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GASTRIC DILATATION AND TETANY.

BY JOHN H. CUNNINGHAM, JR., M.D.,

OF BOSTON, MASS.

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GASTRIC DILATATION AND TETANY.

BY JOHN H. CUNNINGHAM, JR., M.D.,
OF BOSTON, MASS.

THE following case, which has been periodically under the writer's observation for the past twenty-five months, is from the service of Dr. Francis S. Watson of the Boston City Hospital, and to this gentleman I am indebted for the privilege of reporting it. The comparative rarity of this disease, the high mortality under medical treatment, and the good results derived from the few cases treated surgically, make this case worth recording.

Male; single; twenty-eight years old; born in Boston; a collector by occupation. He entered the Boston City Hospital on the medical service of Dr. Charles F. Withington, March 11, 1902.

Family History.—Father died of heart disease. Mother with cancer of groin. One sister living and well.

Past History.—Measles, whooping-cough, and scarlet fever in childhood. Indefinite history of rheumatism. Denies any venereal disease. No history of hæmatemesis could be obtained.

Habits.—Moderate use of tea. Occasional beer and whiskey. No coffee. No tobacco for past ten years.

Present Illness.—Since 1896 the patient has had attacks of vomiting without known cause, which lasted one or two weeks. These occurred at intervals of weeks or months. During the attacks there was a constant dull, heavy, epigastric distress. For the first day or two of the attack he could eat a little toast and tea for breakfast without vomiting, but any ingestion of food later in the day or attack would cause him to vomit. During the attacks he was always obliged to give up work on account of weakness, epigastric distress, and a sense of general ill being, and spent most of the time in bed. During these periods it has been his custom to eat very little.

The loss of weight following the attacks has always been evident to the patient.

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About six months after the beginning of the gastric disturbance the patient began to notice difficulty in distinguishing objects, both near and far. This gradually increased, so that three months later he was fitted with a pair of glasses by an optician. The glasses relieved this difficulty in great measure, but not entirely. During the attacks of vomiting it was with difficulty that he could distinguish the outline of objects, and later he could only distinguish light.

Between the attacks he could distinguish objects fairly well, and could read ordinary print. If, however, he left the glasses off, he immediately became nauseated and frequently vomited. This became so evident to him that he wore his glasses until getting into bed, when he placed them within reach and put them on immediately upon awakening in the morning.

During the interval between the attacks (usually four to eight weeks), he lived chiefly on soups, broths, and common proprietary predigested foods, and was able to do his duties as a collector.

On January 16, 1902, he began to have severe epigastric distress and belched more wind than previously, but passing wind by rectum was absent, as on all previous occasions. During the following two days he vomited everything ingested, which vomitus contained food eaten several days previously. Tingling of the hands, which he had noticed occasionally after vomiting, became more marked, and lasted about half an hour after each severe attack of vomiting.

On January 18, 1902, he was admitted to the Gouverneur Hospital of New York, where he remained fifteen days. He continued to vomit several times daily, and the vomitus occasionally contained "strings of blood." He was kept in bed and fed by mouth while in the hospital, and was discharged, being much relieved. Attempts at this time to pass a stomach-tube failed, and produced tingling in the hands and contractions of the fingers.

During the two months after his discharge from the Gouverneur Hospital, and previous to his entrance to the Boston City Hospital, the patient continued to vomit almost daily after the ingestion of food, which consisted, as before, of soups and broths. Tingling and numbness of the hands became pronounced.

The vomiting occurred about fifteen to thirty minutes after

eating. The vomitus was oftener larger in amount than the food ingested. It never contained blood, and was light colored and sour. He belched much sour, foul gas at all times.

He has been unable to work and has spent parts of each day in bed.

During the past two months the patient has lost thirty-five pounds by actual weight, and much in strength. He has been troubled with constipation for the past ten years, and previous to his first severe gastric disturbance had taken cathartics regularly.

There are no symptoms referable to the other systems.

Physical Examination.—A well-developed, poorly nourished man, pale and slightly anæmic. Not cachectic. Eyes: pupils equal, motions and reactions normal, four millimetres. Thick white coat on tongue. Breath foul. Throat slightly reddened. Neck normal. Pulse, equal, regular, fair volume and tension. Heart area; upper border, third rib. Right border, two and one-half centimetres to right, and left, ten centimetres to left of a median line. Apex impulse in fifth costal interspace. Action regular. Sounds clear. No murmurs. Lungs show good resonance respiration throughout without râles. Liver-dulness extends from the fifth rib to the costal margin. Edge not felt. Spleen area normal and organ not felt. Abdomen slightly retracted. Soft. Tympanitic. Moderate general tenderness. Contour of stomach could not be made out by percussion or auscultation. No tumors. Extremities normal without œdema. No enlarged lymph nodes. Knee-jerks, plantar reflexes, cremasteric and abdominal reflexes, equal and exaggerated. Temperature, 99° F.; pulse, 100.

Urine Examination.—High color. Sp. gr. 1032. Moderately acid. A slight trace of albumen. No bile or sugar. Urea, 2.2. Many hyaline and coarse granular casts.

During the examination the patient vomited thirty-two ounces of a sour-smelling, chocolate-colored fluid (color probably due to some chocolate drank just before admission to hospital). Vomitus contained no macroscopic blood and only an occasional blood-corpuscle microscopically. Total acidity, 0.48. Free HCl, 0.32. Lactic acid absent. Many sarcinæ and bacteria.

