TREATMENT OF BURNS: A PLEA FOR SIMPLICITY

BY

C. W. FLEMMING, O.B.E., M.Ch., F.R.C.S.

Air Commodore; Consultant in Surgery, R.A.F.; Surgeon, University College Hospital

"It can be said truthfully that the treatment of burns has returned to chaos."—Major-General P. H. Mitchiner.

It is sad to think that a distinguished surgeon and respected critic should be forced to the conclusion quoted as a text at the head of this paper. Modern war causes many burns, and during the past five years more surgeons have had to treat these cases than at any time before, and yet it must be agreed that about the treatment a good deal of confusion still exists. In part, at least, this confusion results from the large number of articles published and the numerous memoranda issued by separate authorities. Anyone who adds to this spate of literature takes upon himself a grave responsibility lest he confound yet more deeply the struggler in this therapeutic tangle. Yet General Mitchiner's challenge should be accepted.

My approach is purely clinical and personal. What follows is based on the results of treating regularly during the past five years patients with burns, under conditions that have varied very considerably. The numbers have not been vast, but the intake of patients has been very constant. Much has been learned from surgeons, physicians, pathologists, sisters, and orderlies. I do not intend to refer widely to the writings of others, believing that a picture drawn from the experience of one individual may be clearer than one which is composite.

Origin of the Chaos

The first step in trying to clear the confusion is to analyse some of its causes. A burn is a wound with infinite possible variations. It may extend widely or deeply, or both. Its effects vary according to the general condition of the patient—his age, his fatigue before being hurt, his associated injuries. Treatment depends on factors imposed by time and space: Was the patient burned in a factory, a tank, or a ship? Did his aircraft crash close to a well-equipped hospital or on a temporary landing-strip in the desert or jungle? The list of changeable factors in any single case of burns could be extended, but enough have been quoted to show that each patient must be considered individually. Yet surgeons hanker after a universal panacea. It is not uncommon to be asked, "How are you treating burns now?" That question is as intelligent as "How are you treating fractures now?" The questioner should not really be blamed for the folly of his remark, because from his student days onward he has been led to believe that there is "a" treatment for burns. Even the authors of the admirable *Field Surgery Pocket Book* published by the War Office in 1944 write that "there is *to date* no cure-all for burns," being reluctant to abandon the hope of some magic still to be found. Twenty years ago all burns were treated with carron oil or picric acid. Later, tanning was introduced, and this notable advance fell into disrepute because it was employed in all burns in all places under any circumstances. Unfortunately its defects were not critically analysed: its whole use was condemned, to be replaced by another panacea—the dyes. The saline bath, envelope irrigation, and plaster-of-Paris came next, and again were judged on their universal applicability, and by this uncritical test were found wanting. The same fate probably awaits penicillin.

The treatment of burns must in the present state of knowledge be to some extent empirical, because the pathological processes which make the patient ill or cause his death are as yet not fully understood. But by careful observation of those signs and symptoms which are comprehensible a high standard of treatment can be achieved, function can be preserved, and lives saved. Such a study can perhaps be more easily made in the Royal Air Force. The admissions for burns are steady and regular, and there is only very rarely the urgent pressure of a large number of battle casualties. Furthermore, the nature of the trauma and the extent of the burns which follow an aircraft crash are remarkably constant, so that successive cases are comparable. The extent of such burns depends on the protection

of clothes, and from the same trauma a man is more seriously injured if wearing a sleeveless shirt and shorts instead of full flying clothing. A study of these two groups of cases—those at home and those over-seas—has been clinically instructive. From that study has emerged a plan of treatment which, with variations, can be made applicable to any case of burns; but at each stage of treatment the surgeon must examine his patient, and the details depend on the circumstances of the time and his own experience. There is no single all-embracing universally applicable treatment for burns, and never will be. The surgeon who attains that belief is a long way towards reducing chaos to order.

