TREATMENT OF BURNS IN WAR-TIME.

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As there still appears to be considerable controversy regarding the most satisfactory method of treating burns due to enemy action, we propose to describe the method used in a recent series treated in a military hospital.

During the evacuation from Flanders, a military hospital in England was converted into a C.C.S. to deal with the more seriously wounded cases. Twenty extensive second and third degree burns were dealt with. The less extensive burns and scalds are not considered in this communication.

Eight sailors were admitted within three hours of their injury, sustained from an explosion on board a destroyer. The burned areas ranged from 40 to 70 per cent of the body surface and were complicated by gunshot wounds of the limbs, skull and pelvis. Our mortality was 60 per cent—five of the patients dying of severe toxæmia aggravated by their wounds. No first-aid treatment was administered before admission apart from the administration of morphine.

The other twelve cases were British and French soldiers burned by incendiary bombs and shells. Several had been immersed in the sea for several hours, others had rowed small boats, although the epithelium was completely denuded from their palms. Two had been treated with tannic acid and morphine, six with dry dressings and morphine, and the remaining four received morphine only. Twenty-four to ninety-six hours had elapsed since their injury before they were admitted to hospital.

This small series is considered as a whole as these patients were under treatment simultaneously. More recently we have had to deal with R.A.F. casualties severely burned in blazing planes. The methods used were as described below but the first group is taken as a basis for this article as it is unusual for a hospital to have so many cases of this type to deal with at one time.

To reduce the incidence of sepsis and to facilitate nursing, all severe burns were isolated in one ward. Large shock cradles were improvised by the Garrison Engineer within a space of several hours and the ward was kept at a temperature of about 72° F. A special staff of sisters (Q.A.I.M.N.S.) and V.A.D.s were detailed to attend only to the burns.

Fourteen cases were suffering from severe secondary shock or toxæmia and these were treated in the theatre as soon as possible after admission. The others naturally yielded in precedence to the other urgent casualties but all were treated within twelve hours of admission.
Routine Theatre Treatment.—The temperature of the operating theatre was raised to 80°F., and the most severely injured men were anaesthetized with nitrous-oxide and oxygen. A separate paragraph will be devoted to the anaesthetic problem.

The standard technique was as follows:

The injured surface is gently cleansed with swabs wrung out of warm saline and all dirty and blistered epithelium removed. When particularly dirty or oily, ether soap and ether are used for cleansing. A 1 per cent watery solution of gentian violet is then painted over the raw surface by means of gauze. Apart from its antiseptic and coagulating action, this solution clearly demarcates the raw area. The surface is dried by a current of hot air from an electric hair-dryer. Using gauze, a freshly made 10 per cent solution of tannic acid is now applied and, while still moist, the area is painted with a 10 per cent solution of silver nitrate applied in the same manner. Immediate coagulation takes place and the area is again dried by hot air. A further application of gentian violet is made, particular attention being paid to the edges of the damaged area.

On returning to the ward, the patients were nursed under a shock cradle. As a routine, the coagulum was dehydrated four-hourly with methylated ether, and painted with 1 per cent gentian violet in spirit. Areas which appeared moist or thin were treated hourly if necessary. Burned hands and arms were raised on pillows to reduce oedema.

In four very ill patients, this modified Bettmann’s technique was replaced by the application of gauze rolls soaked in 20 per cent tannic acid to shorten the time spent in the theatre. The burned areas were rapidly cleansed under gas and oxygen and the gauze quickly applied. This method was not adopted as routine as the coagulum is not open to inspection and moistening can occur unnoticed with an increased risk of toxemia.

Anaesthesia.—Severe burns were considered sufficiently serious to require the attention of an experienced anaesthetist, taking precedence in this respect over many other injuries.

Gas and oxygen was the anaesthetic of choice on account of the risk of increasing toxemia by the use of chloroform or ether; for the same reason evipan and pentothal were considered unsuitable as being liable to increase liver and kidney damage.

In practice no difficulty was found in securing comfortable induction even in the worst cases of facial burns. Several patients were so extensively burnt that there was no part of the body where venipuncture could have been performed for the administration of an intravenous anaesthetic.

The technique of anaesthesia was as follows:

A standard Boyle’s apparatus was used. An ordinary face pad with mouth hole was saturated with warm water and was laid gently on the face. This caused no complaint of discomfort and allowed an airtight fit of the face-piece without pressure. Owing to the presence of shock, unconsciousness occurred with five or six breaths of pure nitrous oxide. In about a
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third of the cases relaxation was complete enough with gas and oxygen to permit the passage of an intratracheal tube via the nose into the trachea. In the remaining cases a few breaths of gas bubbled through the chloroform bottle allowed of the passage of the tube. The pharynx was then packed off with damp gauze to ensure an airtight fit of the tube and gas and oxygen anaesthesia was continued throughout the operation.

