

OBSERVATIONS ON THE SURGERY OF TETANUS*

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This paper is especially intended as a plea for more strenuous activities on the part of the surgeon in regard to a more radical, more vigorous and more intelligent application of the principles of antisepticism in the early treatment of wounds, i. e., at the first treatment, even though such a wound appears to be trivial, and especially if it is of the anaerobic class.

Within about a week's time, during the present month of September, 1910, I read among the news items printed in the local papers, the following references to four cases of tetanus, all resulting fatally. Whether or not other cases occurred during this same period of time I do not know, or whether or not there were other cases during this same week that developed tetanus and recovered I do not know. The basis of this study, therefore, relates only to these four cases and the fact that the mortality as mentioned above was one hundred per cent. The cases were described as follows, to-wit:

1. A. L., on August 13, sustained a splinter puncture at the base of the right thumb. The first symptom of tetanus developed August 26, thirteen days following the injury, or, in other words, trismus did not develop until after the lapse of nearly two weeks from the date of receipt of the injury. On that date, August 26, she was taken to a hospital, where she was treated with 3,000 units of anti-tetanic serum. The dose of the antitoxin was frequently repeated, but about three weeks later, or twenty-one days after the first appearance of tetanus symptoms, that is, on September 19, she died of tetanus. It must be observed that there were no reports published in regard to what was done for the local wound.

2. Agnes L., 10, on September 2, sprang barefooted upon the blade of a sickle, sus-

taining laceration of the toes. It is intimated in this item that one or two of the toes were severed from the foot, and on the arrival of the physician the toe or toes were replaced and sutured to the stump. September 8, or six days following the receipt of the injury, the attending physician discovered signs of tetanus, when he had the little girl removed to a hospital, where the anti-toxin injections were administered. The patient succumbed to tetanus September 10, at night, eight days following the receipt of the injury. At the hospital one toe was found to be gangrenous and was amputated, the stump cauterized with pure carbolic acid, and the wound dressed surgically.

3. R. S., 10, on August 12, fell from a wagon, sustaining a slight injury to his leg, which was thought to be so insignificant at the time that no treatment was given it. Twelve days after the injury was inflicted the wound became inflamed and about that time, that is, almost two weeks from the date of the injury, lockjaw developed. He was taken to a hospital, where more than a pint of the anti-toxin was administered by injections, but after hovering between life and death for seven days, he succumbed to tetanus. The reports conclude with the statement that the attendant was unable to account for the sudden change in the boy's condition at the end, that is, September 2. The item also conveys the information that in this case three days before he died his condition improved greatly and he was able to open his mouth more than an inch. There is no mention relating to the point that any special attention was given the wound even before or after he entered the hospital.

4. L. T., 10, died September 5, 2 p. m. Two weeks before the boy stepped on a rusty nail. Only members of the family treated the

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wound. The wound was in the sole of the foot. Later when the foot became swollen the lad was then sent to a hospital at once, where 50,000 units of the tetanus anti-toxin serum were injected into the boy's body. Despite this, he grew worse, convulsions setting in, the jaws became locked and the body shortly twisted into a circle with the head drawn against the heels and in apparent great agony died. No mention is made in this case either as to whether the boy's injury to his foot received any special attention from either the attending physician or the surgeon at the hospital.

Ever since the Hippocratic era, when the more rational study of diseases began to assume more intelligent form, and down through the ages until the discoveries of Behring and Kitasato became the common property of all, the mortality in the dread disease of tetanus has been high, indeed pitifully high. In the light of all the splendid achievements in scientific discovery and the great advancement and improvement in surgical practice of modern times, the mortality of tetanus has shown a steady increase. While it is gratifyingly true that the number of cases, especially on our national holiday, the Fourth of July, has been reduced, and by efforts from sources to which we have not the time to refer, it is a fact that the death rate among this more limited number of cases is growing and growing-alarmingly, and, I might add, in a most mysterious way.