Immediately after the vomiting the patient had a typical

attack of tetany. The attack was equal on both sides. The thumbs were drawn in under the fingers, which were flexed at metacarpophalangeal joint, and very rigid. The wrists were flexed. The arms were flexed at the elbows and rotated inward so that they lay across the chest. The upper legs were in about one-half flexion and the lower legs in complete flexion upon the thighs. The flexions were strong, but both the upper and lower legs could be partially extended, the greater motion being in the hip-joint. The lips were firmly flexed, although not much drawn back, and the patient was unable to speak. The pupils were moderately contracted. The pulse rapid and high. The spasms lasted between two and three minutes, and were repeated several times at intervals of three to ten minutes, but were milder each time. Trousseau's symptom was present in both arms and to a less degree in the legs. Chvostek's symptom could not be satisfactorily demonstrated.

After the attack the patient complained of pain in the flexor tendons of both wrists, and said that he was conscious of what had taken place, but was confused in mind while the attack lasted. The hands remained numb for about half an hour.

A *test breakfast* three days after entrance showed a total acidity of .3 free HCl, 0.18. Lactic acid absent. No macroscopic and an occasional microscopic blood-corpuscle. Many sarcinæ and bacteria. The test breakfast was recovered by vomiting during an unsuccessful attempt to introduce the stomach-tube.

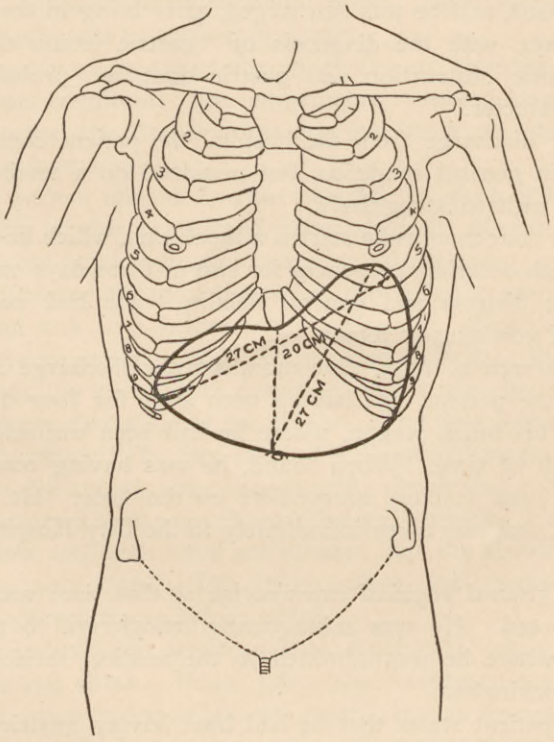
The patient was put on a liquid diet and always vomited within twenty minutes of ingestion. Between the ingestion of food he occasionally vomited an ounce or more of a viscid, whitish fluid not unlike mucus. He continued to belch wind, which together with the vomiting was little relieved by antifermentatives.

Five days after the first attack of tetany there was a milder attack following vomiting. The contractions were as previously noted, and lasted about two minutes, and the patient complained of numbness in the fingers, which lasted one-half hour, and during which time there was marked diminution in pain, temperature, and touch sense.

Two days later an unsuccessful attempt to pass a stomach-tube brought on an attack of tetany more severe than the previous and lasted eight minutes. The parts affected were as previously

noted. In this attack the toes were flexed onto the dorsum of the foot, and the tendons over the dorsum were prominent. The thighs could be extended at the hips with ease, but no passive motion could be produced in the knee-joint. The abdominal muscles were also very rigid. The knee-jerks, cremasterics, and abdominal reflexes were very lively throughout the attack. No

FIG. 1.



Percussion area after distention with tartaric acid and sodium bicarbonate before operation.

plantar reflex could be obtained, the toes remaining in strong flexion onto the dorsum of the foot. Passive motions and massage were very grateful to the patient.

The size of the stomach was determined by divided seidlitz powders with percussion. Areas as in diagram (Fig. 1).

Peristaltic waves were noted for the first time before and after the administration of the seidlitz powder. The waves ran

from the left to the right hypochondrium directly across the epigastrium.

Dr. Withington, feeling that the tetany was due to pyloric obstruction, had the patient seen by a surgeon, who advised operation, but as the patient had begun to take his food better he refused. Ten days after admission to the hospital the vomiting gradually diminished and the patient took nourishment better. He gradually improved in general condition as the vomiting and tetany ceased, and he was discharged, after being in the hospital twenty days, with the diagnosis of "gastric tetany dependent upon pyloric obstruction and gastric dilatation probably of a benign character."

After discharge from the hospital the patient continued to improve in general condition, but remained on a semisolid diet and took cathartics regularly.

After four months he started a lunch cart, which he was able to run, with occasional absences for two or three days on account of gastric distress and general debility. He had no further attacks of vomiting or tetany.

On March 2, 1903, nine months after discharge from the hospital, the patient, not having been seen for four days, was found in his lunch wagon, where he had been unconscious for this length of time. When found, he was having convulsions, and there was vomitus everywhere on the floor. He was unconscious, and was taken immediately to the City Hospital Relief Station.

The general physical examination at that time was as previously noted. He was subsequently transferred to the main hospital, where he was admitted to the medical service of Dr. E. W. Buckingham.

The patient states that he had been having gastric disturbance for several days and had occasionally vomited, following which he had twitching and numbness of fingers. The last he remembers was attempting to fill an oil-can, and when four days later he regained consciousness, he was in the hospital.

His vomiting subsided after transfer from the Relief Station, and he had no further attacks of tetany.

For aid in observing the case while on Dr. Buckingham's service, I am indebted to my friend, Dr. Fritz W. Gay, at that time House Physician to Dr. Buckingham's ward.

Test breakfast showed practically the same analysis as one year ago.

Blood Examination.—Leucocytes, 9000; reds, 4,900,000; hæmoglobin, 60 per cent.

