PERMANGANATES IN SLOUGHING AND TETANUS-INFECTED WOUNDS.

BY

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THE prevalence of sloughing wounds, and those infected with tetanus and gas-forming anaërobic organisms, among the wounded in the war, appears to make it advisable to record my experience of the value of permanganate solutions in the first two conditions, and to suggest the possibility of their usefulness in the third.

Permanganates in Sloughing Tropical Ulcers.

In 1909, in a paper read before the Assam Branch of the British Medical Association, but not published, I described a form of spreading, sloughing ulcer, known locally as Naga sore, which was causing so much loss of labour on tea estates that the Tea Association sent some cases to Calcutta for me to investigate. A fusiform bacillus, which would not grow on ordinary culture media, was found to be present in enormous numbers and to extend deeply into the tissues. Under ordinary antiseptics the ulcers continued to spread rapidly, and, thinking the organism might be anaërobic, I decided to try the effect of the oxidizing agents potassium permanganate and hydrogen peroxide. The results were most striking. A sloughing ulcer 2 in. in diameter, which had doubled in size within a week under mild antiseptic fomentations, within two days of the frequent application of a 1 per cent. solution of potassium permanganate in the form of cold compresses, presented a healthy red granulating surface; after two more days it had commenced to heal around the whole circumference, and proceeded rapidly to complete repair. In a second case a 10 per cent. solution of hydrogen peroxide cleaned up the ulcer quickly, although less rapidly than the far cheaper permanganate. I subsequently received reports from two Assam medical men that they had empirically come to the conclusion that strong solutions of potassium permanganate, 1 to 4 per cent., had a remarkable effect in cleaning up this form of sloughing tropical ulcer.

Cancrum Oris.

This is a common and very fatal complication of kala-azar, and most difficult to control in those emaciated and exhausted subjects with greatly reduced number of phagocytes. For several years past I have treated this gangrenous condition with very frequent washing with a dark purple solution of potassium permanganate (about 1 in 500), together with swabbing the ulcerated surface with a 1 per cent. solution two or three times a day. In several cases this treatment has stopped the sloughing of the tissues, and complete healing has followed, while in more than one patient recovery from kala-azar has ensued. A simple remedy which can control such a very septic condition as cancrum oris is worthy of trial in any form of sloughing wound.

Bedsore.

Encouraged by the success of permanganate in sloughing tropical ulcer, I soon after tried it in the case of a most extensive and deeply sloughing bedsore right across the sacrum, occurring in a remarkable case of streptococcal pneumonia and septicaemia, who had got over the lung inflammation, but was slowly sinking, apparently through septic absorption from the sloughing sacral ulcer. Several layers of lint soaked in 1 per cent. solution of potassium permanganate, and covered with waterproof material, were placed under the bedsore and changed every four hours, with the result that the ulcer rapidly cleaned up, and began to heal, and the man ultimately left hospital cured. In another case of a severe bedsore in a bad case of typhoid in an obese subject, an equally favourable result was obtained by this treatment after other means had failed. It is sometimes necessary to change the cold compresses every two hours to get the best results.

Suppurative Onychia.

Purulent inflammation around the finger-nails is sometimes a very troublesome affection in the tropics. In two

cases, after a variety of antiseptic applications, during several weeks, had completely failed to control the infection, the application of a strong solution of permanganate, until it was no longer decolorized on coming into contact with the discharge squeezed out from around the nail, completely cleared up the condition within three or four days.

Secondary Infection of Liver Abscess Pus.

Although amoebic liver abscesses are nearly always sterile as regards bacteria when first opened, in a damp hot climate the profuse discharge almost invariably becomes infected with a variety of organisms, and is often foul smelling. By irrigating the cavity with a solution of 1 in 500 potassium permanganate, until it returns unchanged in colour, I have repeatedly seen the discharge become sweet and greatly reduced in amount, much to the benefit of the patient.

Explanation of the Above Results.

Potassium permanganate is not usually looked on as a very powerful antiseptic, although very strong solutions do possess considerable bactericidal properties. We must therefore look for some other explanation of the results above recorded than the effect of this salt in destroying pathogenic bacteria. I believe that its most important action is its power of oxidizing, and rendering harmless, the toxins produced by bacteria, which produce a negative chemotaxis, and thus prevent the phagocytic polynuclear leucocytes from dealing with the invading organisms. When their toxins are destroyed by the permanganate they no longer repel the phagocytes, which can now protect the system against their invasion in a manner which non-oxidizing antiseptics fail to allow.

