FLUID RESUSCITATION OF BURN PATIENTS IN BANGLADESH - “DHAKA FLUID THERAPY”, AN ALTERNATIVE APPROACH

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SUMMARY. Whether a colloid solution or an exclusively crystalloid solution or a mixture of crystalloid and colloid solutions should be preferred for the treatment of burn shock has been a topic of discussion for many years. Consequently there are many different formulas. Among them, the Parkland formula is widely used. Our formula is based on crystalloid solutions and is administered as 3-4 ml ¥ kg ¥ percentage of total body surface area (TBSA) burn = ml of Hartmann’s solution in the first 24 h post-burn. Half of the estimated volume is given in the first 8 h and a quarter of the volume in the second 8 h; the remaining quarter is given in the third 8 h. In the second 24 h post-burn, a slightly hypertonic fluid is infused (3% dextrose saline) in adults and half-strength dextrose saline in infants and children. The volume of infusion is adjusted to obtain a urine output of 0.5-1.5 ml/kg/h. Patients below 12 yr with more than 10% TBSA burn and over 12 yr with more than 15% TBSA burn were included in the study, while patients with inhalation injury and superficial burns, and those admitted to hospital 12 h after the burn accident were excluded. The patients were divided into five groups on the basis of extent of the burn area, and the results were analysed in relation to fluid intake and urine output, haemoglobin and haematocrit level in the first three days, the dynamics of the plasma Na+ and K+ level in the first five days, and the outcome of treatment on the basis of extent of the burn surface, the age of the patient, and the time lag between the burn accident and initiation of resuscitation. The cost of the fluid infused for resuscitation was also calculated. To compare our treatment and to differentiate it from others, as also for further evaluation, we named this formula “Dhaka fluid therapy” for burn management.

Introduction

Fluid management is fundamental in the treatment of burn patients during the immediate post-burn period. This fluid management is prognostic for the future outcome. The opinion of burn surgeons varies as to the best solution and the correct amount to be used. At the same time, whether it is best to use exclusively crystalloid or colloid or a mixture of both, and what proportion needs to be used, are still much-debated questions. There are many formulas for fluid resuscitation, e.g. the Evans formula, the Brooke formula, the Moore and Barkly formula, the Parkland formula, and the Haifa formula, plus modifications of these used in different geographic areas and by different races owing to variations in environmental, physical, and genetic constitution, food habits, and other unknown factors.

Bangladesh is a developing country of 130 million people. Ringer’s lactate and large amounts of plasma, and even plasma substitutes (e.g. HAES-Steril, Dextran), are not easily available in all parts of the country. An average number of 1-1.3 million people suffer burn accidents every year. The aim of this study is to consider the resuscitation of burn patients using a fluid formula that is easily available throughout the country, effective, easy to administer, and low in cost.

Thermal injury results in numerous systemic changes, the most significant of which are an alteration in the fluid and electrolyte balance and the formation of oedema in burned and unburned tissue owing to gross fluid shift - this is the basis of burn shock. The development of post-burn oedema formation is secondary to abnormal capillary permeability, which allows protein-rich fluid to escape into tissue spaces. This loss of protein-rich fluid takes place not only in the burned area but also well beyond, and results in decreased plasma volume within minutes of a burn being sustained. Tissue oedema develops quickly within the first 6-8 h post-burn and increases gradually during the successive 8-24 h post-burn. The development of this oedema appears to be obligatory, and it continues as long as
Effective perfusion is maintained or until a new balance develops between the intravascular and the extravascular compartment. Without treatment, the haematocrit (Hct) of extensively burned patients increases progressively, and when half the plasma volume has been lost through the burn area the Hct will be between 60 and 70. By the time one-third of the total blood volume has been lost, the signs and symptoms of severe shock appear and, without treatment, the patient's life is endangered. A patient with an extensive burn (> 50%) reaches this stage within 3-4 h of the accident. The inflammatory mediators released from activated platelets, macrophages, and leukocytes in the burn area are histamine, prostaglandin, serotonin, and other kinins, which are responsible for burn shock - the mediators released in extensive burns may cause multiple organ failure and ultimately death.

