospital where treatment for 3 to 5 days can be carried out. This evacuation to the hospital should be accomplished as rapidly as possible. In the process the patient should be kept in a drowsy state by additional sedation if necessary.

(d) In the evacuation hospital further psychiatric treatment, which need not be detailed here, should result in the return of many soldiers to front line duty within a few days. This is dependent on the early recognition and treatment forward of the evacuation hospital.

(2) A few general rules applicable at all times include the following:

(a) Establishment of rapport.

(b) Speak of a neurosis when necessary to use a term.

(c) Be firm and optimistic in all dealings with the patient. Do not use painful stimulation or surgical procedure for suggestive therapy.

(d) Do not tell the patient that it is "all in his mind," "stop imagining things," or "forget it." The physiological

manifestations of emotions are not imaginary and there is no conscious control over conversion hysteria symptoms.

(e) No one should be permitted to see the patient unless assigned for duty.

(3) In milder states of excitement 0.2 to 0.5 gram (3 to 7½ grains) sodium amytal may be given by mouth. In fixed hospitals where paraldehyde may be available, 2 to 8 cc. (½ to 2 drams) may be given by mouth.

(4) In more active excited states and in acute panic reaction 0.3 to 0.6 gram (5 to 10 grains) sodium amytal diluted with distilled water, a 10% solution, may be given slowly intravenously. For acute panic reactions further sedation with sodium amytal by mouth to give sound sleep should be continued for about 20 hours, interrupted only to afford plenty of food and fluids. In fixed hospitals paraldehyde 2 to 4 drams by mouth may be used. The use of these procedures depends on the evacuation situation.

(5) For insomnia, 0.2 to 0.4 gram (3 to 6 grains) sodium amytal may be given by mouth.

(6) For tension and restlessness, 0.030 to 0.060 grams (½ to 1 grain) phenobarbital may be given by mouth before each meal.

(7) For status epilepticus use intravenous sodium amytal, 10% solution given at the rate of 1 grain per minute until convulsions are controlled. Two grains sodium phenobarbital given intravenously and repeated if necessary may be used. For grand mal attacks of epilepsy give 1½ grains phenobarbital by mouth three to four times a day. All epileptics should be hospitalized as soon as possible and there dilantin may be the drug of choice.

(8) Violence, particularly suicidal or homicidal tendencies, must be immediately controlled, by mechanical restraint if necessary, until the patient can be properly hospitalized.

(10) It should always be borne in mind that, in the majority of cases, early treatment increases the prospect of cure.

#### *d. Prevention.*

(1) The unit medical officer is in a strategic position to do much towards the prevention of neurotic conditions, and even other neuropsychiatric disabilities. While fitting the soldiers into their proper niches so the job is neither too big nor too little for their abilities, experiences and interests, should have been accomplished in earlier selection, classification and assignment, much may remain to be done within the unit before combat. The medical officer should be aware of the need for such procedures and contribute his share in the process.

(2) Helping others to understand the nature and meaning of fear and how to deal with it falls in the province of the

medical officer. Fear is nature's way of mobilizing the individual for an all-out emergency. Physiologically it is preparation of the body for action. The heart and lungs through increased rate of function supply more oxygen where needed. Adrenalin is poured into the blood stream and sugar is released to serve as fuel. Fear within limits increases strength and endurance. However, courage and fear are not opposites. It may be helpful to the soldier to know that courage consists of doing one's duty though one is terrified. Doing a duty without fear is not courageous or brave, just as it is not virtuous to refrain from sin which one has no desire to commit.

(3) Fear may be controlled and kept in its proper perspective by—

(a) Adequate training and discipline. Training should be sufficient to give a man confidence in his ability to handle himself as well as all necessary weapons. Discipline forms habits that make it second nature to carry out his own job as a member of the fighting team. Disciplined habits may take care of a man even when he is too frightened to think clearly.

(b) Confidence in those in command and in other members of his team.

(c) Action. Once the battle is on fear tends to subside. In moments or hours of waiting for combat, work, drill, exercise, seeing that everything is in shape, or any other type of occupation is in order.

(d) Contact with others. Although men should not be in large groups, just the presence of another man not far off minimizes fear. Roll call lets the man know that he is one of a unit and that the others are there.

(e) Knowledge of what to expect. The known is never so frightening as the unknown. Men should be informed of the dangers they may meet, of the plan of attack, and of the tactics and weapons that may be used by the enemy.

(4) These and other factors related to the emotional state of the soldier may not be the direct concern of the medical officer but he has the opportunity and the duty to contribute his part in the understanding of and the action taken in such matters. The medical officer should know his men and his fellow officers and, more important, be known by them. He should be on the lookout for the man who is getting jumpy, going off by himself, becoming sleepless, losing appetite, or showing any other symptoms of nervous strain. He should see that the men are as comfortable, as well fed, and as clean as possible under any given set of circumstances. He should have an interest in their every-day life, their sports, and their military equipment and discipline. He should share their dangers and hardships. These things will gain respect and

confidence and will lead men to the medical officer for discussion of personal problems and not just for sick call. This type of work can be carried out only by the medical officer stationed with troops and it will result in fewer neuroses being sent down the line for more specialized treatment.

## XII. DISABLING SKIN DISEASES

### 1. DIAGNOSIS AND TREATMENT OF SCABIES

1. It is essential that medical officers should be familiar with the clinical features of scabies, so that an early diagnosis may be made, and prompt effective treatment carried out in units. Admission to hospital for scabies should rarely be necessary.

2. Direct contact with the skin of an infested person is the chief method of acquiring scabies. Many cases are venereal. In occasional cases the parasite may be acquired from infested clothing or bed clothing, but this is a far less important or frequent mode of infestation than direct skin-to-skin contact.

3. Knowledge of the habits and life cycle of the scabietic parasite is of value in explaining certain features of the disease in man.

a. *Period of Incubation.* The time between the acquisition of the parasite and the development of characteristic signs and symptoms is variable; the average is from two to three weeks. The incubation period is probably never less than ten days, and may sometimes be as long as six weeks.

b. The duration of the life cycle from the egg stage to the mature female acarus is from one to two weeks. It is probable that infestation occurs principally by the deposition of a mature pregnant female on the skin. Only the pregnant female produces the typical burrow of scabies, but other forms (larvae, nymphs, and adult males) produce varying types of superficial lesions, particularly about the hair follicles.

c. The female parasite is most active when the skin of the host is warm. Itching tends to increase under such conditions, and the infestation is more readily acquired while in bed.

d. Relapses in the disease after treatment are sometimes explained by the hatching of ova after the live parasites have been destroyed.

e. It is probable that the parasite of scabies does not survive temperatures above 120° F. longer than five minutes. At lower temperatures the longest period of survival in blankets or clothing is about 14 days.