Another advantage permanganates possess is that their oxidizing powers can be exerted by strengths which are too weak to injure the tissues themselves, and, by continuing their application until the solution is no longer decolorized, we can be certain that their full effect in destroying any easily oxidized substances, such as toxins are, has been obtained. I have already recorded experiments demonstrating the action of permanganates in destroying the toxins of the cholera and dysentery bacilli, and the successful application of this knowledge in the treatment of these diseases.

Permanganates in the Prevention of Tetanus and other Infections due to Anaërobic Organisms.

It may further be worth recalling at the present time that several years ago I recorded in this JOURNAL (1905, vol. ii, p. 1290) some experiments illustrating the action of permanganates in preventing the infection of wounds by the tetanus bacillus. Five out of six rats, under the skin of whose backs a small quantity of Calcutta street dust had been inserted, died of tetanus; but of six more in which a crystal of potassium permanganate was added to the dust, only one succumbed to the disease. In a second series of animals multiple incised wounds were made in the thigh down to the muscles, and some street dust rubbed in. Of six controls four died of tetanus and one of staphylococcus septicaemia. In three other rats the wounds were washed with a strong permanganate solution half an hour, and in another three one hour, after infection with the same dust. In all six animals treated with permanganate the wounds healed rapidly without any sloughing or tetanus infection.

It is well established that if tetanus spores are thoroughly washed, so as completely to deprive them of their toxins, they may be injected with impunity into a susceptible animal, as the phagocytes can destroy the toxin-free organisms. The destruction of the toxins by an oxidizing agent, such as permanganate, would appear from the above experiments to have a similar effect.

It is not unlikely that permanganates may similarly be able to deprive virulent septic organisms of their powers of infection, but I have never been able to find time to test this experimentally.

The infections with gas-producing organisms, which are being reported among the wounded, are probably due to anaërobic bacilli. Permanganate irrigations may very possibly prevent such infections as well as that of tetanus. Antitetanus serum is certainly an effective prophylactic against tetanus, and has been successfully used in dust

infected wounds in Calcutta. It should never be omitted when available, but under war conditions it may often not be at hand when required.

Conclusion.

In view of the experiences recorded in this note the use of strong permanganate solutions, not less than 1 in 500, for irrigating all dust and earth infected wounds appears to me to be well worthy of trial in the field. The crystals are so easily carried, and the solutions so harmless, that this simple plan could be easily carried out at the dressing stations in the case of all wounds in which any sloughing or suppuration has already commenced, or into which dust or earth is likely to have penetrated, with good hope of lessening the number of cases of tetanus, septic and anaerobic bacillary infections.

IODINE AS AN ANTISEPTIC IN JOINT INJURIES.

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THE accompanying case of severe lacerated wound exposing the knee-joint following an aseptic course after treatment by no other antiseptic than iodine is of special interest at the moment when the claims of the more caustic applications are being advocated:

S. McD., aged 30, shipwright, employed in Portsmouth Dockyard, while at work on November 18th, 1914, in the upper part of an ammunition hoist in a battleship under construction, fell with the staging to the bottom of the hoist, a distance of 40 ft., striking his right leg on some angle-iron. He suffered a severe lacerated wound rupturing the ligamentum patellae and the anterior capsule, widely exposing the interior of the knee-joint. He was with difficulty removed from the bottom of the hoist and received first aid in the dockyard. He was admitted to hospital at 11 p.m., about four hours after the accident.

Condition on Admission.

He was suffering from shock and collapse from haemorrhage. The pulse was 120. The interior of the right knee-joint was exposed by a lacerated wound forming a V-shaped flap, the point 5 in. below lower border of patella, the wings extending to either side of the joint. Part of the tubercle of the tibia was torn away and attached to the patellar ligament which was badly damaged. The anterior part of the capsule of the joint was torn through and was ragged. The crucial ligaments were intact. The joint was full of clot and the whole wound begrimed with oily dirt. There had been considerable haemorrhage and a tourniquet was on the limb.

Operation.