Degrees of Burns

From the clinician's point of view burns are of two degrees—slight and severe. Slight burns are those in which there is no detectable general disturbance; severe burns are those in which the general treatment of the patient is more urgent than the local treatment of the burn. The differential diagnosis is not always so easy as it sounds, because fit young men widely burned show for a few hours an astonishing vitality. One such walked four miles to get help for his injured companions. This temporary well-being leads at times to disaster, for it is followed by a quite sudden collapse. Patients apparently not very ill have been sent by ambulance car or aircraft on journeys they were not fit to make, and have arrived at hospital moribund. If there is any question in the medical officer's mind as to whether the case is one of severe or slight burns the patient must have the benefit of the doubt. No patient has died because his doctor took an over-cautious view of his burns and refrained from rushing him off to a special centre; a number have died because they were thought to be fitter than they in truth were.

Any other classification, or attempt at classification, in the early stages is useless, and (what is worse) confusing.

Slight Burns: Local Treatment

There are three types of local dressings available: (1) wet dressings, changed at intervals, of saline or antiseptic; (2) occlusive dressings, of tannic acid or dyes; (3) greasy dressings. A wet dressing is suitable for a fresh burn not cleaned or an old one gone septic. An occlusive dressing is successful if the wound is clean and the burned area one that is relatively immobile. It is therefore not good as a first-aid dressing, nor on the fingers, face, and flexures. Greasy dressings are very comfortable and proper on the face and fingers, but should not be used too continuously; the raw surface gets grease-logged and indolent. It is admirable as the skin heals. All three have their place in the local treatment of burns if the surgeon knows why he has chosen one of the three for the particular problem he is trying to solve.

Since the appearance of considerable numbers of cases of sulphonamide skin sensitivity, the use of any sulphonamide powder locally is to be viewed with some caution. For first-aid treatment wet saline dressings give reasonable comfort and do not prejudice later treatment; "Glasgow cream," if available, is probably best of all. Penicillin is still experimental. It seems so far to have a place but not a monopoly in the local treatment of burns.

Severe Burns: General and Local Treatment

In every case of severe burns there are a series of symptoms and signs which must be looked for, and, if found, treated. The details of treatment vary, but the particular points should be checked over in each patient.

1. Any case assessed as severe first requires intravenous plasma. It is extremely valuable to have the haemoglobin estimated before treatment is started, and essential to have this done as soon as possible: from beginning to end, the chart of the haemoglobin percentage is as important as that of the temperature and pulse. Follow the plasma by intravenous glucose-saline until it is apparent that the patient can drink enough, without vomiting, to prevent dehydration. A fluid-intake-and-output chart gives the surgeon complete information on this point, and treatment varies accordingly. There obviously cannot be a statutory number of bottles or days during which the drip should be maintained.

2. Local Treatment.—Despite the early appearance of organisms in a burned area there is no desperate rush to get at the wound. Under morphine alone, the burned areas are cleaned with all aseptic rites, blisters snipped, and very carefully dressed with tulle gras or

vaselined gauze or Glasgow cream. If possible, these dressings are to stay on several days; the most likely reason for having to shift them is that they become uncomfortable. Hence the need for care in applying them. Guard the ends of the fingers by a Cramer wire splint which projects beyond the tips. Give morphine for pain. The procedure is slow: to be done properly it must be done carefully. Under the urgent pressure of battle it may be very difficult to do properly, but that is no real criticism of the method. There are surgical operations which cannot be skimmed or done roughly without the work becoming second-rate: the first dressing of a burn is one of them.

3. It is, as already stated, the purpose to leave the dressings alone for four days at least. In the interval the patient needs fluids, glucose, and rest. If his burns are reasonably comfortable he will sleep better with a hypnotic than with morphine. So many doctors seem to have no thought beyond morphine, though the man is suffering not so much from pain as from sleeplessness and nightmares.

4. After three to seven days, depending on the general condition, it is time to think of doing the first dressing. The limbs are beginning to get uncomfortable; the patient is rested; his fluid intake, by whatever route, stable. For an extensively burned patient there is nothing which makes him so comfortable, or the dressing so easy, as a bath. Elaborate machinery, though desirable, is not essential. An ordinary bath, cleaned with cresol, filled with warm water to which salt has been added to give rough normal salinity, does very well. On one occasion a bath filled with buckets of water boiled on primus stoves met an urgent need in treating two badly burned airmen. In the early stages, during the separation of sloughs, a daily bath seems best. Later, when the wound reaches the healing stage, it may make the granulations soggy. Judge the need for baths by the state of the wounds and the comfort of the patient. If the hands are burned, keep the fingers moving in the bath. For limited burns, especially of the hands, the envelope irrigation treatment is successful. With adequate organization, baths are as easy to arrange: with a large number of cases to be treated and a small staff, envelope irrigation may be a satisfactory alternative. But I feel bound to point out that some form of bath treatment centre can be improvised in any hospital if it is thought important enough: in R.A.F. hospitals in one command abroad a bath department was planned in each improvised building as automatically as was the operating theatre.

