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LOCALIZED INFECTIOUS DISEASES FOLLOWING SLIGHT INJURIES AS THE PROXIMATE CAUSE, AND THEIR MEDICO-LEGAL RELATIONS.*

By J. R. McDill, M. D., Milwaukee, Wis., and C. H. Van Alstine, Solicitor C. M. & St. P. Ry., Milwaukee.

Cases claiming damages as a result of slight traumas are becoming more frequent and are, as in other legal actions, often due to improper and ignorant medical and legal suggestion, coupled many times with desire for pecuniary gain. The probable causative relations of trauma to many diseases has always been believed from clinical observation, but the modern sciences of bacteriology and experimental pathology have definitely traced the causative influence of trauma to many subsequent infective processes.

Railway surgeons see more injuries of varying degree that are apt to have medico-legal complications than any other class of surgeons. Slight injuries, the skin being un-

* Read at the fifth annual convention of the C. M. & St. P. Ry. Surgical Association, Chicago, Oct. 28, 1897.

broken, followed by microbic infection, will claim our attention in this paper.

The courts have decided that pathogenic germs in the blood cannot be held to be the proximate cause of a disease, but that which medical men term the exciting cause, as an injury, shall be considered the proximate cause or cause which set in motion the active agents of the disease, by preparing suitable conditions in the tissues for their growth, reproduction and consequent manifestation of their peculiar pathogenic properties.

Dr. Sarles, in a recent paper on "Treatment of Traumatic Infections"[1] rightly says that no distinctions can be made between exogenous or hematogenous infections, as in every case two things are necessary: First, the entrance of the microbe; second, its development.

GENERAL CONSIDERATIONS AND FACTORS IN PREDISPOSITION.

Welch, from whose writings most of the bacteriology is taken for this paper, says:

"All traumatic, and all pathological lesions of exposed surfaces of the body increase in greater or less degree the opportunities for the entrance, lodgment and multiplication of micro-organisms, and these lesions become most dangerous channels of infection when the general resistance of the body to infectious agents is lowered, as in and after various infectious fevers and constitutional diseases.

1. Railway Surgeon, IV, p. 241.

"Hence, injury, inflammation and other pre-existing disease of an internal part are important and common conditions favoring the lodgment and growth of micro-organisms. The general factors are for most part less tangible than the local causes of predisposition.

"Organs and parts of the body may inherit special vulnerability to certain infections. Susceptibility to certain infectious diseases may be manifest in races and families. Age influences predisposition as regards some infectious diseases favorably and others unfavorably. Osteomyelitis is much more common in children than in adults, and in laboratory experiments, young animals, as a rule, are found to be more susceptible to most pathogenic bacteria than old ones. There is a certain insusceptibility of sucklings during the first months of life to certain infectious diseases, such as mumps, measles and scarlet fever, and the embryo possesses remarkable insusceptibility to some infections."

Acute general anæmia, induced by loss of blood, has been shown experimentally to increase susceptibility to infection with various micro-organisms. In general, impaired vitality and nutrition may predispose to certain infections.

The influence of cold in predisposing infections, although long recognized, has been conclusively investigated experimentally by

E. Fischl (Zeits. f. Heilkunde Bd. xviii. Hft. 4.), at Wolfler's clinic. He instituted a series of exhaustive researches concerning this condition with especial reference to the question whether chilling or refrigeration could have a predisposing influence to infection by a small amount of virulent or by attenuated micro-organisms.