4. The diagnosis of scabies is ordinarily easily made. The chief sources of difficulty are a low index of suspicion on the part of the medical officer, and the obscuring of the characteristic lesions and distribution by secondary infection, scratch



dermatitis, or irritation from various medicaments. In relative order of importance, the following are the chief characteristics of scabies:

a. *The distribution.* The sites of predilection are:

1. The genital region. *An itching papule on the shaft or glans penis is almost pathognomic of scabies.* The possibility of coincident venereal disease must also be considered.
2. The interdigital spaces of the hands and the flexor surface of the wrists.
3. The elbows, particularly on the posterior and inner sides.
4. The anterior axillary folds.
5. The region of the beltline.
6. The lower portion of the buttocks.
7. The breasts of women.

In longstanding cases the involvement may become extremely profuse with lesions on the lower legs and feet. However, the head is not involved by scabies in adults.

b. *The scabetic burrow.* In early uncomplicated cases, the burrow made by the adult female may ordinarily be distinguished. The burrow varies in length up to 1 cm. The nature of this superficial twisting lesion may be definitely established by removal of the acarus from the closed end with an ordinary sewing needle, and identifying it with a lens. However, this requires considerable experience to be of practical value to the medical officer, and demonstration of the acarus is an aid, but by no means an essential, in the diagnosis of scabies. In many patients the scabetic burrow may be entirely obliterated by an inflammatory papule (particularly on the penis), by impetiginous or follicular infection, or by irritation from scratching.

c. *The periodicity of itching.* Scabies commonly itches most markedly when the patient is in bed and the skin is warm. Such a periodicity is always suggestive, but it must be kept in mind that dermatitis and eczema also frequently itch more at night, and the diagnosis of scabies should never be made on the basis of this history alone.

5. *Variations from the typical course* and symptomatology occasionally offer difficulty in diagnosis. The chief variations are:

a. Prolonged incubation period between possible exposure and the development of symptoms (see par. 3 a.). Some patients with scabies have only a few lesions for some time after infestation has occurred, and itching may not be a marked feature. Allergic sensitivity to the mite or products thereof is a large component in the development of itching, and some patients become sensitized slowly.

b. *Persistence of itching after adequate treatment.* It must be kept in mind that effective treatment which has killed all parasites and ova sometimes may not relieve itching immediately. In addition to itching from persistent scratch dermatitis, some patients become so sensitized at the sites of scabetic burrows that they develop recurrent pruritic small wheals (hives). This complication is often difficult to distinguish from a true scabetic relapse.

c. Good bathing hygiene tends to keep the number of lesions of scabies at a minimum. In some persons who bathe daily, the lesions may be so few and sparsely distributed as to make the diagnosis difficult, and the webs of the fingers, and the wrists frequently show no lesions.

6. The chief difficulty in the diagnosis of scabies and in judging the effect of antiscabetic therapy arises in patients with the complications of diffuse dermatitis from scratching, secondary impetiginous or furuncular infection, and dermatitis from applied medication.

a. *Scratch dermatitis.* This may occur in isolated patches or be diffuse and widespread. Especially in nervous high-strung patients, the skin may be scratched unrestrainedly in frenzies of itching. The more the patient scratches the more he itches, and this cycle may produce changes in the skin of the severity of ivy poisoning or acute eczema. In such patients, cure of the scabies does not result in prompt relief of itching.

b. *Superficial pyococcic infection* (impetigo, ecthyma or furuncles) is a common complication. The lesions may obscure the burrows and follicular lesions of scabies almost entirely. In a patient with widespread impetigo, the itching is an indication that scabies is the underlying condition (impetigo does not ordinarily itch), and the distribution is usually suggestive. Superficial or deep ulcers, and occasional lymphangitis, may be noted. One of the most disabling complications of scabies is the persistence of furunculosis long after the infestation has been cured. This is particularly liable to occur in troops under active combat condition.

c. *Dermatitis from applied medication.* In patients who have developed irritation from antiscabetic or other local medication, it is often difficult to determine whether or not the patient still has scabies. The chief source of irritation is sulfur ointment, though benzyl benzoate may produce considerable dermatitis if used longer than recommended.

#### 7. *Treatment of Scabies.*

a. Benzyl benzoate has proven to be a satisfactory scabicide, and possesses advantages over sulphur in that it is less irritating, practically odorless, and is easily incorporated in solutions or clean washable emulsion bases. Due to difficulties

in supply, benzyl benzoate is not always easily obtainable, but it is much superior to sulphur for treatment in field units. A non-standard item, Benzyl Benzoate Emulsion Ointment is available. It is packaged in 4 oz. jars, the contents of each being sufficient for the treatment of one patient. The routine for benzyl benzoate therapy is as follows and *should be rigidly adhered to*:

(1) Have the patient take a hot bath for 15 minutes if facilities are available. The affected sites should be scrubbed thoroughly.

(2) Apply benzyl benzoate preparation to *all parts of the body from the neck down*. This should be done under the supervision of trained personnel. If a liquid benzyl benzoate preparation is used, it may be painted on with a brush, or sprayed on with an insecticide gun. Solid or semi-solid preparations should be applied by hand.

(3) The benzyl benzoate should be applied on two successive days. It is not advisable for the patient to take a bath before the second application.

(4) If the itching is not relieved after two applications, a third may be made on the following day. Benzyl benzoate therapy *should then be discontinued entirely for one week*: the chances are over 90% that the infestation is cured, and further application may result in a dermatitis. If itching is still noted, calamine lotion containing  $\frac{1}{2}$ % phenol or boric acid ointment containing 2% camphor may be applied.

b. *Sulphur Therapy*. If benzyl benzoate is not available, sulphur will be found practically as effective against scabies providing the details of treatment are carefully adhered to, and the ointment is of proper strength.

(1) *Strength of Ointment*: The regular 15% U.S.P. sulphur ointment is too strong for use as a scabicide and will produce dermatitis in most skins. It should be diluted as follows:

Ung. sulphurus (USP)	80.0
Ung. zinci oxidi or	
Petrolatum	40.0

This 10% strength will be tolerated well by persons with brunette type skins. However, in persons with blond or auburn hair, it is advisable to use only a 5% strength of sulphur.

