

neal reflexions. The appearance of a band will warn the surgeon which way *not* to cut. 2. The bowel was empty. It is difficult to roll an empty colon on its long axis so as to bring a band into view if the gut be exposed midway between the peritoneal reflexions. 3. The bowel was closely attached to the back of the abdomen. The attachment of the descending colon to the abdominal parietes varies greatly in different subjects. Sometimes the amount of fat between the quadratus lumborum will be very great, while again it may consist of but a thin layer; I have never found it entirely absent. I am inclined to think that the relation between the descending colon and quadratus lumborum muscle is more constant when the bowel is empty rather than when it is distended. My observations on this point are, however, but few in number, and very inconclusive. In Case I. the peritoneum was cut down upon, but avoided. Two anatomical peculiarities enabled me to recognize this membrane when my knife approached it: 1, a sudden increase in the density of the connective tissue, and at the same time there came into view, 2, a plexus of fine vessels, bleeding freely at a touch of the knife. I had been previously dividing, of course, the subperitoneal fat, and the change in tissue was marked. The relation between the colon and the kidney is worth noting, for the kidney can always be felt through the subperitoneal fat as soon as the muscles are divided.

It is scarcely necessary to call attention to the very great relief experienced by the two patients recorded, after the operation, and urge that recourse be had to colotomy in certain affections of the lower bowel, where, while we cannot cure, we can give relief from intense suffering with but moderate risk.

ARTICLE XI.

THE TREATMENT OF TRAUMATIC TETANUS BY HYDRATE OF CHLORAL. By
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NOTWITHSTANDING the great advances made in modern therapeutics, traumatic tetanus, as few other diseases, continues to baffle surgical skill as it did in times long gone by, and annually carries numberless victims to the grave. For this not uncommon disease almost every remedy has been tried and found wanting, and it remains for the future to show us some cure that will relieve the unfortunate patients attacked by this destroyer of life. Much has been said of late as to the efficacy of chloral in cases of traumatic tetanus, and it is my intention to add to the literature of the subject a few cases in which cure, whether as a direct result of the treatment or not, certainly took place during the administration of this drug.

The prognosis in traumatic tetanus may be looked upon as always unfavourable.

vourable, for Gross says that the chances of effecting good "when the malady is fairly established are very slender in any case, however mild."¹ In Holmes's *Surgery* this sentence occurs: "In acute traumatic cases the prognosis is most unfavourable, and there is scarcely a well-authenticated instance of recovery on record."² Such being the character of the disorder with which we have to grapple, it must be acknowledged that to a remedy under which several successive cases recover there must be accorded a certain modicum of honour.

Dr. J. R. Beck has collected³ 36 cases of traumatic tetanus treated essentially by chloral, in which a recovery took place in twenty-one instances; while Dr. H. C. Wood has tabulated⁴ 18 additional cases resulting in 9 recoveries and 9 deaths. In the *Practitioner* for November, 1872, Dr. Macnamara, of Calcutta, gives his experience in tetanus among the natives, and says that he treats them by giving forty grains of chloral at bedtime, and by providing proper diet of a nourishing kind. In severe cases an additional thirty-grain dose is given at midday. Out of 20 successive cases 17 recovered. Though these cases were probably idiopathic in many instances, the testimony is nevertheless valuable. Within a few years the medical journals have been constantly reporting cases of recovery from tetanus under the use of chloral, but isolated cases have their value diminished because the fatal cases are not so likely to appear in print. Nevertheless the fact remains that many cases of traumatic tetanus have recovered while such treatment has been employed. The drug has been introduced into the system by various channels; M. Oré has treated cases of tetanus, though, I believe, unsuccessfully, by intravenous injections of hydrate of chloral;⁵ while success has followed its administration hypodermically in acute traumatic tetanus,⁶ and it is stated that a case recovered where chloral in conjunction with bromide of potassium was given by enema.⁷ Dr. Agelastos, of Bucharest, believes that he prevents the occurrence of locked-jaw in traumatic cases by the timely employ of chloral.⁸ Verneuil says that chloral allays the muscular contractions, and especially those of the respiratory apparatus, which in the last stages of the disease cause asphyxia; and that it changes the acute into the chronic form of the disease. He gives instances of cure where the patients took 100 grains and 245 grains daily without any bad symptoms. The first of these tetanic patients recovered after thirty days, having been given \mathfrak{z} vj of chloral during that space of time.⁹ Hence it is seen that there is a good deal of evidence supporting the theory of the efficacy of this drug in the treatment of tetanus.