The purpose of fluid resuscitation is to prevent burn shock by giving adequate fluid without overloading the vascular system, thus preventing acute renal failure, respiratory complications, and ultimately multiple organ failure. The methods for resuscitating extensively burned patients have changed strikingly during the past half century, with a resultant marked reduction in morbidity and mortality due to burn shock, hypovolaemia, and acute renal failure. The importance of salt-containing fluid in the restoration of blood volume deficit in the early post-burn period was first recognized by Parascondolo in Naples in 1901 and by Haldor Sneve in the United States in 1905. A formula for fluid replacement based on burn extent was first proposed by Harkins and adopted by the United States National Research Council. This first formula predicted burn patients' fluid needs, and the subsequent formulas of Cope and Moore and of Evans et al. emphasized colloid-containing fluids for volume replacement in the immediate post-burn period. In 1953 Reiss et al. at the Brooke Army Medical Center conducted a retrospective study of the fluid received by surviving burn patients. They found that salt-containing fluid had been given to patients who survived, and they based the Brooke formula on this finding. In 1968, the Parkland formula emphasized a greater volume of balanced salt solution, as recommended by Baxter and Shires, and in 1970 Monafo proposed a resuscitation regimen consisting of smaller volumes of hypertonic fluid.

It has been observed that the Parkland formula is used in many centres around the world. This formula has certain advantages over others in that it produces a satisfactory response in most patients and is also cost-effective, safe, and simple to follow. As Ringer's lactate is mildly hypertonic, there is no need for free water during the first 24 h post-burn, and one disadvantage of this formula is the large amount of fluid given, resulting in extensive oedema in all organs. The physical principle at the basis of formulas containing colloid in addition to crystalloid is the building-up of oncotic pressure in blood vessels, contributing to the maintenance of intravascular fluid, as in the formulas of Evans', Brooke,11 and Goodwin. There are however other claims that if colloid is given early during the resuscitation period this may cause accumulation of fluid in the interstitial space, especially in the pulmonary interstitia.

A burn patient whose resuscitation is more demanding requires meticulous monitoring and may necessitate modification of standard fluid therapy in relation to particular physical and biochemical needs, e.g. to prevent complications such as respiratory insufficiency, acute renal failure, and sepsicaemia.

The Dhaka fluid therapy formula

We have been using this formula since February 1998 in the City Hospital (Pvt.) Ltd, Dhaka, Bangladesh. It is a modification of the Baxter and Shires formula.

First 24 h post-burn
Total fluid: 3-4 ml/kg body weight (kg) percentage burn = ml
First 8 h - half total fluid
Second 8 h - quarter total fluid
Third 8 h - quarter total fluid
Nature of fluid - Hartmann's solution
- 4 ml/kg/% burn is given to young adults; 3 ml/kg/% burn to infants, children, the elderly, and patients with compromised heart function

Second 24 h post-burn
- 5% dextrose saline for adults and half-strength dextrose saline for child and infants to maintain urine output at 0.5-1.5 ml/kg/h
- no colloid or plasma

The total fluid is given in a manner that is believed to reduce respiratory complications due to oedematous lungs and to oedema of the central nervous system and the gastrointestinal tract. Enteral feeding is started as early as intestinal peristalsis appears, usually from the second day post-burn. Fresh blood or albumin can be used when the haemoglobin percentage or plasma albumin level falls below normal.
Dhaka fluid therapy is a modification of the Baxter and Shires formula, and the point of difference is that Baxter and Shires used a crystalloid such as Ringer's lactate that is not easily available in Bangladesh, whereas we also use a crystalloid such as Hartmann's solution in the first 24 h post-burn but in a slightly larger volume than in the Baxter and Shires formula. In the second 24 h post-burn, Baxter and Shires used Ringer's lactate, while with Dhaka fluid therapy we use a slightly hypertonic solution, 5% dextrose saline, and half-strength dextrose saline to obtain a urine output of 0.5-1.5 ml/kg/% burn.

Materials and methods

This was a prospective study. The study population consisted of 448 patients admitted to the City Hospital (Pvt.) Ltd (Burns and Plastic Surgery Hospital), Dhaka, Bangladesh during the period of February 1998 to March 2003. After exclusion, the study sample numbered 203 patients.

