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EXTENSIVE LACERATION OF THE HAND,

CAUSED BY THE

EXPLOSION OF A BOTTLE OF "WHITE GUNPOWDER" WHILE HELD IN THE HAND.

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THE following case of severe traumatic injury presents many interesting features in connection with the severity of the lesion, the nature of the treatment pursued, ending in almost complete restoration of the functions of the injured member, and affords another striking example showing the imperative necessity for unceasing caution while manipulating the oxy-salts of potassium and chlorine, or analogous explosive compounds.

The injury about being described was caused by the explosion of a compound known as "white gunpowder," a substance in common use in Mexico and others of the Spanish-American republics, and consisting of ferrocyanide of potassium, loaf sugar, and potassium chlorate = $K_4Fe''Cy_6 + C_{12}H_{22}O_{11} + ClO_3K$.

Shortly after noon of November 12th, 1874, Professor K. was engaged in his laboratory demonstrating to a class of students the character and pyrotechnic properties of various chemical compounds used in the arts and in *civilized* warfare. After the explosive nature of a mixture of potassium chlorate and sugar had been shown by means of a drop of sulphuric acid, the professor took a bottle containing between three and four ounces of white gunpowder, and essayed to pour therefrom a few grains on a small wooden slab, placed within two or three feet of where the mixture of chlorate of potassium and sugar had been exploded, but the contents had barely touched the wooden surface when sudden and violent ignition took place, the flame passing upwards and into the bottle, which was held about four inches above the slab, and a terrific explosion of the whole contents took place, shattering the vessel and scattering the fragments in all directions, and with sufficient force to break and damage many of the apparatus and fixtures at several yards distance. Upon first impulse the cause of the disaster was surmised to have been the result of spontaneous combustion, or as a sequence of the percussion produced by the fall of the powder from the bottle to the slab, but subsequent investigations rendered it more than probable that the accident was caused by the contact of the powder with a particle of sulphuric acid that might have dropped from

the glass rod used to carry the acid to the mixture previously experimented on, or that might have been blown to that point by the former explosive experiment. The atmosphere of the room was supercharged with peroxide of chlorine evolved during preceding experiments. To all these may be added the possibility that the friction produced by pouring the rough granules of powder through the ground mouth of the bottle may have been the source of ignition. Although it is stated¹ that this powder will not explode by friction or concussion, requiring contact with red-hot flaming substances, yet molecular change may have rendered the former modes possible, as this specimen had been prepared some five years previously, during which time it may have acquired properties differing materially from the article as ordinarily found. The force of the explosion was such that small particles of the shattered bottle impinging on the convex surface of thick heavy glass vessels made perforations therein similar to those usually produced by a gunpowder projectile when fired through glass at close distance. Two or three of the students seated on the front seats, received contusions and slight flesh wounds from small fragments of the glass.

The point of greatest resistance to the explosive force was the centre of the palmar aspect of the right hand of Professor K., the palm thereof having been rent and torn into numerous shreds, the thumb disjunct at its carpo-metacarpal attachments, the arteries constituting the superficial and deep palmar arches were dissevered and poured out their contents freely, and the muscular tissues were bruised and contused to an extreme degree. Being close by at the time of the explosion I saw him a few moments afterwards, and, having wrapped the hand up temporarily, had him conveyed to his quarters close by. Considerable shock having been produced, brandy and water were administered. Two vessels required ligation, and hemorrhage from several small branches was controlled by torsion or the application of the liquid persulphate of iron. Some twenty silver wire sutures were required to bring the lacerated points of the integuments together, as far as it was practicable to do so, after which the wounds were dressed with lint saturated with carbolized glycerine, one volume to seven, covered with oiled silk and a roller bandage. The limb was then placed on a suitable splint, the fingers and palm extended, and the whole supported by a handkerchief sling suspended from the neck. A fragment of glass had laid open the ultimate joint of the little finger of the left hand, and there were two extensive lacerations of the ring finger of the same hand. Arterial hemorrhage from the little finger was controlled by the application of persulphate of iron, after which the wounds in these fingers were dressed with the carbolized glycerine and suitable bandages. The patient having a strong repugnance to chloroform, anæsthesia was not resorted to; nevertheless, he bore the pain and suffering attendant on the necessarily tedious process of adjusting the dissevered parts with remarkable patience and fortitude.

