THE TREATMENT OF BURNS

BY

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This paper describes the methods of treatment used for cases of burns admitted to the Accident Service of the Radcliffe Infirmary. On account of its importance the treatment of burns of the hands is given in some detail.

Principles of Treatment

Burns are wounds with special characteristics. The treatment of each should be governed by the same principles, which may be defined as follows:

1. *Time*.—The injury must be treated at the earliest opportunity.

2. *Cleaning*.—The lesion and its surroundings must be thoroughly cleaned without further injury to the tissues.

3. *Excision of Dead Tissues*.—This is the most important step in the successful treatment of all wounds. Unfortunately the size and situation of burns, together with the difficulty of distinguishing dead from living tissue, render the complete excision of all devitalized tissue impossible in the majority of cases.

4. *Drainage*.—No provision for drainage need be made. The aim of treatment is to keep the burned area as dry as possible. Natural drainage may be hindered by the superimposition of an impermeable coagulum, such as that produced by tannic acid and similar agents.

5. *Rest*.—Damage to the growing tissues partaking in the repair of the lesion is avoided by keeping the part at rest. Rest is the most effective means of abolishing pain and the accompanying muscular spasm. Infrequent dressings minimize injury to tissues growing on the surface.

6. *Prevention of Oedema*.—Oedema should be prevented by the application of firm pressure (Siler and Reid, 1942) or, when a limb is involved, by elevation of the limb. Fluid leaving the damaged capillaries round a wound forms the exudate which escapes from the raw surface, and the growth of organisms is favoured by the excessive moisture. At the same time, fluid escaping into the tissues is removed by the lymph stream. Therefore, movement of an oedematous part carries with it a greater risk of sweeping bacteria and their toxins into the general circulation (Barnes and Trueta, 1941).

7. *Replacement of Lost Skin*.—Where the full thickness of the skin has been destroyed it should be replaced at the earliest opportunity by means of skin grafts.

Technique of Treatment

On admission of the patient to hospital a rapid examination of the burns is carried out. Morphine (1/4 gr. for an adult) is given, and the patient made comfortable in bed. When the burns exceed 10 to 20% of the body surface, and shock is likely to develop, a transfusion of human serum is immediately started. Serum is preferred to plasma because of its higher protein content. The pulse rate and blood pressure are recorded at intervals of 15 to 30 minutes, and the haemoglobin estimated. In the initial stages no attempt is made to calculate the total fluid requirements on the basis of a single determination of the haemoglobin. Such calculations are misleading, because fluid continues to escape from the blood during the first 48 hours. Thus the haemoconcentration may actually increase while fluid is being administered (Fig. 1). The rate and amount of the transfusion are controlled by the blood pressure. The cessation of transudation from the capillaries, and of the need for transfusion, is shown by the return of the haemoglobin to approximately normal levels.

As soon as the patient is under the influence of morphine he is transferred to the operating theatre. Originally a general anaesthetic was administered in order to clean the burns, but it has been found possible to carry this out, both in adults and in small children, under the influence of morphine alone.

Special gentleness is necessary when cleaning the palms of the hands and the edges of the burn, because these are the most sensitive parts. The burns are cleaned with soap and water, or with some more powerful antiseptic detergent—e.g., cetyltrimethyl-ammonium-bromide (C.T.A.B.) (Barnes, 1942). In order to ascertain the percentage of cases that were infected before admission to hospital bacteriological examination was carried out on swabs from the untreated surface of burns admitted within 48 hours of the accident. In an unselected group of 52 major and minor burns pathogenic organisms were

FIG. 1.—Records from a severe case of burns, showing rise of value of haemoglobin during course of serum transfusion. The patient was a man aged 32 with extensive burns of body and arms.

isolated on seven occasions (haemolytic streptococci, 2; *Staphylococcus aureus*, 5). It is clear, therefore, that the majority of cases that become infected do so only after admission to hospital. This is due to exposure to infection from the nose, throat, and, in particular, hands of nurses and doctors, and possibly from infected bedclothes.

During the cleaning all loose epidermis is removed, and blisters are either excised or punctured and pressed down on the raw surface. A final washing with soap and water is given, and the surface lightly dried. A single layer of fine-mesh good-quality bandage, which may be either dry or impregnated with vaseline, is applied. On the whole I prefer the dry bandage.

For the limbs, including the hands, complete immobilization is secured by enclosing them in plaster-of-Paris casts applied directly over the gauze. The hand is placed in the "position of function"—i.e., slight dorsiflexion of the wrist, 60 degrees flexion of the metacarpo-phalangeal joints, 45 degrees flexion of the interphalangeal joints, and with the thumb opposed to the index finger. In such a position maximal relaxation of the long muscles of the fingers is obtained. If the burn is deep, or if it extends above the level of the wrist, the elbow is immobilized. The olecranon and epicondyles are padded, and the joint is fixed in a slightly flexed position (120 degrees), with the forearm semi-pronated. A thick pad of wool is placed round the arm at the upper level of the cast in order to fill the gap that will otherwise inevitably appear between the limb and the plaster during the first few days. The cast is made with a long slab of plaster laid over the back of the forearm, moulded over the fingers, and carried up the front of the forearm. The cast is completed by one or two plaster bandages, and a small loop is made by which it may be suspended (Fig. 2).