(2) *Routine of Treatment*. With sulphur therapy it is especially important that a thorough preliminary bath be taken before the first treatment. The sulphur ointment is then applied to *all parts of the body* below the neck for three successive nights, with especial care to rub the ointment into the most markedly involved sites thoroughly. On the morning after the last treatment the patient should take a bath

and put on clean underwear. Secondary or sulphur dermatitis should be treated with calamine lotion or boric acid ointment.

8. Treatment of scabies in the presence of a complicating factor.

a. Superficial pyococcic infection. If this is mild, proceed with the antiscabetic routine in the usual way. The infection will ordinarily subside along with the scabies. If the pyococcic infection is severe, antiseptic therapy with sulfadiazine or ammoniated mercury ointments may be necessary. In such patients treatment can ordinarily be best carried out in hospital.

b. Severe scratch dermatitis. If the underlying scabies has not been treated previously, it is advisable to proceed with antiscabetic therapy in spite of a dermatitis of even severe grade. Under such conditions benzyl benzoate is less irritating than sulphur. If it is necessary to use sulphur therapy, the strength of the ointment must not be over 5%.

c. Dermatitis from antiscabetic treatment. This will ordinarily be due to sulphur, although dermatitis of the genitalia is sometimes produced by benzyl benzoate ointment. If the antiscabetic treatment has been recent, treat the skin with soothing lotions or ointments for several days to allow the dermatitis to subside, and to determine whether or not the previous treatment has cured the scabetic infestation. If it is necessary to repeat the regimen of treatment, benzyl benzoate is preferable.

9. Thorough inspection of personnel for scabies should be made at least once monthly. If frequent infestations are noted, such inspections should be made once weekly. Only by prompt recognition of the disease before complications have developed and before other members of the unit have become infested, can scabies be controlled satisfactorily. Stripped examination is essential and can be made rapidly. Special attention should be paid to the hands, wrists, elbows, anterior axillary folds, penis and buttocks. Adequate examination for scabies will also be found useful in the recognition of other contagious diseases.

## 2. ECZEMA AND DERMATITIS

(Eczematous Dermatitis, Eczema, Plant Dermatitis, Contact Dermatitis, Atopic Dermatitis, Nummular Eczema)

a. The conditions listed above are all superficial inflammatory skin reactions in response to chemical or physical irritants or sensitizers (allergens); or superficial inflammations of unknown cause. As a group, they constitute the most commonly encountered of all skin diseases.



b. The common forms are (1) *Contact Dermatitis or Contact Eczeme*. Caused by contact with external irritants and especially with substances (allergens) to which the particular skin has become hypersensitive.

(2) *Atopic Dermatitis*. Dermatitis associated with hay fever, asthma, etc., in the individual and/or family.

(a) Usually dry (unless infected, scratched, or maltreated), thickened, scaly, often pigmented.

(b) Usually very itchy.

(c) Usually chronic and difficult to manage (severe or chronic is a cause for rejection in the armed forces). As a rule, "dies out" in the late twenties or before.

(d) Usually localized in cubital spaces, popliteal spaces, face, neck, dorsa of hands, feet.

(3) *Nummular (Coinlike) Eczema*. Cause unknown.

(a) Patchy, round or oval, crusting, scaling or oozing plaques of varying size and number. Central healing is common, giving appearance which suggests ringworm to the layman. Not very itchy as a rule.

(b) Frequently appears on dorsa of hands, extensor surfaces of arms, legs, thighs, etc., but can affect any part of the skin.

(c) Chronic and recurrent course, but eventual cure.

(4) *Miscellaneous "Eczemas" of unknown origin*. Patchy or diffuse; acute, blistered or seeping; subacute, scaly, and red-dened, circumscribed or generalized; or chronic, thickened, torpid and pigmented; often sparse and in isolated plaques.

(5) Infected eczema or eczematized infections. Combinations with seborrheic dermatitis, impetigo, folliculitis, boils, running ears, draining sinuses, fungous infections (hands and feet, groin, etc.).

c. General therapy for all forms of eczema-dermatitis.

(1) Whenever possible, find and remove causes (especially external agents) by considering localization, and by taking a careful history.

(2) Wet dressings or soaks whenever possible. Saturated boric acid solution, or 1 : 5000 potassium permanganate solution, or normal salt solution.

(3) Calamine lotion with  $\frac{1}{2}\%$  phenol or, if obtainable, the following:

Camphor	2.0
Zinc oxide	20.0
Talc	20.0
Glycerin	15.0
Water	70.0

(4) As process becomes subacute, change to boric acid ointment, or zinc oxide ointment to which  $\frac{1}{2}\%$  phenol or 2% camphor has been added.

(5) Chronic phase (thickening, hyperkeratosis, often hyperpigmentation).

(a) Ichthyol (ichthammol)	1.0
Ung. zinc oxide	60.0
(b) Crude coal tar	3.0
Ung. zinc oxide	60.0

Apply once or twice daily.

(c) Castellani's carbol fuchsin paint (British term—Pigmentum carbol fuchsin).

Apply once daily.

d. Treatment of eczema of the hands and feet.

(1) This "twin" involvement of the hands and feet is a common form, often baffling etiologically, resistant to treatment, and incapacitating. If there are many recurrences the patient is ordinarily to be regarded as unfit for full duty.

(2) In persistent cases, refer patient to hospital.

e. Eczema of legs.

(1) Consider possibility of stasis, associated ringworm infection of the feet, or *sensitivity to uniform* as etiologic factors.

(2) Calamine lotion, or bandaging with thick layer of zinc oxide paste, or application of compound carbofuchsin paint.

(3) If there is evidence of sensitivity to uniform, long cotton underwear (available from QMC on recommendation of a medical officer) may be curative.

(4) Some patients with chronic eczema of the lower legs develop an explosive generalized "id" reaction of the rest of the body ("maneuver" dermatitis). If such a reaction is noted, immediate hospitalization is advisable.

f. Eczema of external auditory canal.

(1) Wash out canal with warm oil.

(2) Apply ointment containing 2% salicylate acid and 3% sulphur in petrolatum once daily; or carbol fuchsin paint once daily.

(3) If fissures or secondary infection are present, apply 2% silver nitrate, or sulfathiazole, or sulfadiazine ointment. (For periods of a few days only, because of the risk of producing sensitization.)

