SURGICAL PROCEDURES IN GENERAL PRACTICE

This is one of a series of articles contributed by invitation

THE TREATMENT OF BURNS AND SCALDS

BY

PHILIP H. MITCHINER, M.D., M.S., F.R.C.S.

In dealing with the treatment of burns and scalds in general practice one of the most important things to realize is the far better prognosis which can be given in the case of scalds than in the case of burns. For whatever the treatment used, it is a well-established fact that the mortality rate in scalds is only one-third of that from burns, and therefore in any scald a correspondingly better prognosis can be given than in a burn of the same extent.

Why do Burnt Patients Die?

One of the first things to remember is the importance of prophylaxis, and in order to apply this effectively it is necessary to understand the causes which result in the death of the patient. It has been established that 80 per cent. of the deaths ensue from shock and collapse, which are due partly to the absorption of histamine and other toxic bodies from the damaged tissues, partly to the excessive loss of fluid from these tissues, and, lastly, to the pain from the exposure and stimulation of nerve endings. The remaining 20 per cent. mostly result from sepsis, and occur not within the first two days as in the case of the collapse, but in about a week or ten days from the infliction of the burn.

Discussion of the researches which have led to these findings is out of place in such an article as this, but those who wish to inform themselves of the details are referred to the many works on the subject. It will be seen from the above that for any treatment to be efficient it must be directed primarily to the avoidance of collapse and must aim essentially at the complete coagulation of *all* damaged tissues in order to prevent the absorption of toxins, the escape of fluids, and excessive pain. Secondly, thorough cleansing of the damaged area and its surroundings is necessary if sepsis is to be avoided. By the thorough application of these two principles, coagulation and cleansing, the modern treatment of burns has been able to show such a great advance that the mortality from these injuries has dropped to one-tenth, as will be seen by the study of Table I.

TABLE I.—*Mortality of Burns and Scalds in St. Thomas's Hospital*

Year Groups	Treatment	Mortality (per cent.)	
		Burns	Scalds
1894-1898	Baths and ointment	39.6	18.8
1900-1903	2 per cent. picric	39.7	7.0
1924-1928	2 " " "	15.5	7.5
1929-1936	2 per cent. tannic	4.0	1.7

Coagulant

It is essential that to be efficient a coagulant should be able to penetrate while acting, so that the entire depth of damaged cells may be reached. There is otherwise

a grave danger that a superficial coagulum (which still permits of absorption and escape of fluids from the deeper uncoagulated tissue) may lead to a sense of false security through having caused cessation of pain and a temporary improvement in the patient's condition—an improvement which is not maintained but is succeeded in a few hours by the advent of that "secondary collapse" so well described by Wilson of Edinburgh and so frequently fatal. It will be seen that the ideal coagulant not only should be capable of penetrating but it must be used in a solution weak enough to allow it time to penetrate into the depths of the damaged tissues. As the mortality table shows, the use of picric acid led to a fall in mortality; this was due to its coagulant properties, but no greater fall occurred, because picric acid coagulates only the superficial tissues. Tannic acid, on the other hand, if used in a sufficiently weak solution, is capable of penetrating through the entire depth of the damaged tissues, and therefore gives far better results than either picric acid, silver nitrate, or strong solutions of tannic acid, which produce only a superficial coagulum.

The older methods of treatment by ointments or paraffin-wax merely secured cessation of pain and in no way procured coagulation, so they will be mentioned merely to be condemned. Similarly the modern method of treatment by crude cod-liver oil preparations offers in its results no comparison with those obtained by coagulation, though it has the advantage over the older greasy dressings that sepsis can be held largely in check. The gentian-violet treatment also aims at antiseptics, but it does not produce coagulation, so that the results are not satisfactory in severe burns, though considerable absorption of the dye occurs.