In the experiments he endeavored to show to what a degree a gradual and transitory reduction of the bodily temperature predisposed to infectious diseases. The animals used were rabbits, and the infectious material, the diplococcus pneumoniæ of Frænkel-Weichselbaum. For each chilled animal infected a normal control animal was likewise inoculated. The results were as follows:

In ten cases neither experimental or control animals became ill. In these ten experiments the cultures used were avirulent. In two cases the chilled rabbit became ill with pneumococcus septicæmia and recovered later; the control animals were not affected. Fischl assumed that the virulence of the culture used here must have been slight. In three cases the chilled animals died of septicæmia and the three control animals were not at all disturbed. In ten cases the chilled animals were affected by pneumococcus septicæmia and the control ones had slight transient symptoms of sickness. Five cases finally died very much sooner than the control animals. These in-

vestigations seem to prove beyond doubt the pronounced influence of refrigeration of the body as a factor favoring the development of septic disease. Fischl goes farther into the reason of why a chilled animal is more susceptible. He also investigated the changes in the number of the white blood cell of chilled animals with and without infecting them, and investigated also the bactericidal power of the blood serum which was found to be unchanged by chilling. Fischl's interesting experiments seem to conclusively prove that besides the animate exciting cause of infectious disease, the condition of the organism attacked has a powerful effect in determining the onset of an attack.

Prolonged narcosis may impair resistance to some pathogenic micro-organisms, as shown by Klein and Coxwell, in frogs and rats, and Rosewell Park says: "There is good reason to think that chloroform and ether administered for some time may produce such changes in the blood and tissues that vital processes of repair, cell resistance and chemotaxis may be so far interfered with as to facilitate subsequent infection."

The most important class of experiments showing the predisposing influence of certain chemical substances upon infection are those in which various ferments and bacterial products have been used. It seems to be a fact that the chemical products

of some bacteria favor the development of infection with other bacteria. Park, Bouchard and others lay much emphasis upon auto-intoxication from the intestinal tract as a predisposing cause of infection, particularly with pyogenic cocci and the tubercle bacillus.

Among other diseases characterized by lessened resistance to infection may especially be mentioned acute and chronic Bright's disease, arterio-sclerosis, cardiac disease, alcoholism, syphilis, rickets, scurvy, leucocythæmia, Hodgkin's disease and malaria.

LOCAL CAUSES IN PREDISPOSITION.

After infectious agents have passed through the portal of entry and entered the general circulation they may find local conditions favoring their lodgment and development, Without such local predisposition they are often incapable of doing harm.

Chauveau's classical experiment many years ago demonstrated the predisposition of injured internal parts to infection. He twisted off without rupture of the skin one of the testicles of a young ram from its vascular connections, and observed that when he had injected shortly before the operation, putrid fluid containing micro-organisms, directly into the circulation, the injured testicle became the seat of septic gangrene, while without such injection the testicle became necrotic, and was absorbed without becoming infected.

The experiments of Rosenbach, Orth and

Wysskowitch, Prudden and others, have shown that bacteria do not readily become attached to the smooth surface of the heart valves, but that pyogenic cocci readily adhere and set up septic endocarditis when the valves have been previously torn by a sterile probe passed down the carotid artery. The predisposition of injured bones and joints to the settlement of pathogenic cocci is established by both clinical and experimental observations.

The existence of a diseased or injured part within the body, by no means involves, of necessity, the localization therein of infectous processes which may be caused by pathogenic micro-organisms in the circulation. The damaged part may be spared, and an apparently healthy part attacked. The endeavor to obtain experimentally in animals the localization of suppuration in a fractured bone, or other injured or diseased part by pyogenic cocci injected into the circulation often fails, and in the hands of Rinne failed so regularly that he opposes, although without sufficient reason, the whole doctrine of locus minoris resistentiæ. By a different line of experiments Gottstein came to the same conclusion as Rinne.

In the great majority of instances of localized infection of internal parts we are unable to give a satisfactory explanation of the localization, but we are undoubtedly able, in some

cases, to explain localization by such apparent local predisposing causes as trauma.

The most frequent pathogenic processes observed clinically to follow trauma, and due to micro-organisms in the circulation, are those caused by pyogenic cocci and the tubercle bacilli.

PUS INFECTIONS FOLLOWING TRAUMA.