(4) Warn patient against habit of repeated scratching.

(5) Treat associated seborrheic dermatitis of the scalp.

g. Dermatitis of scrotum, perianal area.

(1) Care in cleansing after bowel movement. Have patient use moistened toilet paper if possible.

(2) Sitz bath in 1 : 5000 potassium permanganate solution; or 1 : 1000 silver nitrate solution, one or more times daily if acute.

(3) GI foot powder or calamine lotion one or more times daily.

(4) If persistent and severe, refer patient to hospital.

h. Dermatitis from external contact substances.

(1) Plant dermatitis is encountered less frequently in E.T.O. than in the United States. Other forms of contact dermatitis, especially that due to uniforms, footgear, oil or grease (often with boils) and a wide variety of chemical substances, are fairly common and often disabling. In any patient with a dermatitis, careful inquiry should be made regarding possible contact irritants. Obviously, discovery of the responsible substance is of far greater value than any external treatment.

(2) If sensitization to an external contact substance is suspected, measures to protect the skin should be taken. In general, the skin should be thoroughly washed with soap and water after contact with a suspected allergen; however, this may not be feasible if any dermatitis has already developed. For special occupational duty hazards, special protective measures may be necessary and consultation should be sought.

### 3. PYODERMAS

#### (Impetigo, Ecthyma, Secondarily Infected Eczema or Fungus Infections)

##### 1. General.

a. The principal etiologic agents are staphylococci and streptococci.

b. The infection may be primary (example: impetigo); or secondary to other eruptions (example: secondary to dermatophytosis). Pyogenic infection may play an important role as a complication of almost all forms of dermatitis.

c. Pus and purulent crusts are the distinctive features, although in chronic processes it may be necessary to examine carefully to recognize the pyogenic element in scaling, infiltrated eczematous patches and plaques of dermatitis.

d. The types of skin lesions include pustules, bullae, vesicopustules, ulcers, folliculopustules, furuncles and carbuncles.

e. Some forms (particularly impetigo) are contagious and autoinoculable. However, as in fungous infections, transmissibility has been overrated. Individual susceptibility, dependent on factors which are not well understood, is a crucial factor.

f. Irregular bathing habits, trauma, irritation from rough heavy clothing, exposure to oils, greases and dust, as well as the high incidence of contact dermatitis and insect bites in the field, are factors which result in a higher incidence of pyogenic infections in military personnel.

g. All food handlers with cutaneous pyogenic infections on the hands or face should be taken off duty or transferred to other work until the lesions are healed.

(1) *Impetigo*.

(a) Remove crusts gently with soap and water or hot compresses.

(b) Apply 5% sulfadiazine or 5% sulfathiazole in a water-miscible emulsion base three or four times daily. Use small amounts of ointment rubbed in thoroughly. Do not continue application of sulfonamide ointments for periods longer than five days.

(c) If such a preparation is not available use 5% ammoniated mercury ointment, or 2% silver nitrate, or benzoyl peroxide ointment.

(d) In some patients an ointment is not helpful; calamine lotion containing 0.1 mercuric chloride may be used.

(e) In *extensive* and advancing impetigo, if improvement is not noted in four days, treatment in hospital is advisable.

(2) *Ecthyma (Ulcerative Impetigo)*.

(a) Cleanse and apply a sulfonamide ointment as in impetigo. A powdered sulfonamide, with bandaging, may be used.

(b) If the lesion is painful and extensive, or if there is any systemic reaction, admission to hospital is advisable.

(c) In chronic resistant cases the possibility of diphtheria of the skin or of leishmaniasis cutis should be suspected, especially in troops returned from tropical climates.

(d) Alternative local treatments are 5% ammoniated mercury ointment, carbolfuchsin paint, 2% silver nitrate.

(3) Impetiginous dermatitis is a diffuse moderate to frankly pustular superficial inflammation which occurs in secondarily infected dermatitis, fungous infections, intertriginous dermatitis and superficial injuries. In general the treatment is similar to that for impetigo, but wet soaks with hot permanganate or boric solution, and careful cleansing of site of involvement are especially necessary. On subsidence of the infection, treatment of the underlying dermatitis or eczema becomes necessary.

(4) *Infections of Hair Follicles*. These may vary from superficial pustules at the follicular orifice, to chronic deep involvement which is extremely resistant to treatment.

(a) Acute pustular folliculitis. Recognize and treat as soon as possible; the older the infection, the more likely it is to become persistent and chronic. Sulfonamide ointments are much less effective than in impetigo.

(b) Ung. Quinolol comp. (British Ung. Benzoylis peroxidii) applied once daily after thorough cleansing with soap and water. At times this may produce considerable burning, if so, dilute to half-strength with petrolatum.



(c) 5% ammoniated mercury (twice daily) or 3% sulphur ointment (once daily) may be used, but are less satisfactory.

(d) In some patients a drying lotion is more satisfactory than an ointment. Add 2% sulphur or 0.1% bichloride of mercury to calamine lotion, apply twice daily.

(e) Thorough cleansing and rinsing of razor in hot water when possible. Avoidance of common towel.

(f) Patients with persistent severe folliculitis should be admitted to hospital for study.

(5) *Ulcers*. Any chronic ulcer is ordinarily a subject for hospital consultation.

#### 4. DERMATITIS MEDICAMENTOSA, TOXIC ERYTHEMA, URTICARIA, ERYTHEMA MULTIFORME

a. Detailed information on the diagnosis and treatment of these fairly common dermatoses cannot be included in this Manual. At times the etiologic factor may be easily determinable, e.g., sulfonamide sensitivity in dermatitis medicamentosa, or food sensitivity in acute urticaria, but at other times the etiology may remain undetermined after the most detailed analysis.

b. In general, a cathartic, suspension of any prior oral medication and application of calamine lotion to control the itching are all that can be carried out in the field in this group of conditions. If the process is extensive and disabling, or if there are repeated recurrences, the soldier should be referred to a hospital.

#### 5. ACNE VULGARIS

a. This common dermatosis, while ordinarily of only cosmetic importance, may sometimes be sufficiently severe to interfere with the carrying of a rifle or pack. Also, marked active lesions or scars on the face may have a bad effect on the morale of the affected soldier.

b. The following simple regimen of treatment will be helpful in most cases.

(1) Wash the affected parts thoroughly with strong soap once or twice daily.

