DAKIN'S "DICHLORAMINE-T" IN THE TREATMENT OF THE WOUNDS OF WAR.

By JOSHUA E. SWEET, A.M., M.D., F.A.C.S.,
PROFESSOR OF SURGICAL RESEARCH, UNIVERSITY OF PENNSYLVANIA,
PHILADELPHIA, PA.; CAPTAIN, MEDICAL RESERVE CORPS,
UNITED STATES ARMY.

UNITED STATES ARMY BASE HOSPITAL No. 10, FRANCE.

(Report to the Medical Research Committee.)

[AFTER a short preliminary discussion of the advantages and disadvantages of such chlorine-containing solutions as eusol, Dakin's solution, and Daufresne's modifications thereof, Professor Sweet states that Dr. Dakin entrusted the honour of testing the surgical value of dichloramine-T (toluene-para-sulphodichloramine), described by Dunham and Dakin in the *BRITISH MEDICAL JOURNAL* of June 30th, to Dr. Walter E. Lee, of the Pennsylvania Hospital, and himself. The results obtained there are being published in America (*Journal of the American Medical Association*), but Professor Sweet, working with the United States Army Base Hospital No. 10, has since been able to test the effect of the new preparation on war wounds in a British general hospital in France. With regard to the results there he reports as follows:]

We have treated some eighty patients with Dakin's "dichloramine-T"; some have been old cases with foreign bodies lying in the bone, and suppuration did not stop until the foreign body was removed. Fresh cases, in which enough integument was left to permit it, have been treated with dichloramine once and immediately closed, and have healed by secondary intention. Sixteen cases, old and fresh, were cultured after treatment with "dichloramine-T" for varying periods, of which eleven gave no growth whatever; of the five in which a growth appeared, four were old cases of deep bone involvement; the only growth was the *Staphylococcus aureus* in four cases and in one case the *pyocyanus*.

The wounds fill rapidly with granulation tissue of healthy colour, which exhibits no tendency to exuberant growth and no tendency to become water-soaked and indolent; the skin edges grow in very rapidly.

These results are no different from those which can be obtained by other methods, and no one would believe them if they were any better. Let me say, therefore, that the surgeons of the unit are agreed that the wounds treated by "dichloramine-T" are in every way as satisfactory as they have ever seen under any method; and two of our surgeons have had previous experience in France, while all are surgeons of long experience in civil practice.

The results along other lines are capable of more definite demonstration, and it is on these that I would lay the most emphasis.

The new "dichloramine" solution is made by dissolving the crystals of "dichloramine-T" in chlorinated eucalyptol and then diluting this solution by the addition of chlorinated paraffin oil. It is best applied by an oil spray, an ordinary hard rubber or all-glass atomizer being the most practical method. Metal atomizers are not suitable, since the metal is attacked by the chlorine. This oily solution presents the first great advantage—the dressings do not stick to the wound and the entire act of dressing is relatively painless. The gauze does not have to be separated from the granulations by soaking. It is therefore not even necessary in the average wound to place a waterproof protective covering over the bed-linen while dressing, and the necessity of moving the part or the patient is obviated. The old dressing is simply lifted off, and the wound sprayed; the force of the spray will dislodge sloughs, and the wound is covered with a fresh dressing. It is evident that a very important saving of time results from this simplicity of dressing. One surgeon has repeatedly dressed thirty wounds in ninety minutes—an average of three minutes to each dressing. These figures and the figures to be given later, refer to the acute wards, where the patients are all bed patients.

The solution contains enough available antiseptic so that one dressing every twenty-four hours is ample for large, deep wounds, and one dressing every forty-eight or seventy-two hours is enough for the simple or more superficial wounds. Since the solution contains so much

available chlorine and does not have to be renewed every few hours, the use of the Carrel tube is entirely done away with. The oily solution of "dichloramine-T" creeps into all the wound crevices and corners, and it can be readily introduced into sinuses by means of a cotton swab dipped into the solution.

The amount of this new solution needed for wound dressing should be emphasized. At first thought it would seem that a solution containing oil of eucalyptus and paraffin oil would be far too expensive for general use in comparison with eusol. Forty-two wounds were dressed by one surgeon with 35 c.cm.; another surgeon dressed 154 wounds with 115 c.cm. These figures apply to the acute wards, and include many compound fractures and extensive buttock and thigh wounds. The fact that so little fluid has to be used, and that therefore only the wound discharge has to be cared for, results in a tremendous saving of gauze and cotton. I give below a table of the results of a comparison of the amounts of gauze and cotton used during different periods in the four acute surgical wards of the hospital. Each ward is in charge of surgeons of equal skill, and all trained in the same hospital; the nurses are also all graduates of the same hospital training school; in other words, the comparison is not between workers trained in different schools of surgical technique.