To study the outcome of treatment, the burn patients were divided into five groups according to the extent of their burns, as follows:

Group I: Patients with 10-20% TBSA burns
Group II: Patients with 21-30% TBSA burns
Group III: Patients with 31-40% TBSA burns
Group IV: Patients with 41-50% TBSA burns
Group V: Patients with more than 50% TBSA burns

Exclusion criteria
- Patients with superficial burns
- Patients with superficial partial-thickness burns
  * < 10% TBSA burns - age under 12 yr
  * < 15% TBSA burns - age over 12 yr
- Patients with inhalation injury
- Patients admitted more than 12 h after burn accident

The data collected included age, sex, patient's weight in kg, percentage TBSA burn, amount of fluid infused and urine output, haemoglobin percentage and haematocrit level, serum electrolytes (Na⁺, K⁺), time lag period between admission and accident, and outcome of treatment. The variables were evaluated on admission as pre-infusion values, and these variables were re-evaluated in the following 3-5 days after initiation of fluid therapy.

Adequacy of resuscitation. This was chiefly based on clinical and biochemical monitoring. All patients included in the study were subjected to the following procedures in order to guide the fluid resuscitation:

a. an overall clinical assessment was made and patency of airways was ensured;

b. TBSA burn was calculated using the Lund-Browder chart and body weight was recorded in kg;

c. the venous system was cannulated with a central venous catheter or a wide-bore cannula;

d. an indwelling urinary catheter was introduced;

e. a blood sample was taken for baseline haematological or biochemical analysis.

A patient was considered well resuscitated when

- an overall clinical assessment was made and patency of airways was ensured;

- TBSA burn was calculated using the Lund-Browder chart and body weight was recorded in kg;

- the venous system was cannulated with a central venous catheter or a wide-bore cannula;

- an indwelling urinary catheter was introduced;

- a blood sample was taken for baseline haematological or biochemical analysis.

A patient was considered well resuscitated when thirst was absent, the pulse rate was less than 120/min, urine output was 0.5-1.5 ml/kg/h, the body surface was warm, and there was a good sensorium level with normal haemoglobin percentage and normo-
mal haematocrit and serum electrolyte (Na⁺, K⁺) levels.

Statistical analysis. All statistical analyses were performed by computer using the statistical software package SPSS-10.0 for Windows. Appropriate statistical formulas and statistical tests were used as applicable. A p value of less than 0.05 was considered as significant by setting a minimum level of statistical significance at 5%. The results are printed in tabulated form as well as in figures.

Results
The study comprised 203 patients - 102 male (50.25%) and 101 female (49.75%). The mean age of the males was 19.28 years and that of the females 19.20 years. The demographic data revealed no significant difference between the two sexes groups with regards to age and distribution of TBSA burns (Table I).

Table VI - Total outcome of treatment on the basis of extent of burn

<table>
<thead>
<tr>
<th>Extent of burn (percentage of TBSA)</th>
<th>Number of patients</th>
<th>Mean age of patient (yr)</th>
<th>Number of death</th>
<th>Percentage</th>
<th>Number of DORB</th>
<th>Percentage</th>
<th>Mean hospital stay (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gr I = 10-20% TBSA burn</td>
<td>62</td>
<td>19.62</td>
<td>75</td>
<td>3.60</td>
<td>4</td>
<td>4.48</td>
<td>21.02</td>
</tr>
<tr>
<td>Gr II = 21-30% TBSA burn</td>
<td>40</td>
<td>20.08</td>
<td>22</td>
<td>8.00</td>
<td>2</td>
<td>5.00</td>
<td>20.65</td>
</tr>
<tr>
<td>Gr III = 31-40% TBSA burn</td>
<td>29</td>
<td>27.97</td>
<td>15</td>
<td>6.20</td>
<td>3</td>
<td>10.34</td>
<td>25.36</td>
</tr>
<tr>
<td>Gr IV = 41-50% TBSA burn</td>
<td>11</td>
<td>23.86</td>
<td>3</td>
<td>27.27</td>
<td>8</td>
<td>72.73</td>
<td>21.45</td>
</tr>
<tr>
<td>Gr V = &gt;51% TBSA burn</td>
<td>41</td>
<td>24.17</td>
<td>7</td>
<td>73.52</td>
<td>32</td>
<td>76.04</td>
<td>14.64</td>
</tr>
<tr>
<td>Total</td>
<td>203</td>
<td>22.24</td>
<td>121</td>
<td>64.63</td>
<td>53</td>
<td>26.19</td>
<td>19.35</td>
</tr>
</tbody>
</table>