(2) Apply lotio alba (Potass. sulphurett 4%, zinc sulphate 8% in water or equal parts of water and alcohol) once or twice daily. This will ordinarily produce some exfoliation of the skin, which is desirable. Or apply 10% sulphur in zinc oxide ointment every night. Or 3-6% sulphur in calamine lotion.

(3) Advise the soldier to obtain as much exposure to natural sunlight as possible.

(4) Advise avoidance of excess of chocolate or nuts in diet.

(5) Drain pustules with small stab incision. This will decrease subsequent scarring.

## 6. PSORIASIS

a. Individuals who have suffered from psoriasis prior to arriving in E.T.O. commonly have a flare-up in the disease after arrival. Factors in this exacerbation apparently include decreased opportunity for exposure to natural sunlight, changes in diet, and increased nervous tension incident to foreign service. It is important, therefore, to institute treatment promptly in individuals who develop psoriasis, or in whom the extent of involvement increases.

b. The most useful simple measures are:

(1) Application of 10% ammoniated mercury ointment every night, or—

(2) 3-6% crude coal tar in zinc oxide ointment every night (this is sometimes objectionable because of the staining of clothing which is produced), or—

(3) 0.1-1% dithranol (Cignolin) ointment every night.

(4) As much exposure to natural sunlight as possible.

c. If the dermatosis becomes so extensive as to become objectionable in barracks, or if eczematization and itching develop, or there is any associated arthropathy, the man should be referred to a hospital.

## 7. WARTS

Warts are ordinarily incidental and unimportant, and require no treatment. In the following types, however, treatment may be necessary.

a. *Painful* plantar warts.

(1) Relieve pressure; correct any underlying orthopedic abnormality.

(2) Shave off thick skin of top with scalpel or razor.

(3) Apply 20% salicylic acid in flexible collodion (ordinary "corn cure"), or piece of salicylic acid plaster, or small amount of zinc oxide paste containing 20% salicylic acid; cover with adhesive tape and allow to remain in place for 3 to 7 days. Clip away softened skin and apply silver nitrate stick or other caustic to base.

(4) Treatment by surgical removal, or electrodesiccation, or X-ray may be employed by experienced medical officers.

(5) No method of treatment of plantar warts is entirely satisfactory; in general, if they are not causing symptoms, *let them alone*.

b. Venereal warts, usually in region of glans penis or anus.

(1) Rule out venereal disease.

(2) Cleanse frequently with soap and water, drying thoroughly.

(3) Dust several times daily with talc containing 10% powdered boric acid and 0.1% mercury bichloride.

(4) In dirty macerated lesions, 1 : 5000 KMnO<sub>4</sub> hot soaks or application of 2-10% silver nitrate.

(5) Venereal warts are frequently resistant to the above measures, and may require electrodesiccation in a hospital.

c. Ordinary warts on the hands may require treatment if they are numerous or large, and subject to fissuring. Repeated application of trichloroacetic acid or nitric acid with a sharpened wooden applicator may be curative, but the method is tedious. If facilities for electrodesiccation are available, ordinary warts should be removed by this method. Flat warts of the face may become extensive, and interfere greatly with shaving. Mild exfoliation produced by the application of calamine lotion to which 5-10% sulphur and 2% resorcin have been added, is sometimes helpful for flat warts. In resistant cases, expert electrodesiccation may be necessary.

### XIII. BITES AND STINGS

a. *Biting Insects.* Those that may cause annoyance in the United Kingdom are lice, fleas, bedbugs, and chiggers. Lice infestations may be readily detected by examining suspected personnel. Inspection of clothing, particularly the underwear, is sometimes useful in detecting light infestations. Bedbug infestations are also readily detected by a careful search of cracks and crevices in and around the beds for these insects in their daytime resting places. In cases where fleas or chiggers (harvest mites) are responsible for the annoyance, it is frequently more difficult to demonstrate the insect responsible. However, fleas are large enough to be readily seen with the unaided eye, and their bite is irritating. Men attacked by these insects should therefore have seen the insects responsible. On the other hand, chiggers are so small as to be almost invisible to the unaided eye, and their bites are not irritating until several hours after they have become attached to the host. They are therefore frequently not observed. Careful examination of fresh unscratched "bites" by the medical officer should reveal some of these mites on the host.

(1) Light infestation of bedbugs can usually be dealt with by the use of *insecticide, liquid, finished* (Quartermaster issue). Several applications are usually required, and they must be thorough. The spray must come into contact with the various stages of the bedbug to effect a kill. It is therefore necessary to direct the spray into all cracks and crevices in and around the beds in which the insects may be hiding. Heavy infestations can best be controlled by fumigation, carried out by the Engineers.

(2) Flea control can be accomplished by thorough scrubbing of floors to prevent breeding in dirt and debris in cracks. Fleas on pets may be controlled by the application of *insecticide, powder, body insect* (Quartermaster issue). This powder may also be used to protect troops that are required to frequent places where fleas are prevalent. For this purpose the powder should be sprinkled on the clothing around the ankles and wrists and thoroughly rubbed into the cloth.

(3) Pubic lice should be treated by dusting the affected parts thoroughly with insecticide, powder, body insect (Quartermaster issue) twice, with an interval of one week between applications. It should rarely be necessary to shave the groin. If insecticide powder is not available, apply ammoniated mercury ointment every night for several nights. Do not use blue ointment; it frequently causes dermatitis. When DDT powder becomes generally available, it should be used in preference to any of the preceding treatments.

#### XIV. CARE OF FEET

##### a. *Foot Hygiene.*

(1) Health function of feet can be maintained only when rigid hygienic precautions are continually enforced by frequent periodic inspection.

(2) Bad foot hygiene results from failure to keep the feet clean and from trauma to the feet.

(3) Proper cleanliness necessitates thorough washing with soap and water, particularly between the toes, and scrubbing of the nails, followed by complete rinsing. The nails should be trimmed transversely and in such a manner that the lateral edges are never cut back toward the cuticular attachment.

(4) Excessive moisture plays an important role in maceration of the skin and proliferation of surface bacteria and fungi. Socks should be changed as often as is practicable, especially during forced marches. Persons whose feet perspire excessively should change socks and shoes at midday whenever possible, and should never wear oiled shoes. The Army foot powder should be dusted on twice daily.



