restored by replacement therapy the choice of an anesthetic agent must be determined largely by the extent of the surgery to be done. That a general anesthetic is a contributing factor in the production of an irreversible state is well established experimentally. For this reason local anaesthesia is the one of choice and should be used whenever possible. When local anaesthesia cannot be used, ether is the best all-round choice. In general, spinal and pentothal anaesthesia should be avoided; at times they may be employed in exceptional circumstances by the highly-experienced anesthetist, provided the circulation has been restored to normal by replacement therapy.

Attention is directed to the specific usefulness of local anesthesia for amputation of badly injured limbs, especially when the circulation fails to respond after adequate replacement therapy. If adequate blood and plasma infusion have been given and the blood pressure remains low, it is evidence of an irreversible state. To delay further is to accept a fatality. On several occasions the writer, or his colleagues, has had occasion to advise immediate amputation under local anaesthesia while the replacement therapy is continued. Following removal of the damaged limb a general improvement of the circulation has followed, with eventual recovery.

Surgery in the patient who has been in severe shock is not for the dilettante or the beginner. Since the duration of the anaesthesia is a contributing factor to an irreversible state, what is to be done must be done expeditiously.

THE PROBLEM OF SHOCK

There can be no doubt that in the present war early and adequate restoration of the blood volume by massive blood and plasma infusion is enabling thousands of men to survive injuries which would have proved fatal in the last war. There remains, however, a comparatively small, but significant, group of cases in which adequate replacement therapy is without avail. In this group are very extensive burns (80-100 per cent of the body surface), multiple explosive wounds with extensive damage to muscle, and late decompensated shock, irrespective of original cause or causes, but especially when complicated by sepsis (peritonitis, retroperitoneal cellulitis, etc.). Two factors which contribute to this irreversible state are the extent of the destruction of tissue and the time which elapses between the injury and surgical measures designed to correct the condition (for example, the debridement of extensive muscle wounds or the amputation of badly mangled limbs). A third factor which affects the response of the circulation to replacement therapy is the age and general condition of the patient. An elderly, malnourished individual cannot withstand losses of blood or plasma which hardly affect a young, hardened soldier. Very extensive injuries (i.e. a burn of go per cent of the body area), even in well-conditioned individuals and even when treated promptly, will not respond to therapy. Less extensive injuries such as bomb wounds (land mine) of both legs, if treated by replacement therapy and amputation or debridement, as indicated, do well. If delay ensues, however, no favourable response to replacement therapy occurs. A discussion of the causes of this irreversible state is not within the scope of this paper. As suggested recently, it may be a generalised cellular death in which the heart as well as other viscera is affected. Whether this is a consequence of a specific toxin absorbed from the injured area, or of an altered metabolism of the cells because of anoxia, is unknown. From the practical point of view, all that can be done at the moment is to prevent this state from developing by early and adequate replacement therapy, followed by prompt surgery. Surgery in explosive wounds involving muscle is as important in preventing shock as in preventing sepsis.

SUMMARY

Practical points in the diagnosis, treatment, and prevention of shock derived from experiences in military surgery are presented.

BIBLIOGRAPHY


FIRST AID TREATMENT OF BURNS

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There is considerable confusion at the present time regarding the first-aid treatment of burns. Many of the methods, which have been recommended, are unsuitable and interfere with the subsequent treatment. The first essential is to appreciate that every burn involving more than 5 per cent of the body surface and burns of the face, hands, feet and eyes should be admitted at
the earliest possible moment to hospital, and preferably to a hospital with a burn centre. Burns involving less than 5 per cent of the body surface may be treated at home, but extensive burns and deep burns of moderate size are not suitable for domiciliary treatment; this fact is unfortunately not thoroughly appreciated, and too often cases, which have been treated outside, are admitted to hospital after the wounds have been grossly infected. Investigation has shown that the majority of burns are not infected provided they are admitted to hospital within twenty-four hours of the injury, but that later they are infected with the haemolytic streptococcus.