¹ System of Surgery, vol. i. p. 644.

² Vol. i. p. 327.

³ St. Louis Medical and Surgical Journal, June, 1872.

⁴ Treatise on Therapeutics, pp. 292-293.

⁵ Practitioner, August, 1877.

⁶ American Journ. of Med. Sciences, April, 1877, p. 534.

⁷ Hospital Gazette, New York, April, 1877, p. 15, from London Lancet.

⁸ New York Med. Journ., April, 1877, p. 436.

⁹ New York Med. Journ., 1876, p. 97.

While having charge, as Resident Surgeon, of Dr. R. J. Levis's ward of the Pennsylvania Hospital, I had the care of four cases of traumatic tetanus, all of which were treated by Dr. Levis with hydrate of chloral; of this number three recovered, and one died. On looking over the Hospital Notes from April 1, 1873, to April 1, 1877, a period of four years, I find nineteen cases of traumatic tetanus treated. Of these patients 16 died and 3 recovered, which were the three cases mentioned above as treated successfully by chloral. Below is given a schedule of the cases with an epitome of the treatment. Some of them were given tonics and stimulants in addition, but, in order to avoid complication, the treatment directed especially to the tetanic symptoms is alone mentioned.

Cases of Traumatic Tetanus occurring in the Pennsylvania Hospital from April 1, 1873, to April 1, 1877.

No.	Month of occurrence.	Sex.	Age.	Injury.	Treatment.	Day death occurred after advent of tetanus.	Result.
1	May 1873	M.	24	Lacerations of scalp and knee, hurrowing of pus	Morphia	2d	Death.
2	June 1873	"	31	Amputation at shoulder, erysipelas	Conia	3d	Death.
3	June 1874	"	27	Burns of face, neck, arm	Atropia, ¹ Emplastrum conii to hack	8th	Death.
4	July 1874	"	19	Amputation of arm for gangrene from injury	Atropia, Tr. of belladonna	4th	Death.
5	July 1874	"	10	Fracture of femur and forearm, lacerations	Atropia, Tr. of cannabis Indica	7th	Death.
6	Aug. 1874	"	15	Laceration of hand	Opium, Tr. of physostigma	10th	Death.
7	Oct. 1874	"	47	Railroad crush of thigh	Opium, commenced before tetanus occurred	3d	Death.
8	Sept. 1874	"	19	Gunshot wound of arm	Chloral		Recovery.
9	Nov. 1874	"	5	Burns of body and arm	Chloral	7th	Death.
10	Nov. 1874	"	7	Fracture of arm, laceration of thigh	Opium, Bromide of potassium	3d	Death.
11	Nov. 1875	"	35	Compound fracture of elbow (resection)	Chloral	4th	Death.
12	Nov. 1875	"	45	Lacerated and contused finger (admitted with tetanus)	Chloral		Recovery.
13	Nov. 1875	"	12	Pirogoff amputation (primary)	Opium, Calomel, Conium	2d	Death.
14	Feb. 1876	"	21	Gangrene from railroad contusion of the knee	Opium, Atropia	2d	Death.
15	July 1876	"	57	Pirogoff amputation of foot (secondary)	Chloral(?)	(?)	Death.
16	Jan. 1876	"	11	Railroad crush of feet	Opium, Atropia	6th	Death.
17	Nov. 1876	"	20	Gunshot wound of axilla	Chloral		Recovery.
18	May 1876	"	22	Amputation of leg for necrosis of ankle	Atropia, Morphia, Bromide of ammonium	4th	Death.
19	Sept. 1876	"	21	Burns of arms and face	Morphia, Chloral on last day	2d	Death.
Total—Deaths 16, Recoveries 3.							