During the study period, the mean fluid infusion was 3.52, 2.31, and 1.76 ml/kg/% burn on post-burn days (PBD) 1, 2, and 3, respectively (Table II). The mean urine output was respectively 1.73, 2.08, and 2.38 ml/kg/h (Table II). The data for fluid infusion were just significant (paired T test was performed, p = 0.001) and the data for urine output were also just significant (paired T test, p = 0.001). In different burn extents, the mean fluid infusion in the first 24 h post-burn was within the range of our formula, and fluid requirements gradually decreased (Fig. 1a). The mean urine output was satisfactory and gradually increased, which indicated the excretion of oedema fluid (Fig. 1a).

The mean haemoglobin percentage (Hb%) was 13.39, 11.99, and 11.07 gny/dl, while the mean haematocrit was 48.15, 40.81, and 35.59, respectively.
tively, on PBD 1, 2, and 3 (Table III). The mean Hb% and Hct values, irrespective of burn percentage, were significantly lower on PBD 3 than on PBD 2 (Figs. 2a, b). This is desirable when fluid resuscitation is adequate. The data for Hb% and Hct (Table III) are statistically highly significant (paired T test, \( \rho_{\text{Hb}} < 0.001, \rho_{\text{Hct}} < 0.001 \)).

Table VI - Total outcome of treatment on the basis of age during treatment with this fluid therapy (Figs. 3a, b). This is desirable when resuscitation is adequate. The data for plasma Na\(^+\) and K\(^+\) levels (Table IV, I) were statistically just significant (paired T test, \( \rho_{\text{Na}} = 0.001 \) and \( \rho_{\text{K}} = 0.001 \)).

The overall outcome of treatment in relation to burn extent in different age groups (Table V) was as follows:

Group I - Total number of patients, 82; mean age, 14.62 yr; survivors, 75 (91.46%); deaths, 3 (3.65%); discharge on risk bond (DORB), 4 (4.48%); average hospital stay, 15.02 days.

Group II - Total number of patients, 40; mean age, 14.62 yr; survivors, 33 (82.50%); deaths, 7 (17.5%); DORB, 2 (5.0%); average hospital stay, 15.02 days.

Group III - Total number of patients, 29; mean age, 14.62 yr; survivors, 22 (75.86%); deaths, 7 (24.14%); DORB, 3 (10.34%); average hospital stay, 20.65 days.

Group IV - Total number of patients, 11; mean age, 25.86 yr; survivors, 7 (63.64%); deaths, 4 (36.36%); DORB, 0; average hospital stay, 20.45 days.

Group V - Total number of patients, 41; mean age, 24.27 yr; survivors, 3 (7.31%); deaths, 32 (78.04%); DORB, 6 (14.63%); average hospital stay, 10.07 days.

The conclusion is that the survival rate was higher in patients with a lower burn percentage (Fig. 4).

The data for plasma Na\(^+\) and K\(^+\) levels (Table IV, I) were statistically just significant (paired T test, \( \rho_{\text{Na}} = 0.001 \) and \( \rho_{\text{K}} = 0.001 \)).

Table VII - Total outcome of treatment on the basis of ti-

The conclusion is that the survival rate was higher in patients with a lower burn percentage (Fig. 4).

Table VIII - Total outcome of treatment on the basis of time-

The plasma Na\(^+\) level was within the normal range, i.e. 139.45, 134.96, 136.18, 136.87, and 137.34 m mol/l (Table IV) and the plasma K\(^+\) level was also within normal limits, i.e. 4.17, 3.86, 3.76, and 3.89 m mol/l on PBD 1 to 5 (Table V). Serum electrolytes remained within the normal range.

Table IX - Survival of deceased patients according to time-age, 16.05 yr; survivors, 32 (80%); deaths, 2 (5%); DORB, 6 (15%); average hospital stay, 20.65 days.

Group III - Total number of patients, 29; mean age, 27.07 yr; survivors, 18 (62.06%); deaths, 8 (27.58%); DORB, 3 (10.34%); average hospital stay, 25.38 days.

Group IV - Total number of patients, 11; mean age, 25.86 yr; survivors, 7 (27.27%); deaths, 8 (27.27%); DORB, 0; average hospital stay, 20.45 days.

