AN EMERGENCY TREATMENT OF BURNS

R. W. S. MILLER, F.R.C.S.E.

Lately Registrar, Burns Unit, Accident Hospital, Birmingham

Introduction

IMMEDIATELY following injury by burning there is a loss of plasma-like fluid through the walls of damaged capillaries into the extravascular space, and onto the skin surface, unless the latter has been coagulated. If the burn is small, the compensatory mechanisms of the body can usually compensate for the loss of fluid, but if large there will be oligaemia, which, if not treated, may lead to circulatory failure.

The aims of treatment must be to save life by:

1. Restoring and maintaining the plasma and red cell volume.
2. Correcting or preventing dehydration.
3. Restoring the electrolytes and protein which have been temporarily lost extravascularly, or permanently lost in the burn exudate.

It is presumed that initially there is little red cell loss.

The treatment of this oligaemia varies from centre to centre; whole blood, reconstituted dried plasma, "Dextran", and saline being used alone or in combination. All have been used in the Burns Unit of the Accident Hospital. In 1960 Wilson and Stirman described their findings using an oral hypotonic solution of Sodium Chloride and Sodium Bicarbonate in the treatment of major burns during the first 48 hours after injury, and comparing this method with the use of intravenous saline and blood. They concluded that the results obtained with the use of this balanced salt solution were superior to those obtained with intravenous colloids. This followed upon the observations of Moyer and his colleagues in 1944 who had found that an oral saline/bicarbonate solution plus intravenous defibrinated blood was more effective than oral saline alone or in combination with intravenous serum in prolonging the life of experimentally burned animals, (two thirds body surface at 85°C for 30 secs.) without inducing complications that were incompatible with life.

It was decided to use a similar method in treating major burns admitted to the Burns Unit but to limit its use to those cases in which the burns were between 15% and 35% in surface area, excluding erythema (in children 10 to 35 per cent), provided that colloid had not been given previously, that there were no tracheo-bronchial complications, and that primary excision of the burn was not contemplated. For burns of over 35% colloid and saline have been used in approximately equal proportions.

Management

On admission to the Burns Unit the area of the burn is assessed and the height of the patient measured in centimteres. From the latter measurement, the expected normal Blood Volume, Red Blood Cell Volume, Plasma Volume as well as the average daily fluid intake can be derived from the chart described by Aberdeen (1961)

(Fig. 1). As soon as possible the patient is offered an oral solution containing 3.0 gms. of Sodium Chloride and 1.5 gms. of Sodium Bicarbonate in 1,000 mls of water in a measured volume, calculated on the basis of *twice the normal daily requirement.*