(5) Trauma to the feet originates from poorly fitting shoes or from the application of force in excess of that to which the feet have been accustomed, and usually follows forced marches. Soldiers' shoes should be fitted to avoid points of constriction or pinching; the shoe pressure should be uniformly distributed. They should be laced snugly and carefully inspected with the wearer standing erect and bearing a weight equivalent to that of a soldier's pack. New shoes should never be worn on march. Socks should be fitted to the size of the foot. In general, because of their greater absorbability, light wool issue socks are preferable.

(6) The gradual accommodation of the feet to increasing weight bearing, together with cleanliness and attention to footwear, minimizes the incidence of foot injuries. The following are suggestions relative to the care of the feet after long marches:

(a) Wash the feet in cold water; after drying, use a dusting powder.

(b) If the skin is tender, bathe the feet in warm salt water or alum water; if the feet are swollen and perspiring, soak them in a 2 per cent solution of formalin; if they are very tender soak them in a 1 percent solution of formalin or a 1 : 5000 solution of  $\text{KMnO}_4$ .

(c) Open blisters with a sterile needle, and circle them with adhesive tape to lessen pressure.

(d) Dry and stretch the shoes.

(e) Wash and dry the socks.

(7) The importance of a foot bath with soap and water cleansing, vigorous massage (20 minutes), dry socks, and a change of shoes in the prophylaxis of foot disability resulting from exposure to cold and moisture cannot be overemphasized.

#### *b. Fungus Infections of Feet.*

a. It is important to distinguish ringworm infections from contact dermatitis due to footgear, pyogenic infection, and eczema. In ringworm infections there is almost always some involvement of the skin between the toes.

b. *Do not* apply strong ringworm remedies, e.g., Whitfield's ointment or tincture of iodine, in acute inflammations, whether of dermatophytic, pyogenic or eczematous origin.

c. Treatment.

(1) Acute phase.

(a) Relieve the patient from duty if possible. As a rule *severe acute* fungous infections should be treated in hospital.

(b) Hot foot soaks of potassium permanganate (1 : 8000 solution) or boric acid solution, or normal saline for twenty minutes three to five times daily.

(c) Calamine lotion containing  $\frac{1}{2}\%$  phenol.

(d) Drainage of large vesicles by punctures with sharp-pointed curved scissors.

(e) Watch for secondary pyogenic infection.

(2) Subacute phase.

(a) Apply GI foot powder every morning.

(b) *One-half strength* Whitfield's ointment, or compound carbol fuchsin paint, (Castellani's paint) or 3% salicylic acid in alcohol. Apply at night.

(c) Continue foot soaks, preferably potassium permanganate, as long as fresh blisters are appearing.

(d) Remove tops of blisters and macerated skin with curved scissors or curette. This is essential to rapid improvement.

(3) Chronic phase.

(a) Emphasis on foot hygiene. *Careful drying of feet, especially between toes.* Regular use of foot powder. Changing of socks, dry footgear if possible.

# WOUNDS OF LARGE BLOOD VESSELS

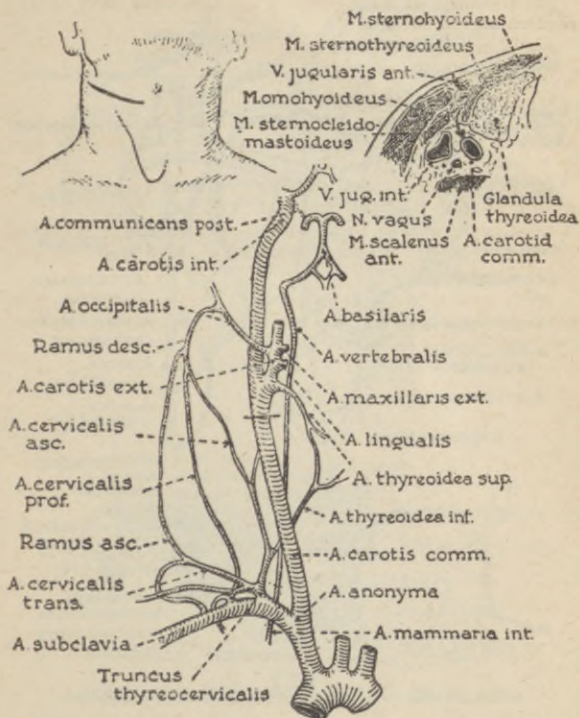


FIG. 1.

Common carotid artery—incision, approach, and collateral circulation.

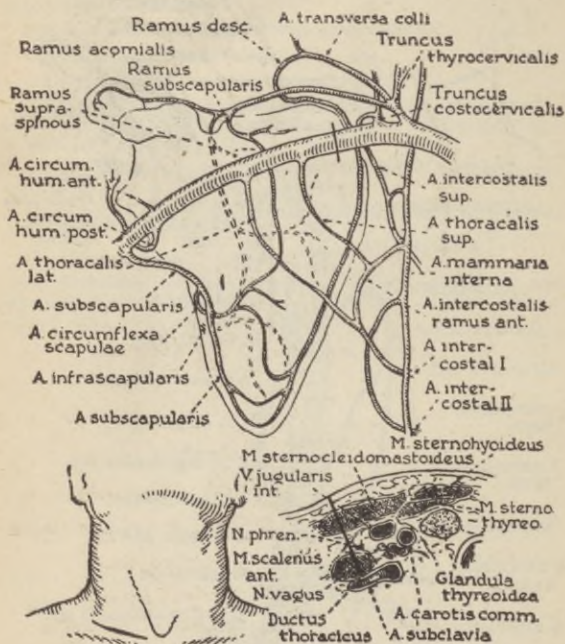


FIG. 2.  
Subclavian artery—incision, approach, and collateral circulation.



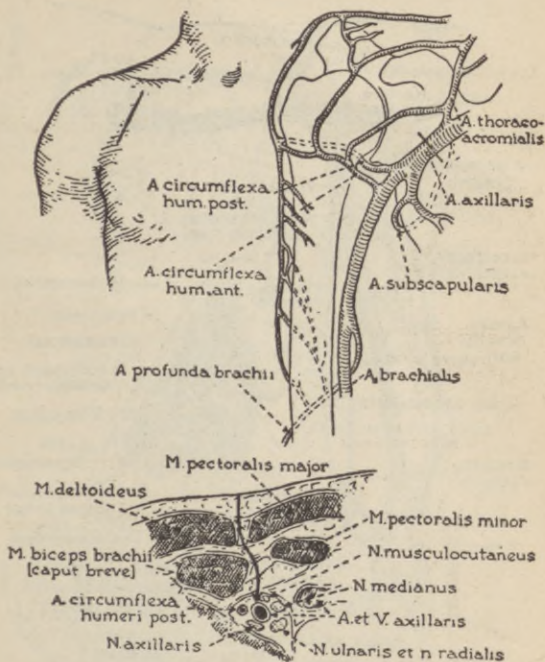


FIG. 3.  
Axillary artery—incision, approach and collateral circulation.

