POTASSIUM PERMANGANATE IN THE TREATMENT OF ANAEROBIC INFECTION OF WOUNDS.

(A Preliminary Note.)

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If the projectiles themselves be excluded, the chief danger to the soldier in France and Belgium arises from the activity of anaerobic facultative parasitic micro-organisms, more particularly the Bacillus aerogenes capsulatus (B. Welchii). It is the prevention and control of infection by this bacterium that forms the chief problem for surgeons working in casualty clearing stations.

During the past year the author has employed potassium permanganate in the dressing of severe lacerated wounds, and has critically compared its effect with that of other antiseptics. It is because the writer is convinced that in this germicide we have at our disposal a very valuable prophylactic and curative agent, and one deserving, at least, a more extensive trial by other surgeons, that this note is published.

In the treatment of severe lacerated wounds certain operative and mechanical procedures are essential; these comprise:

(a) Arrest of haemorrhage—vascular and capillary.
(b) Provision for the evacuation from cavities of blood and transudates; adequate drainage.
(c) Excision of all obviously devitalised tissue, whether such tissue has been killed by the force of the projectile, interference with blood supply, or by the activity of gangrene-producing microorganisms.
(d) Proper posturing and adequate splinting.
(e) Conservation of circulation.

In many, perhaps the majority of cases, such treatment will suffice; and, unless these measures are conscientiously carried out, supplementary treatment will avail but little. There is, unfortunately, a large percentage of cases in which, owing to various causes, these operative and mechanical measures prove inadequate, and for which some solution having a bactericidal or inhibiting effect upon the bacilli must be employed.

It is not the author's intention in this note to contrast the effect of solutions of potassium permanganate, eusol, hypertonic saline,
etc. Both eusol and saline solutions have been employed, but owing to the satisfactory results obtained with permanganate this preparation has been made use of with increasing regularity.

Reasons for the employment of potassium permanganate in the dressing of severe lacerated wounds and of gas gangrene infection may be tabulated as follows:

1. It is inexpensive, even at its present increased price.
2. It is a powerful oxidizing agent.
3. It is an effective germicide (even in dilutions much greater than may be profitably employed).
4. It is astringent, thus acting as a hemostatic, minimizing oozing and controlling the development of interstitial œdema.
5. It does not macerate epithelium nor other tissues.
6. It is a mild irritant in the dilutions employed, and hence stimulates the circulation of blood through adjacent tissues.
7. It causes but little pain.
8. It induces the prompt appearance of firm, healthy granulations and the early separation of sloughs.
9. It does not stain nor otherwise alter the appearance of tissues other than those which are necrotic.

The chief objection to the employment of the drug is that it is a dirty preparation, and renders both dressing and bed linen unsightly.¹

Certain precautions in its employment are necessary. Solutions must be prepared at least once daily. Water above a temperature of 110° F. should not be used in preparing the solution, nor should the solution be heated above this point. When hydrogen peroxide has been employed as a cleansing fluid this should be washed off with saline or an excess of potassium permanganate before the dressing is applied.

A solution of two or three per cent is applied in dressing patients who are under an anaesthetic, while for patients who are conscious a solution of one half to one per cent is less irritating. The burning sensation, of which some patients complain, is of very short duration, passing off in five minutes, or even less.

In applying the dressing it is important that a sufficiently large dressing be employed. The author uses sufficient loosely shaken-out gauze soaked in the solution to fill in all cavities and crevices.

¹ Instruments, gloves, bowls and hands which have been discoloured can be readily cleansed by means of small quantities of acidified hydrogen peroxide solution.
Potassium Permanganate in Treatment of Wounds

in the wound. Through this, gauze numerous small rubber tubes protrude. Several thicknesses of gauze cover the surface of the wound. Over this is placed one or two thicknesses of cotton wool also soaked in the solution. The whole is then covered with jacout or with dry cotton wool. Owing to the absence of maceration an impermeable covering may be employed with advantage in many cases.

Dressing should be changed more or less frequently, depending upon the nature of the case. It is unusual for it to be necessary to change the dressing next to the wound more frequently than once in twenty-four hours.

As a rule, it has been found useful to repeat the permanganate dressing for four or five days, although not infrequently, even in cases in which gross gangrene has been present, two dressings suffice to arrest infection and prepare the wound for treatment by means of some bland dressing such as saline or boric acid.

In the treatment of those parts of the body which can be advantageously treated by baths, potassium permanganate in dilutions of 1 to 200 to 1 to 500 is used.

It is difficult to analyse results of treatment upon the statistical basis, since the wounds vary so greatly in extent and importance of tissue injured and in the length of time which intervenes between the reception of injury and their coming under observation at the clearing station. Variations, also, in the nature, size, and velocity of the projectile and in the amount of contamination influence profoundly the cause of reaction and repair in the wound.

The difficulties of keeping accurate records in a clearing station—more particularly during those periods of activity when most cases are seen—increase the difficulties of analysis.

Several hundred cases have come under the author's observation; of these a large percentage, at the time of admission, showed evidence of aerogenes infection. Of these some forty had massive or rapidly extending gas gangrene. Three cases were moribund as a result of aerogenes infection, and although efforts were made in all three cases to control the disease and stimulate the heart all died within four hours of admission.

Conservative interference, if so far as this refers to amputation, has been practised in all cases, and in but one case—a penetrating wound of the chest—has a patient been lost as the result of aerogenes infection and toxæmia. Many patients have, of course, died as a result of the severity of the wounds, and, unfortunately, a certain number of those cases which are evacuated are known to
have ultimately succumbed to chronic intoxication, intravascular thrombosis, etc.; but in so far as gas gangrene itself has been concerned our results have been very gratifying. Nor have we any undue proportion of other wound complications. The great majority of cases have been evacuated with wounds free from slough, with granulation progressing favourably and with the patients constitutionally in relatively good condition.

In a very large group of severe lacerated wounds of the buttock, thigh and arm, seen early and before aerogenes infection had made itself manifest, our results have been uniformly good. In a certain number of cases of this nature other preparations, more particularly eusol, have been employed. The results in such cases have been less satisfactory, and we have returned to potassium permanganate as the dressing of choice.

**Summary.**

Unless adequate operative and mechanical treatment of wounds infected with the *B. aerogenes capsulatus* is carried out, no antiseptic employed as a dressing will be of value.

Potassium permanganate should be employed in the dressing of all wounds in which *B. aerogenes* infection has commenced, as evidenced by the characteristic odour, the anchovy-sauce-like discharge, gas bubbles, emphysema or tympanites of the tissues, and the pinkish, dull alteration in the appearance of the muscles. In addition, all the more extensively lacerated wounds, especially if accompanied by bone comminution or injury to important vessels, are best treated with potassium permanganate dressings.

In the author's hands potassium permanganate solutions in dilutions of from three to one half per cent have proved more efficacious in the prophylaxis and treatment of wound infection by the aerogenes group of anaerobes than other preparations.