elsewhere in the country. This may be regarded as fortunate in view of the wide dispersal of other passengers and the crew of the ship.

Summary

A case of typhus fever occurring in this country is described.

The importance of including typhus fever in the differential diagnosis of pyrexia of uncertain origin is stressed.

We are indebted to the Department of Health for permission to publish this report.

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TETANUS AFTER HEAD INJURY IN AN IMMUNIZED SUBJECT

BY

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At a time when the results of active immunization against tetanus are coming under review, the following case seems worthy of record. Five days after a penetrating head injury the patient developed tetanus and died, despite the fact that he had received active immunization and the standard 3,000 units of A.T.S. one hour after the accident. The source of the infection and the clinical picture presented, in combination with the results of a severe brain injury and a meningitis, are also of interest.

Case History

A pilot aged 23 was involved in an aeroplane accident on April 10, 1943. He was landing a bomber and crashed into another aeroplane which was on the runway. His head was thrown forwards on to the control panel and he lost consciousness. The aircraft were jammed together but were little damaged; the pilot remained in his seat. He had multiple facial wounds, which were cleansed and sutured at the station, 3,000 units of A.T.S. being given one hour after the accident. Tetanus toxoid had been given on Feb. 16 and Feb. 20, 1940, but none since, so far as could be ascertained from the documents.

On admission, 18 hours after the accident, the patient was severely confused and had a slow bounding pulse of 48 a minute. Numerous small sutured wounds were present on the face, but just below the left eye was a punctured wound 1/4 in. in diameter, and a probe passed in about 1 in. encountered jagged bone edges. There was severe bruising around both eyes and moderate swelling of the face. The left eye was a little proptosed, with subconjunctival haemorrhages and chemosis; there was also a partial third and a complete sixth nerve palsy. The tone of the right arm and leg was slightly increased, and the right plantar response was extensor. There was no neck rigidity, and Kernig's sign was negative.

A radiograph of the skull showed that a large foreign body had entered through the left cheek and was lying intracranially. From its position it appeared that it had passed through the frontal lobe and must be lying very close to, or actually in, the frontal horn of the left ventricle.

Treatment.—Immediate operation was performed by Major P. B. Ascroft under pentothal anaesthesia. The entry wound in the left cheek was enlarged and numerous small bony fragments and wood splinters were removed. The large foreign body was seen at the bottom of the wound, and was easily removed with forceps. It proved to be a rectangular piece of wood 10 by 0.8 by 0.8 cm., painted on three sides. Bleeding ceased spontaneously and the wound was left open, a gauze drain impregnated with sulphanilamide powder being inserted. Culture from the wound grew *Staph. albus* aerobically and anaerobically. Sulphathiazole was given intravenously and later by mouth, a blood concentration of 9 mg. per 100 c.cm. being reached. Three days after operation the temperature rose to 100° F. and the patient developed a little neck rigidity and a positive Kernig sign. Lumbar puncture showed a C.S.F. pressure of 290 mm., with 128,000 red cells and 3,600 white cells (66% polymorphs) per c.mm. The disproportionate number of white cells, with the polymorphonuclear preponderance, indicated a meningitis, although the culture was sterile. The following day the neck rigidity increased and the patient developed attacks of fine tremors in both legs lasting for a few minutes at a time; the C.S.F. now grew *Staph. albus* on culture. Sulphadiazine was substituted for sulphathiazole, as he did not seem to be responding to the latter.

On April 15 his mental condition was a little improved, but the tremors in his legs continued, and now affected his left arm. Since the accident the patient had only been able to open his mouth a little, owing to his facial injuries; but now the nurse noticed that it was becoming more difficult for him to open it to drink. In the evening he had a typical generalized tetanic spasm lasting about a minute and accompanied by marked neck retraction and cyanosis. Following this the tremors in his legs were more pronounced, his jaw remained very stiff, and his neck was thrown right back. The C.S.F. contained 2,400 white cells (60% polymorphs) per c.mm. and was sterile on culture. Tetanus was diagnosed, and 100,000 units of A.T.S. were given intravenously. A small dose of rectal avertin was employed to control the tremors, which were now almost continuous. His condition, however, deteriorated rapidly, the respirations mounting and the temperature rising to 105° F. He became comatose, and as this deepened so the neck rigidity passed off. He died in the early hours of April 16, six days after the accident.

Necropsy.—A well-built young man. Facial wounds over left maxilla, right zygoma, and right side of chin. Bruising of skin from chin to clavicles. Track, containing blood-clot and a few flakes of white paint, leading from wound in left cheek along ventro-lateral borders of maxillary antrum and left orbit, and thence by an opening, 2 by 1 cm., in lesser wing of sphenoid to enter inferior surface of left frontal lobe. Detachment by fracture of left anterior clinoid process. Left optic nerve intact. Left third, fourth, and sixth nerves not demonstrably injured, but lying at margin of perforation at anterior end of cavernous sinus. Cavernous sinus empty. Altered blood in sphenoidal air sinus. Purple gelatinous clot in left posterior ethmoidal air cells and left maxillary antrum. No significant changes in other organs.