TABLE I.—Gauze and Cotton-wool Used July 5th, 1917.

Wards.	Gauze (6-yard rolls).	Cotton (1-yard rolls).	Treatment.	No. of Patients.
1	12	2.5	Eusol	23
2	10	4	Eusol	22
3	3.5	2.5	Dichloramine-T	23
4	6	2.5	Eusol	25

Taking a longer period, the amount of gauze and cotton used in seven days by three of the acute surgical wards is given in Table II. Ward 2 changed during this period from the use of eusol to the use of dichloramine-T; the figures from this ward are therefore not available. The number of patients was the same in the three wards, and the proportion of relatively slight and extensive wounds in each ward was the same.

TABLE II.—Gauze and Cotton-wool Used from July 4th to July 10th, 1917, inclusive.

Ward.	Gauze (6-yard rolls).	Cotton (1-yard rolls).	Treatment.
1	72	38.5	Eusol.
3	33	7	Dichloramine-T.
4	45	18	Eusol.

This saving of material is of importance in several ways. Not only does it effect a saving of labour from the cotton field to the hospital, not only a saving of transport, but an important saving in the hospital itself; the time taken by the nurses in the preparation and sterilization of material can be utilized for the care of the patients, and to this can be added the saving in time, labour, and material by doing away entirely with the need for the Carrel tubes. The need for so little solution in wound dressing, and the fact that the dressing need only be sufficient to care for the wound discharge means that the bed-linen is not wet, with a consequent saving in the moving of the wounded, and an increase in their comfort and well-being.

The dichloramine-T solution, like all the other chlorine compounds, is a very active lymphagogue in fresh wounds, and the amount of wound excretion may be considerable. The lymphagogic effect may be directly watched in suitable wounds. As granulation tissue develops, the lymph discharge greatly decreases until the wound becomes comparatively dry. The dichloramine-T also possesses to a marked degree the characteristic power of the chlorine solutions in aiding the digestion and removal of necrotic sloughing tissues. The new solution seems more effective in cleaning up sloughing tissue than the older chlorine compounds. While the majority of our cases come from

the casualty clearing station in excellent, clean condition, a sufficient number have reached us with necrotic tissue in the wound amply to satisfy us of the rapidity with which the dead tissue is freed under the dichloramine-T. The tendency to secondary haemorrhage is certainly not increased. We have had only one secondary haemorrhage in the series, which includes a number of deep buttock wounds, and cases of exposed great arteries of the arm and leg.

The solution is not irritating to the skin or mucous membrane, except possibly in the rare individual who possesses an idiosyncrasy to the eucalyptus oil. Such individuals have been reported in dermatological literature. Among the patients treated here we have encountered only one case of dermatitis, but since it did not develop until after two weeks' use of the solution and was accompanied by high temperature, it is not clear that it should be ascribed to the eucalyptus oil or to the well-known action of wound excretion.

The constituents of the solution are stable although the final combination is not indefinitely stable nor can it be exposed to strong light. It is easily prepared from the constituents. The dichloramine-T which I have was put up in packages of 10 grams each; the content of one package is dissolved in 75 c.cm. of chlorinated eucalyptol and diluted with equal parts of chlorinated paraffin oil as needed, making, therefore, approximately a 6.5 per cent. solution of dichloramine-T.

The first application of the solution to a fresh wound produces a smarting or burning sensation, which passes away in a very few minutes; in some individuals this seems quite severe, but I have yet to see the patient who does not prefer this slight smarting to the real pain of removing a wet dressing which has dried around the edge of the wound. After the second or third application this smarting sensation on applying the solution seems to have disappeared.

Since the time to treat an infection is before the infection starts, it is hoped that the dichloramine-T solution can be given an early trial at the field ambulance and casualty clearing stations.

Conclusions.

Dakin's "dichloramine-T," in solution in eucalyptol and paraffin oil, is of great advantage in wound treatment—even if the final results in wound healing were no better, because—

1. It saves the pain of wound dressing.
2. It effects an appreciable saving of dressing material.
3. The amount of solution needed is of small bulk.
4. The number of wounds which a surgeon can dress in a given time is far greater than by any other method.
5. The elimination of the Carrel tube simplifies the dressing and the problem of transportation of the wounded.
6. The elimination of the Carrel tube saves the time taken by the nurse for the periodic flushing.

AN EXPEDITIOUS METHOD FOR THE STUDY OF ENTERIC STOOLS:

A REPORT ON THE EXAMINATION OF 1,200 SPECIMENS OF FAECES FOR ENTERIC ORGANISMS.

