TREATMENT OF BURNS BY ENVELOPE IRRIGATION

BY

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While no single method for the local treatment of burns has been found universally satisfactory and acceptable, the technique described by Bunyan (1940) of sealing the affected part in a coated silk envelope and irrigating with electrolytic sodium hypochlorite merits a thorough and critical trial. In the past six months 16 cases have been treated by this means at the London Hospital and 8 by other methods. Two were caused by electricity; the rest were due to the commoner agents encountered in civil practice and to wartime incendiary bombs. When the burns were multiple, as was often the case, different methods were used on the separate lesions and comparisons made between them.

The two main problems in the local treatment of any burn are the prevention of infection and the prevention of pain. The latter is largely a matter of controlling the former. If infection is prevented a superficial burn will heal satisfactorily by any method and a deep burn will be the sooner ready for the essential skin graft. Though descriptions of cases and their treatment glibly describe the degree of a burn, I have only once seen mentioned the difficulty presented by this assessment (Mowlem, 1941). It is often impossible to decide on the depth of injury at different sites of the lesion for several days, when it is frequently seen that original estimates were incorrect.

In general, large superficial areas heal more slowly than small deep ones, and the time required for the last few areas to heal, especially over the dorsum of finger-joints, is most tiresome. Many cases after a time advance extremely slowly, and a change of treatment is required to hasten progress. Healing is usually most rapid on the face, less so on the upper extremity, less still on the lower extremity, and slowest of all on the dependent flexor aspects, notably behind the knee. It is more rapid in the young than in the old, and in women's faces than in men's, where the growth of beard may lead to considerable discomfort and delay. It is particularly necessary to shave the scalp if forehead lesions are anywhere near the hair margin. The only delayed healing of a face burn was due to this omission.

Theatre toilet, though universally accepted in principle as essential, seems to be regarded as of less importance in practice; especially is this so in burns of moderate degree and extent, which are treated in out-patient departments. This is a great mistake, for one night spent in hospital following an efficient cleansing under anaesthesia may save many visits later as an out-patient. A stoker with burns of face and hand caused by his furnace "blowing back" was treated as an in-patient with no theatre toilet. A few days after he left hospital his substitute was admitted with almost identical burns from the same faulty furnace. With similar treatment, following cleansing under anaesthesia, he left hospital healed in two-thirds of the time.

Lastly, how does one honestly maintain "full aseptic precautions" in cleaning up a burn in the theatre, especially an air-raised casualty?

Technique of Bunyan - Stannard Envelope Method

The principle consists in enclosing the affected part in a transparent coated silk envelope, irrigating with electrolytic sodium hypochlorite three times daily through vents provided, and using the envelope* as the only dressing between irrigations.

Numerous modifications and improvements have been made since the method was first used to overcome various difficulties as they arose. A case of burns of the hand, wrist, and forearm is now treated in this hospital as follows:

When any necessary treatment for shock has been given the patient is anaesthetized in the theatre. An assistant first washes and swabs away loose debris with normal saline and rests the limb on a sterile towel. The surgeon, prepared as for an operation, "with full aseptic precautions," next cuts away with scissors any blistered areas and removes with forceps such injured tissue as can be removed with a minimum of force. No scrubbing is employed, as it adds further trauma to already damaged tissues. The limb is then suspended freely over a bucket and hosed or syringed with a 20% solution in tap-water of "milton" at 105° F. for 10 to 15 minutes, until thoroughly clean.* A suitable-sized envelope is then drawn over the limb, and the upper open end sealed well above the limit of the lesion by two overlapping turns of special webbed adhesive strapping. Variban has been substituted here when the recommended strapping was unavailable, but is less satisfactory. The patient is then returned to the ward.

About six hours later the first irrigation is given in the ward. The limb is supported on a mackintosh pillow so that the elbow is higher than the hand. The lowest vent of the envelope is doubled over on itself and closed with a special clip. As a substitute a spring-backed paper-clip with edges guarded by slit rubber tubing works admirably. For added security to the seal a rubber ribbon is tied firmly around the envelope just distal to the strapping. From a large container with delivery tube and glass nozzle, 2½% milton—i.e., 1½ oz. milton to 1 pint of tap water—at 105° F. is directed through the upper vent into the envelope and over the lesion. When the envelope is sufficiently filled to cover the lesion completely the upper vent is doubled over and clipped. The patient is then encouraged to move his fingers and wrist in the fluid for three to five minutes, before the fluid is drained into a bucket by releasing the lower clip. The process is now repeated once, and the complete performance takes about twenty minutes. After the second emptying the rubber ribbon is untied and the limb must hang down, with all vents open, to drain for twenty minutes. The process is repeated the following morning with 2½%, but thereafter 5% milton is used thrice daily.