The urine at this time gave evidence of more active renal disorder. It was pale. Sp. gr. 1011; strongly acid. Very slight trace of albumen. No bile. No sugar. Urea, 1.4. A few hyaline and fine granular casts with many small round cells adherent (renal). Many small round cells (renal). Small amount of fat, free and adherent to small round cells.

There were no symptoms subjective or objective referable to the renal condition. The temperature remained about normal, and the pulse was always below 100 and above 70, and of good volume and tension.

The patient remained in the hospital ten days, at the end of which time he was discharged, relieved of the immediate inconvenience, and again refusing operative interference.

On October 27, 1903, the writer was called to see the patient and found him in a severe attack of tetany. The contractions were more pronounced than in previous attacks. When lying on his side the knees were drawn up under the chin, the lower legs strongly flexed upon the thighs. The feet were flexed to their full extent. The face showed well-marked trismus and the angles of the mouth were considerably drawn out. The pupils were contracted and were about three millimetres. The muscles of the neck and back were not affected, but the abdominal muscles were very rigid. The arms, wrists, and fingers were in tetanic contractions as before noted.

The patient was semiconscious, understood what was said, but could not speak. Pulse, 126; poor volume and tension.

The attack lasted about one hour. It was learned that for the past week he had been vomiting after everything eaten, and had attacks of tetany several times daily, often lasting twenty minutes.

The patient was sent to the Boston City Hospital immediately, and was admitted to the surgical service of my former chief, Dr. Francis S. Watson, through whose courtesy I was able to follow the case.

The general physical examination was at first admission to the hospital, except that the patient's condition had failed con-

siderably. The outline of the stomach was visible in the epigastrium, and the greater curvature was visibly distinct at the level of the umbilicus without any dependent area of dulness or clapotage. Peristaltic waves were visible, running from left to right over the stomach area. These peristaltic waves could be made more evident by placing a cold hand over the epigastrium or flicking it with a towel wet in cold water.

Urine examinations as previously noted on Dr. Buckingham's service.

The patient complained of much pain in all the parts involved in the tetanic contractures for hours after they had ceased.

His condition began to improve twenty-four hours after admission to the hospital and the tetany and vomiting became less. Trousseau's symptoms could always be produced by a moderate degree of pressure over the brachial plexus and vessels several minutes after the contractures had subsided. Chvostek's symptom became evident about the mouth by a tap with the finger over the course of the facial nerve, and could be produced in a less degree in the extremities by taps over the respective motor nerves. The temperature, as on previous stays in the hospital, continued normal.

Operation two days later by Dr. Francis S. Watson.—After etherization a stomach-tube was passed for the first time, and the stomach thoroughly washed with normal salt solution, removing much dark, turbid fluid, and without producing tetany. All previous attempts to pass the stomach-tube had failed; the patient vomiting violently and immediately developing well-marked tetany, although on no occasion did the tube pass more than halfway to the stomach.

Through a median incision the stomach was found considerably enlarged; the walls thin and atonic, and the vessels much dilated. The right kidney was not abnormally situated or mobile.

The stomach surface was negative except at the pylorus, where palpation showed there was thickening and induration. The surface was smooth, without adhesions, and gave no visual evidence of a pathological condition other than thickening at the pylorus.

A posterior gastrojejunostomy was performed, observing the point urged by Mayo, viz., that of attaching a loop of jeju-

num to the most dependent portion of the greater curvature. The communicating openings were made at least three inches in length.

The incision was closed without drainage and united *per primam.*

Course of Case following Operation.—The patient was put on rectal feedings and received only warm water, in two-drachm doses by mouth for three days, after which time broths were given in increasing amounts and the rectal enemata were gradually omitted, so that on the fifth day following the operation the patient was on a liquid diet.

The wound healed by first intention and the stitches were removed on the tenth day.

The convalescence was uneventful, the temperature and pulse remaining normal at all times. The patient relished the liquid diet, which was gradually increased, so that twelve days after operation he was taking full hospital diet which included meat stews and potatoes.

From the time of operation on, he was free from all gastric symptoms, and relished full hospital diet, including steak, chops, and chicken.

He gained steadily in weight and strength. He was up on the twenty-first day after operation with a fitted abdominal swathe. Two days later he complained of pain in the left leg, and upon examination a phlebitis extending along the course of the long saphenous vein from the ankle to the groin was found. This subsided after two weeks' constant poulticing.

At the time of discharge from the hospital, seven weeks after operation, the patient expressed himself as being heavier and in better strength than he had been for fifteen years, but suffered the inconvenience of moderate swelling which persisted after the phlebitis.

The stomach area determined by percussion and auscultation at different times showed it to be much smaller than before operation.

Course of Case after Discharge from the Hospital.—Word occasionally received from the patient showed steady increase in weight and strength, with absolutely no return of gastric symptoms or signs of tetany. The bowels continued regular, one or two movements daily without the use of laxatives. The informa-

tion obtained in reference to diet showed that the patient was eating all sorts of food except pastry. The writer was, however, informed by his sister that the patient was very irregular about his meals, and ate everything, including corn beef and cabbage, mince and apple pie, and fruit in abundance. She also regretted that he chewed considerable tobacco and smoked much, but was pleased to note an entire change in the patient's disposition, which for years had been very disagreeable.

The swelling in the left leg following the phlebitis persisted, and the patient wore a silk rubber stocking during the day.

The patient was seen on January 6, 1904, nearly three months after operation, having gained twenty pounds in weight since his discharge from the hospital. His appearance was entirely changed, and there had been absolutely no gastric symptoms or signs of tetany. At this time he weighed 150 pounds. The patient stated that he was eating everything in large amounts and felt he could not get enough; his bowels were regular without laxatives, and he would be at work except for the swelling in the leg, which bothered him considerably, especially over the dorsum of the foot. He admitted eating pastry of all sorts and chewing tobacco, and said he smoked several pipefuls of tobacco daily and occasionally a cigar, but that he had used no liquor except a few glasses of beer.