Before discussing the first-aid treatment it may be useful to stress some general points. In civilian practice the great majority of burns and scalds occur in children, and it is estimated that 45 per cent of the total deaths from burns and scalds occur before the sixth year of life. That children suffer from burns to a greater extent and more frequently than adults is due to the prevalence of domestic accidents from hot water, tea, etc.

The higher death-rate in children may be attributed to three main causes; firstly, the thinness of the skin; secondly, the effects of shock; and thirdly, the extent of the burn. This last factor is the most important as in the child the surface area relative to the body weight is much greater than in the adult. The site of the burn is an important factor in the prognosis. Burns involving the chest wall or abdomen are especially dangerous owing to the close proximity of the viscera, on the other hand, in burns involving the back, which is well protected by several layers of muscles, the prognosis is better. Generally speaking, it may be said that the further the burn is from the centre of the body the more hopeful is the prognosis.

The aims of first-aid treatment are to combat shock and prevent infection of the wound; in the presence of shock attention should be directed to the patient rather than to the burn. In extensive burns, the first-aid treatment, in so far as the burn itself is concerned, should consist of masterly inactivity, and the prime object should be to transfer the patient to hospital as soon as possible. If the patient's clothes are on fire a blanket or coat should be wrapped round him and he should be rolled on the floor. No attempt should be made to put out the flames by pouring water over him. The burned area must not be exposed by cutting away the clothing, but exposed areas can be covered with a clean sheet or towel if a suitable dressing be not available. While waiting removal to hospital the patient should be covered with blankets and kept warm by protected hot-water bottles; it is important to avoid excessive heat, as this is harmful in shocked cases. Care should be taken that the blankets, which are usually infected, do not come in direct contact with the burn. The adult patient should be given an injection of ½ grain of morphia and a drink of well-sweetened hot tea. Active first-aid treatment should be reserved for burns of moderate or small extent on exposed parts of the body. Too often the subsequent treatment of a burn is prejudiced by unsuitable first-aid treatment. Many patients arrive at hospital with some domestic remedy applied, and frequently covered by a non-sterile dressing.

**ERRORS IN TREATMENT**

Many of the substances applied to the burned areas are quite unsuitable and often harmful. Sodium bicarbonate is very frequently used, but it does not appear to have any value, though it is supposed to relieve pain; any relief of pain that does take place is probably due to the fact that the burn is covered. Flour applied to a burn is apt to cake, and is difficult and painful to remove. Cold tea is very often used, but it has no value as a remedy. Carron oil, linseed oil, olive oil and cod-liver oil should not be used as they form sticky varnishes, which makes the wound difficult to clean, and have the additional disadvantage of the smell being objectionable to the patient. One of the most popular first-aid dressings is some form of tannic acid jelly. These jellies have won an unwarranted reputation; it has to be remembered that in small superficial burns the wound will often heal, no matter what application is used, and this fact has helped to popularise tannic acid as a domestic remedy. The jelly is applied direct to the wound and forms a coagulum, and as the wound has not been cleaned previously infection frequently ensues. In burns which require hospital treatment the coagulum may have to be removed, and this may be a matter of difficulty. This form of treatment should never be used in burns of the face, hands or feet.

**Useful Methods of Treatment**

Triple dye is a better method than tannic acid jelly, and it may prove useful when the patient cannot be removed to hospital, as in the case of ships at sea, but it has the same disadvantage of tannic acid that it forms a coagulum, but one which is softer and more pliable. The triple dye, which consists of gentian violet 1 per cent, brilliant green 0·1 per cent, euflavine 0·1 per cent, to which 5 per cent sulphadiazine is added, is applied in the form of a jelly; any blisters that are present are opened with scissors. After application of the jelly no covering is required. In the last war paraffin wax was used, and recently it has been
recommended again. The wax consists of paraffin wax, vaseline and cod-liver oil, which is melted in a water bath and poured into a spray gun. The burned area, which does not require preliminary cleansing, is sprayed with the liquid wax. The wax is washed off daily with warm water and reapplied. It is claimed that this method reduces pain and shock, but it is a rather complicated procedure for everyday practice. A useful and easily applied method of first-aid treatment is to dust the wounded area with sulphanilamide powder and cover it with tulle gras. The tulle gras does not adhere to the wound, and can be easily removed.

