grams, taken by Dr. McDonough, showed that the lipiodol was arrested at the level of the eighth dorsal vertebra. This confirmed the clinical localization, and the laminae of the eighth, ninth, and tenth dorsal vertebrae were therefore removed. Mr. A. Chance assisted. As soon as the ligamentum subflava was opened a gush of thick pus welled up, chiefly from the left side. When the dura pulsated freely the wound was drained, and partially closed. A posterior plaster case was applied. A pure culture of *Staphylococcus aureus* was grown from the pus, and a vaccine prepared.

Subsequent History.—On the day following the operation there was complete flaccid paraplegia, with total absence of response to all forms of stimulation. Sensation was unimpaired except over Scarpa's triangle on the left side. On the next day voluntary movement of the left great toe returned; stimulation of the sole produced slight movements of the toes. Painful flexor spasms occurred, chiefly in the left leg, and recurred periodically for seventeen days. Eleven days after the operation good movement was noted in the left leg at all joints. Knee-jerk and ankle-jerk present; slight ankle-clonus. Normal plantar response. No movement in right leg except slight movement of great toe. Knee-jerk and ankle-jerk exaggerated; ankle-clonus. No plantar response. Light touch present over both limbs. Sense of position of toes accurate in left foot, usually accurate in right foot. Sixteen days after the operation voluntary movement appeared in right leg, and improved from day to day, though there was no power yet to flex the hip or knee. Left leg movements were fairly good, but the patient made no attempt to move either leg unless told to do so. The temperature, which had oscillated at first between 100° and 103° F., gradually subsided in the third week, and the pulse rate, at first 120 to 130, descended to normal. The bladder condition remained unchanged. The wound looked clean, but discharged freely. The general condition improved, and toxic symptoms disappeared.

On September 3rd the patient began to pass urine at will. On October 1st the power of walking began to return. The gait was spastic. A month later she was able to walk about a quarter of a mile; gait slightly spastic; tendon-jerks slightly increased; transitory ankle-clonus. Shortly after this slight girdle pain returned at the level of the lower chest, disappearing in the erect position. This passed off following the extrusion of a spicule of bone from the sinus. Further progress was uneventful, and at the end of April, 1934, the patient is normal in every way.

Summary

We present a case of epidural spinal abscess in which recovery followed a surgical operation. The interesting features of the case were as follows:

1. The intensity of the pain, which at its height defied all drugs, including morphine.
2. The radiation of pain round the trunk.
3. The relief afforded by the adoption of an attitude which relaxed the spine.
4. The evidence of anterior root irritation, as shown by sudden stiffening of abdominal muscles.
5. The almost complete absence of anaesthesia.
6. The latent period of eight to nine days which preceded paralysis.
7. The fact that adequate drainage was secured by the removal of three laminae. Operations on a much more extensive scale are described in the literature.

Our experience with this case suggests that removal of a large number of laminae is unnecessary. This is of obvious importance in regard to operative risk.

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TETANUS IN TOY-PISTOL WOUNDS

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The prophylactic use of antitetanic serum has proved so useful in cases where infection is suspected that the following case, illustrating a rare mode of infection, is worthy of notice so that early treatment on prophylactic lines can be instituted and a probable catastrophe prevented.

Case Record

An otherwise healthy boy of 8 was admitted to the Glasgow Royal Infirmary on December 9th, 1933, suffering from tetanus. The following history was obtained.

On December 2nd, 1933, he was playing with a toy pistol and some blank cartridges, for which he had exchanged a magic lantern with another boy. The pistol went off unexpectedly, and he sustained a wound of his left index finger, for which he was treated at home by his mother. On December 9th, seven days later, he developed stiffness of his jaws, and the family doctor was called in. He diagnosed tetanus, and sent him into the Royal Infirmary at once.

On admission there was well-marked trismus, associated with tenseness of the neck and back. There was also slight head retraction. He could open his mouth half an inch. He had slight convulsions, associated with some degree of opisthotonos. The left index finger was seen to have a septic wound at the base.

The boy was put into a side room with the blinds drawn and antitetanic serum administered at once. His condition gradually became worse, and on the third day the left index finger was amputated. He died quite suddenly the following day.

Serum Treatment.—On admission he was given 40,000 units of antitetanic serum intramuscularly and 20,000 units intrathecally. Next day he was given 120,000 units intramuscularly and 80,000 units intrathecally. On December 11th he had 10,000 units intramuscularly, and on the 12th 12,000 units intramuscularly and 40,000 units intrathecally. On the 13th he was given 80,000 units intrathecally.

The cerebro-spinal fluid showed nothing on culture or smear. No cultures were taken from the wound on the finger either before or after amputation.

In an endeavour to discover the source of infection I obtained from the procurator-fiscal one of the two remaining cartridges. The police were unable to trace where the cartridges were bought. However, I managed to buy some of a similar make in a shop. The original cartridge and some of the bought ones I gave to Dr. Robert Cruickshank, bacteriologist to the Glasgow Royal Infirmary. Others I sent to Dr. Clark Trotter, medical officer of health for Islington, at his own request, and he had them examined by Professor James McIntosh, director of the Bland-Sutton Institute, Middlesex Hospital. Professor McIntosh reports as follows:

"The wads were made of a rough type of paper. The cultures grew staphylococci, streptococci, coliform bacilli, and diphtheroid bacilli. No *Bacilli tetani* grew."

Dr. Cruickshank reports as follows:

"None of the bullets examined bacteriologically gave a growth of *B. tetani* either by cultural methods or by pathogenicity tests, nor were there organisms of an associated nature, such as *B. sporogenes*, which would have suggested the possible presence of *B. tetani*. The organisms recovered were aerobic and spore-bearing bacteria such as might be found in dust and in the atmosphere. On physical examination of the cartridges there was no evidence of any material—for example, horse-hair felt—likely to harbour *B. tetani*."