Examination of the brain, after fixation, revealed slight purulent exudate in the leptomeninges at the base of the organ. On section the perforation in the left frontal lobe was continuous, with an ill-defined area, measuring 5 by 4 by 4 cm., of haemolytic softening which involved the ependyma of the left frontal horn and extended laterally to the island of Reil. A mass of clot, 2 cm. in diameter, occupied the centre of this area. The ventricular system contained fluid blood. The remainder of the brain was congested.

Microscopical Examination.—The site of laceration in the left frontal lobe showed extensive ill-defined necrosis, with haemorrhage, fibrin filaments, and uneven purulent infiltration extending into the white matter. The adjacent fringes of leptomeninges contained thrombosed vessels and showed early fibroblastic proliferation, but little cellular infiltration. A few Gram-positive and numerous morphologically similar Gram-negative bacilli, interpreted as *Cl. tetani*, were present in the necrotic tissue. Over the right Rolandic area the leptomeninges showed stages in phagocytosis of extravasated red corpuscles by large mononuclear cells, accompanied by a few lymphocytes. Chromatolysis and karyolysis affected some of the pyramidal cells. Similar meningitis, with a moderate amount of purulent exudate, was present over the midbrain and medulla oblongata. No organisms were observed in Weigert-Gram preparations. The aqueduct contained a little pus. The nervous tissue of the brain-stem at these levels was not affected, save for chromatolysis and "ischaemic" degeneration of occasional neurones.

Bacteriology.—Swab from depths of wound track grew *Cl. tetani*, *Staph. albus*, diphtheroids, and *B. subtilis*. Presence of tetanus confirmed by positive virulence test on guinea-pig. *Cl. tetani* also isolated from the left ventricular fluid.

Comment

The head is one of the less common sites for the development of tetanus. In the last war the French incidence was 4.7%, the German 4.2%, and the British 3.3%. In the present war, in the Middle East up to the end of 1942, none of the 18 cases reported by Boyd and MacLennan (1942) followed head wounds, and Eden (1943) and Ascroft (1943) encountered no instance in over 800 head wounds. Radley Smith (1942) reported 6 cases occurring in a London E.M.S. sector in the first two years of war; four of the cases had head wounds in addition to other injuries, but in only one was there a suggestion that the head wound may have been the source of infection, and no wound cultures were mentioned.

Diagnosis.—In the present case the association of the results of a severe brain injury with a meningitis and tetanus provided an interesting problem in differential diagnosis. The fine tremor observed in the early stages of the illness was similar to those seen in some cases of ventriculitis, and may have been connected with the presence of blood in the ventricle, as was found at necropsy. In addition to the major spasm, the diagnosis of tetanus in the presence of meningitis was helped by the increasing jaw stiffness at a time when the swelling of

the face due to the local trauma was subsiding, and the gross neck retraction present in the later stages was out of proportion to the severity of the meningitis, and was becoming worse, although the cell content of the cerebrospinal fluid was diminishing and the culture had become sterile.

As to the origin of the tetanus, it seems that spores must have been present in the wood splinter which had come off the control panel. Instances of tetanus arising from dirt carried in by splinters are well known, but in this case a careful check of the accident showed that at no time was there any ground contamination, and the wood when removed at operation was quite free from dirt. In this connexion it is interesting to note that von Eiselsberg (1888) reported a case of tetanus arising from a wood splinter, and that two years later virulent organisms could still be grown from it. Pulvertaft (1937) investigated a fatal case of tetanus developing after hysterectomy, and drew attention to the frequency of virulent tetanus spores in cellulose wadding manufactured from wood and used for dressings. From his experiments, however, he concluded that the contamination occurred after the cellulose had been made, and was presumably due to the physical characteristics of the material. Fildes (1929) in a comprehensive account of the tetanus bacillus mentions unsterilized felt used in orthopaedic work and the wads from blank cartridges as other sources of infection. It is clear, therefore, that the spores can live in wood and wood fibre for a long time and constitute a potential danger.

Immunization.—From all recent reports the value of active immunization combined with prophylactic A.T.S. at the time of wounding seems established. Bensted (1941) recorded not a single case in the immunized subject at the time of the Dunkirk evacuation, although 8 cases occurred among unprotected personnel. In the Middle East, Boyd and MacLennan's 18 cases contained 5 which had had previous immunization, but none of these received prophylactic A.T.S. These authors pointed out that the protection afforded by active immunization had its limitations. There were two special groups of cases to be considered: the odd cases that did not seem to respond to the routine two-dose method formerly employed in the Army; and the cases of overwhelming infection with excessive toxin production usually attributable to inadequate surgical treatment of the wound. They concluded that a third dose of toxoid should be given, and a routine dose of antitoxin after wounding, and they stressed the importance of adequate surgical treatment of the wound. Radley Smith's cases afford interesting collateral evidence. Both Service and civilian casualties were treated in this sector, and of the 7 cases reported six were civilians, and the one Service casualty had not received active immunization. All the cases, however, had received the customary 3,000 units of A.T.S. after injury, and Radley Smith concluded that one dose of A.T.S. did not prevent tetanus and that, following the E.M.S. recommendation, the dose should be repeated at weekly intervals for three weeks. McGill (1943), in reporting the case mentioned by Boyd and MacLennan illustrating the lack of response to active immunization, advised the giving of A.T.S. after wounding, to cover such a contingency. Norman's (1943) case affords further evidence of the necessity for regular maintenance doses of toxoid after the routine two doses at the beginning.