**METHOD USED IN BURNS UNIT, GLASGOW ROYAL INFIRMARY**

The most suitable form of first-aid dressing is one which will prevent infection, and which at the same time can be easily removed without causing either pain or damage to the tissues, so that it will not interfere with the subsequent hospital treatment. Any superficial burn, which remains free from infection, will heal in a few days irrespective of the form of treatment used. If the burn be infected by the haemolytic streptococcus the healing period may be greatly delayed by damage to the tissues which may be severe enough to necessitate skin grafting in what was originally a relatively superficial burn. Healing may also be delayed by staphylococcal infection, but this is not usually so troublesome as a streptococcal infection. It is sometimes recommended that a local anaesthetic should be incorporated in the dressing, but there does not appear to be any advantage in this, as usually little or no pain is present when the burn is covered by a suitable dressing; the patient complains of pain only when the burn is exposed to the air.

The method employed in the Burns Unit at the Glasgow Royal Infirmary, where approximately 1,200 cases per annum are treated as out-patients embodies these principles. Two types of cream are used in the Burns Unit, one for the first-aid treatment, usually known as Glasgow No. 9 cream, which contains from 3 per cent to 10 per cent sulphanilamide, 25 per cent castor oil, and a detergent known as C.T.A.B. (cetyl trimethyl ammonium bromide) or Cetavlon, which is also a very useful antiseptic. The other cream is used for the routine treatment of burns in the wards, and the preparation at present in use contains 3 per cent sulphanilamide, 3 per cent sulphathiazole and 25 per cent castor oil emulsified by Lanette Wax S.X. This cream can also be used for the first-aid treatment, but it is not so powerfully bactericidal as the No. 9 Cream. Both of these creams are oil in water emulsions, and being oil in water emulsions they can be easily washed off. These frequently form a substantial film composed of exudate and fibrin over the injured area.

The first-aid cream is spread on lint with a sterile spatula or knife and applied to the injured area, and covered with cotton wool and a bandage; blisters should not be opened. It is essential to take all possible precautions to do dressing as aseptically as possible. The No. 9 Cream should not be kept on for longer than forty-eight hours as there is a slight risk of dermatitis from the C.T.A.B. This risk is not great, C.T.A.B. has been used in the Burns Unit in over 3,000 cases since 1942 with only four authenticated cases of dermatitis. These creams were formulated for the Burns Unit by Professor J. P. Todd, who has appended a description of them. Although the preparation of these creams for hospital use requires some special equipment, satisfactory creams can be and are easily made by any chemist.

**BURNS OF SPECIAL REGIONS**

**Burns of the Face.**

The great majority of burns of the face are superficial and heal rapidly. The coagulation treatment, either as tannic acid or dyes, should not be applied to the face, especially to the eyelids, lips, ears or nose. If the first-aid cream recommended above be not available, cold cream or vaseline are good substitutes, and one of these should be generously smeared over the face, which is left uncovered.

**Burns of the Eyes.**

The eyelids usually afford protection to the eyeball, and it is only rarely that the eyeball is affected. Only one case in which both eyeballs were completely destroyed, and the patient survived has been admitted to the Burns Unit in recent years. When the eye is affected the damage usually consists of injury to the cornea and adhesions between the eyeball and the eyelids. Before attempting to examine the eye, it is advantageous to instil some 1 per cent pantocain or 2 per cent butyn into the conjunctival sac; these local anaesthetics have no harmful effect on the cornea. The conjunctival sac is then washed out with saline and some albuclid drops instilled. It is advisable to round off the treatment by the addition of parolein or pure liquid paraffin drops. When it is known that the eye is burned by acid the sac should be washed out with 2 per cent solution of sodium bicarbonate; in ammonia burns a weak solution of boracic should be used. In chemical burns it is most important to carry out prolonged washing out of the conjunctival sac, and to finish off with the addition of some liquid
paraffin. When there is any question of injury to the cornea it should be an invariable practice to ask an ophthalmic surgeon to see the case as soon as possible, a procedure which should never be omitted. Atropine should not be used as a routine, especially in elderly patients, unless the cornea is definitely involved.