Provided a rubber ribbon is tied below the seal during irrigation to take the hydraulic pressure, the more elaborate methods of sealing first used are quite unnecessary. In one case no seal at all was employed, the envelope being held in place between irrigations by a piece of tape tied around the limb, and this proved both satisfactory and comfortable.

For the first case treated here—in a home-made envelope which leaked—normal saline was used. Considerable oedema persisted, and the burn and surrounding healthy tissue became increasingly macerated. After a week milton was substituted, and the oedema disappeared in two days. The maceration followed less rapidly.

This maceration did develop, however, especially of the cornified palms of labourers, in subsequent cases when using milton. It is now almost completely overcome by adequate postural drainage after each irrigation and by leaving all vents open between-whiles. Although this latter theoretically admits secondary infection, which the envelope method was designed to occlude, in practice it does not seem to occur. If a tendency to maceration is still found, resting the limb on hot-water bottles to increase evaporation will almost certainly overcome it. This has not been necessary here since the early cases. The distension of the envelope with oxygen after each irrigation to prevent maceration was suggested, but it did not seem to be of any value, and, in any case, attention to drainage is all that is usually required.

If the lesion is thoroughly hosed with 20% solution at the initial cleansing a degree of anaesthesia appears to be produced. After the first early morning one, using 2½%, subsequent irrigations with 5% do not give rise to any complaints. Though a few say it stings—and this stinging

* These envelopes, made for different parts of the body in a variety of shapes and sizes, may be obtained from William Stannard & Co., Leek, Staffs.

* Milton is an electrolytically prepared solution of sodium hypochlorite, stabilized at 1%.

sometimes begins even half an hour after irrigation—the majority of patients welcome the procedure as painless and comforting.

An electrolytically prepared hypochlorite was chosen, as saline remains after the liberation of its nascent chlorine; whereas chemically prepared varieties, such as eusol or Dakin's solution, have more irritant end-products. Milton was thus used, as it filled requirements, and was supplied to hospitals at the special price of 3s. 6d. to 5s. a gallon, according to quantity. However, since the first few cases, when Milton was used, the hypochlorite employed has been prepared electrolytically in the hospital dispensary. With an apparatus made entirely by the chief dispenser, Mr. C. H. Sykes, a 1% solution of electrolytic sodium hypochlorite is prepared by switching on the current and switching it off when a bell rings. This has been found to remain completely stable after six months, and is diluted in the theatre or ward to the strength required. The cost is about 6d. a gallon. The only further essential is the non-interference by enemy action with the electric supply.

The initial disadvantage of leakage and wetting of the bed through an imperfect seal has disappeared since using a rubber ribbon; but, at seams especially, and also by permeation through the envelope, a certain amount of fluid still gets through. In a "good" envelope this may not start for nearly three weeks, but sometimes it begins as early as the fifth day. It is quite controllable by a mackintosh sheet under the part, but when the fault is eliminated by technical improvement in manufacture the method becomes entirely free from "mess"—except perhaps in the theatre at the initial cleaning. (I believe this difficulty, due mainly to delay in obtaining materials, has now been overcome.)

When filling an envelope enclosing a leg, the lower part is bellied out by the entering fluid, which draws the upper part painfully tight across the limb until raised off it by the envelope's becoming completely filled. If a length of Gooch splinting is placed beneath the limb and the free edges are drawn up on either side and suspended from a bed cradle, a trough is formed outside the envelope which prevents this.

With an extensive deep burn, progress becomes delayed after a time—as with many chronic conditions. This time of delay presumably varies with individuals; sufficient long-standing cases, however, have not been treated to do more than suggest that, with the envelope method, the first four to six weeks is the period of most rapid improvement. If, when envelopes are changed on account of leaking, the lesion is again hosed down with 20% solution, healing appears to be accelerated.

Only limb burns have been treated here by this method, though a case is still being awaited which can be enclosed in an envelope extending from breasts to mid-thighs and allowing easy use of a bed-pan by an ingenious gusset. It has so far only been successfully fitted and filled on an uncomplaining student.

A few cases of infection have been treated, but these are not discussed in this paper.