An operation was performed immediately under open ether anaesthesia. Intravenous saline was given at the same time. The wound was protected and the skin of the whole limb was shaved and shampooed with ether soap, cleaned with spirit biniodide (1 in 1,000), dried and sprayed with iodine 2 per cent. in alcohol. A very thorough toilet was performed. The edges of the skin wound were pared about $\frac{1}{4}$ in. all round. The gauze protection was removed from the wound, and all clots and dirt washed out of the joint by irrigation with normal saline solution. All badly soiled and damaged tissue, including the greater part of the patellar ligament, was cut away, and the joint thoroughly swilled with iodine solution, a gloved finger puddling the solution into all the synovial pockets. The iodine was immediately washed out with saline and the process repeated. The remains of the patellar ligament were sewn to the remains of the periosteum and deep fascia about the tubercle of the tibia with iodized catgut. The capsule was not completely closed. The skin was sutured with a special form of mattress stitch of silkworm gut. To allow for oozing of serum the extremities of the wound were not completely closed, but artificial drainage was not employed. The closed wound was sprayed with iodine and covered with sterile gauze and cotton-wool, and the limb placed in a back splint with side protection.

Progress.

The subsequent course was that of an aseptic operation on the joint. There was slight rise of temperature for the first forty-eight hours, after which it fell rapidly to normal; there was some slight oozing for the first day. Pain and constitutional disturbance in this case were less than occurred in a case of excision of semilunar cartilage performed on the same day after long preparation and under the strictest aseptic precautions. The wound has been sprayed with iodine daily, and has healed by first intention except at one corner where drainage was allowed. On the fourteenth day after the accident there was no pain, no effusion, and passive movements were commenced. The patient was sitting in a chair with the leg on a back splint.

The routine described above—that is to say, thorough skin toilet, paring of every particle of soiled and badly damaged tissue, swilling with iodine 2 per cent. in alcohol and with saline alternately, closure of the wounds by piling up the skin edges with mattress sutures to ensure complete coaptation, and the avoidance of artificial drainage—has been employed in all cases of lacerated wounds and compound fractures, and wounds of joints treated by me in the naval hospitals of Chatham, Plymouth, and Haslar during a period of four years. No other antiseptic than iodine is used in contact with the wounds. The results have been most gratifying. Sepsis has been extremely rare, and when it has occurred has invariably originated in the skin wound and never in the depths of the wound. The mattress sutures employed reduce the chances of infection by the skin wound. Every effort is made to secure rapid healing of the skin. Every particle of damaged skin is removed, plastic manœuvres being sometimes necessary to secure easy coaptation. A loose stitch or two permits free drainage of serum, and these gaps are closed as soon as possible. It is a great safeguard to spray the wound daily with iodine.

The case here recorded is the severest test to which I have subjected this method of treatment by iodine. If the repair of the ligamentum patellae proves efficient there is every prospect of a perfect functional result. Would such a functional result be likely after an application of pure carbolic?

While recording the almost uniform success of the iodine treatment without drainage in my experience, it is only fair to say that the cases admitted into the naval hospitals have generally received their injuries in ships or dockyard workshops, where they are not likely to be infected by very virulent organisms; also, we receive the patients very shortly after the occurrence of the injuries, and not infrequently iodine has been immediately applied to the wounds on giving first aid.

It will be noted that I have referred to "spraying" iodine. Iodine applied by means of an ordinary continuous bellows spray-producer is a most handy, efficient, and economical method. By this means the expenditure of iodine in this and other naval hospitals has been reduced to one-tenth of the amount formerly used when the solution was applied with swabs and brushes. A spray-producer with hook attachment, by which it can be fastened to the belt or coat, should prove useful for ambulance work in the field.

A SIMPLE FORM OF PORTABLE DRESSING STERILIZER.

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As there is much need at the present time for surgical equipment which combines simplicity of construction, and therefore moderate cost, with efficiency I think it right to publish an account of an improved form of the sterilizer for dressings which I introduced a good many years ago. The appliance was originally devised for sterilizing steel instruments with steam without rusting them, and for this purpose I introduced the method of controlling the direction of the current of steam by means of a three-way stopcock inside the sterilizer.¹

This device enabled me to give effect to a suggestion made to me at the time by Professor John Haldane, of Oxford, which was to heat the instruments before the steam came in contact with them and thus avoid condensation of moisture on their surface.

Shortly afterwards, however, the method of boiling instruments in a weak solution of alkali was introduced, and as this was a better method I adopted it for instruments and applied the sterilizer to the sterilizing of dressings.² For this purpose it has proved relatively better adapted than it was for instruments. The control of the direction of the steam by means of the internal stopcock with the pipes leading from it has two advantages—it enables one to finish the dressings practically dry, and it makes it possible with a very simple mechanism to introduce the steam into the inner chamber at the point or points most suitable for rapidly permeating