The experience of almost all surgeons contains cases of localized suppuration following bruising of the part, beginning by limited spontaneous pain, acuity of the classical signs and symptoms, and an isolated swelling characteristic of the suppurative process. The cases recorded are few compared to the unpublished clinical cases, which have come under the observation of most physicians and surgeons. A typical case of this nature which progressed to fatal septico-pyemia, occurred in the recollection of the writer, and began as a localized suppurative process about a shoulder, pounded by the recoil of a shot-gun while hunting.

Secondary attacks of osteomyelitis is probably the most familiar example of germ latency and although always limited in extent and mild in their course, the germs which have lain quiescent as long as twenty years or more, may reassert their suppurative functions at any traumatism, chilling or violent exertion.

Pneumonia not infrequently is attributed to injury, and pneumonia is thought by many to

prepare the lung for the implantation of tubercle bacilli (Jacoud, loc. cit.). The following case seems to illustrate probable traumatic pneumonia:

In June, 1893, the writer attended a case of pneumonia in a young man 26 years of age, which resulted fatally. Family history good and personal habits fair. He was delirious when first seen, and could give no history, but he had just returned from a neighboring city, and, for some reason was supposed to have been injured by a fall. Death on the seventh day of illness. Post-mortem examination June 4, 1893. Body well nourished, and no external evidences of injury. The middle third of the right lung was in the second stage of catarrhal pneumonia. The remainder of the lung was deeply congested and œdematous. Recent pleuritic adhesions, easily broken down, extended from the axillary line to the vertebral column. About the center of the pneumonic area, beneath the visceral pleura was a pale, thin clot the size of a silver half dollar, beneath which the parenchyma of the lung was ecchymotic. Beneath the parietal pleura and corresponding in location exactly to the appearance described on the lung to which it was firmly adhered was found a similar sized area of circumscribed plastic pleuritis. The subjacent tissues of the thoracic wall upon being incised showed evidence of old blood extravation to the same extent, but no

rib fracture or evidence of injury to the skin was discoverable. His heirs sued for collection of an accident insurance policy on the deceased. Testimony was given that a rather severe injury at a point on the external wall of chest could have resulted in a lesion of milder degree of the underlying lung, which might have been sufficient to set in motion processes in the lung due to germs in that organ, the circulation, or both, that resulted in the peculiar pathologic condition called pneumonia.

That no demonstrable lesion of the cutaneous surface was found assuming the conditions described to be due to trauma, was accounted for by the density and great mobility of the integument of this region. Cases were cited of severe chest injuries with rib fracture from external direct forces, which left no marks, unless for a short time, upon the skin. All other organs were normal. The cranial cavity was not examined. The microbic element of the pulmonary disease was not looked for.

TUBERCULOSIS FOLLOWING TRAUMA.

The most frequently recorded and most serious pathogenic process from both medico-legal and pathologic standpoints which follows trauma of mild degree is the tubercular.

It has long been known that tuberculosis of bones and joints is prone to follow injuries, particularly slight injuries, and the surgeon is

now not infrequently called to testify in accident and negligence cases to the possibility of this disease following and being due to a trauma.

Senn (Tuberculosis of the Genito-Urinary Organs, 1897,), says: Antecedent inflammatory affections and trauma are the etiologic conditions that most frequently determine tubercular infection." The influence of trauma in determining localization is well illustrated by a case he quotes, which was reported by Faulds (Lehigh Valley Med. Mag., April, 1892). Patient 21 years of age. First symptoms after a football game; a player falling upon and striking him in the left lumbar region with his knee: Pain on micturition, occasional hæmaturia and pyuria, loss of strength and flesh and tenderness over the kidney. Death in several months and caseous tuberculosis of the left kidney was found. The opposite kidney contained a few tubercular nodules. Mesenteric glands cheesy. Spleen showed a few nodules. Apex of left lung contained a small cavity.

Since the time of Koenig and Mueller's beautiful experiments of producing tubercular infarctions in bone, since supplemented by Watson-Cheyne, Schüller and Krause, the subject of the relation of trauma to the tubercular process has received much attention and has become of great importance from a

diagnostic standpoint, as well as from the medico-legal point of view.