Comment on the Method

Infection.—As bacteriological controls here have been so incomplete, the subject of infection can only be discussed clinically—i.e., when granulations are pale pink and no pus is present, infection is assumed to have subsided or not to have occurred, as the case may be; though cultures from the surface would almost certainly show organisms. In not a single case treated from the onset by the envelope method has severe infection occurred. With a theatre toilet it has been subclinical; without this cleansing it was only slight, and rapidly subsided. This is a very

important advantage; for whereas with any other method preliminary cleansing in the theatre is essential, with an envelope the healing time is not so disastrously prolonged if this still highly desirable cleansing has to be omitted. And in certain circumstances this omission may be inevitable. Where infection is already present an envelope is the most satisfactory method of cleansing. Repeated dressings of any nature should be done not less often than two-hourly—which is very time-consuming, and is disturbing to the patient—or they stick, and their removal is painful and destructive. This can be avoided by covering with tulle gras; but cleansing is then very much delayed, as the gaps in the mesh soon became blocked by exudate. Hypochlorite compresses clean more rapidly than saline, which produces maceration by the tenth day at the latest. This is the great disadvantage of the saline bath. The envelope sticks not at all or very slightly, is the least painful method, thrice-daily irrigations are adequate, and progress can easily be watched without disturbing the lesion or the patient.

Pain.—This is virtually absent. After the first early morning irrigation patients seldom mention more than a slight stinging. This is rather the exception, and has not persisted for more than a day or two. In three cases in which both hands were burnt, one was treated with an envelope, the other by ointment dressings—and in each instance preference was volunteered for the envelope.

A patient treated by Mr. Alan Perry had the whole of his hand coagulated by a severe electric burn. It was enclosed in an envelope and irrigated for thirteen weeks, four envelopes in all being used. During this time part of the palm and all the digits except the little finger sloughed away, but after the first few days there was no complaint of pain or any sign of secondary haemorrhage.

A girl aged 16, whose nerve had completely gone following burns of both lower limbs from thighs to feet, was treated by triple dye jelly. Despite initial theatre cleansing, one leg and then the other became infected, and although this was suspected—even leading to re-examination under anaesthesia on the fourth day, when no pus was found—it was not until the ninth day that the pellicle showed definite signs of infection beneath. From then onwards the whole areas of both legs became infected. One was treated in an envelope, the other with Milton compresses over tulle gras. The patient became almost unmanageable, and begged for the second leg to be enveloped. After this had been done she settled down in a few days, and took the greatest interest in watching the progress of her condition through the transparent envelopes.

There is no doubt that patients have preferred the envelope to any other method used on them—though, with a number in a ward at once, mass suggestion certainly plays a part. The only real complaints have been of soreness from the strapping seal.

Use.—This is a further great advantage in treating hands. From the second day they can be used, painlessly, for coarse movements through the envelope, such as feeding, holding a book, or doing the hair. For superficial burns of the hands no movement should be lost. For deeper burns the patient continues to move the hand while waiting for sloughs to separate—at first only in the fluid, but in a few days at all times. Where loss of tissue—e.g., tendons—means inevitable impairment, movement of course suffers; but otherwise, movement never having been lost, the tedious process of regaining it does not arise. The only disadvantage of using the hands too enthusiastically would appear to be the earlier leaking of the envelope.

Nursing.—The staff are saved a great deal of time if several cases are being treated by the envelope method. One preparation does for all, and there is no scrubbing up between cases. While one patient is moving the fluid over his lesion the envelope of the next is being filled. With a solitary case, rather less time and preparation are involved in "dressing" the burn.

Cost.—This depends on the size of the area to be treated, as the larger this is the larger the envelope and the more solution required. For an arm, however, the hypochlorite as prepared in our hospital dispensary would cost 3½d. a day. To that is added the cost of the envelopes: no other dressings are required.

Analysis

The 24 cases involved 51 areas; these were treated as follows:

(a) *Ointment dressings* were used only for clean burns. If an area of infection developed it was quickly controlled by compresses, before it became deep or extensive. All faces except one were dealt with by this method, and 14 cases in all.

(b) *Saline Compresses.*—This method was used in 8 cases, one of which, a burnt face, healed satisfactorily in nine days. In all the others it had to be abandoned, as maceration became too marked. The method is, however, useful for a few days to clear up a limited area of infection.

(c) *Electrolytic sodium hypochlorite compresses* in solutions varying from 5 to 50% were found more effective than saline in treating infected areas, of which 7 were encountered.

(d) *Flavine in paraffin* was used in only 3 cases. It appears to have little advantage over ointment for a clean burn, and is more messy.

(e) *Triple dye jelly* was applied to 6 areas after careful cleansing under anaesthesia. In every single case almost the whole area covered became infected, superficial burns became deep, and weeks were required to heal. One needed a skin graft and another may do so. Even if perfect healing had occurred, the method was messy.

(f) *Envelope Irrigation.*—This was employed on 13 burns from the start and on 8 after infection had supervened.