For burns of the trunk a thick dressing of wool and gauze is firmly applied with crêpe bandages. The dressings should extend well beyond the margins of the burn, and many bandages should be used to prevent gaps appearing in the dressings as a result of movements of the patient in bed. When a limb is extensively burnt, thoraco-brachial and hip spica casts are used. On the other hand, a burn of the trunk alone is not enclosed in plaster, because of the lack of complete immobilization within the casts.

Subsequent Treatment

When the burn is extensive continuous records of blood pressure and haemoglobin are made for the first 48 hours or so. The urinary output is measured: a return of the normal output is a good prognostic sign. Dressings are kept as dry as possible by exposure to the warm air of the room. During the first few days they become soaked with exudate from the dependent parts, and thus provide an avenue for infection which may reach the burn. Large plaster casts must be dried under a heat cradle and similar precautions be taken to keep them dry. When soakage does occur it is inadvisable to change the

FIG. 2.—Photograph showing complete enclosure of a burnt hand in plaster. Note loop for suspension of cast.

dressings or casts, for this would still further increase the risks of infection. The exudate dries after the second day, and by no means every such case becomes infected. Among the cases I treated there was a high incidence of infection with *Ps. pyocyanea*. The appearance of the characteristic green pus indicated that in the majority of these cases infection started from the edges of the dressings, and presumably came from the bedding.

Management of the Plaster Casts

When a fresh burn of the hand and forearm is enclosed in plaster it is essential that the limb should be adequately elevated. Failure to do so is followed by swelling and intolerable pain. The hand must always lie above the level of the elbow and the elbow above the shoulder. It is particularly important to watch the position of the elbow when a patient sits up in bed during the first few days. When these precautions were observed it was never found to be necessary to interfere with casts applied as early as three hours after the accident.

When the plaster has dried the cast becomes warm. This warmth over the region of the finger-tips is an indication of a satisfactory circulation beneath the plaster. Movement of the fingers within the cast can usually be detected after 24 to 48 hours. When vaselined gauze is used as a dressing the vaseline soaks through the plaster during the first 24 hours. Other than this there is no exudate unless the burn is infected. It is important to use an absorbent type of plaster (home-made bandages) so that any exudate formed may readily make its way to the outer surface. Elevation should be maintained for two days in the case of superficial burns, and for periods up to 10 days when the burn is deep or infected. Elevation considerably reduces the exudate from an infected burn. If elevation is maintained for several days the elbows may become sore. This may be relieved by abducting or adducting the shoulder in order to shift the pressure points.

Change of Dressings

The initial dressing is left in place for 10 to 21 days. Superficial burns are usually healed at the end of this time (Fig. 3). For deeper burns the dressings are changed in order to remove any sloughs that have become loose. When casts are applied to burns of the hands that are seen late and are already oedematous, they will become loose within a few days.

It may then be necessary to change the cast earlier, but when there is a serious local infection it may be wiser to delay the change in order to avoid possible systemic reactions as a result of the manipulations (Fig. 4).

Dressings are changed in the operating theatre with the usual aseptic precautions of a surgical procedure. In order to avoid injury to the fingers plaster casts are removed with a knife rather than with plaster shears. The dressings are carefully removed, and those that are dry and adherent to the surface are not disturbed. The raw surface is cleaned with soap and water. Loose sloughs are cut away, taking care to avoid injuring living tissue beneath. At each change of plaster for

FIG. 3.—Petrol burn of hand and forearm cleaned with soap and water, put into plaster cast, and left undisturbed for 3 weeks. Healing complete on removal of cast. Full function returned within 24 hours.

a burn of the hand the patient is encouraged to put the wrist and fingers through a full range of movements. A fresh dry dressing and another cast are applied if the burn is not healed. After the first change, dressings are renewed at intervals of 7 to 10 days until either healing is complete or all dead

FIG. 4.—Temperature chart of man aged 42 admitted with septic tanned burns of both hands and arms. Casts applied to both arms. 7 days later plaster casts were changed because they were very loose. Note rise of temperature, which was accompanied by a rigor.

tissue has separated and the surface is ready to receive a graft. Grafting can be undertaken with every prospect of success 3 to 6 weeks after the time of injury.