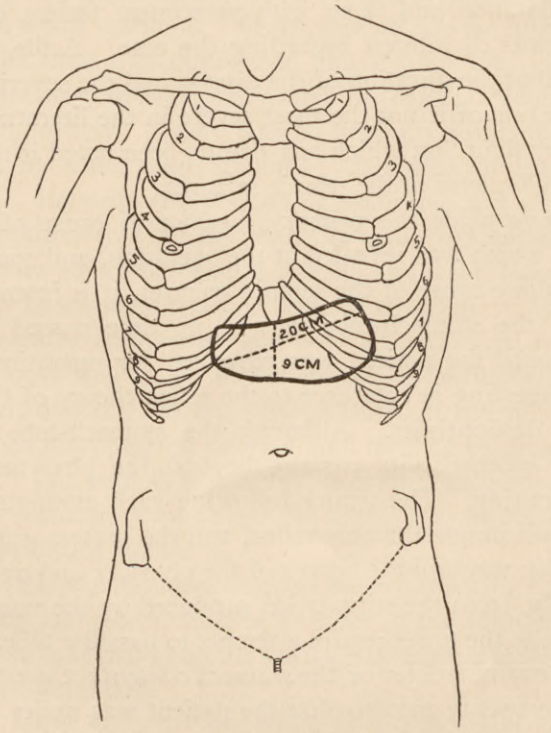
He expressed much gratification at the improvement in his eyesight, and said that he could distinguish objects and print now much easier without his glasses than he could before with them; and that he had not worn the glasses for many days without any of the gastric symptoms which used to follow when he left them off.

Divided seidlitz powders given at this time produced loud gurgling in the epigastrium and lower in the abdomen. The stomach area, percussed as quickly as possible, showed the area as in Fig. 2.

The patient expressed a sense of fulness in the epigastrium after the administration of the seidlitz powder, but this disappeared in less than three minutes. By comparison of Figs. 1 and 2, the relative size of the stomach before and after operation is certainly striking. The diminution in the size of the stomach, the gurgling and the quick disappearance of the sense of fulness, are good evidence that there is a large outlet between the stomach and the intestines.

Urine.—Color normal. Moderately acid, 1018. No albumen or sugar. Urea, 3.1. Sediment; occasional small round cells (renal). Cryoscopy, 2.10.

FIG. 2.



Percussion area after distention with tartaric acid and sodium bicarbonate three months after operation.

The patient has since been seen several times, the last occasion being on March 9, 1904, which is five months after operation. On this date he weighed 172 pounds. He has been absolutely without gastric symptoms or suggestions of tetany, and says, "I was never so well in my life." He is irregular in his meals, which consist of everything, and he uses alcohol in moderation.

The size of the stomach at this time was practically as at the last examination, which is recorded in Fig. 2.

The *urine* is normal in all respects, and a cryoscopic freezing-point of 2.9, and an urea elimination of 3.8 shows a normal renal function.

The long period of time which the patient has been under observation and his high degree of intelligence have helped the writer considerably in recording the case.

Beside presenting the typical picture of long-standing gastric dilatation and stasis with subsequent tetany, there are special points of interest regarding the case. Aside from remarking that the duration of the disease and the severity of the tetany are one of if not the most severe in the literature, nothing further than that which has already been noted is to be said about the character of the tetanic seizures.

Leaving aside the primary mechanical cause of the obstruction, which was revealed at the operation, and considering the immediate cause of the tetanic seizures, it is interesting to note that the stomach-tube was at no time passed into the stomach until the patient was etherized for operation. This fact is interesting in reference to the reflex theory of Germain-Sée and Berlizheimer. Although the stomach-tube did not reach the stomach, its passage beyond the pharynx caused severe vomiting. The tetany following such attempts to pass the tube was unquestionably reflex, and the spasms were due to reflex action through the nerves of the pharynx and œsophagus or, possibly, from the stimulation produced by the vomiting as a sequence to the unsuccessful attempts to pass the tube.

The examinations of the *stomach contents* at various times during the twenty months that the patient was under observation before operation show it to be light colored, always acid,—without macroscopic blood and only an occasional microscopic corpuscle,—sarcinæ and bacteria were usually numerous even with the acid reaction. The total acidity was never much increased over normal, which is also true of the free hydrochloric acid. Lactic acid was invariably absent.

By comparison of Figs. 1 and 2, showing the size of the stomach before and after operation, it is interesting to note the diminution in the size of the organ. It previously measured twenty centimetres in the median line and twenty-seven centimetres in its longest diameters; while following the operation its median dimension was nine centimetres and its longest axis twenty centimetres.

The *urine* examined during the attacks of vomiting and tetany showed marked concentration, which is in keeping with the observations of others. The color was always dark, the specific gravity high, moderately acid, and albumen was always present in small amounts. There was no bile or sugar at any time. The urea was diminished and hyaline and granulated casts were always present, and sometimes associated blood, renal epithelium, and fat. There was no difficulty in micturition, as described by some, and attributed to spasm of the bladder sphincter. Between the periods of vomiting and tetany, and after discharge from the hospital, the urine was passed in normal amounts, of normal specific gravity and color, less acid, and with only the slightest possible trace of albumen. The urea remained slightly diminished, and only an occasional hyaline or granular cast was to be found in the centrifugalized urine. Since operation the amount has remained practically normal, the albumen disappearing entirely, and rarely a hyaline cast can be found. The urea is eliminated in normal amounts, and the cryoscope freezing-point shows the kidneys to be secreting the normal amount of solids.