Summary and Conclusions

Treatment of burns by envelope irrigation with electrolytic sodium hypochlorite has been tried in 16 cases, and the results are compared with those in 8 cases treated by other methods.

When thorough surgical technique is impossible the envelope method will minimize the dangers of infection; and when infection is already present no other method will clean the wound so rapidly or so effectively. By its use treatment is almost painless—an advantage especially noticeable in infected cases. The method is cheap and convenient, making nursing simple.

Other methods will heal a burn or bring it to the stage of grafting within comparable degrees of time, attention, and discomfort, provided all goes well. The great value of envelope irrigation is that one can be quite certain that in no case treated by it, with or without theatre cleansing, will anything more than mild infection occur. Can this be claimed for any other method?

I should like to thank Mr. Neligan, Mr. Perry, and Mr. Dix for permission to publish these cases, and to record my appreciation of the enthusiasm shown by the nursing staff despite early difficulties.

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The Biochemical Society would like to give any possible assistance to foreign visitors to this country who are interested in biochemistry. The following notice, published in the last programme of the Society, may be of interest: "On behalf of the Society the Committee wish to extend a cordial invitation to biochemists and others interested in biochemistry, from the British Empire and countries abroad, to attend meetings and to take part in the discussion of papers. If such visitors wish to receive programmes of the meetings and advance abstracts of papers, they should send their names and addresses to the Secretaries." The Secretaries of the Biochemical Society are: Dr. F. G. Young, National Institute for Medical Research, London, N.W.3, and Dr. W. T. J. Morgan, Lister Institute of Preventive Medicine, Chelsea Bridge Road, S.W.1.

MUMPS MENINGO-ENCEPHALITIS

BY

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In a recent epidemic of mumps among soldiers 234 cases were treated in hospital. For the most part only the more severe cases were seen, the milder ones obtaining treatment in their own camps. In a mumps epidemic with meningeal symptoms, coming as it did at the end of a severe epidemic of meningococcal meningitis, it was not surprising that quite a few patients with mumps were sent into hospital with meningitis as the tentative diagnosis. In only 5 of these cases were the symptoms severe enough to justify lumbar puncture. In all these cases a pleocytosis was obtained in the cerebrospinal fluid. Many more cases were sent in for lumbar puncture, but the diagnosis rested largely on the recognition that such a symptom can occur. It was soon apparent that it was not necessary to have either parotitis or orchitis: the meningeal symptoms in contact cases of mumps could be presumed to be due to the mumps infection.

That meningeal involvement occurred fairly often in a mumps epidemic has been known since the middle of the eighteenth century, but it was not until 1902 that Monod described the findings in the cerebrospinal fluid. Gordon (1913) was able to produce an encephalitis in a monkey by intraspinal injections of saliva filtrates. Both Birnberg (1939) and Silwer (1936) suggest that the frequency of symptoms from the central nervous system varies from epidemic to epidemic. Pleocytosis in the cerebrospinal fluid may or may not produce meningeal symptoms. It is stated that there is an increase in cells in the cerebrospinal fluid in 50% of cases of mumps, though some authors put the figure as low as 0.1%.

Table showing Illustrative Cases

Case No.	Age	Presenting Symptom	C.S.F. Cell Types	Cells per c.mm.	Complication	Days after Onset
1	26	Parotitis	Small mononuclear; occasional large mononuclear	230	None	—
2	36	Meningitis	All lymphocytes	375	Parotitis	1
3	35	Submaxillary swelling	" "	525	Orchitis	6
4	32	Meningitis	Lymphocytes; occasional endothelial cell	1,078	None	—
5	22	"	All lymphocytes	928	Orchitis	11

No organisms were seen in any of these cases, and the cultures remained sterile. In two the C.S.F. pressure was raised, but both patients were very excited; the other cases were within normal limits of pressure. In Case 2 the fluid was not quite clear, while in Case 4 the fluid was definitely opalescent. In Case 5 no parotid swelling was seen, though a severe unilateral orchitis developed eleven days after the onset of meningeal symptoms.

If parotitis had been present the symptoms of a meningeal involvement were fairly easy to recognize. The onset varied from the first to the fourteenth day, though commonly it occurred about the fourth or fifth day. Headache, with a pyrexia generally over 100° and quite often over 102°, appeared, ushered in by nausea and vomiting. Some degree of neck rigidity was a constant finding, the patients complaining of pain in the head, neck, and back. In two of the cases head retraction was present. Bradycardia, Kernig's sign, and photophobia completed the picture of a meningeal reaction. The temperature, vomiting, and headache generally began to subside on the third day. Most patients were free from any symptoms except weakness soon after the fifth day. One patient, who was in hospital for a month, still complained of head-