BY

F. B. BOWMAN, M.B.TORONTO, MAJOR C.A.M.C.,

OFFICER COMMANDING NO. 2 CANADIAN MOBILE LABORATORY.

(Report to the Medical Research Committee.)

DURING six months in 1916 the examinations of faeces for enteric organisms (*B. typhosus*, paratyphoid A and B) made at this laboratory numbered 1,200. No claim for originality is made for the technique adopted, and the procedure is reported as having been, in my experience, efficient as well as simple. A minimum of culture media, glass-ware, etc., is required, and the culture media are easily prepared.

Nearly all the samples were sent from a hospital which admitted only patients convalescent from enteric fever or dysentery, and Army Council instructions in regard to the routine examinations were carried out carefully.

Each patient was given a numbered basin, and the specimen was obtained from this. We have always used

specimen containers (supplied by Messrs. Baird and Tatlock) consisting simply of small, wide-mouthed bottles, well stoppered with an ordinary cork, in the centre of which is fastened a small child's toy tin spoon, the whole enclosed in a wooden case.

Materials Required.

1. Peptone Water.

Peptone (Baird and Tatlock) ...	10.0
Sodium chloride ...	5.0
Water ...	1,000.0

To dissolve, place in autoclave for five minutes. Shake well, filter, and tube. Sterilize in autoclave at 15 lb. for fifteen minutes. Each tube should contain about 5 c.cm.

2. Endo's Medium.

Liebig's extract of beef ...	10.0
Sodium chloride ...	5.0
Peptone ...	10.0
Water ...	1,000.0

Dissolve in autoclave at 120° C. for five minutes. Add 30 grams of washed agar, and autoclave at 120° C. for fifteen minutes. Filter and neutralize to litmus. Add 10 c.cm. of a 10 per cent. solution of sodium bicarbonate and 10 grams of lactose. Place in steamer for one half-hour. When plates are to be poured, the above stock (1,000 c.cm.) should be melted and 5 c.cm. of alcoholic basic fuchsin solution (basic fuchsin 3 grams, alcohol 57 c.cm.) added, and 25 c.cm. of a 10 per cent. solution of sodium sulphite. Then steam for fifteen minutes and pour into plates. Allow to cool and store in the dark till ready for use.

By placing a circle of blotting paper in the lids of the Petri dishes before sterilizing them, all the water of condensation is absorbed; this aids greatly in making successful cultures.

3. Hiss Medium.

Liebig's extract ...	5.0
Sodium chloride ...	5.0
Distilled water ...	1,000.0

Dissolve in autoclave at 120° C. for five minutes, add 8 grams of washed agar and melt in autoclave at 130° C. for five minutes. Add 20 grams washed gelatine, dissolve and cool to 45° C. Clear with the white of one egg in the autoclave at 120° for five minutes, filter, and to filtrate add 1 per cent. of dextrose and sterilize in the steamer for one half-hour. Put about 5 c.cm. into each tube and sterilize in the steamer again. This medium at 37° C. remains quite solid, and will retain gas bells.

I have found that the following procedure saves twenty-four hours in the examination of suspected colonies.

The tubes containing the Hiss medium are placed upright in a basket in a basin containing ice water, and a few cubic centimetres of a fairly stiff plain agar is poured into each tube and the tube immediately sloped, producing the result shown in the diagram.

4. *Standard Agglutinating Serums.*—We have obtained these from the Royal Army Medical College, Millbank, and from the Standard's Laboratory, Oxford.

Procedure.

Each specimen is given a number and a peptone water tube the same number. A piece of faeces the size of a pea is removed with a wooden applicator from the specimen bottle and thoroughly emulsified in a tube of peptone water. Each specimen is allowed to stand about half an hour and is then ready for plating.

The Endo's medium having been poured, the plates should be a very faint pink in colour and as dry as possible. A curved glass rod is passed through a flame and when cool plunged into the peptone water emulsion and then removed. The lid of the Endo's plate is removed with the left hand, and while revolving the plate the glass rod is smeared from the centre to the margin like the spokes of a wheel; the same procedure should be carried out on a second plate without recharging the rod.

These plates are incubated overnight and examined for suspicious colonies. *B. coli* being an acid producer will appear as beautiful golden metallic-looking colonies, and streptococci as small crimson dots; any colonies grey in colour with no metallic lustre should be regarded as suspicious. These are fished off with a platinum needle and stab cultures made into the Hiss tubes, and at the same time streaks are made on the superimposed agar

A. Plain agar slope.
H. Hiss medium.