The interpretation placed upon the urine during the attacks of vomiting and tetany must be in favor of the supposition that some toxine is acting upon the kidney structure during the process of its elimination.

The *blood* examination while at the hospital showed a moderate secondary anæmia and slight leucocytosis, which, since discharge after operation, has entirely disappeared. It is to be regretted that cryoscopy of the blood, together with the urine, could not have been done during the attacks of tetany, and one is unable to remark upon Küssmaul's theory of concentration of the blood in this disease as the immediate cause of the tetany.

The *eyes* are of considerable interest, becoming affected early in the gastric disturbance (in 1896), causing him much inconvenience, and being a constant stimulus in producing vomiting and tetany whenever he attempted to go without his

glasses. Their improvement since operation is certainly remarkable.

The pupils during the attack were contracted, which is in accord with the observations of Bouveret and Devic, and contrary to those of Tresilian and Küssmaul.

It is unfortunate that no ophthalmological report of the eyes at an early stage is to be had. An examination by Dr. Myles Standish, of the Harvard Medical School, on January 14, 1904, is as follows:

Ophthalmological Examination O. U. V. = 20/100.
O. D. V. = 20/100 with +2.00+.50 ax. 90° v = 20/20.
O. S. V. = 20/100 with +2.00+.50 ax. 90° v = 20/20.
Near vision = Snellen type, 1.25 D.
Esophonia, 11°.

" In short, his ocular conditions are such that he maintains binocular single vision only with the greatest difficulty, and any disturbance which upsets his nervous balance would be likely to produce the symptoms of which he complained."

It is evident from Dr. Standish's examination that there are certain abnormal conditions of the eyes which have always existed independent of his gastric condition.

The patient's belief that his eyes are so much better is partially true, and is dependent upon his improvement in general health; the mechanical abnormalities of the eyes, however, still remaining.

The *motor aphasia* during the attacks and the comparatively slight involvement of the sensory speech area are certainly worthy of note.

The feebleness and rapidity of the *pulse* which has been noted during the tetanic spasms are confirmatory of the observations of others, and is explained by Dickson as being due to spasmodic contractions of the blood-vessels themselves.

The *temperature* remained about normal, but was more frequently below this point than above.

The *reflexes* were always normal in character but considerably exaggerated, and during the attacks those which were not involved to the degree of spasticity showed marked increase.

The reflexes three months after operation were all slightly exaggerated, but less so than at any time since the patient has been under observation.

Symptoms.—The symptom, tetany dependent upon gastric dilatation, and known as gastric tetany, is to be differentiated from the tetanic spasms occurring in gastro-enteritis, pregnancy, thyroidectomy, the puerperal state, acute fevers, and the carpopedal spasms associated with rickets; also from those produced from toxine substances, as in lead and morphine poisoning, etc.; and from the diseases of the nervous system, such as epilepsy, hysteria, and the definite lesions of the spinal cord, *e.g.*, syringomyelia. The epidemic form described by Frankl-Hochwart is apart from the subject, and is not to be considered.

Gastric tetany dependent upon dilatation of the stomach was recorded by Küssmaul only as far back as 1869. The tetany of gastric dilatation is usually dependent upon pyloric stenosis, subsequent dilatation and hypertrophy of the organ, and associated stasis and hyperchlorhydria. The pyloric obstruction is usually benign, due to cicatrization of a gastro-ulcer, and gives rise to a series of tetanic contractions which are fairly characteristic The obstruction may be malignant, as in the cases of Trevelyan, Bouveret, and others, or may be dependent upon pressure from other organs.

The attack of tetany most commonly follows severe vomiting, or less frequently after emptying and lavage of the stomach.

Usually the first symptom is pricking and numbness in the hands. This early symptom, as a rule, is of so little inconvenience to the patient that it is frequently overlooked unless the surgeon puts the question direct. Later in the disease there may be an aura of fatigue, and the attack is usually preceded by severe vomiting.

Tetanic contractions appear in the hands; the fingers being flexed at the metacarpophalangeal joint, and the outer phalanx usually extended. The thumb is adducted into the palm of the hand. The wrists are either strongly flexed or less frequently

extended. The lower arm is flexed at the elbow and rotated across the chest. The legs are flexed at the hips and knees; the ankles and toes flexed or extended. The face occasionally shows trismus, with the corners of the mouth considerably drawn out. Transitory blindness has been recorded by Küssmaul and Bouveret. The patient may remain conscious and quiet, motor speech being involved, or delirious with absence of sensory speech. The muscles of the neck, chest, back, and abdomen are less commonly involved. The limbs are sometimes tense and œdematous and the patient may be cyanotic.

The attacks last for a few minutes, occasionally or frequently repeated, or may even continue for days and weeks. These prolonged cases are almost invariably fatal.

The groups of muscles usually involved are in the order above stated.

Certain symptoms—Trousseau's, Chvostek's, Erb's, Hoffmann's—are usually present.

Trousseau's Symptom.—As the attack subsides, pressure over the principal nerve-trunk or blood-vessels, enough to impede the venous or arterial circulation, will reproduce the paroxysm.

Chvostek's Symptom.—A slight tap over the principal nerve, for example, the facial, will throw its muscles of distribution into spastic contractions, giving evidence of the increase of the mechanical excitability of the motor nerves.

Erb's Symptom.—A faradaic current applied over nerves and muscles shows great increase of electrical irritation.

Hoffmann's Symptom.—Slight pressure over the sensory nerves gives evidence of their increased excitability as shown by parasthesia in the region of their distribution.

After the attack has passed off, great pain is experienced in the parts involved, and massage and passive motions are very grateful to the patient.