In this table there are nineteen cases, and in six of them chloral constituted the treatment of the tetanic complication, while in No. 19 it was commenced a short time before death. The 3d case is not considered an instance of chloral treatment, because the evidence seems to show that the

¹ In this case chloral is mentioned as the treatment on the first day, but no note regarding it follows; hence it was probably suspended as the other drugs were employed.

other remedies were those directed for the cure of the disease, and that chloral was administered incidentally only at the beginning of the symptoms of tetanus. It is of course understood that some of these cases were of the most severe type, while others were much milder; but the fact is that only three of the 19 cases recovered, and that these were treated with chloral. One and perhaps two of those who recovered would be considered severe cases, while the other was of a mild subacute form; but it is impossible at this late date to say how many of the fatal cases were instances of mild traumatic tetanus. Again, it is impossible to determine in how great a degree the chloral may have assisted in preventing much more severe paroxysms than actually occurred in the cases in which it was employed. I shall give the full notes of the four successive cases treated in Dr. Levis's ward, in order that the character of the disease in each instance may be fully appreciated; for it is not to give undue credit to chloral that this article is written, but to show that in a series of cases treated by various drugs the patients who recovered were each treated by chloral. Hence if those to whom other remedies were administered died without exception, would it not be well for the profession generally to give hydrate of chloral a thorough trial in traumatic tetanus? It at least can give no worse results than other remedies, and really seems to give promise of affording better.

CASE I.—The first case, which was reported in the *Phila. Medical Times*, Dec. 12, 1874, was a boy aged 19 years, admitted September 26, 1874, who was injured while gunning by the load from a fowling piece, tearing away the inner side of the left arm and forearm, for about six inches. The shot and wadding were buried in the tissues, which in a few days assumed an erysipelatous condition, so that the limb became exceedingly swollen, and gave the patient a great deal of pain. The treatment adopted was tonics internally, and local applications, first of carbolized oil, later of lead-water and laudanum; while free exit was given to the foreign material which was being discharged from the wound. On the 14th day, tetanus developed with the characteristic physiognomy, the stiffness of the jaws, and the rigidity of the abdominal muscles. These symptoms were followed by pain in the cervical and dorsal regions, opisthotonos, spasms of the muscles of mastication with laceration of the tongue, and retention of urine. He could scarcely separate his teeth, and was fed on liquids exclusively. At the onset of this complication chloral was prescribed in ten-grain doses every two hours, with occasional doses of morphia when the pain was very severe. The object was to keep the patient thoroughly under the influence of chloral and induce sleep, hence the dose and interval of administration were varied according to indications. The average amount received by the boy during twenty-four hours was one hundred grains. Four days after the advent of tetanus, the arm was laid open with the bistoury and the intermuscular spaces torn up with the finger, to relieve tension, and to remove any portion of clothing or shot that might be imbedded in the wound. The limb was then dressed with a flaxseed poultice. Subsequently, amputation was discussed, but deemed inadvisable at such a length of time after the onset of the tetanic symptoms. The treatment by chloral was steadily continued, and after the lapse of ten weeks the patient was enabled to leave

his bed cured. On account of the original injury to the arm, which had not cicatrized, he was not discharged until nearly two months later.

