THE SURGICAL AND ANTISEPTIC VALUES OF HYPOCHLOROUS ACID (EUSOL).

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In June, 1915, we first began to make use of 0.5 per cent hypochlorous acid (eusol) as an antiseptic. Six months have now elapsed and it may be of interest to summarize its relative values. Previous to adopting hypochlorous acid, use and experiment had been made of all the better-known antiseptics, and therefore the ultimate adoption of a single antiseptic was of interest, as the comparison brought more clearly into view the relative advantages of the more newly employed method. For facility of description the use of hypochlorous acid (eusol) will be described under two headings:—

(a) General use—in simple general wound treatment.

(b) Special use—in special wounds, or in special body localities or diseases.

It is unnecessary to enter into any detail regarding the preparation of the solution of hypochlorous acid (eusol); for such details one is referred to the paper by Professor Lorrain Smith and others in the British Medical Journal of July 24, 1915.

Briefly our method of preparation was as follows: In a Winchester quart bottle twenty-seven grammes of dry bleaching powder were placed, and to this one litre of water was added; the mixture was shaken, and twenty-seven grammes of boric acid were added; the bottle was now filled with water, the solution was thoroughly shaken, allowed to stand for a few hours, and then filtered through cotton wool. The clear solution is eusol; it is slightly alkaline to litmus and it contains approximately 0.5 per cent hypochlorous acid. The solution was stocked in air-tight stone jars.

(a) General Uses.

In war work it may be accepted as a general principle that every wound is an infected one, and naturally the further principle follows: that the treatment of such wounds must be adopted on antiseptic lines. In dealing with such cases two ideals are kept in view: thorough drainage of the part, and as complete disinfection
of the wound as is possible. The efficient antiseptic is one which, while it exerts its antiseptic action, does not devitalize the body tissues; it seems to us that in the hypochlorous acid solution (eusol) we have as nearly as possible the ideal antiseptic.

In an ordinary gunshot or stab wound our procedure has been to open up the wound as thoroughly as possible; its interstices and crevices are thoroughly washed out with eusol, the solution being warmed to body temperature. A laterally perforated tube is passed into the wound, and around the tube, between it and the wound edges, gauze soaked in warm eusol is lightly packed, while over the wound surface similarly treated gauze is placed. The frequency of dressing depends on the condition of the wound, if there be a gross infection the dressing is repeated every four hours; in lighter infections the interval is correspondingly lengthened. It is not necessary to change the tube or even the surrounding gauze at each subsequent dressing; it is often sufficient to inject fresh eusol into the tube from which it is dispersed through the lateral openings into the surrounding gauze. We have found it essential, however, to change the tube at least once in twenty-four hours, and the gauze at least twice. It has been our experience that under this treatment infection rapidly disappears from the wound. It is a striking fact that suppuration does not occur, or if it has been present in the wound, it disappears very rapidly after application of the solution. A suggestion has been made to us that this is a disadvantage as the excretion of deleterious matter is prevented; we have not observed any such disadvantage, and probably disinfection and elimination of toxin are so thorough that any such excretion is unnecessary. Healthy granulation tissue begins to appear within fifty-six hours, and having appeared it grows with remarkable rapidity. When the stage of granulation tissue formation has been reached we have found it advantageous to intermit the eusol dressing for periods of twenty-four hours with dressings of hypertonic saline solution.

At this point it is important to discuss the disadvantages or objections which may be raised to this method of treatment. Four of these have at one time or another presented themselves, but, on investigation, they have all proved negligible. They are:

(1) *Pain in the Wound.*—When the stage of granulation tissue formation has been reached, a stinging, burning pain is complained of after the application of the eusol, which lasts for a period of about thirty minutes. We have never noted that the pain possessed any real degree of severity, and probably it is less than that produced by almost any other variety of antiseptic.
To illustrate "The Surgical and Antiseptic Values of Hypochlorous Acid (Ensol),"
b by Captain John Fraser and Captain H. J. Laxes, R.A.M.C.
(2) Irritation of the Surrounding Skin.—In only a single instance out of an experience of several hundreds of cases have we seen this occur. We believe that reasonably frequent changing of the dressing entirely prevents its occurrence.

(3) Arrest of the Wound Secretion.—Undoubtedly throughout the first three days of the application of the antiseptic the wound under treatment is drier than one would expect in such a wound, and, as we have mentioned, this fact has been quoted to us as a disadvantage. We have never found any disadvantage arising from this.

(4) The Surrounding Skin becomes Dirty.—Eusol mixed with blood pigment forms a greenish compound on the skin which is dirty in appearance and somewhat difficult to remove, but the compound is assuredly an antiseptic one, and after some days it can be washed away. No other objections have been quoted to or observed by us.

(b) Special Uses.

Gas Gangrene.—One of the most dreaded complications which arises in modern warfare is the infection of a wound with a gas-producing organism. Wounds inflicted in warfare under modern conditions especially as regards locality would appear to be particularly liable to such infection. In these cases eusol has proved of inestimable benefit. A summary of experience in this connection was published in the British Medical Journal of October 9, 1915. The infected wound is treated on the scheme which we outlined in describing the general treatment of wounds, and special attention is paid to frequent changing of the dressing. The usual experience is that the infection is early and completely arrested. Occasionally cases of this description come under our care so late that local measures are insufficient, and amputation is the only possible procedure. In order to procure the best stump, it is frequently necessary to cut the flaps so that they pass through what appears to be infected tissue. We, have frequently done this with impunity since we adopted the use of hypochlorous acid. It is sufficient to open up the gas-infected area, and wash it out thoroughly with the antiseptic.