Tresilian reports a case in which blindness lasted for three days, associated with aphasia for one day. Küssmaul records a similar case. These men record the pupils as widely dilated and

not reacting to light during the attack, while Bouveret and Devic record the pupils as usually contracted.

Etiology.—Küssmaul, Germain-Sée, Berlizheimer and others, Bouveret and Devic, have presented the most probable theories, based upon experiments, to explain the cause of gastric tetany.

Küssmaul's Theory.—This theory considers the loss of fluid from the tissues of the body to be produced by increased secretion of the gastric mucosa, frequent vomiting, and the inability of the tissues to regain sufficient fluid by absorption from the gastro-enteric tract. To support this theory he parallels the contractures in cholera, which he considers also due to concentration of the blood by loss of its fluid in the stools, but now known to be due to the toxines absorbed from the intestinal canal. Without explanation, he believes that the inspissated blood affects the motor centres of the nervous system.

Fleiner and Jürgensen state that there is diminution in the amount of the blood serum, and, therefore, a fall of blood-pressure is probable. Other investigators have failed to find diminution in the amount of the blood serum. This theory, *per se,* has few adherents, but very likely remains as a casual factor.

Germain-Sée, Berlizheimer.—These men, together with Müller, Collier, and others, have explained the tetanic spasms as being reflex action produced by stimulation of the sensory nerves of the stomach. Certain facts are given in proof of this theory, namely, the usual onset of the tetany following an attack of vomiting or passage of the stomach-tube. Albu states that the stimulation of the sensory nerves of the stomach is not the underlying factor, but only the momentary cause of the spasm. As an analogy he cites strychnine poison in the frog and tetanus in man, in which conditions convulsions are produced by irritation of the nerve ending in an already existing pathological condition.

Bouveret's and Devic's Theory.—This theory is dependent upon the belief of auto-intoxication due to prolonged and ab-

normal chemical processes of digestion in certain cases of gastric retention and hypersecretion.

Bouveret and Devic, in three cases of tetany with gastric dilatation, isolated a substance, soluble in alcohol, from the stomach contents which was closely allied to syntonin, and identical with the peptotoxine of Brieger. This substance when injected into the circulation of animals produced general convulsions. Frankl-Hochwart, however, state that these cases were never proven to be gastric tetany, as the symptoms of Trousseau, Chvostek, and Erb were all absent.

Following this experiment, Albu, Gumprecht, Landsteiner, Blazicek, Berlizheimer, Von Jaksch, and Dickson failed to produce tetanic convulsions by injecting untreated gastric contents into animals.

Bouveret and Devic admit that a new substance is produced in the extraction of the toxine by alcohol which does not pre-exist in the gastric contents.

Elaborate chemical experiments by Halliburton and McKendrick further complicate this theory and make it so speculative that it cannot readily be accepted. The employment of alcohol by Bouveret and Devic may in itself have been the cause of the convulsions produced.

Dickson, in experiments by subcutaneous injections into rabbits and guinea-pigs with the following solutions of untreated stomach contents, removed from a patient three days after the onset of the tetany, failed to give any evidence of convulsions or paralysis.

1. Filtrate of unaltered stomach contents.

2. Filtrate of stomach contents evaporated to dryness, *in vacuo,* over strong sulphuric acid at a temperature of 40° C. and extracted with normal saline solution.

3. Filtrate of stomach contents evaporated as in No. 2; extracted with alcohol, again evaporated to dryness, and then extracted with normal saline solution.

Hyperchlorhydria and sarcinæ have been present in the great majority of all cases reported. None of these, however, can alone justly be considered as the etiological factor.

No one of the three theories presented can be considered as embodying the true cause of the contractions; and it may even be doubted if the three together cover all the etiological elements involved in this disease.

The third theory, that of auto-intoxication, is, however, most in keeping with the known conditions in other diseases, and is the one usually accepted.

Albuminuria has been an almost constant symptom in the reported cases of gastric tetany, although post-morten findings have failed to give evidence of renal disorder. The albuminuria is probably due to the elimination of concentrated toxic elements, and cannot in any way be considered an etiological factor, as renal symptoms have been consistently absent. Diminution in the amount of urine has been almost constant, and has been invariably concentrated with evidences of lessened metabolism.

Local Conditions.—Post-mortem and operative examinations show ulcers in various stages of cicatrization, most commonly in the duodenum as reported by Bamberger, Renbers, Dujardin-Beaumetz, and others. Less frequently both in the duodenum and stomach as reported by Moynihan, Loeb, and Neumann. The reported cases of Trevelyan, Bouveret, Devic, and Riegal show malignant disease of the pylorus to be a fairly common factor in producing gastric dilatation and subsequent tetany. The pyloric obstruction is occasionally produced by pressure from growths in or abnormal positions of, certain organs in the abdomen, for example, the right kidney.

Blazicek records a case in which the dilatation was dependent upon a large gall-stone. Berlizheimer's case showed the obstruction to be due to pressure from a pancreatic cyst upon the duodenum. A case of hour-glass stomach producing gastric tetany is reported by Müller.

Prognosis.—Statistics by various authorities show that the prognosis is very grave. The mortality is high, and recovery without operation is comparatively rare.

The fatality of the recorded cases is startling. Series of cases by different authorities are as follows: Frankl-Hochwart,

eleven cases, ten died; Bouveret and Devic, twenty-three cases, eighteen deaths; Albu, forty cases, thirty-one died; Riegal, twenty-seven cases, sixteen deaths. The mortality figured from these cases and as stated by other authorities is between 70 and 80 per cent., and nearer the latter than the former.

The etiology of the obstruction, although the primary cause, plays a minor part in the gravity of the prognosis; the real pernicious factor probably being that unknown factor which is the immediate cause of the tetany.