Becker (Ueber Contusionstuberkulose, in Ver. Pfalz. Aerzte xi., 11, 12, 1895.) and Kaufmann exhaustively discuss the relations between injuries and tuberculosis with citation of examples. These relations have acquired especial importance in Germany on account of accident insurance law, where it is considered that the patient has a claim for indemnity if the accident occasions the outbreak of a concealed or a threatened tuberculosis or hastens it. A paper by Spengler (Ueber Fussgelenk-und Fusswurzeltuberkulose, Deutsche Ztschr, f. Chir. xliv., 2, p. 1, 1896), on ankle and tarsal tuberculosis showed that in about half of the 136 cases reported there was a history of antecedent trauma.

Sabrazes and Binaud (Sur l'anatomie pathologique et la pathogenie de la tuberculose mammaire de la femme, Arch, de Med. Experim. vi., 6, p. 838, 1894), believe that aside from those cases in which tuberculosis of the mamma is a direct extension from a neighboring tuberculous ulcer or rib caries, that the leucocytes are responsible for this rare affection of the mammary gland, and that an accidental cause is necessary to start it, which is, in the cases described, generally a trauma. In the portion of the mamma so damaged numerous leucocytes laden with bacilli and tuberculous poison are deposited and thus

originates the tuberculous abscess. Perichondritis tuberculosa Auriculæ, Haug (Erkrankungen des Gehörorgans bei Tuberkulose, Arch. f. Klin. Chir., xliii., Jubil.-Heft.) thinks can often be traced to a remote trauma.

Jacoud (Sur. l'origine hospitalière de la phthisie pulmonaire, Bull. de l'Acad. de Med. lx., 4-7, 1896) reports four cases of hospital tuberculosis, which belong to traumatic phthisis. Three patients who were previously healthy men, suffered injuries to the chest, for which they entered the hospital and there became tuberculous. In two cases Jacoud could trace tuberculosis to a traumatic pneumonia. The post-mortem examinations showed no traces of old tuberculous deposits, so that the assumption that they were hospital infections can hardly be denied.

Schilling (Münch. Med. Woch., No. 40, 1895.) reports the case of a boy eight years of age who showed brain symptoms eleven days after a severe fall. Fracture of the inner table, with irritation by fragments of bone was suspected, but before operation could be made the patient died. Autopsy showed tuberculous meningitis and cheesy softening of the bronchial glands. It would seem most probable that the bacilli in the glands, where they were encapsulated and latent, becoming mobilized by the trauma, and set free in the circulation found at the seat of injury the favor-

able conditions for their lodgment and reproduction.

A patient of Wagner's (Ein Fall von Lungenschwindsucht, dessen Entstehung ursächlicht mit einer durch Trauma hervorgerufenen Lokaltuberkulose zusammenhangt. Vjhrschr. f. gerichtl. med. x., 2, p. 385, 1895.) injured his elbow in 1886, which joint became tuberculosis, and later the lungs were attacked. Wagner traced in a comprehensive manner the phthisis in 1895 back to the accident in 1886. A patient of Schaeffer (Trauma und Tuberkulose. Ebenda. x., 1, p. 29, 1895.), 34 years old, no hereditary taint, fell from a carriage upon the left side of the body. The result was symptoms of chronic inflammation of the membranes of the cord in the dorsal region. Five years later an exudative pleuritis occurred, and nine years after the accident death from pulmonary tuberculosis followed. Schaeffer thinks it probable that it was tuberculous meningitis which later attacked lung and pleura.

The predisposing causes of tubercular epididymitis, given by Senn, are: Inherited soil, antecedent or coexisting disease of the testicle and trauma. As exciting causes of tuberculosis of the testicle, which is often secondary to the disease in the epididymis, most authors enumerate traumatism and chronic gonorrhœal inflammation in the posterior portion of the urethra and in the epididymis.