8 P.M. Has been quite nervous and restless. Had his clothing removed and found four small contused wounds on the right leg and thigh, one of which had bled a considerable quantity without detection; complains of a sense of fulness about the right hand. Some oozing of blood having taken place, I removed the outer bandage and substituted a many-tailed bandage therefor. Half a grain of sulphate of morphia was administered and

¹ *Vide Wagner's Technology, p. 154 et seq.*

quiet enjoined. An hour later I saw him again in company with his relative, Professor E. R. Peaslee, and repeated the morphia, after which I left him with injunction to court sleep by repose and quiet.

13th. 8 A. M. Slept about four hours during last night, but not until after two and a half grains of morphia had been taken to induce sleep. Complains of intense pain in the hand, shooting from one point to another. Opened the outer dressing and saturated the under layers of lint with carbolized glycerine. Ordered milk-toast and an omelet as diet, and perfect quiet enjoined.

14th. Feels very comfortable, having slept all night and the hand being almost free from acute pain. Carbolized dressing applied through the original dressing so as not to expose the wounded surface to the action of the air.

15th. Continues to do well. Sleeps well, appetite good. Bowels moved by Seidlitz powder.

16th. Doing well. Appetite excellent. Repeated dressing, and allowed soup, chicken, quail, fruit, and milk, as may be desired.

17th. Sat up in an easy chair some eight hours. Continue diet and treatment same as yesterday.

18th. Did not sleep as well as usual, and complains of failure of appetite. Ordered *fld. ext. cinch. arom. ter in die*. *Haust. cit. magnes.* to move bowels, which show a tendency to constipation—potassium bromide gr. xx at bedtime to be repeated *pro re nata*.

19th. Feels better, but complains of loss of appetite. Continued treatment, and ordered fresh cider at his request.

20th. Somewhat better. Sat up several hours during the afternoon of yesterday. Appetite capricious. Ordered raw oysters, cream, and milk *ad libitum*.

21st. Slept better and feels better. Beef-tea and a glass of sherry twice a day.

22d. Some slight oozing through dressing; lifted up the edges of the inner dressing and poured carbolized glycerine directly on the wounded surface, which appears to have reunited without suppuration.

25th. Continual improvement—feels in excellent spirits; sleeps well, good appetite, no pain in hand.

While sitting chatting with the patient he sprang in his seat, as if he had been stung by a hornet, and said he had a violent and sudden twinge in the nerves of the fingers, which occurred again in a few moments, but with less severity. States that he had two or three twinges on the preceding day, but paid no attention thereto, as they were not severe, and he imagined they were caused by the process of reunion. Ordered potassium bromide gr. xv *ter in die*, and continued former treatment. At my evening visit found him comfortable and more cheerful than usual, although disturbed by an occasional violent twinge or jerk in one or other of the fingers of the right hand. From these symptoms I deemed it prudent to open the dressing and examine the wounds, in order that I might act as their condition might indicate. Assisted by Dr. Fitzgerald, U. S. Army, I removed the dressing, and was much gratified to find the wounds united by first intention at almost all points, presenting a perfectly healthy condition and promising most satisfactory results.

The centre of the palm shows healthy granulations where the integument has been completely destroyed. Removed with caution and without pain the silver sutures, but the two ligatures were allowed to remain,

not having become detached yet. Painted the palmar aspect of the fingers with a mixture of tincture of iodine ℥j, morphia sulph. gr. viij, with three or four coatings; then reapplied the carbolized dressing on successive strips and layers of lint soaked in a solution consisting of five parts of glycerine to three of carbolic acid. No pain was caused, and no notice of the disagreeable tetanic sensation up to ten o'clock, at which time I left him for the night. Potassium bromide gr. xx, to be taken *pro re nata*. Nothing transpired to cause the patient to even surmise that I had any suspicion of impending danger.