In accordance with the reports published by the *Journal of the A. M. A.* for the present year, the last Fourth of July in the United States there were 72 cases of tetanus following the receipt of that form of injury which usually occurs on that heretofore noisy occasion. Sixty-four, or over 93 per cent of those cases of tetanus which were reported as having developed tetanus following injuries received on the Fourth of July in 1910 died from the disease. In 1909, the reports go on to state, that that only 84 per cent of the tetanus cases following the Fourth of July of that year proved fatal, and in 1908, of the Fourth of

July cases of tetanus, only 72 per cent proved fatal, following the anaerobic injury. On the Fourth of July of this year there were 150 reported as compared with 92 in 1910. Fourth of July injuries have been greatly reduced, at the same time the mortality by inverse ratio constantly increased. What rational explanation can we put forth to account for this unfortunate showing? Can it be due to one or two or both of the following causes:

1. Can it be reckoned how many cases would avoid or survive an attack of tetanus if there were no neglect or lack of attention on the part of parents at the time or immediately following the day on which the injuries were sustained? If all of this fault or much of it can be justly laid at the door of those responsible for the early care of the case, then how may this be remedied? The answer must come to this, in the form of a demand for a crusade for public education.

2. Can this increasing death rate be justly laid against a possible inefficiency of the application of surgical methods? In other words, can it be charged that the doctor depends too much upon the curative power of the anti-tetanic toxin serum and depends too little upon efficient surgical intervention?

Let us investigate a little further and perhaps more light may be thrown upon one or the other of the horns of the dilemma. At this stage I shall briefly refer to a single case occurring during this same period of time and that presented a typical anaerobic wound. An elderly lady, 60 years of age, was engaged in driving her chickens about the chicken-house. In trying to prevent their escape, she sprang with much force upon a rusty nail, which was forced into the middle of the sole of her foot to the depth of about one and one-half inches. I saw her on the second morning. She was then, as she expressed herself, "feeling quite sick," and had slept but little the preceding night. Her face was somewhat blanched with an anxious expression and she appeared otherwise nervous and apprehensive. I at once made the necessary preparations, and

after protecting the external opening of the wound, I scrubbed the entire foot. I then had chloroform administered, and when thoroughly under its influence I cut from the entire length of the wound all of the exposed raw surfaces with a rimer I devised for the purpose. I then excised the lid-like piece of tissue from the opening of the wound. After thus enlarging the wound to some considerable proportions throughout its entire course, I then swabbed it most thoroughly with a 4 per cent solution of formalin. After protracted efforts at swabbing I filled the wound with pure tincture of iodine, then washed the adjacent tissues about the wound with ether, rubbing with considerable force the tissues with a piece of cotton saturated with ether. During this process the outlet of the wound was kept plugged by means of a piece of gauze. After completing the disinfection I sealed the wound with dissolved rubber tissue, placed a compress of gauze and cotton immediately over the wound, then surrounded the foot and ankle with cotton and a roller bandage and placed the foot and leg half way to the knee in a fixed dressing. The old lady made a good recovery without any rise of temperature or symptom of tetanus infection. The second night following the operation, and after the effects of the surgical procedure which necessarily entailed considerable shock, and after the effects of the chloroform had worn off, she slept much better and on the third day began to improve, and in two weeks was able to limp about the house. Tenderness in the region of the wound only remained as a hindrance to easy walking up to the present time.

This single case came up during the same period of time, and with a wound similar in nature to those sustained by the four cases recited above, and which developed tetanus and terminated fatally. The wound in each case was typically anaerobic. Is there reasonable justification for the belief that with a less heroic method of treatment of the wound in the last case described, that she might also

have developed tetanus with fatal termination, as in the other cases?

From whatever direction you may draw your conclusion, I have much faith in the belief that it is possible to decrease the mortality records by more surgical aggressiveness.

No one of us, perhaps, is better able to appreciate the full gravity of a wound that is almost certain to be followed by infection than our valued fellow-member, Dr. Carl Fish. As an illustration of this fact I may cite your attention to an accident which befell him and relate the extreme measures adopted by him in order to avoid its serious consequences. He was engaged in handling some anthrax substance with a needle in one of our hospitals and accidentally pricked his finger. Almost immediately thereafter he sought the services of Dr. Morfitt and had the end of his finger cut away. Even where demanded, those less informed might hesitate to doing the same thing to others.