In nearly all the patients the whole face and hands were uniformly burnt so that there was no possibility of judging the degree of oxygenation of the blood. The colour of the conjunctivae was bright pink under all circumstances, leading us to believe that the explosion causing the burns had released considerable quantities of carbon monoxide. Under these conditions to provide a steady quiet anaesthesia with gas and oxygen was difficult even after the insertion of an intratracheal tube. On those occasions when a supplement was needed chloroform was used in preference to ether. This choice was made with the full realization of the theoretical factors involved in regard to the possibility of toxic damage to the liver. In several cases nothing but gas and oxygen was needed. In the others, to facilitate the passage of the intratracheal tube, a deeper level of anaesthesia was needed momentarily. Occasionally too, during an operation lasting perhaps an hour, a dangerously light level of anaesthesia would occur. At such times a few breaths of gas, which had been gently bubbled through chloroform would establish the required level of anaesthesia. Were ether used in such circumstances the result of one or two breaths would be to start the patient coughing or heaving, necessitating full saturation with ether before quiet could be restored. Ether is a poor adjuvant to gas and oxygen since so often its attempted use in small quantities ends in a full ether anaesthetic being administered, the nitrous oxide playing very little part at all, except as a vehicle.

Ward Treatment.—This is best discussed under the headings of Secondary Shock, Toxaemia, Sepsis and Healing. Primary Shock was not seen in this series.

Secondary Shock.—Secondary shock was marked in several cases and blood-pressure readings were considered along with the clinical assessment of the patient's condition. If the blood-pressure did not rise after a short period under the shock cradle, combined with the administration of fluids and morphine, early coagulation usually arrested the progress of the shock. Intravenous administration of fluid was rarely necessary as almost all patients consumed and retained enormous quantities of fluids and glucose. When necessary, fluid was administered rectally and intravenously. Desoxy-corticosterone acetate was administered in 5 mgm. doses intramuscularly, usually four-hourly. The preparations used were Percorten and D.O.C.A., generous samples of which had recently been supplied to us by the manufacturers (Ciba, Ltd., and Organon Laboratories, respectively). The periodicity was based on the usual signs of shock supplemented where possible by repeated blood-pressure readings. A low diastolic reading was
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considered a more pressing indication for the corticosterone than a low systolic reading.

Toxæmia.—We have no certain knowledge of the source or constitution of the toxic substance but we do know that it causes central necrosis of the liver lobules and that it alters the blood chemistry in a way that suggests damage to the suprarenal cortex. Thus coagulation may inhibit the outpouring of toxin from the damaged surface; glucose will help to support the liver and the synthetic corticosterone frequently reverses the changes in blood chemistry.

Toxæmia was present in some cases on admission and these were dealt with by early coagulation. Where toxæmia developed after coagulation, attention was directed to moist or thin areas of the coagulum. Fluids and glucose were forced and fluid intake and output charted. Desoxytocicosterone acetate was administered in 5 mgm. doses intramuscularly and the periodicity here was judged by a careful chart of hourly pulse, temperature and respiration readings. The 5 mgm. were given every two or four hours according to the severity of the toxæmia. The common features of toxæmia which arose were sustained pyrexia, restlessness, rapid pulse and respiration rates (simulating pneumonia), hiccup, vomiting (once blood-stained), delirium and coma. The blood-pressure did not fall until the condition was well established. No blood chemistry investigations could be carried out. Owing to the difficulty of obtaining sufficient synthetic corticosterone, Eucortone (the suprarenal cortical extract made by Allen and Hanbury) was used in some of the cases. Large doses were required and the results were not so dramatic as in the cases in which the synthetic preparation was used.

Unfortunately no necropsies were performed in the five cases that died of severe toxæmia.

Sepsis.—Sepsis was never serious and in no case was the tannic acid regime terminated from this cause. Where necessary, the coagulum was incised, dried and painted with the gentian violet in spirit. In two cases, the coagulum was removed entirely from septic areas and, after cleansing, tannic acid was applied again with a satisfactory coagulum resulting. No sulphonamide was required in this series, although we have proved its value in civil life when severe sepsis ensues.

Healing.—As a rule the coagulum should be left until it strips off readily —usually at the end of the second week. In deep burns the coagulum may take many weeks to separate but unfortunately, in this present series, the cases had passed to another hospital before the coagulum had entirely separated and we have no knowledge of the ultimate result as regards healing of all areas.

It is our practice to treat clean raw surfaces with cod-liver oil or an ointment such as Trinity Ointment (eucalyptus, zinc-oxide, lanoline and soft paraffin). The healing of large raw areas is expedited by the use of Thiersch grafts, and whole-skin grafts may be necessary.
By careful attention to the flexures from the outset and appropriate splintage where necessary the incidence of contractures can be minimized.

It is not unlikely that tannic acid will prove unpopular in many circles in the near future. The efficiency of the tannic acid method depends largely on the time which has elapsed between the actual injury and the treatment and on the thoroughness with which cleansing is carried out before coagulation is attempted. In wartime it is easy to visualize circumstances interfering with both these factors and many imperfect "tans" will occur.

In spite of this, we hope that coagulation will still be adopted as a first-aid method, even in the absence of facilities for thorough cleansing. Even imperfect coagulation will lessen the risk of shock and toxæmia.

The choice of a coagulant is a matter of personal experience and the method described in this article has been used in 300 cases of moderate and severe burns and scalds with gratifying results.

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