5. Food, with extra proteins, is the next care. In practical terms this meant abroad plenty of eggs. Patients with badly burned faces are apt to go short, but an adequate diet is very important. As important is attention to the bowels: these patients get constipated, and are much more comfortable and eat better when their bowels start to move.

6. Check the haemoglobin at any time that the patient's condition causes anxiety or if progress is slow, and always on the tenth day. If it is below 80%, check daily, and if thereafter it falls two days running, give a pint of blood. Give more if this does not check the fall, but one transfusion sometimes starts the curve upwards.

7. As the patient's general condition improves, the question of first-aid grafting where skin has been destroyed becomes urgent. The aim of the general surgeon is to preserve function and give the plastic surgeon as good a foundation to work on as possible. Ogilvie's definition of the need at this stage for "more optimism than sense" is the guide. It is often practicable to get skin to "take" on a raw area on the back of the hand that is continuous with discharging areas over infected phalanges. It is beyond the scope of this paper to discuss details of grafting, but it is important to know when to start this procedure. The answer is—at the very first sign of spontaneous healing at the edge of the raw areas. Whatever the bacteriology of the wound may be, natural healing shows that conditions are favourable for trying to graft. If the first attempt fails, try again. Thiersch, "postage stamp," and pinch grafts all have their place.

Summary of Important Points

It has already been explained that there can be no universal treatment for burns, but the purpose of this contribution is to try to show that there are certain recurring clinical pegs on which to hang the details of treatment.

1. Decide whether the burn is slight or severe. If in doubt, treat as severe and give general treatment first.
2. Local treatment depends on the nature of the wound and a consideration of outside factors such as nursing and transport.
3. Prevent dehydration by checking fluid intake and output. Ensure sleep.
4. Baths.
5. Watch the diet. Keep the bowels open.
6. Watch the haemoglobin and keep the record on a chart.
7. Graft at the first prospect of success.

By going over these points when faced with a case an intelligent approach to treatment is achieved. It used to be so common to find the surgeon wondering what to "put on" a dirty-looking burn ten days old when the patient had been constipated for a week and had a haemoglobin of 50%. Whether or not sulphonamides, penicillin, or anything else should be used can all be decided by observation of the individual patient, his wounds, and his charts. They cannot be given by rule of thumb.

Shock and Toxaemia

These two words appear in any paper or discussion on burns, and this one is no exception. They are, however, introduced for a special reason. Until they receive a much more definite meaning the surgeon treating burns would do well to forget them. That is not to deny that they are pathological factors, and it is to be hoped and expected that pathological and biochemical research will endow them with meaning which will aid the clinician in specific therapy. Until that day arrives the surgeon should break down his patients' symptoms and signs into words which have a practical application—pain, sleeplessness, dehydration, anaemia, and so forth. He will find it more profitable than sheltering behind "shock" and "toxaemia," which delude him into thinking he has made a diagnosis, and leave him stranded as to what to do to help. In certain severe cases he will find that there remains, when all possible lines of treatment have been used, some unknown factor which is keeping the patient ill and preventing progress, and for convenience that something unknown can be called "toxaemia." It is, however, for the clinician a dangerously seductive word, and there is a good case for using it very cautiously and a better one for not using it at all.

Comment

The infinite variety of problems presented for solution in the treatment of burns means inevitably that a volume of great size would be required to cover all the points that can arise. The omissions in this paper are deliberate. The points stressed are of universal application, and on them can be based the details which must be considered in every case. One omission demands a note—namely, the value of blood-pressure estimations. In so many of my patients has it been impossible from the nature of the burned areas to obtain readings that I have ceased to rely on them, depending on other signs for guidance; but if the blood pressure can be measured it helps.