Cryptorchism is mentioned by Nepveau and Kocher as one of the most potent of exciting causes. Tuberculosis of these organs is noted for its insidiousness and chronicity, although, in rare cases, Barling (Double Acute Tubercular Disease of the Testis. London Lancet, April 9, '92), says: "I can readily understand that in the event tuberculosis develops in a testicle or epididymis, the seat of an injury or antecedent or inflammatory disease, that it might, in rare cases, pursue an acute course." Dr. J. G. Mumford of Boston, in an article on the treatment of sprains by massage (Bost. Med. and Surg. Journal), states that he has seen a number of cases of ankle sprains that resulted in severe chronic tuberculosis.

W. V. König's (Tuberkulose des Schultergelenkes, Besprochen auf Grund des Beobachttungs Materiales der Chir. Klink. zu Göttingen. Deutsche Ztsch. f. Chir. xxxlliv-v., 403. 1893.) report on tuberculosis in the shoulder joint showed that eleven cases followed trauma. Schuchardt, in an article on the tendon sheaths, says: "The tubercular fungus always begins in a circumscribed spot on the tendon sheath, generally following traumas, and is transmitted to the spot through the circulation.

Further information on this subject can be found in recent papers by Prof. Fuerbringer (Zur Cauistik der traumatischen Knochen-

tuberkulosen. Aerztl. Sachverst. Ztg., Berl., 11, 405. 1896.) and Dr. Paul Guder (Ueber den Zusammenhang zwischen Trauma und Tuberkulose, Vjhrschr. f. gerichtl Med. vii., viii., 1894. ix., 1895).

Mr. C. H. Van Alstine, a recognized authority on the law of negligence, and solicitor for the C., M. & St. P. Ry. Co., in a personal communication, kindly gives the following valuable legal light on the forensic medical aspect of this subject.

THE MEDICO-LEGAL RELATIONS.

In the law of negligence, as administered in Wisconsin, and in most jurisdictions, negligence, causing an injury to the person, is not actionable, unless it was also the proximate cause of the injury. The words "proximate cause" in the law of negligence have a peculiar meaning, differing materially from their ordinary signification, and they have not the meaning when applied to negligence causing a personal injury that they have when applied to a personal injury causing a disease. When a lawyer asserts that "negligence was the proximate cause of the injury," he means this: The injury was the natural and probable result of the negligence, produced immediately by such negligence, or by such negligence setting other causes in motion, each in order being started naturally by the one preceding it, and altogether constituting a complete chain or succession of

events so united by a close causal connection as to form a natural whole, reaching from the negligence to the injury and producing it, and ought to have been foreseen, in the light of the attending circumstances, by a man of ordinary intelligence and prudence engaged in the business in which the person guilty of negligence was engaged at the time of the injury.

It will thus be seen that an essential element of proximate cause as applied to negligence, causing an injury to the person, is a finding that a personal injury ought to have been foreseen in the light of the attending circumstances as the natural and probable result of the negligence. It is, however, not necessary that an injury to the person in the precise form, or to the precise extent inflicted by the negligence, ought to have been foreseen. If the personal injury was the natural and probable result of the negligence, and a personal injury in some form ought to have been foreseen, in the light of the attending circumstances, as the natural and probable result of the negligence, actionable negligence has been proven, and the question of damages arises. In every case of actionable negligence the guilty party is liable for all the damage which directly or proximately flows from his negligence, whether such damage might or might not have been foreseen by the person guilty of the negligence as a natural and probable result of his negligence. It will thus be seen that when

the question of damages has been properly reached, one essential element of proximate cause, as applied to negligence causing the injury to the person may properly be omitted in determining the elements of damage.

The definition of proximate cause, therefore, as applied to negligence causing an injury to the person, may properly be said to be a rule for determining actionable negligence, while, as applied to a personal injury causing a disease, it may properly be said to be a rule for determining the elements of damage resulting from actionable negligence. It necessarily follows that the rule for determining whether a personal injury proven was the proximate cause of the disease proven, is this: Was the disease the natural and probable result of the injury, produced immediately by such injury, or by such injury setting other causes in motion, each in order being started naturally by the one preceding it, and altogether constituting a complete chain or succession of events so united by a close, causal connection as to form a natural whole, reaching from the injury to the disease and producing it.