My personal view is that it is entirely inefficient and devoid of curative results to treat a case in which there is an anaerobic wound by merely cleansing and cauterizing the same. It is insufficient to simply pour the wound full of pure carbolic acid or even pure nitric acid and then submit the case to a doubtful fate, for in such instances it is just possible that the tetanus bacilli have gone beyond the limits of these escharotics, and after the formation of the eschar, an ideal field would likely be established for the growth of the bacilli behind the eschar. They would be found to be living in a medium destitute of free oxygen, their natural habitat. The wall of the typical anaerobic wound must be completely excised, after which the wound must be thoroughly swabbed throughout its entire depth with a 4 per cent solution of formalin; then the cavity may be filled with pure nitric acid or preferably pure tincture of iodine. The opening of the wound is then to be protected by gauze and a solution of guttapercha, and then the entire extremity should be immobilized.

After it has been cleaned out, and I mean

thoroughly cleaned, not sparingly, but efficiently made clean, it is better to seal the wound than to allow it to remain open and exposed to after-infection. In considering other phases of the subject we must not lose sight of the fact that the tetanus anti-toxin serum is not germicidal; that it possesses absolutely no power as a germicide; the power and duty, therefore, of securing bactericidal results remain entirely with us, and in trying to delegate this power to the anti-toxin, we are committing a wrong against the welfare of the patient.

It is under only certain conditions that the serum of Behring and Kitasato exercise any control over the tetanus toxin or have any power to neutralize them. Experience teaches that cases with long incubation periods come within the power and control of the injections better, improve and sometimes recover completely, provided, of course, that the wound into which the tetanus bacilli found entrance has been properly cared for. This fact must have an important practical bearing on the methods of employing complete thoroughness in clearing the local wound of all germ life and in antisepticizing the contiguous tissues and keeping them sterile.

In regard to the powerless influence upon the tetanus anti-toxin, it is a fact, I believe, that these microbes will themselves grow in the tetanus anti-toxin serum. There are many other phases of this broad subject that demand further careful study and consideration, but which time will not permit me to dwell upon. We must not fail to keep before us, when treating a case with an anaerobic wound, the following points in regard to the uses of the tetanus anti-toxin. It is known in the first place that the greater portion of the amount originally injected is usually eliminated unchanged in the secretion and excretion. Again, the maximum amount of anti-toxic substance injected into the tissues is not found in the circulation until after the elapse often of thirty to forty hours, and even after injection

of large quantities, there will be but a trace found in the cerebro-spinal fluid. Owing to the fact that absorption takes place so slowly the injections might be made directly into a vein in desperate conditions. Inasmuch, too, as a greater portion of the anti-toxin is eliminated unchanged, the injections must be repeated sufficiently often to make up for the continuous loss, and the inability of nerve tissue to take up the anti-toxin from the circulation, is the most significant fact of all so far as the serum treatment of the cases is concerned. But the stage in the course of a given case at which the conscience of the attending surgeon may likely feel most acute is when he is beginning to realize that there is no improvement after the case has lingered for days and weeks before the more serious form of the symptoms develop and death takes place. Especially will he find intervals of chagrin afterward over the case which shows improvement, that is the case in which there is noted a marked relaxation of the trismus, but eventually returning seizures destroys life.

My own clinical observations give me convincing faith in the belief that the tetanus organism itself does not enter the general circulation and set up its mischief there. It remains, I am wholly of the opinion, all of the period of time that the patient is suffering from the effects of its toxin in the original wound. It may never go beyond the limits of the wound. Here it is actively stored away from the presence of free oxygen. What mischief it does it does while concealed in the original wound, hence, in those seemingly stubborn cases, in which the organism is permitted to remain unmolested in the wound, industriously turning its poisonous product into the adjacent vessels, for days, and in some instances for weeks, is it unfair to think that not all has been done that might have been done in the way of clearing the wound of these accessible and localized death-dealing micro-organisms?