Skin Grafting*

In the majority of cases thick split-skin grafts cut with the Padgett dermatome were used. No attempt was made to clean the raw surface by means of frequent wet dressings before grafting. Dressings or plaster casts that had not been changed for periods up to 14 days were removed at the beginning of the operation, and the surface cleaned with soap and water or C.T.A.B. immediately before applying the grafts. Although the number so treated was small, it is worth recording that 10 consecutive cases were successfully grafted in the presence of infection with *Ps. pyocyanea*. A firm dressing was applied over the grafts, and a plaster cast was sometimes added. Limbs were elevated to control exudate from the surface. The grafts were not inspected for 10 days.

Functional Results

In a series of 20 hands immobilized in plaster casts for 3 to 5 weeks permanent stiffness was never seen (Figs. 5 and 6). It must be stated that in only one case was the burn severe enough to lead to exposure of the extensor tendons after the separation of the slough. The fingers recover their mobility within a few days of the removal of the cast if active exercises

* The operations in these cases were performed by Dr. J. M. Converse of the American Hospital in Britain.

are encouraged. The newly healed skin may feel tight, but this can be relieved by rubbing in lanolin, as recommended by Wakeley (1942). The hand and wrist may temporarily feel weak as a result of the immobilization of the muscles.

FIG. 5.—Burns of hands of man aged 32 immobilized for 3 weeks; grafted and immobilized for 10 days.

FIG. 6.—Same patient as Fig. 5. Movements 8 weeks after accident.

Discussion

It has been found possible to treat burns by methods similar to those successfully applied to the treatment of other wounds. Burns are particularly liable to become infected, on account both of their size and of the impossibility of removing dead tissue. The incidence of infection can be reduced only by exposing the lesions as infrequently as possible. In a busy general hospital dressings can be carried out with proper aseptic precautions only if they are done at long intervals, thus permitting time and care to be taken over them. Where infection does take place systemic disturbances resulting from it may be controlled by immobilization of the affected region. The benefits to be derived from the immobilization of a series of infected burns have been described by Roulston (1941). Immobilization of the hand does not necessarily lead to stiffness, provided care is taken to place the fingers in a good position. Nevertheless, it would be unwise to continue such immobilization for periods exceeding 4 to 6 weeks.

It is sometimes stated that part of the treatment in the later stages of a deep burn should include the cleaning of the raw areas by means of frequent wet dressings before applying skin grafts. It seems doubtful whether a case so treated, with all the risks of cross-infection attendant on the frequent changes of dressings, fares any better than one given a single cleaning just before laying on the grafts. The mere presence of bacteria upon the surface of the wound is no indication as to the possibilities of success with skin grafts.

When a large number of cases have to be dealt with simultaneously there is a great advantage in being spared the

necessity for the frequent changing of dressings in all the cases. A case of extensive burns is in need of careful and continuous nursing during the first few days. Such attention is the more easily given when there is no need to interfere with the local lesion.

Summary

The principles which govern the treatment of burns as wounds are outlined.

A simple technique of treatment, which includes the use of plaster-of-Paris casts for burns of the hand and forearm, is described. If plaster is applied, elevation of the limb is essential, to prevent oedema, and the hand must be placed in the correct "position of function."

The value of immobilization, infrequent dressing, and the prevention of oedema is pointed out.

Burnt hands do not become stiff merely as a result of immobilization, provided that this is carried out correctly for a limited period.

In spite of the presence of infection with *Ps. pyocyanea*, skin grafts will "take" on granulating burns that are dressed infrequently.

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SULPHAGUANIDINE IN NEONATAL EPIDEMIC GASTRO-ENTERITIS

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Since the virtues of sulphaguanidine in the treatment of alimentary infections were discovered by Marshall and his colleagues (1940, 1941) this sulphonamide compound has won general recognition as the most effective drug hitherto employed in the treatment of a variety of intestinal infections. It has greatly lessened the severity of the symptoms and the duration of illness in the various types of dysentery, and has been very successful in infective gastro-enteritis in infancy and childhood. The principal object of this paper is to record the excellent results achieved with this drug in epidemic gastro-enteritis in the newborn, the most lethal of the commoner neonatal infections.

Epidemiology of Neonatal Gastro-enteritis

Outbreaks of infective gastro-enteritis occur periodically in all maternity hospitals in which opportunities for cross-infection among the infants arise owing to imperfect architectural and nursing arrangements. In all epidemics the vast majority of affected infants are bottle-fed. The publicity given to the prevalence of the disease in the maternity hospitals in New York City by Rice and his collaborators (1937) has focused attention on the appalling waste of infant life in maternity hospitals from this preventable alimentary infection. These workers reported 505 cases of epidemic diarrhoea in 11 maternity hospitals in New York in the 2½-year period July, 1934, to Dec., 1936, the incidence being the very high one of 14%. The earlier literature contains surprisingly few references to such a common disease. The paper based on the largest series of cases, and the only one of note emanating from this country, was published from this hospital in 1936

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