Tetanus infection from blank cartridge wounds has not received much attention in this country, although it has been known for some time in the United States, where

it was common following the celebrations of Independence Day on July 4th. In America,¹ in 1903, despite official warnings, over 400 patients died from tetanus due to this cause alone. The incubation period was short and the disease very virulent. In the majority of cases the wounds were in the hands. Recommendations were made regarding the sale of toy pistols and blank cartridges and the giving of antitetanic serum in all wounds of this nature. This reduced the mortality to three in the 1914 Independence Day celebrations.

Miss Smith² reported four cases with three deaths, occurring in London in 1932. The wadding of the blank cartridges was examined for *B. tetani*, but none were found. However, other anaerobes were isolated, particularly *B. sporogenes*. She points out that this does not exclude *B. tetani*, as it is difficult to isolate *B. tetani* from mixed company. In America, following the 1903 cases, a large number of blank cartridges were examined, but in no case was *B. tetani* found, although one culture, inoculated into rats, caused death from convulsions. Other instances of death from tetanus associated with toy-pistol wounds were reported by Stokes,³ Schofield,⁴ and Clark Trotter.^{5, 6} In Dr. Clark Trotter's case the cartridges were examined by Professor McIntosh, and *B. tetani* was found. It was observed then that only in those cartridges with a wad containing hair felt was the organism obtained. Dr. Clark Trotter remarks that thorough sterilization, before being used as a wad, is the only certain way of preventing these accidents.

There is, of course, no direct evidence that the tetanus infection in this case was derived from the cartridge, but the frequency of tetanus after wounds due to the use of toy pistols and blank cartridges suggests that either the infecting organisms were already present in the cartridge or that the type of wound, associated with mild sepsis, may predispose to tetanus infection. The rarity of tetanus seen at the out-patient department of a large hospital, such as the Glasgow Royal Infirmary, which deals with a very large number of street accidents, would suggest that either of these two reasons is correct. It is important that the general public and the medical profession should be aware of this possible danger from toy-pistol wounds, so that early treatment can be given, as, once the disease is established, the prognosis is well-nigh hopeless.

I am indebted to Mr. Dunbar of the Glasgow Royal Infirmary for allowing me to publish this case, and to Professor McIntosh and Dr. Cruickshank for the bacteriological examinations, and also to Dr. Clark Trotter for sending me a copy of his annual report.

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THE TREATMENT OF PNEUMOCOCCAL EMPYEMA WITH BILE SALTS

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The lysis of pneumococci by bile was noted by Neufeld¹ over thirty years ago, and Levy² in 1907 proposed its use as a differential test between pneumococci and streptococci of the *viridans* group. Many workers have sought for a chemotherapeutic agent in the treatment of pneumococcal infections—notably Lamar,³ Morgenroth and Levy,⁴ and Felton.⁵ Cocchi⁶ in Italy and Thomson⁷ in this country have described the treatment of pneumococcal empyema by aspiration of the pus followed by the injection of a solution of sodium taurocholate. This method appeared to offer so many advantages that we decided to try it, and in our first cases we used the 20 per cent. solution of sodium taurocholate recommended by Cocchi.

It has been customary for some years in this laboratory to add 0.1 c.cm. of a 10 per cent. solution of sodium desoxycholate to 5 c.cm. of broth culture (brought to pH 7.8) as a test for pneumococci. Lysis should occur within five minutes. This modification of the classical test was made following the suggestion of Mair,⁸ and laboratory experience of the varying potency of individual samples of commercial sodium taurocholate. In addition, there is the advantage of using a substance which is chemically pure. We accordingly decided to try this salt clinically.

Before doing this we made *in vitro* experiments to compare the lytic potency of the sodium taurocholate in use with that of sodium desoxycholate. A thirty-hour broth culture of the strain of Type I pneumococci, recovered from one of the cases undergoing treatment,

was used. Before adding the substances under test the broth reaction was adjusted to pH 7.8. It was found that whereas 0.2 gram of sodium taurocholate (1 c.cm. of a 20 per cent. solution) was required to produce lysis in 5 c.cm. of the broth culture, 0.0125 gram (0.25 c.cm. of a 5 per cent. solution) of sodium desoxycholate achieved the same result—that is, the sodium desoxycholate is sixteen times more potent.

We endeavoured to assess the toxicity of the desoxycholate by animal experiment. Three 250-gram guinea-pigs were taken. The first received 1 c.cm. of a 10 per cent. solution intraperitoneally, and death occurred in twelve hours. The post-mortem revealed intestinal necrosis with haemolysis. The second received 1 c.cm. of a 2.5 per cent. solution intraperitoneally with no observable ill effect, while the third received 1 c.cm. of a 10 per cent. solution intramuscularly into the thigh and survived. We realized also that absorption might produce severe haemolysis, for *in vitro* experiments showed that it is over a hundred times more haemolytic for washed sheep's red corpuscles (fragility 0.65–0.5) than sodium taurocholate. For these reasons we have not injected sodium desoxycholate into an empyema until the presence of frank pus shows that a definite abscess cavity has formed.

Method of Use and Results

The technique of the treatment of empyemata by the injection method is simple. The presence of pneumococci in the pus must first be confirmed, since it is only on these organisms that lysis takes place. The abscess cavity is then aspirated again, and as much pus as possible drawn off. With the needle still in position the solution of sodium desoxycholate is injected, and we have used from 5 to 20 c.cm. of a 5 per cent. solution of the salt.

The best results seem to be obtained by repeating the aspiration and injection daily, or every other day, in the early stages, but the length of time that can be