26th. Found him comfortable at my morning visit after having had a good night's rest without having had to resort to the sedative. The twitching has almost disappeared, there being nothing more than an occasional formication about the fingers. Repeated the application of the iodized morphia and carbolized glycerine. He says he feels great mental relief at the removal of the sutures, as he feared the process would prove a very painful ordeal. Evening. Passed a good day—no pain or twitching worth noticing. Bowels moved by citrate of magnesia; appetite excellent—beef-tea, milk, cream, and similar nutritious diet allowed according as they are fancied.

27th. Passed another comfortable night. No pain in hand more than a slight feeling of discomfort. Continue treatment as before.

28th. Continued improvement. Remained up until ten o'clock P. M. last evening. Slight pain in fingers, to relieve which the stronger carbolized dressing was applied.

29th. One ligature came away, the other not yet detached from bottom of wound. Removed dressing from fingers of left hand, and found the wounds in the little and ring fingers completely healed; no evidence of the slightest suppuration having taken place during the reparative process.

December 1. Steady improvement. The wounds in the lower limbs are not yet healed, as the dressings had to be removed and re-applied daily, owing to the difficulty of keeping them in position. Unlike the wounds in the hands, these have suppurated and are healing over by granulation. During this process a series of phlegmons have succeeded each other in the vicinity of the wounds in the thigh, and have caused a good deal of suffering and constitutional disturbance. Ordered cit. ferri et quin. ℥ij, fld. ext. cinch. arom., syrup. zingiberis, spirits vini gallici, aqua, āā ℥ij. M. A tablespoonful to be taken three times daily.

5th. While the patient was being dressed, secondary hemorrhage from the superficial palmar arch took place. Pressure on the radial and ulnar arteries restrained the flow of blood until assistance arrived, when the bleeding was controlled by compresses, lightly applied over those vessels, and by the application of a saturated solution of persulphate of iron to the mouth of the bleeding vessels.

8th. No return of hemorrhage—patient comfortable, with good appetite, and enjoys plenty of sleep.

12th. Continues to improve. The wounds in the right hand have entirely healed except a small spot in the centre of the palm, through which the ligature still hangs attached, its knot preventing its detachment by gentle traction. Went out to-day for the first time.

25th. The remaining ligature came away this day, leaving the hand in a much better condition than there was any reason to hope for under the most favourable expectations. The recurrence of boils on the thigh has continued to give much annoyance.

January 1. All dressings dispensed with from this date. The power of flexion in the thumb and fingers, and sensation in the second and third phalanges of the first, second, and third fingers, are considerably impaired. To overcome the former, gentle passive motion in flexion and extension is kept up daily, and for the latter a mild Faradaic downward current passed through the radial and ulnar nerves every alternate day. Despite the disadvantages of a highly nervous temperament and the extremely sensitive character of the extensive cicatrized surface, the condition of the hand and fingers continued to steadily improve, so that the professor was able to resume his professional labours, and was returned to duty on the 31st of the month, with the prospect of the limb ultimately regaining all its lost power.

Remarks.—When the extent, character, and location of the principal injury, the terrific force and shock that produced it, the age and temperament of the subject, the danger from tetanus in injuries of this nature, and the presence at one time of premonitory symptoms indicative of the advent of that fearful complication, are taken into consideration, the results obtained are far better than could have been hoped for under the most favourable circumstances. To the antiseptic treatment I believe the satisfactory progress and termination of the case are principally due. Had the usual course of removing the dressing from and exposing the wound once or twice a day to the air been practised, suppuration doubtless would have supervened, and with it the lurking danger from tetanus would have been vastly increased, to say nothing of the constitutional effects likely to result from extensive suppurative inflammation. Had that course of treatment been pursued, the satisfactory results obtained could not have been secured, and, indeed, it is not beyond the range of probability that the sacrifice of the limb might have become necessary in order to preserve the life of the patient. The local anæsthetic effect of the carbolic acid added materially in maintaining the tranquillity of the patient, while preserving the wounds free from pyogenic tendencies.

January, 1875. Status presens.—The functions of the hand have steadily improved, and would be almost restored to perfection could the patient be induced to submit to suitable manipulations to produce complete flexion and extension of the fingers on themselves. Sensation has been gradually and almost fully recovered, a slight paresis being all that remains to indicate the places formerly deprived of feeling.

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