**Burns of the External Genitalia.**

These burns are difficult to deal with and are very liable to become infected. Tannic acid should never be used in these burns as it tends to interfere with the circulation and increases the oedema of the parts. As these burns are always infected, the coagulum formed by the tannic acid is an additional disadvantage; a tannic acid coagulum in the presence of sepsis forms a tenacious slough, which is very difficult to remove. The most satisfactory treatment is to apply the first-aid cream recommended, or a plain sulphonilamide or sulphathiazole cream and a pressure dressing. Moist or wet dressings should not be used.

**Burns of the Hands and Feet.**

Here again coagulation methods should not be used, as a coagulum on the fingers or toes tends to interfere with the circulation and may lead to stiffness of the digits. A sulphonilamide cream or sulphonilamide powder and tulle gras are the most satisfactory first-aid dressings. If the hand be burned it should be placed on a splint in the optimum position and the part elevated.

**Burns of the Air Passages.**

Inhalation burns are frequently serious and may be caused by either flame or steam. The gravity of the condition may not be apparent until a few hours after the accident, when the air passages may become filled with froth and mucus. Oxygen should be administered preferably by the oro-nasal type of B.L.B. mask. If laryngeal obstruction develops early tracheotomy is indicated, the operation should not be postponed. These cases should be removed to hospital without delay.

**SPECIAL TYPES OF BURNS**

**Electrical Burns.**

The hand is the part most frequently affected in electric burns owing to its liability to come in contact with a live wire. If the skin be wet the injury will be more severe, a dry skin is much more resistant to the electric current. Most of these burns are caused by low voltage currents; high-voltage currents generate great heat and may also cause serious burn from flash, and, in addition, interfere with the respiratory centre and lead to cessation of respiration. When the injured person is unable to free his hand from the live wire, owing to contraction of the muscles, no attempt must be made to pull him free as the rescuer himself may be injured; the correct procedure being to turn off the switch. In these cases in which respiration has ceased, artificial respiration must be carried out.

**Phosphorus Burns.**

The injured part should be immersed immediately in water as the phosphorus continues to burn in the tissues. The burned part should be soaked in a 2 per cent solution of sodium bicarbonate, the actual percentage is not important provided that the solution is not too weak, a rough measure is two tablespoonfuls of sodium bicarbonate to a pint of water. The burn is then swabbed with 1 per cent copper sulphate, and the particles of phosphorus removed with forceps. After removal of the particles of phosphorus the part is again washed with sodium bicarbonate solution and examined in the dark for phosphorescence. When the phosphorus has been removed, the ordinary methods of burn treatment may be applied. Dressing containing oil should not be used for first-aid treatment as phosphorus is soluble in oil.

**NOTES ON THE BURN CREAMS**

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The various Burn Creams evolved in the Glasgow Royal Infirmary were made possible by the introduction within recent years of new types of compounds. These substances have the property of converting oil and water stirred with them in a molten condition to a cream-like emulsion freely miscible with water. This property is due to the polar nature of the molecules of these wax-like substances on one end of which is a hydro-carbon radical and on the other a water soluble grouping such as sulphuric acid. In making creams with these substances it is only necessary to melt the waxes, to add water, and, if required, some additional oil, and to stir the ingredients together; no elaborate machinery is necessary. The cream can then be sterilised by heating at 110° C. for thirty minutes, shaking to reform the cream as it cools. The desired medicament sulphanilamide, sulphathiazole or penicillin can then be incorporated aseptically, care.