On one point of detail a personal view is submitted. Severely burned patients travel badly until their general condition is stabilized, which usually takes from four to ten days. Long journeys for injured patients form a tragic feature of surgery in an overseas command. Burned patients do better if their general condition is treated well and they are kept quiet and still even under quite rough conditions, with poor facilities for local treatment, than if they are hurried away to the most lavishly equipped special centre. Paradoxically, some of the most severely burned men have lived because the medical officer forward has had no doubt in his mind that a journey would be fatal, and has kept and treated his patient, while others less badly injured have been sent on their way and have died. Hence the urgency of the need for teaching that in any case of doubt general treatment must have priority, and for eradicating the belief that there is some local dressing, be it ointment, powder, dye, or lotion, which can by its wonderful property save the patient's life.

Conclusions

In our knowledge of the treatment of burns there are gaps. They will be filled by the researches of pathologists, biochemists, and others; and with the information they provide the surgeon will be able to approach his patients with more confidence than he now has. My failure to refer to the amount of work done on this subject implies no disparagement, but its very mass is to the clinician somewhat confusing. It is my contention that the surgeon who tackles a case of burns as he would any other traumatic problem, with an analysis of symptoms and signs, will find his anxieties enormously reduced, his path clear, and in his mind tidiness instead of confusion. He will find himself varying his detailed technique from case to case as in any other branch of surgery. As research develops new information he can try new lines, for with their variety burns

keep on presenting new difficulties for solution. But withal he must avoid the confusion of detail and not be ashamed to rely on the simple practice of good surgery.

I am very grateful to many medical officers serving on units and in hospitals and in administrative posts, to nursing sisters, and to orderlies. They have shown that the handicaps imposed by an over-sea campaign, the necessary improvisations, and long distances are no real bar to a high standard of burns treatment when faced with intelligent enthusiasm and understanding. For such views as are not in accordance with the current teaching on burns, or appear unduly dogmatic or provocative, I am solely responsible.

FIRST-AID TREATMENT OF PHOSPHORUS BURNS

BY

W. McCARTAN, M.D., M.R.C.P.

AND

E. FECITT, M.P.S.

(Brighton County Borough Mental Hospital, Haywards Heath)

The facility with which copper combines with active phosphorus to form copper phosphide has been the basis of most methods of first-aid treatment of persons contaminated with phosphorus. The standard treatment suggests that the burning phosphorus should be extinguished with water, keeping the burned area damp and removing the patient to hospital for surgical attention as quickly as possible. The burn is treated with aqueous solutions of sodium bicarbonate and copper sulphate.

The principal objections to this treatment are that such solutions are cumbersome to carry and are not likely to be immediately available in civil defence and active service conditions, although speedy application is, of course, all-important. Also, the number of persons contaminated may be so large that immediate active surgical attention to all is not possible, and in the meantime it is necessary to repeat the application of the solution—not the best treatment for an already shocked patient. There is, further, the danger that repeated applications of fluid may wash particles of phosphorus to the periphery, with the risk of peripheral burns.

The possibility of damage to this institution by phosphorus-containing incendiaries during air attacks and the prospect of having to deal with a number of casualties among our population led us to investigate this matter with a view to producing a substance which fulfilled the following requirements: (a) it should be readily available in a compact form; (b) all the remedies should be contained in one compound; (c) it should immediately extinguish the phosphorus and inactivate the products of phosphorus combustion—i.e., phosphorus pentoxide and phosphoric acids; (d) it should be viscous and stick to the skin so as to remain in position, and also hold the particles of phosphorus *in situ*; and (e) it should be easily removed by warm water.

Godding and Notton (1942) suggested the use of copper sulphate, glycerin, and starch. Tomski (1943) recommended for trial two creams, the first containing 20% of sodium bicarbonate, and the second copper both as oleate and as sulphate. Tomski suggested that the two creams could be carried by fire guards, wardens, etc. Goldblatt and Oakeshott (1943) considered that aqueous solutions of copper sulphate would be unlikely to interact with solid phosphorus or with phosphorus dissolved in some solvent not miscible with water to produce total inactivation of the phosphorus. They suggested the use of copper oleate, with which they combined a rubber solvent.