It is the rule that death occurs sometime after the tetanic seizures have become well developed by failure of the patient to respond to treatment. However, Marten and Trevelyan each report a case which proved fatal within a few hours of the first attack.

Besides the serious danger of the patient's dying during the actual attack of tetany, there is always the probability of its recurrence and certainty of ultimate death.

Treatment.—Until recent years the treatment of gastric tetany has been entirely medical, and as yet the number of cases treated surgically is perhaps too small to admit of just comparison. However, the relatively large number of cases treated medically show a mortality in the vicinity of 80 per cent., while, so far as the writer can find from a careful search of the literature, the surgical cases show a mortality of 37.5 per cent.

The medical treatment is directed towards emptying the stomach of its residuum and keeping it so; thereby eliminating whatever toxic substances may enter the circulation or cause the tetany from this source; and also to thus improve the tone of the stomach and the motor insufficiency.

At the onset of an attack of gastric tetany the organ should be emptied by an emetic or, if possible, the stomach-tube. Even after the vomiting which frequently precedes the attack considerable putrefying material will still remain in the stomach. Trousseau found that ice applied over the spine was beneficial in some cases. Others advocate placing the patient in a tepid bath just as soon as the spasms begin, and, if the case is not chronic, to continue the baths three or four times daily, at a temperature

of 30° C. Sedatives, usually the bromides, and also morphine, are to be administered during the attack; and if the paroxysms occur frequently, sedatives are to be continued with regularity. It is a question, however, if any drug diminishes the violence or frequency of the spasms. It may be found an advantage to keep the patient on rectal feedings as long as the vomiting persists, and lavage should be carried on in those cases in which it is possible.

Between the attacks thorough lavage is to be practised often enough to remove the stomach's residuum and to prevent putrefaction. A small, easily digested diet should be given and strict attention must be paid to keeping the bowels open. Also the general health and hygienic surroundings of the patient must receive careful attention.

Various solutions have been advocated as the medium with which to cleanse the stomach; chiefly mild antiseptics. That adopted by Professor Greenfield is, perhaps, the best known. By means of the stomach-tube he empties the organ and cleanses it thoroughly with a solution of sodium phosphate, two drachms to the pint, boric acid, or Condy's fluid. He then leaves in the stomach a solution of sodium phosphate, two drachms to the pint of hot milk.

Medical treatment undoubtedly does much to aid the patient through the immediate attack. How much it improves the tone of the stomach, lessening the motor insufficiency and overcoming the stasis, is questionable; and it is certainly true that the underlying factor, the mechanical obstruction, which causes the dilatation, cannot be overcome in this way and still remain.

Even relieved of the symptoms the patient is still an invalid, with the chances of an early recurrence and unfavorable prognosis regarding life constantly before him.

In view of the improvement in the technique of gastric surgery, the brilliant results obtained in the last cases in the small series which have been operated should necessarily make surgical procedures in this disease more common in the future than in the past. With the exception of Mayo Robson's cases, in which the duration and severity of the tetany is not minutely

recorded, but may have been present for some time, all the patients were in the *extremis* of the disease.

In all the cases operated upon, gastric dilatation with obstruction of the pylorus dependent upon some definite lesion was found. Although the writer, with others, believes that practically all cases of gastric dilatation, motor insufficiency, and stasis unrelieved by medical treatment should be operated upon, one must insist that those cases which develop tetany as a sequence should be operated upon immediately following the onset of such symptoms. The mortality of about 80 per cent. in the cases of tetany treated medically show that the disease is a very serious one.

Whatever may be the especial cause or effect upon the general system by the symptom, gastric tetany, is speculative; yet it is certainly severe and much more serious than gastric dilatation alone, from whatever cause. The primary underlying factor is pyloric obstruction; the inability of the patient to hold the proper amount of nutrition in the stomach; or, if able to retain the sufficient nutrition, the inability through motor insufficiency to force it into the intestines because of the small lumen of the pylorus.

The pyloric obstruction, if sufficient to cause dilatation, motor insufficiency, and stasis, and to produce gastric tetany, is too serious a condition to be overcome by medical treatment, and operative interference is necessary to establish a sufficient outlet of the stomach into the intestines.

Gastro-enterostomy, pylorectomy, and pyloroplasty are indicated. In view of the statistics of Robson, Mayo, and Munro, regarding these operations in benign cases, the procedures in themselves are shown to be accompanied by a surprisingly small mortality.

One hundred and one gastro-enterostomies by Mayo Robson show a mortality of 3.9 per cent. and twenty cases of pyloroplasty, twenty recoveries. To quote from Mr. Robson regarding the mortality of his cases of gastro-enterostomy: "Death was due to the extremely low vitality at the time of operation."

In 168 cases of gastro-enterostomy performed by Mayo, 157 recovered and eleven died, a mortality of 6.5 per cent.

Munro, of Boston, in personal conversation, stated his recent figures of gastro-enterostomy as twenty-five recoveries and two deaths, both deaths being due to disease foreign to the operation. These figures show that the operation in itself is not to be feared, and it is a general surgical belief that, if the cases could be subjected to operative treatment before the patient is practically starved to death by lack of intestinal absorption, the mortality would be even lower.

The surgical cases are so few in number and so concisely recorded that the salient points of each case are given below.

CASE I.—Mayo Robson.—Man; thirty-four years old; suffering five years with epigastric peristalsis giving the ordinary picture of pyloric obstruction. For some time before the operation he had "cramps" in his limbs, especially the legs. While in the hospital, just before operation, he had a severe attack of tetanic spasm described as follows: "affecting almost all the muscles of the body." "So extreme were these and so widespread, the muscles of the trunk and of the cervical region, as well as those of the limbs being affected, that the question of poisoning by strychnine was raised."