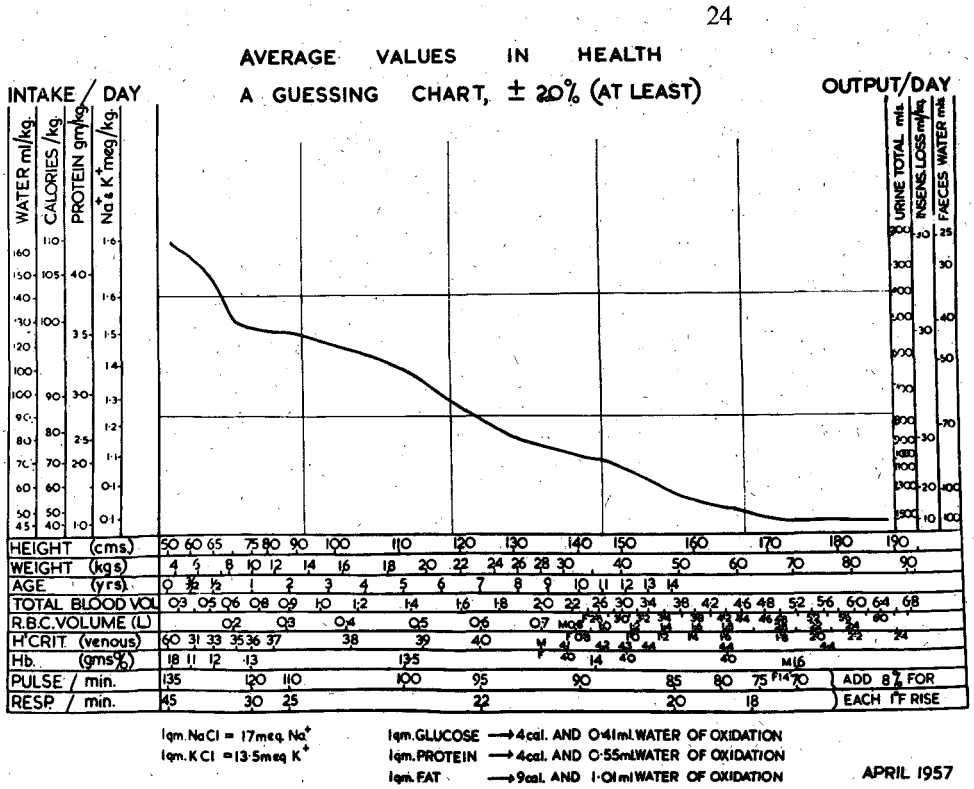

Figure 1. *Readings are made by drawing a vertical through the height measured in centimetres. Where this cuts the curve of the graph a horizontal line gives value of fluid intake and urinary output.*
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At the start of the trial the patient was allowed to drink as much fluid as he desired, but it was found that a badly burned patient would drink very large volumes to assuage his thirst, and that this tended to cause vomiting and subsequent non-absorption. The patient is now given a measured volume hourly, usually in divided doses, until the danger of circulatory collapse is remote, when he is changed to a normal hospital diet supplemented by Complan. The Saline/Bicarbonate solution is not sweetened but is offered chilled or with added concentrated fruit juice to mask its brackish taste.

In the initial stages the condition of the patient is assessed hourly, but as the circulatory disturbance comes under control, the periods between examination are extended, although the hourly nursing regimen is continued. The assessment of the patient's condition requires a complete appraisal; reliance should not be placed on any one test, but on the general trend. Some of the factors governing the overall general condition upon which attention is focused are:

1. The pulse rate, which tends to return to normal as soon as absorption is adequate.
2. The blood pressure taken with a sphygmomanometer. Normal values do not necessarily reflect a normal blood volume; often a sphygmomanometer cannot be used if the arms are badly burned.
3. The temperature of the skin as assessed by the examiner's fingers, provided that the patient has been in the same environment for some time. A cool or grey skin is usually indicative of a low blood volume.
4. The diminished intensity of heart sounds or the presence of a soft aortic second sound suggests a reduced cardiac output.
5. Changes in the mental state, disorientation, irritability or restlessness may indicate that there is a poor cerebal circulation. These signs must not be considered as indications for analgesic or sedative drugs until it is quite certain that the circulation is adequate.
6. The urinary output should be of the order of 30 mls per hour in adults (half this volume in children); these volumes must be taken as average over several hours. Owing to the dangers of urinary tract infection there is no place for the use of a urethral catheter unless the burns involve the external genitalia, perineum or are over 30 per cent in area. Where a catheter is used, it should be self-retaining or preferably of Gibbon type with closed drainage into a sterile container.

   Oliguria is usually present for the first 24 hours. In the majority a diuresis has commenced by the end of this period, although in some cases this did not occur for 48 hours.
7. If on examination there is evidence of gastric fullness, or if there has been frequent vomiting with a worsening of the general condition, an intravenous infusion of Ringers Lactate is given in volumes equal to those previously given by mouth, and the oral intake stopped. With improvement, the intravenous intake is reduced and the oral intake increased until the former is no longer required. Where intravenous therapy has been necessary it has usually been started between 10 and 16 hours after burning. Where deterioration continued despite intravenous lactate, colloid solutions were substituted. This occurred in six cases.
8. With experience it has been found that the haematocrit or haemoglobin levels have proved of little value in the treatment of burns by this method. Values may be raised by as much as 20 per cent while the patient is warm, comfortable and passing urine in more than adequate volumes.

Local Treatment

In the Burns Unit, all "shock" burns are admitted to a special room set apart for the purpose, with most of the equipment for treatment readily available. Patients are retained in this ward for the period of their "shock" treatment—usually about 48 hours. The burns themselves are left exposed and dusted with an antibiotic powder—chlorhexidine powder or Polybactrin spray—unless they involve the hands when sterile towels are used as a cover. Systemic antibiotics are given in appropriate dosage for four or five days.

Should there be tracheo-bronchial complications an elective tracheostomy is necessary. A careful tracheostomy regime is essential, possibly supplemented by urgent and frequent bronchoscopic clearance and the instillation of local antibiotics, to prevent the development of a fatal tracheitis.