CASE II.—J. P., aged 35, while working in a cellar was buried beneath a portion of falling wall, and sustained a compound fracture of the right olecranon with such laceration of the soft parts that the end of the humerus and the ulna protruded. He also received a simple luxation of the ankle. On admission, he was suffering severely from shock which precluded any operation at the elbow, though, of course, the dislocation at the ankle was immediately reduced. He reacted slowly and pretty well, and on the fifth day resection of the elbow-joint was performed in the ordinary manner. During this time he had been taking stimulants and quinia, and after the operation tincture of the chloride of iron was added. The following evening trismus was observed, and he was immediately placed upon ten grains of chloral every two hours, with a very occasional hypodermic of morphia to relieve pain. The arm, being swollen and discharging freely, was dressed with carbolic acid. The cervical and abdominal muscles were rigid, and the patient at times could scarcely separate his teeth. The day before his death his pulse was 140, respiration 36, temperature 100.8° , and the patient was delirious. The fatal issue occurred on the fourth day after the resection, or the ninth after the receipt of injury; the patient dying, not in a state of spasm, but from gradually increasing exhaustion. The spinal cord was examined after death by Dr. Longstreth, who found the vessels extremely full, almost no fluid in the arachnoid space, slight adhesions between the arachnoid and dura mater, and no evidence of lymph. The cord itself seemed rather lacking in firmness. The severity of the injuries in this case, as evinced by the tardy and somewhat imperfect reaction, render it probable that recovery would have been doubtful, even if tetanus had not supervened.

CASE III.—This patient was admitted after the tetanic spasm had shown itself subsequently to the injury. C. K., aged 45, an ironworker, had, ten days previous to his admission, received a contusion and laceration of the end of the second finger of the right hand, by having it caught under an anvil. The injury had evidently not been severe, for no fracture of the phalanx had occurred, and the laceration of the soft parts was nearly healed when he came to the hospital. Four days previous to this time there was noticed stiffness of the masticatory muscles, and he then found that he had locked-jaw. When he was examined, it was found that the wound was not entirely cicatrized, though it was apparently an insignificant injury. His teeth were tightly closed, and the tongue had been bitten a number of times by the involuntary snapping together of his teeth. There was no stiffness of the posterior cervical muscles. Fifteen grains of chloral hydrate were ordered to be given every hour. The patient was admitted on the evening of November 18, 1875. The following day there was noticed rigidity of the abdominal muscles, which was well marked; but there had been some relaxation of the spasm of the masticatory muscles. The finger was dressed with extract of belladonna, and the chloral administered in doses of ten grains every two hours. On the 21st, it was noted that there was post-cervical rigidity, and that the patient had had a severe spasm in the latter part of the day. He was always rigid, but at times there was an increase of the muscular spasm as is usually the case in tetanus. Accordingly the drug was increased to gr. xv every two hours, day and night; which gave him 180 grains in the 24 hours. This was continued for four days, when the period between the doses was increased to three hours.

Nine days later the chloral was reduced to the small dose of ten grains, three times daily. The patient was improving during this time, as shown by the greater infrequency of the clonic, and the less severe character of the tonic spasms. The diminished dose, however, seemed scarcely sufficient, for on the night of December 6th, which was two days after the last reduction in amount of chloral, the patient complained of considerable rigidity and a good deal of pain. Twenty grains of chloral was administered twice during the night, and next morning the patient stated that relief had been almost immediate. Chloral was therefore given in fifteen-grain doses every three hours for a short time. The symptoms gradually subsided, and the drug was decreased accordingly, until finally it was discontinued altogether. On the 24th of December, thirty-six days after admission, the patient was discharged cured. The extract of belladonna had been used as a dressing to the finger for a considerable time, but, as stated, the injury was almost healed at the time of admission, and therefore required but little attention.