Operation seven days later; pyloroplasty. "The obstruction was found to be cicatricial stenosis with hypertrophy of the pylorus." The convalescence was uneventful. Mr. Robson states that in a letter from the patient four years later, he expressed himself as a "new man," and had been without recurrence of the "cramps."

CASE II.—Man; twenty-four years old. Mr. Robson records the gastric condition and the symptoms of tetany as follows: The patient had "severe painful cramps of the extremities and abdomen with persistent vomiting." "He gave a history of having had pain after food for several years previously and to have vomited blood, since which time he had never been well and had gradually lost flesh." "For some little time before I saw him he had vomited every day unless the stomach was washed out."

Operation.—Pyloroplasty. "The pyloric orifice would only permit the passage of a No. 10 catheter." Diagnosis. "Simple stricture of the pylorus." The recovery was uninterrupted. Mr. Robson states that a letter received from the patient one year later stated that he had had no further trouble with his stomach.

CASE III.—Mayo Robson.—Woman; twenty-nine years old. This patient had suffered severe abdominal pain associated with vomiting and loss of weight for seven years. At the end of six years operation was advised and refused. No record of tetany appears up to this time. One year later the patient returned, and Mr. Robson's record at that time is

quoted as follows: "The pain in the abdomen was excruciating and occurred every day." "She said it was associated with severe cramps in the legs and thighs, and at night she was kept awake by the pain." "Vomiting of large quantities occurred daily and she was steadily losing weight and strength."

Operation.—"Active ulceration of the pylorus, which was adherent to the gall-bladder, liver, and abdomen walls, and was so much thickened as to form a distinct tumor." "Pyloroplasty was performed after the adhesions had been separated." "Recovery was uneventful." A report sent to Mr. Robson a little over three months after operation stated that "she had gained flesh and was well."

Seven months after operation the patient began to have stomach symptoms, but with little loss of flesh. The record shows that, beginning two years after operation, "the vomiting and loss of flesh and well-marked stomach splash showed that the pyloric trouble had recurred, and, as I found a distinct tumor of the pylorus which I believed to be simple inflammatory induration, I performed a gastro-enterostomy."

A letter one year later states that the patient was well and had regained her weight. There were no returns of the painful cramps from the time of the first operation.

CASE IV.—Fleiner.—Lacks details of conditions found at time of operation, which was a gastro-enterostomy. The patient showed no untoward symptoms for the first four hours, then became restless, and two hours later died with symptoms of collapse. The autopsy showed round-cell sarcoma of the pylorus, excessive dilatation of the stomach, and extensive degeneration of the parenchyma of the heart, the kidneys, and the liver. The gastro-enterostomy wound and the local operative conditions showed nothing that would have entered as a factor in the fatal result.

CASE V.—Fleiner.—Operated in the Clinic of Czerny of Heidelberg. On this case a pyloroplasty was done. The condition found at the time of operation was a benign constriction of the pylorus and dilated stomach. The pyloric stenosis was referable to a foregoing duodenal ulcer, which had healed, and from which there had resulted numerous adhesions between the pyloric region, the liver, and the gall-bladder, while between the appendix and the gall-bladder there was a separate set of adhesions which had probably resulted from appendicitis of many years before. The adhesions about the pyloric end of the stomach were divided and pyloroplasty was performed.

The patient died ten days later. Autopsy showed: Pneumonia; pleurisy; purulent peritonitis over the cardiac end of the stomach, and acute parenchymatous nephritis.

CASE VI.—Gumprecht.—In this case the duration of the tetany was of long standing.

Operation.—Pyloric resection. The pylorus was broadened and thickened, and gave evidence of stenosis from an old ulcer. The lumen would

admit a lead-pencil, but the finger could not be introduced into it. The patient died in five days of general peritonitis.

CASE VII.—This case, which has been beautifully reported by W. C. Carnegie Dickson and later operated upon by Mr. Caird, is one of the most brilliant of the recorded cases.

Man; forty-seven years old. Gastric disturbance for sixteen or seventeen years, during the latter part of which time he had had four or five attacks of tetany. The stomach was much enlarged, and had a considerable residual of old putrefying food. The attacks of tetany and observations while in the hospital are recorded with great care and minuteness, and the reader is referred to Mr. Dickson's own descriptions for details.

The patient was at times *in extremis*. He, however, gradually improved, and left the hospital three months later, relieved of his vomiting and tetany.

After three months his gastric symptoms began to return and he lost considerable weight. He returned to the hospital and Mr. Caird did a gastrojejunostomy. "The pylorus was found to be greatly narrowed and somewhat thickened and hypertrophied, and at its upper and posterior part there were firm, puckered, cicatrical adhesions to the surface of the gastrohepatic omentum, while similar old peritonitic bands were also found between the lower and anterior aspects of the pylorus and the adjacent surfaces of the great omentum."

The recovery was uninterrupted, and at the time of Mr. Dickson's article in 1901, several months after the operation, the patient was perfectly well, eating and doing everything and enjoying life in every way.

Analysis of the Operated Cases.—Without going into details, this series of eight operated cases shows three deaths, two of which were due to complications incident to any abdominal operation, and the third, collapse, attributed to the very low vitality of the patient at the time of operation.

In conclusion, the writer wishes to express his appreciation of the courtesies extended by Drs. C. F. Withington and E. W. Buckingham by placing the records of the case, while on their services, at his disposal.

The history of this case while on Dr. Withington's service has been recorded, with other forms of tetany, in a paper by Dr. Lawrence W. Strong.

A complete bibliography is not given in detail, as many of the references recorded include the remaining articles upon the subject of gastric tetany.

The most complete bibliographies are to be found under

the references of the following men: Risien Russell, Trevelyan, Souttar McKendrick, and Halliburton and McKendrick.

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