One of us suggested the use of *sapo mollis B.P. Add. III* as the base for incorporating copper sulphate, and after many trials a compound was prepared with a final content of 4% copper salts. The damage to tissue by burning phosphorus is thought to be due not only to the heat of combustion and to the corrosive action of phosphoric acids formed as the terminal result of such combustion but also to the intensely hygroscopic action of phosphorus pentoxide, which is the intermediate stage of the change. Phosphorus pentoxide "mops up" water with great avidity and with the production of intense heat, and we

suggest that, applied to the skin, a film of water sufficient to extinguish the phosphorus flame will not be adequate to provide the pentoxide with enough water to supply its needs; thus tissue fluid is called on, causing further damage. For this reason a high proportion of water was mixed with the compound. It was also felt that water loosely held in depth over the area by such a compound might act as a better conductor of heat than air and that in this way the heat generated by the change— $P_2O_5 + 3H_2O \rightarrow 2H_3PO_4$ —would be more easily removed from the site of the injury. The method of production of the copper-soap compound is described later.

Bench and personal trials showed that the compound was extremely quick in action. Burning phosphorus was extinguished immediately and phosphide formation was very rapid. It also appeared to us that the inactivating layer of copper phosphide on the surface of a piece of phosphorus was of greater depth than with the copper sulphate solution. The black phosphide particles were very clearly visible in the green mass of the compound, giving an excellent colour contrast, and this may be important where manual removal in the operating theatre afterwards is necessary. The compound is adhesive and remains *in situ*, but is easily washed away with warm water.

Through the co-operation of the Ministries concerned, arrangements were made for tests to be carried out on experimental burns, and we are deeply indebted to Prof. G. R. Cameron and Mr. F. Burgess for their reports and for permission to publish them.

REPORT I

Treatment of Experimental Phosphorus Burns with Copper Sulphate Soap (Prof. G. R. Cameron and F. Burgess)

Adult rabbits (2 kg. body weight) were given standard phosphorus burns on the shaved skin of their backs. Under nembutal anaesthesia, 0.1 c.cm. of a 50% solution of yellow phosphorus in carbon bisulphide was applied to an area of skin enclosed by a metal ring 19 mm. in diameter, ignited, and allowed to burn for 15 seconds. Such burns are remarkably similar in depth and reaction, and heal in about 5 to 6 weeks when treated simply by water application. Two such burns were made on each rabbit—one being treated at once by repeated application of the copper sulphate ointment, which was renewed until it failed to turn brown or black, the other burn serving as a control and treated in some instances with water alone, some with the standard sodium bicarbonate-copper sulphate solution method (*Medical Manual of Chemical Warfare*, 1943, p. 50). In a third group the copper sulphate ointment was compared with copper sulphate ointment followed after two hours by 2% solution of sodium bicarbonate. In all instances the ointment was allowed to remain on the burn for several days. Comparison of healing times, judged by separation of the scabs which invariably form on the burnt surface, was adopted as the measure of effectiveness of treatment. Results are shown in Table I. It is apparent that the ointment-treated phosphorus burns heal more rapidly than burns treated with water or with the standard sodium bicarbonate-copper sulphate solutions. In the latter case there was as much as a fortnight's difference in healing times; in the former, nine days. These results are statistically significant.

With the third group of experiments, in which application of copper sulphate ointment was contrasted with ointment application followed after two hours by removal of ointment with sodium bicarbonate solution, the procedure was changed. All animals were killed on the 28th day, when healing was nearing completion, and the burns examined microscopically. The notes in Table I bring the main findings into contrast. There is no doubt that the follow-up of copper sulphate ointment application by washing with 2% sodium bicarbonate solution has aided healing; the bicarbonate solution is also excellent in removing the ointment if cleaning up of the burnt area is desired.

One striking effect of the ointment is the marked tissue reaction seen during the first 24 hours around phosphorus burns so treated. We examined microscopically the burns of five rabbits at this stage and found a great deal more oedema and cell infiltration than in burns treated by other methods. It is possible that an excessive reaction might have its disadvantages; it might lead, for instance, to more pain if the oedema were