CASE IV.—This is an instance of subacute tetanus, which possibly would have recovered on any treatment, because the symptoms were mild and the amount of chloral given small. The history is as follows: J. H., aged twenty years, was injured by his gun, loaded with No. 5 shot, exploding while he sat upon a fence, with the muzzle towards the armpit. The charge entered the inner side of the right axilla, and made a ragged wound, from which the patient says there was profuse hemorrhage. He was admitted the following day, when examination showed a wound in the thoracic side of the right axilla, and made it evident that there was no fracture. There was no shot near the surface of the body, the radial artery was beating, the hand was warm, and sensation seemed good. The pulse was frequent and the temperature high from inflammatory fever. Oxide of zinc ointment was applied to the wound, and a careful watch kept lest hemorrhage should occur. A good deal of bloody pus and sloughing tissue were discharged from the wound, which was washed out daily with antiseptic solutions, and iron and quinia were given internally. Under this line of treatment the discharge diminished, and the patient did well. Fifteen or sixteen days after he was brought to the hospital he had a chill, fever, headache, and some soreness of the throat. During the night he noticed that his jaws suddenly snapped together. This convulsive action of the muscles of the jaw occurred two nights before he mentioned it; and then it was noticed one evening that he could not open his mouth, because of stiffness and the pain induced by the attempt to do so. Chloral was given during the evening in small doses, and the next day (November 26th) the prescription ordered was chloral hydrate grs. x, bromide of potassium grs. xx, three times daily. The following day the bromide was omitted, and the chloral treatment employed alone, except that the tonics were continued which had been ordered early in the history of the case. The symptoms of tetanus were confined to trismus, with the occasional "snapping" at night and slight spasms of the forearm of the wounded side, which once in a while was involuntarily rotated. There was no rigidity of the posterior cervical muscles. On December 8th it is stated in the notes that chloral had been continued in the same dose and manner, with an occasional extra dose at night. The symptoms were decreasing, and there was less snapping together of the jaws. A few days later the drug was stopped, and there was no noticeable trismus and no further spasms at night. From this time the man may be considered cured

of tetanus. The wound soon healed, with the exception of a fistulous track which discharged a small amount of limpid fluid, as though connecting with some synovial sac. He was discharged by request in this condition. The elbow-joint could be flexed and extended by the patient, but the hand showed typical wrist-drop, from injury, no doubt, to nerves in the axilla. This paralysis of motion was not determinable at the early examinations, while the arm was yet too painful to be moved. Sensation remained good as it was when the patient was admitted to the hospital.

In this connection I wish to say a word regarding the urine of patients using chloral continuously. A year or so ago Dr. Morris J. Lewis and myself were examining the urine of a former case of diabetes insipidus, and to our astonishment obtained, with Fehling's solution of sulphate of copper, potash, and soda, a yellowish-red precipitate. The result, however, was different, when, having observed that the urine had been brought from the ward in a bottle labelled chloral, we tested a new specimen. This led me to make some experiments with normal urine to which various small quantities of chloral had been added, and I found that in certain proportions a yellowish-red precipitate, very much like that given by saccharine urine, was obtained. Bearing this fact in mind, I determined to test the urine of this last tetanic patient, who was taking chloral grs. x thrice daily, and I found a similar reaction when using Fehling's solution, in the proportion of one part to two of urine. This precipitate, however, was not as red as usually seen in cases of diabetes mellitus. Beale states that chloroform, as well as grape sugar, will reduce the suboxide of copper, but I do not know whether a similar action of the allied drug chloral has been mentioned. Even if the precipitate be not suboxide of copper, the fact that a yellowish deposit occurs seems important to bear in mind, because of the universal use of chloral internally. The fermentation test for sugar would, no doubt, be a proper one to prevent any error in diagnosis.

In this article no attempt has been made to collect the cases of traumatic tetanus that have been reported as cured by chloral, which, by the way, are many; but an impartial statement regarding the results of treatment in the Pennsylvania Hospital has been its object. Woorara has been recommended and employed in this affection, especially in Italy, and a recent journal¹ gives an epitome of thirteen cases of traumatic tetanus collected from various sources, where recovery took place in seven instances under the employ of this drug. Whether chloral or woorara is to take precedence in the highly honourable position to be assigned to the victor over tetanus, or whether a new, more potent, drug is to be born at the hands of chemists, must remain unsettled till further advance is made in the warfare against disease.

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¹ N. Y. Med. Journ., June, 1877.