The Use of Tannic Acid

One important point in relation to tannic acid is to remember to use weak solutions. Personally I advocate a 2 per cent. strength—certainly never over 5 per cent. It must be borne in mind that tannic acid in solution readily grows a large selection of moulds and thus becomes very septic; so an antiseptic has usually to be added to prevent this. Various antiseptics have been tried, the most successful being perchloride of mercury 1 in 2,000. It has been found, however, that this solution decomposes in about two months, and in order to prevent this a powder is used which not only keeps indefinitely but dissolves easily in warm water. This consists of tannic acid, 17½ grains, and perchloride of mercury, 1/2 grain, to be dissolved in two ounces of warm water. This gives a 2 per cent. tannic acid solution with 1 in 2,000 perchloride of mercury; and the two ounces, in addition to being sufficient for each spraying, will soak a compress dressing 6 by 4 inches, which is large enough to cover the average burn met with in domestic practice. In the case of larger burns two or more powders, as may be necessary, can be dissolved in a corresponding quantity of water. As the perchloride, however, has the disadvantage of being scheduled as a poison, many other antiseptics have been tried, including acriflavine and hexyl-resorcinol, of which the latter in a 1 in 2,000 solution is the most beneficial. These, however, frequently cause pain to the patient and interfere with the formation of a hard and

satisfactory coagulum. *It cannot be too strongly impressed on the practitioner that the addition of this anti-septic is to preserve the tannic acid solution, and does not prevent sepsis in the area of the burn, which must therefore be most carefully cleansed, as described later.*

After these preliminary remarks I will proceed to consider in detail the treatment with tannic acid. This may be applied by either the compress or the spray, but inasmuch as the spray treatment is possible only in hospital it will not be described here: experience shows that it never gives good results in severe burns when applied under the conditions of private practice, and it is unnecessarily complicated in slight cases, where the compress or the application of tannafax jelly gives equally good results. In passing, it may be mentioned that tannafax jelly is an excellent method for treating small burns such as so frequently occur in homes, where it can with advantage be kept with the stock of first-aid applications. It does not, however, give satisfactory results in large or extensive burns. (A full description of the spray method can be found in *The Modern Treatment of Burns and Scalds*.)

First-aid Treatment

The treatment of burns, as of any injury, resolves itself into first-aid and final treatment. The first-aid treatment must be immediate, because the sooner a coagulant is applied the smaller is the likelihood of collapse. It may be argued that few homes keep tannic acid; but there are very few where tea is not procurable, and the infusion of tea as we drink it contains from 2 to 5 per cent. of tannin—a fact realized long ago by the Chinese, who have successfully dressed their burns with tea for over 5,000 years. All that is necessary, therefore, as a first-aid measure is to soak clean linen in tea and apply it promptly all over the burnt area. Care must be taken that the tea is sufficiently cooled, so that no scald is inflicted by its application.

Oils, flour, and butter must have no place in the first-aid treatment of burns, for, although they stop the pain, that is all they can do, and collapse, often fatal, will occur.

After the application of tea or tannic acid wrap the patient up well and give plenty of warm fluids to drink; an injection of morphine, 1/4 to 1/3 grain, or a dose of tincture of opium, according to the age of the patient, may be given with advantage, and this fact must be recorded. Do not hurry the patient into an ambulance and rush him to hospital; he will be very much better if he is left lying quiet for half an hour before being transferred.

Final Treatment

The final treatment consists in the *application of the tannic acid compress*; but first the burnt area and surrounding skin must be thoroughly cleansed, and this can be efficiently carried out only under anaesthesia. Burnt patients are liable to pulmonary complications, so that inhalation anaesthesia should be avoided; similarly there is a tendency towards albuminuria, with renal and hepatic inefficiency, and therefore barbiturates such as evipan or avertin are not without their risks. For these reasons heavy dosage with opium or morphine, as suggested in Table II, has been found most satisfactory to induce anaesthesia in these cases. In this respect it must be remembered that the drug will need at least half an hour to act before the patient is sufficiently somnolent to permit cleaning to be proceeded with.

TABLE II.—*Opium Dosage for Cleansing Burns and Scalds*

1.—IN CHILDREN

Age	Preparation	Dose
1 month	Tinct. camph. co.	℥ij-ijj
2 months	" " "	℥iv-vj
3 "	Tinct. opii	℥ $\frac{1}{2}$ - $\frac{3}{4}$
6 "	" "	℥ $\frac{3}{4}$ - $\frac{1}{2}$
1 year	Tinct. opii (a) or Inj. morph.	℥ij-ijj
Over 1 year	Tinct. opii or Inj. morph.	grain 1/75 ℥ij for each year and ℥ij in 15 minutes if necessary grain 1/75 for each year

2.—IN ADULTS

Age	Preparation	Dose
12-15 years	Tinct. opii and Inj. morph.	℥xxx grain $\frac{1}{2}$
15-20	Tinct. opii and Inj. morph.	℥xxx grain $\frac{1}{2}$
Over 20 years	Tinct. opii and Inj. morph. (b) or Inj. morph. (c)	℥xxx grain $\frac{1}{2}$ - $\frac{1}{4}$ grain $\frac{1}{2}$ - $\frac{1}{4}$

(a) Tinct. opii is more satisfactory than morphine. (b) For women. (c) For men according to stamina.