Compound Fractures.—The persistence of infection in cases of compound fracture is notorious, and we have noted great improvement in the treatment of such cases; the infection early disappears, and further measures of treatment can be more readily undertaken. Further, the absence of suppuration and the arrest of infection
have greatly reduced the necrosis and subsequent sequestrum formation which is so troublesome.

Joints. In severe cases, where the joint is disintegrated, we have had the same experience as in cases of compound fracture. Special mention must be made of small penetrating wounds of joints causing a haemarthrosis; these are almost invariably infected; bits of clothing have been recovered from the joint cavity, and the general and local conditions may point to the presence of pus. It is our practice at once to open and drain the joint, and irrigate with warm eusol. The inflammation has quickly subsided, and the joint has shown no signs of the formation of adhesions. In cases where the cartilage has been visible, no granulations or appearances of destruction have been seen on its surface.

Cranial Surgery. A large proportion of the cases with which we have to deal are compound fractures of the skull, associated usually with extensive injury to the underlying brain. Almost without exception the cases are infected and, we believe, that the main degree of the mortality in the more recent type of case is due to a progressive septic change in the brain.

While the operation is proceeding, we have found benefit by having a continuous irrigation of the tissues with eusol: the warm fluid is suspended in a vessel above the patient and continuous irrigation is thus ensured. In all subsequent draining and dressing the same antiseptic is employed. By these means we believe we have reduced the degree of septicity in such cases.

Chest Surgery. Empyema. We find that we can with perfect safety irrigate the pleural cavity with a warm solution of eusol. The cases in which we have used the method have been those of infected bullet or shell wounds with subsequent empyemata. No doubt the cavity was localized where the irrigation was employed. Subsequent to the use of the antiseptic the discharge invariably diminishes and disappears more quickly than we had previously experienced. It seems to us that in these cases its use is ideal and we have had no experience of the complications which are usually so dreaded from adopting such a procedure.

Abdominal Surgery. We have had experience of this antiseptic in three different types of cases under this heading—in appendix abscesses, in general peritonitis, and in cases of bullet wounds of intestine or other viscera. Before using the antiseptic in the peritoneal cavity we carried out some experiments on rabbits, in which we opened the abdominal cavity and thoroughly washed its surface with eusol, leaving a certain amount in situ before closing
the wound. Subsequent examination showed no deleterious effect, not even in the shape of an adhesion.

In the treatment of appendix abscesses we have had satisfactory results: the discharge was arrested and healing proportionately hastened.

In regard to general peritonitis we speak with great diffidence, as our experience with the antiseptic in such cases has been limited to a single example. Briefly, the facts are as follows: A man was admitted to hospital who, four days previously, had had an onset of acute appendicitis. When admitted he was found to be suffering from acute general peritonitis; the appendix was ruptured and extensively gangrenous; the abdominal cavity was actually as full of pus as it could be, and there was a large subphrenic collection on the right side. Drainage was established in the pouch of Douglas in both iliac fossæ in the right kidney pouch and in the right subphrenic region. Twelve hours later irrigation with eusol was carried out through the various drainage tubes. At the next dressing it was noted that the discharge had entirely altered; it was now almost clear and up to the period of writing, i.e., four days after operation—the discharge has practically ceased, while the patient is making a satisfactory recovery. But as we have said we quote the result with great diffidence, as our experience in this relationship is limited and the result we have quoted may be merely a coincidence.

Cases of perforating wounds of the abdomen which have been operated on and which require subsequent drainage of the peritoneal cavity, we invariably irrigate through the tubes, with very beneficial results.

Urethritis.—Cases of chronic urethritis appeared to be very suitable for treatment with eusol and, consequently, irrigation was carried out with eusol of known strengths (titration being done) 0·17, 0·25, 0·5 per cent hypochlorous acid. In some cases pain was experienced with the strong solution, in the others it was comfortably borne in full strength and proved to be very efficient. The discharge became rapidly less.

In cases of acute urethritis we had not so much success. There was considerable pain and smarting, and the solution appeared to be too irritant for the highly inflamed mucous membrane of the urethra.

Finally, we wish to mention a special use of eusol to which

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1 This case made a complete and rapid recovery.
reference has been made in a paper by Professors Lorrain Smith and Ritchie and Dr. Rettie (British Medical Journal, November 13, 1915)—namely, its value as an intravenous injection in the antagonism of toxæmias.

We have experienced a number of cases of acute toxæmia subsequent to infection of a wound with a gas-producing organism. Hitherto, such toxæmias have been fatal in a considerable proportion of cases. In such cases we now employ intravenous injection of eusol, varying in amount from forty cubic centimetres to seventy cubic centimetres. To the eusol common salt is added in the proportion of 8.5 grammes of salt to the litre of eusol. With this method of treatment we have had most gratifying results. These form the subject of a communication at present in process of publication (British Medical Journal, January 15, 1916).

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