A brief general statement of a proper method of proving that disease was produced by a personal injury may prove convenient to the medical witness.

After a medical expert has, from a personal examination of the injured person, or upon a

hypothetical question embodying symptoms, sworn to the particular disease from which the injured person is suffering, he may be interrogated concerning the cause of the disease. The proper method is to place before the expert, either by the testimony of the injured person given in the presence of the expert, or by the testimony of other persons given in his presence, or by a hypothetical question, based upon the evidence, embodying the injured person's condition for some time prior to the injury, and all subsequent events, facts and circumstances, and then ask him what, in his opinion, produced the disease? If upon such question being put to him, he can see from the facts placed before him that prior to the injury there existed an efficient adequate cause, according to etiology, for the disease, he should answer that the disease was the result of such cause, unless he can see some new efficient adequate cause not incidental to but independent of the first, which intervened between it and the disease.

This follows from the following rule of law, "Having discovered an efficient adequate cause that is to be deemed the true cause, unless some new cause not incidental to, but independent of, the first shall be found to intervene between it and the result." If he can see an efficient adequate cause, according to etiology, for the disease, which, independent of the injury, intervened between the injury and

the disease, he should answer that the disease was the result of such cause, and was not the result of the injury, but if he can, from the facts placed before him, see no efficient adequate cause for the disease prior to or subsequent to the injury, and can see that the disease was, according to etiology, the natural and probable result of the injury, and that it was produced immediately by the injury, or that the injury set other causes in motion, each in order being started naturally by the one preceding it, and altogether constituting a complete chain or succession of events so united by a close causal connection as to form a natural whole, reaching from the injury to the disease and producing it, he should answer that the injury produced the disease; otherwise he should answer that the disease was not the result of the injury.

In many cases the question of whether a disease is the result of an injury is submitted to the jury upon the opinion of medical experts to the effect that the disease could be produced by the injury, together with proof negativing all other causes, and from such evidence the jury are permitted to infer that the injury was the actual cause of the disease. Such method of proving that the disease was the result of the injury is, to say the least, somewhat loose, but if proper, a medical expert can, after he has given such an opinion, be required upon cross-examination to state

whether the disease was produced immediately by the injury, or at the end of a succession of events, and if he answers at the end of a succession of events, he may be required to trace, if he can, the succession of events, and to show that each in order was started naturally by the one preceding it. He may, of course, be asked other questions.

If the disease in question in the action usually follows the injury in question, there is no difficulty, for it is easy to see in that case that the injury was an efficient adequate cause of the disease. On the other hand, if the disease in question does not usually follow the injury in question, it is easy to see that there will be some difficulty in showing, according to etiology, that the disease is the natural and probable result of the injury.

CONCLUSIONS.

1. It is conclusively established both by clinical experience and experimental investigations, that infectious diseases due to micro-organisms circulating in the blood can and do sometimes follow a slight personal injury.

2. Where negligence proximately causes a slight personal injury, and the injury proximately causes disease, the injury and the disease are both elements of damage in actions for negligence.

3. These two facts should teach the surgeons for railways and other corporations to

keep accurate and minute records of all cases of slight injury, together with careful anamnesis extending over the entire period from infection of the trauma to the disappearance of the last vestige of its results.

4. When an action for damages is contemplated medical experts should remember that these infectious diseases do not usually follow injuries, and that, therefore, the disease must, in order to constitute an element of damage, be clearly traced to the injury, either immediately or by an unbroken chain or succession of events reaching from the injury to the disease and producing it.

5. It should further be borne in mind that the effects of slight injuries upon most tissues are generally rapidly effaced by physiological processes, and if an infective complication should arise therefrom, it should follow soon thereafter, and would be expected to pursue an acute course.