N.B.—Should slow or shallow breathing give rise to anxiety atropine sulphate 1/200 to 1/50 grain should be administered hypodermically.

Essential Cleansing

When the patient is well under the morphine the first-aid dressing is removed and the area of the burn and the skin round it are cleaned. It is the latter which is most likely to be septic, as it has not been properly burnt, so it must be cleaned with especial care. On this depends the entire success of the treatment with tannic acid, and I venture to say that *if your treatment fails it will be because the area has not been cleaned properly, and for no other reason whatsoever*. All dead skin must be removed, debris picked off, blisters pricked, the raised skin cut away, and the whole area washed with soap and warm water, using a flannel or sponge. When the area is thoroughly clean—particularly round the edges—it should be sponged with ether. The tannic acid dressing is then applied.

The Compress

Into the 2 per cent. tannic acid solution, made up as described, dip a dressing of three layers of sterile lint or six layers of sterile gauze, cut to extend three inches beyond the obvious edge of the burn. Take it out dripping, and apply loosely and evenly over the burnt area. Then bandage the dressing firmly into position and leave it to dry, with the area rendered immobile by skeleton splints or suitable fixation: this is perfectly simple, and keeps the patient warm. If the burnt area is large a cradle should be used, and extra heat must of course be applied to warm the patient; but do not let the heat be too strong or the compress will dry before the tannic acid has had time to penetrate and secondary shock will subsequently develop, as the deeper damaged tissues are not coagulated. An electric lamp a little way off, or a hot-water bottle held near the dressing, will be sufficient to dry the compress slowly, and, incidentally, will not concentrate the solution.

After-treatment

The patient must be kept warm and fluid be given freely to combat collapse. The dressing should be left untouched for two weeks approximately, by which time the coagulum will separate naturally when the bandage is cut. Fixation of the burnt area must be maintained for the first twenty-four hours at least, so that the coagulum of tannic acid can solidify, and if the burn is in any of the flexures of the body the limb must be extended by splints, so as to avoid contraction and subsequent deformity from destroyed subcutaneous tissue or muscle. A burn extending all over the hand, for instance, would entail separating the fingers with rolls of bandage between the knuckles, so that they would not become webbed at the base and leave the hand deformed. In first or second degree burns these splints may be removed in forty-eight hours in most cases, but with deeper burns they must be retained till the coagulum separates, and often have to be reapplied for some time after this.

At the end of two weeks cut the bandages and the coagulum will lift away from the burn. Any areas that are inclined to stick should be left a day or two longer, when they too will come away neatly.

Complications

Various complications may occur during the course of treatment.

1. *Cracking of the coagulum* results unless efficient fixation is maintained for the first twenty-four or forty-eight hours, and is an indication that the dressing must be removed and the burnt area re-tanned with the part properly fixed. Similarly, if hexyl-resorcinol or acriflavine solution is used a soft and unsatisfactory coagulum may result, and this is also an indication for re-tanning.

2. *Sepsis* may occur, though in this respect it must be realized that the escape of a little serous or sanious discharge round the edges of the coagulum is of frequent occurrence and does not mean that sepsis is present. Pain, pyrexia, and a discharge of frank pus alone indicate sepsis; these call for the removal of the loosened coagulum, thorough re-cleansing of the area, and reapplication of a tannic compress, when a satisfactory result will be obtained.

3. In burns which have destroyed the skin *ulceration* will of course be present when the tannic acid coagulum separates. All that is necessary in these cases is continued splintage to prevent contracture and the application of a suitable lotion, or the use of some method of skin grafting to effect healing, which can be obtained with very little scarring.

Special Burns

Burns in certain situations, such as the face, perineum, and buttocks, are better treated, if possible, by the spray, though with care an excellent result can be obtained by the compress. In the case of a burnt hand great care must be taken in the application of compress and bandages to individual fingers and the clefts between them, as well as in the splinting of the hand and fingers and the fixation of the latter apart by means of rolls of bandage stitched between the digits well clear of the clefts.

Up till now only fire and water burns and scalds have been considered, but there are also many very bad *chemical burns*. Tannic acid is equally good for these, but the chemical that has inflicted the burn must first be neutralized completely before the tannic acid is applied.