Conclusion

In the case here reported there is a very likely explanation for the development of tetanus. The type of wound was ideally suited for the growth of the organism, and its nature and situation prevented a proper surgical cleansing of the wound. As shown at post-mortem examination, some necrotic material and blood-clot were present along the track. The 3,000 units of A.T.S. given were presumably inadequate to combat the toxin production, and no maintenance dose of toxoid had been received since the initial immunization in 1940.

Considering all these cases together, the evidence strongly favours the present Army recommendation that active immunization be produced by two initial doses at a six-weekly interval, followed by yearly maintenance doses; and that, after wounding, 3,000 units of A.T.S. be given. Proper surgical treatment of wounds, whenever possible, is an essential factor in the prevention of tetanus.

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Medical Memoranda

Locked Twins

As *Eden and Holland* gives a history of locked twins as occurring in 1 in 90,000 deliveries, the following case seems worth recording.

CASE RECORD

The patient was a primipara aged 36. Twins had been diagnosed, and confirmed by radiograph; the first was lying as a breech, the second as a vertex. The patient was admitted to the maternity home on the afternoon of Feb. 22, 1944, with a history of pains since midday. These were good, and she was fully dilated at 8 p.m. Half an hour later a strong pain pushed the breech out as far as the umbilicus, and must at the same time have driven the head of the second baby through the brim and on to the neck of the breech baby. During the next half-hour pains were few and poor, then started to improve. Even with the poor pains the nursing staff had expected some advance, as the babies were 3 to 6 weeks premature and small (subsequent weighing showed that they were both 3 lb.); and as this did not occur they sent for medical aid.

On arrival I found that the breech baby had advanced as far as the axillae, but was dead. Per abdomen, one foetal head was found in the left iliac fossa, and the other could be felt to be engaged from the right. Manipulation of either head moved the breech. To obtain maximum relaxation for further examination, a general anaesthetic was given.

The diagnosis of locked twins was confirmed per vaginam. The arms of the breech were easily delivered; the head of the second baby and the neck of the first were then found filling the upper part of the pelvic cavity, and in spite of the small size of the babies normal delivery would have been impossible. Per vaginam, the head was levered out of the pelvic brim while expert help pulled from the abdomen, manipulating the head into the right iliac fossa. The first twin was then easily delivered. The membranes of the second foetus were ruptured and the patient was allowed to come out of the anaesthetic. After a few good pains a living male child was born. The subsequent course of the delivery was normal; the twins were found to have been uniovular.

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An Unusual Dislocation of the Foot

The following is an account of a simple tarso-metatarsal dislocation of the foot. According to Wilson and Cochrane (1928), pure dislocation at this joint without a fracture is very rare. The cause is most commonly direct violence from a run-over accident. It can be caused also by the fall of a heavy object or by forcible flexion of the forefoot. The dislocation may involve all the metatarsal bones, and may be anterior or divergent—e.g., lateral bones laterally, and vice versa. Böhrer (1935), describing the injury, states that the dislocations of this joint are of many varieties. All the metatarsal bones may be dislocated inwards, upwards, outwards, or downwards—upwards and downwards being the most common. Single metatarsals—usually the first and fifth—may be displaced separately. Dislocation of all the metatarsals plus the first cuneiform has also been described in the older literature.

CASE REPORT

The actual method of trauma in this case is interesting. The patient, a Royal Marine aged 38, was assisting to push a four-wheeled gun-trailer weighing 10 tons, and was standing on the right side, facing forwards, between the two wheels. The trailer was being pushed up a slight gradient, when it began to slip backwards, and the front wheel rolled slowly over his left foot, from the medial to the lateral side. The wheels had rubber tyres. He was seen within half an hour of the accident; the foot was already somewhat swollen, and a superficial wound, through the skin only, was present on the antero-medial part, as though the skin had been split open. A radiograph showed, not the multiple fractures of the metatarsal shafts that were expected, but the picture seen in the accompanying figure. The cuboid and cuneiforms appear to have been squashed together, and the base of the second metatarsal forced out of its mortise. The metatarsals have been forced laterally, the fifth completely dislocated, the second, third, and fourth being subluxated laterally to a lesser degree. The relation between the base of the first metatarsal and the first cuneiform is certainly abnormal, and it appears as though the metatarsal had been displaced below the