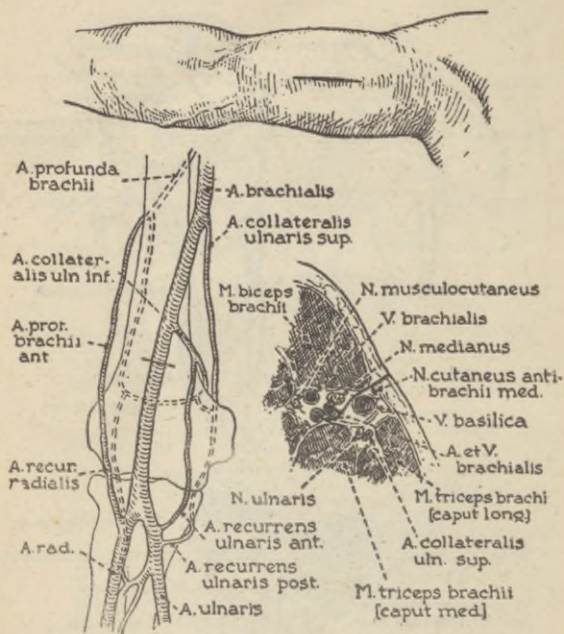


FIG. 4.  
Brachial artery—incision, approach, and collateral circulation.

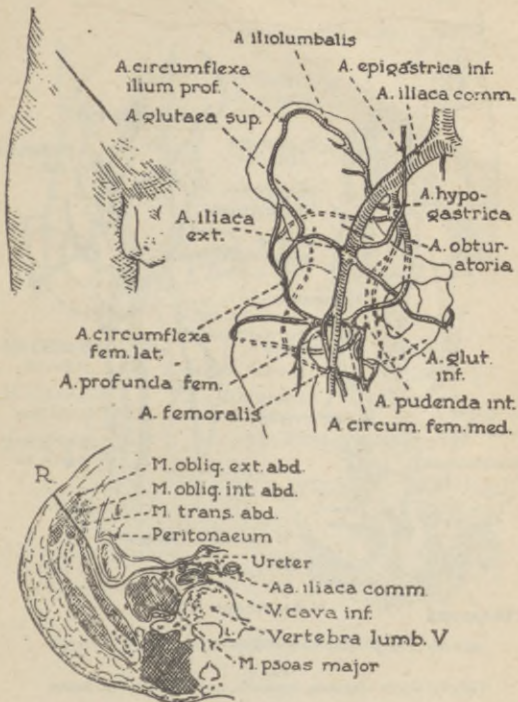


FIG. 5.  
Iliac artery—incision, approach, and collateral circulation.

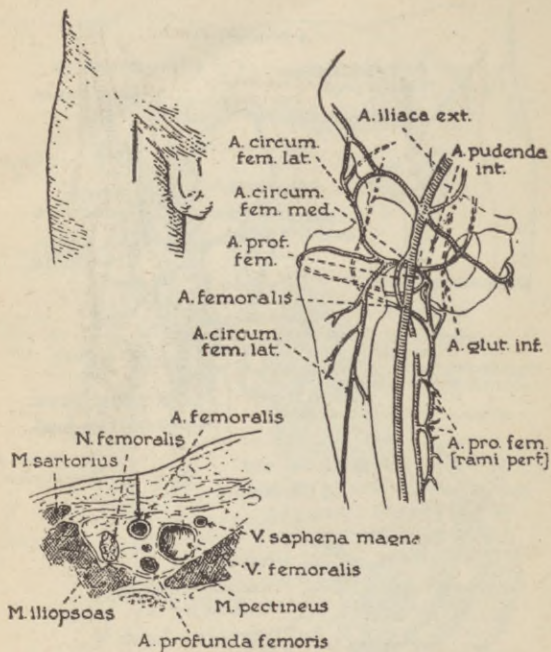


FIG. 6.  
Femoral artery—incision, approach, and collateral circulation.



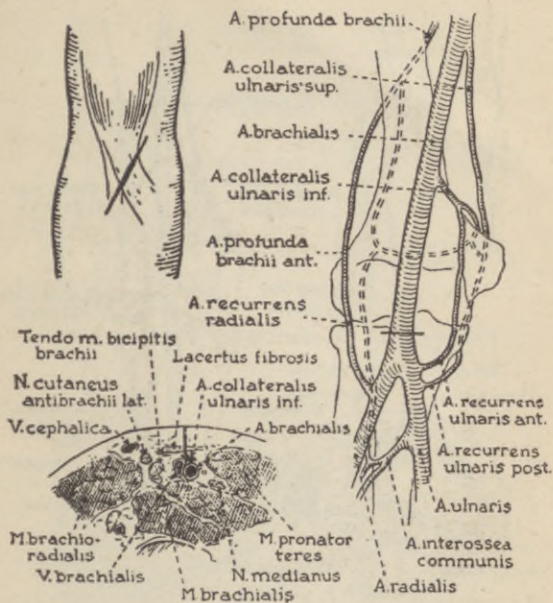


FIG. 7.  
Cubital artery—incision, approach, and collateral circulation.

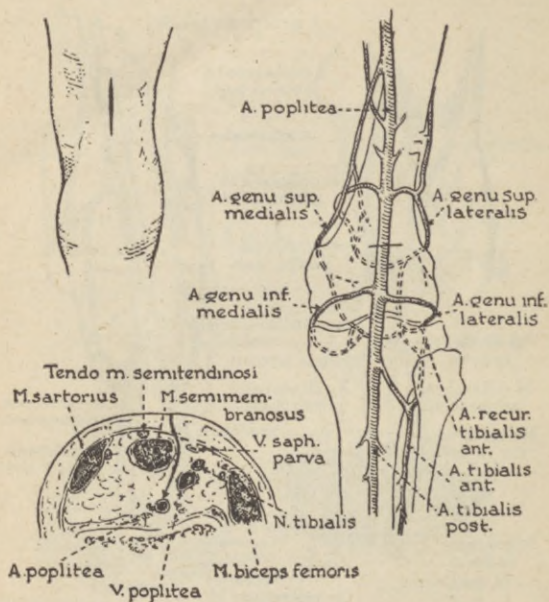


FIG. 8.  
Popliteal artery—incision, approach, and collateral circulation.