In any such burn washing freely with a large quantity of warm water is essential, and in addition an *acid burn* must be neutralized with an alkali—bicarbonate of soda, for instance—while an *alkali burn* should be neutralized with a 2 per cent. citric acid solution; this is best, as it penetrates the tissues, while most of the other acids (for example, acetic) act only on the surface.

Electrical burns are very difficult indeed to treat. They are often fatal, and so the need for treatment does not arise. Only a very small burn shows—a sort of stab in the flesh where the current has entered. The patient should be moved away from the current at once—even before it is switched off; but of course the rescuer must take the greatest care not to become electrocuted himself. The patient must be treated for collapse and the small burn with tannic acid, but very little else can be done. Pain will be intense through all the nerves. A certain amount of relief can be obtained from the use of veronal tablets, but morphine must on no account be given.

In the case of burns from *mustard gas* the medical man must protect himself by using rubber gloves and, of course, by wearing an overall and respirator. The first thing to do is to neutralize the gas with bleaching powder emulsion, then wash the area with plenty of water, dry over with ether, and put on a tannic acid compress.

For *lime or gas burns* in the eyes irrigate the eyes first with a neutral fluid such as a 2 per cent. solution of citric acid, and then instil sterile castor oil and a drop of 1 per cent. atropine solution.

Lastly I will just mention *sunburn*, which, after all, is a burn and often requires specific treatment. The popular idea of treating sunburn is to put on grease and lie out in the sunshine. Of course as a result the patient is very nicely basted, and suffers all the pain of a fire burn. Here is a prescription which has been found very beneficial when dealing extensively with sunburn at Territorial camps:

R.	Calamine	...	...	...	...	400 grains
	Zinc oxide	...	...	...	...	400 "
	Tannic acid	...	...	...	...	100 "
	Glycerin	...	...	...	...	1 ounce
	Water	...	...	...	...	1 pint

This lotion should be applied at hourly intervals until the irritation is relieved. Incidentally the lotion has itself a pleasant tanning effect on the skin.

Other Methods of Burn Treatment

Many other methods have recently been used, but the majority fail in that they do not produce coagulation; considerable shock therefore ensues from the escape of fluid, and in severe burns this frequently has fatal results. Thus they cannot in the majority of cases be considered as efficient as a weak solution of tannic acid.

Crude cod-liver oil has had a considerable vogue, but is no better than any other grease dressing, though, as stated, it holds sepsis largely in check.

Gentian violet (1 per cent. aqueous solution) is an excellent antiseptic and keeps burns clean. No better treatment can be used for small first and second degree burns. It must be realized that absorption takes place in all burns, and the urine may be discoloured, while there is of course a violet discoloration of the skin, which persists for a considerable time. Moreover, as no coagulation of the damaged tissues occurs shock will result from loss of fluid. This antiseptic unfortunately does not combine well with tannic acid.

Silver Nitrate.—A 10 to 20 per cent. solution of silver nitrate rubbed into the burnt area produces a tough and rapid coagulum; but here again it does not always penetrate into the deeper tissues, and so a certain amount of collapse occurs in severe burns. Next to tannic acid, however, an application of silver nitrate and gentian violet gives the best results; but here once more the primary essential cleansing of the burn and surrounding area is necessary if sepsis is to be prevented. The patient having been given a dose of sedative, and the area of the burn being cleansed as already described under the tannic acid treatment, the whole of the burn area is painted or sprayed once with a 1 per cent. aqueous solution of gentian violet and is thoroughly swabbed over with a 10 to 15 per cent. solution of silver nitrate, care being taken that the silver nitrate does not escape over the surrounding skin. The area is now again sprayed or painted with a 10 per cent. solution of gentian violet at fifteen-minute intervals for five or six times, the patient in the meantime being kept warm under an electric cradle and given plenty of fluids to drink. Should it be necessary the painting or spraying with gentian violet can be repeated once or twice daily for the next day or two. From the use of this method the American authorities report a mortality of 7.3 per cent., apparently for both burns and scalds; this is considerably higher than that from weak tannic acid solution, as might be expected when one realizes that in the case of extensive burns the silver nitrate coagulum does not extend into the deeper damaged tissues.

Many other antiseptics have been combined with tannic acid instead of perchloride, the most popular of which is acriflavine. This substance, however, in my experience, is not satisfactory for the reasons already given. The same objections apply to the great majority of antiseptics that have been tried in this connexion.