Once the circulatory disturbance is under control, sedative and analgesic drugs may be given, but have seldom proved necessary.

Discussion

Up to the time of writing, seventy-three patients were treated for their fluid loss by this method, their ages varying between 7 months and 84 years, the area of burns being illustrated in Table 1. Just over half the cases treated were children who formed most of the admissions to the Unit, but there were also a number of elderly patients for whom it was felt that the method offered the least disturbance.

TABLE I

Burns Area as % Body Surface	*Number of Cases*
10 — 14%	19
15 — 19%	29
20 — 24%	7
25 — 29%	13
30 — 35%	5

Distribution of Cases

Of the 14 deaths that occurred, none died during the "shock" phase of 48 hours. Eleven patients, all elderly, had a mortality probability of 90 per cent or over; two had illnesses complicating their burns and one, a child of three, died five days after her accident from congestive atelectasis. In spite of these findings, the mortality was no greater than that found with colloid therapy.

The volumes of fluid administered varied widely, but were related to the height of the individual concerned and to the time that elapsed between the accident and admission to hospital. The average volumes assessed for age are shown in Table 2.

Fluid is retained in the tissues as oedema until reabsorption by the lymphatics is greater than the loss from the capillaries. When the volumes of fluid administered by this method are compared with those given to patients on colloid intravenously plus oral water, it is found that the totals are virtually constant for any given size of burn.

The electrolyte values—particularly sodium and potassium—have shown a similar pattern to that found in those cases treated with colloids alone; an initial sodium retention followed by a moderately high urinary sodium content once diuresis has occurred provided that renal function is adequate. Calculated on a basis of mEq Na/1% burn/Kg body weight, less sodium is given by the administration of Saline/Bicarbonate solution than with colloids since the solution is hypotonic with respect to Sodium and the total fluid intakes were constant. There is an initially elevated potassium excretion in response to stress and arising from damaged tissues, but this gradually reverts to normal levels which vary with the daily intake.

TABLE II
AVERAGE VOLUMES OF FLUID ADMINISTERED
(The figures indicate a total of Saline/bicarbonate solution plus Ringers Lactate given intravenously)

Age of Patient	*Number of Cases*	*Period After Burning*		
		By 8 Hours	*By 24 Hours*	*By 48 Hours*
0 — 4 yrs.	33	690 mls	2260 mls	3830 mls
5 — 9 yrs.	11	930 mls	2940 mls	5160 mls
10 — 19 yrs.	8	1240 mls	4660 mls	8580 mls
20 — 29 yrs.	4	1560 mls	5150 mls	8180 mls
30 — 39 yrs.	3	1430 mls	5340 mls	9650 mls
40 — 49 yrs.	2	1350 mls	5100 mls	9330 mls
50 — 59 yrs.	2	1350 mls	6530 mls	7520 mls
60 and over	12	1210 mls	4090 mls	8040 mls

As colloids are not given during the "shock" phase the total plasma protein concentration falls lower with this form of therapy, and does so at a slightly earlier stage than in those cases treated with colloid. By the fifth post-burn day the plasma protein concentrations are comparable, but during the subsequent slow return to normal the gamma globulin concentration rises considerably above normal, with a concomitant subnormal concentration of albumen. The rise in the fibrionogen level observed by Prendergast and his colleagues (1952) in burns treated with plasma, appears to be delayed but does occur in these cases.

The red cell loss of those patients treated by this method was no different from that found in burned patients treated with colloids when the size of the burn was compared. Apart from two patients known to have been anaemic before their admission, transfusion of whole blood was never carried out during the first 48 hours, but was given as necessary to maintain the haemoglobin above 75 per cent during subsequent weeks.

Experimental studies by Wilson and Stirman (1960) have shown that there is less pulmonary congestion in burned animals treated with a saline/bicarbonate solution given intravenously than in those with comparable burns treated with intravenous blood and saline. Of the deaths that have occurred in this series only two showed evidence of pulmonary congestion. Similarly in Wilson and Stirman's series there were no deaths from this cause in the first two days after burning.

Conclusion

It would seem that the use of a saline/bicarbonate solution of this type given orally might be of great value in the treatment of burns occurring in a major conflagration or following a nuclear explosion. In such events stocks of colloid solutions and the necessary apparatus for their administration would be at a premium. Saline/bicarbonate solution is easy to make up, requires no sterilisation or complicated techniques in its administration and can be given with considerable freedom.

Acknowledgment

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