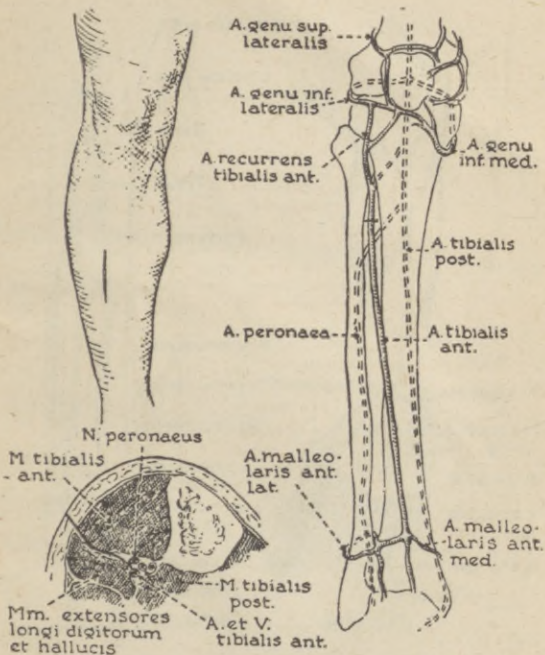
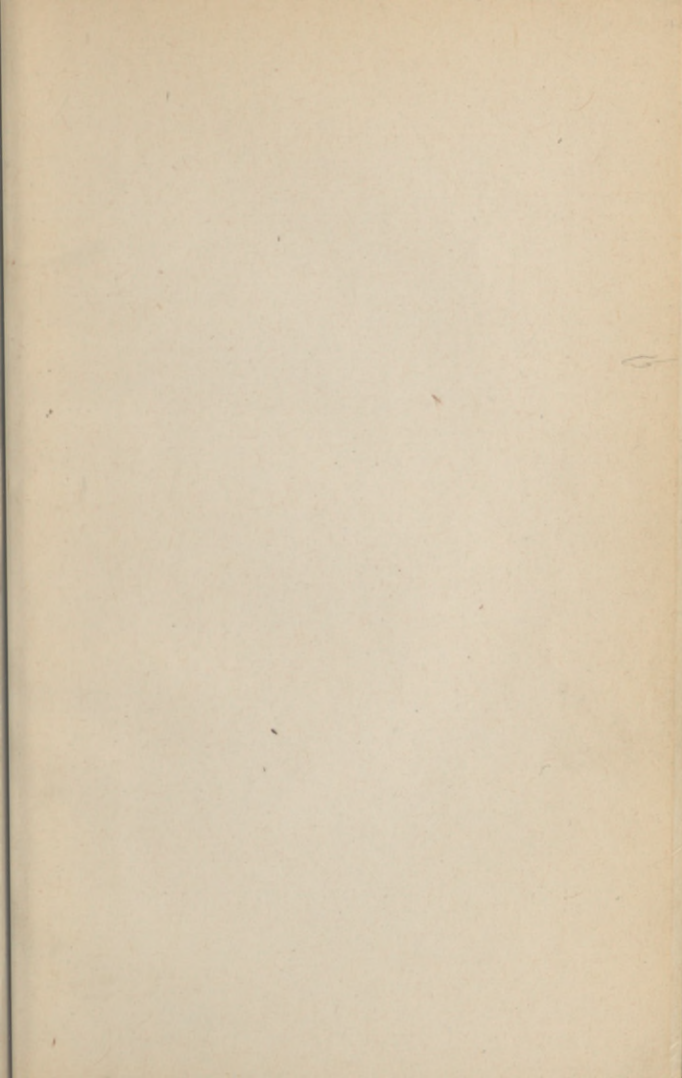
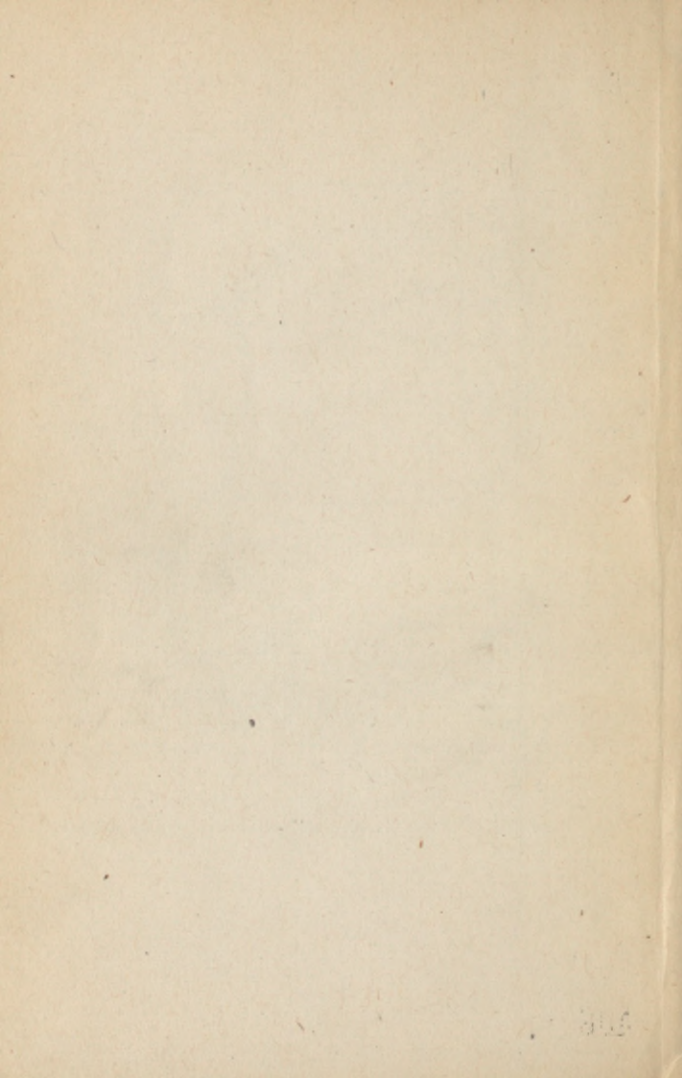


FIG. 9.  
Anterior tibial artery—incision, approach, and collateral circulation.









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