Finally, I would say to those practitioners who bring forward instances where some particular treatment has given good results in individual cases of burns that any treatment may be successful in the case of a slight burn, but that in severe burns cleansing and coagulation alone can be relied on to preserve the patient's life, with the minimum of disfigurement and the maximum relief of pain and the prevention of collapse and sepsis.

CROYDON TYPHOID INQUIRY

EVIDENCE OF EXPERT WITNESSES

The tribunal inquiring into the outbreak of typhoid fever in Croydon continued its sittings over Christmas. The first evidence called on behalf of the Corporation was that of a geological expert, who spoke as to the structure of a gathering ground of the suspected well, and a consulting water engineer, who testified as to the character of the water from the Addington supply. The latter witness, Mr. S. R. Rafferty, agreed that this well had been known for a number of years to show variations in the quality of the water. He agreed also as to the danger from workmen's latrines in the vicinity during such time as some work was proceeding on a school belonging to the local authority, and as to the undesirability of the presence of a pig farm at this particular spot, though he would not say that this was a possible source of danger. It was further put to this witness that on the other side of the wood from the reservoir there was a ground, just outside the Croydon boundary, which was used as a week-end camping place for some hundreds of people and had no sanitary conveniences of any kind. The witness replied that there had been no means of dealing with such a state of affairs, unless it could be held to constitute a local nuisance, until the passing of the recent Public Health Act.

Medical Officer of Health's Evidence

Dr. O. M. Holden, medical officer of health for Croydon, who was in the witness chair for three days, traced the history of the epidemic and of the inquiries set on foot regarding water, drains, etc., immediately the cases occurred. He had been under the impression that the whole of the Croydon water was chlorinated, and was surprised to hear that the high-level supply, which included that from the Addington reservoir, was not. Chlorination of the Addington well began on November 1. He had studied reports of a predecessor of his in 1905-8 regarding the liability of the Addington well to surface pollution. He knew the conditions on the gathering ground, and for some time he had been a little uneasy about this well; he had drawn attention to the fact that the analyses of the water from this well did not appear to be satisfactory and had recommended chlorination.

In reply to his own counsel, Mr. Sandilands, K.C., Dr. Holden said that the duties of the medical officer had been considerably increased during the last twenty years, but the water supply had never been put upon him. He did not wish to deny that as medical officer he had a certain responsibility. He considered the limit of his responsibility to be to advise the responsible authority on the bacteriological analyses, which were the only material he had before him. At the end of 1930 he advised that chlorination should be considered by the borough engineer, and he had been under the impression that chlorination was carried out at Addington well from that time. It was put to him by Mr. Lyons, counsel for the South Croydon Typhoid Outbreak Committee, that in 1931 he had reported that some solid contamination had been getting into the Addington water, and that if the area were built on to any greater extent and cesspools multiplied there would be grave danger to the public health, and that when in 1936 he reported that the water supply was satisfactory he omitted to point out what he really knew—namely, the danger which he had appreciated five years earlier. Dr. Holden denied this.

He was also asked what steps he took to prevent householders drinking water from their own cisterns after he knew the water to be contaminated. Dr. Holden replied that the precautionary measures taken on November 1 at the source of supply safeguarded the water by November 3, on which date he first knew the water to be infected, but he agreed that nobody visited the unoccupied houses, drained off the water, and chemically treated the tanks.

Precautionary Measures Adopted

When the inquiry was resumed on Tuesday, December 28, Dr. Holden was further cross-examined by Mr. Montagu Lyons, who asked first as to the dates when the Addington well was chlorinated. The witness said that the records would be with the borough engineer. The borough engineer, like himself, had been under the impression that the supply had been continuously chlorinated since an earlier complaint was made, but he discovered at the beginning of the outbreak that only intermittent chlorination had taken place.

Asked how many cases would be brought to his notice in the same area before he decided that an outbreak was probably beginning, he replied that two or three cases of any infectious disease in the same neighbourhood would cause him to think seriously of the likelihood of spread. But he desired to make it plain that at first the water was not specially considered. It was one of a number of things, including milk and other articles of food, which had to be examined, and there was no reason at the end of October, when the first four or five cases had been notified, for giving water the priority.

Dr. Holden was questioned as to a statement he had made that in recent years water had seldom been found to be the cause of typhoid. He said that the statement was a fair one, though it might have been amplified. Certainly the most serious outbreak of recent years (Bournemouth) was not due to water. Asked why in a