Group V - Total number of patients, 41; mean age, 24.27 yr; survivors, 3 (7.31%); deaths, 32 (78.04%); DORB, 6 (14.63%); average hospital stay, 10.07 days.

The conclusion is that the survival rate was higher in patients with a lower burn percentage (Fig. 4).
The outcome of treatment on the basis of age group (Table VII) shows a significantly higher survival rate in the lower age group. The data in this table are also statistically highly significant ($t^2$ test, $p < 0.001$).

The total study sample was divided into two groups in relation to the initiation of resuscitation (Table VIII). The number of patients with resuscitation starting within 4 h of the accident was 130 (64.04%): survivors, 87 (42.86%); deaths, 30 (14.78%); DORB, 13 (6.40%). The number of patients with resuscitation starting 4 h after the accident was 73 (35.96%): survivors, 44 (21.68%); deaths, 23 (11.33%); DORB, 6 (2.96%) (Table IX). The data analysis ($t^2$ test, $p < 0.05$) showed a highly significant association between the time of burn and the start of resuscitation. The improvement was greater in patients resuscitated within less than 4 h of the accident.

In this study, nineteen patients were discharged from hospital under a DORB (9.35%). This was due to the transfer of the patient to other countries for better treatment, to financial problems, to patients moving to public or other low-cost hospitals, or to discontinuation of treatment in the realization of inevitable death.

The requirements of i.v. fluid in the first 48 h post-burn and their cost in the case of a 50-kg adult patient with 50% TBSA burns were calculated according to Dhaka fluid therapy and the Parkland formula (Table X). With Dhaka fluid therapy, the total amount of fluid required was 14,575 ml, costing Tk 887 (US$ 15.16). With the Parkland formula, the total amount of fluid was 13,250 ml, costing Tk 2,034 (US$ 34.76) when plasma substitute (HAES-Steril) was used and Tk 5824 (US$ 99.55) when plasma was used.

**Discussion**

The principal cause of burn shock is the loss of circulating plasma. The basis of the prevention and treatment of burn shock is the replacement of substances in adequate amounts to permit the effective blood flow to the brain, liver, and kidney. Whether colloid or exclusively crystalloid or a mixture of both solutions should be preferred for the treatment of burn shock has been a topic of discussion for many years. The Copenhagen burn unit used different fluid therapy routines to prevent burn shock: from 1959 to 1961, plasma according to the Evans formula (1952);13 from 1962 to 1964, saline solutions;14 and from 1964 to 1970, Dextran 70.15-17 The Copenhagen unit found that all methods of prophylactic shock treatment were satisfactory,18 but no conclusive answer was found as to which was the best. In particular, the question whether colloid or crystalloid exclusively should be preferred could not be answered.

It is strongly emphasized that any formula presented for the calculation of fluid and salt requirements is only a guide to therapy and is not to be considered an infallible rule. The adequacy of therapy is confirmed by simple determination of adequate urine output and of the haemoglobin and haematocrit levels. The most important guide is the patient's clinical response. The present study was designed to consider the efficacy of Dhaka fluid therapy for burn management. As said, this formula has been used in the City Hospital (Pvt.) Ltd, Dhaka, since February 1998.

The fluid loads calculated are listed in Table II. The mean volumes infused were 3.52, 2.31, and 1.76 ml/kg/% burn on PBD 1, 2, and 3, respectively. The volume infused in the first 24 h post-burn was within the range of our formula (Fig. 1a) - this was the same volume as that infused according to the Haifa formula2 but less than the Parkland formula. It was slightly higher than the fluid volume recommended by Baxter and Shires (2.88 ml/kg/% burn).19 In the second 24 h post-burn, the volume infused was more than with the Haifa and the Parkland formulas. The difference in volume may be due to the use of colloid in these formulas. Monafo19 suggested using a solution containing 250 mEq Na+, 16 mEq lactate, and 100 mEq Cl to reduce the fluid load. The amount needed in the first 24 h post-burn was 1.96 ml/kg/% burn, compared with 1.5 ml/kg/% burn in the second 24 h post-burn. The rationale of this method of management is that by increasing intravascular osmolarity, the requirement of fluid is reduced. Demling19 proved this thesis in an animal model, while Huang20 failed to reach the same conclusion, observing a higher rate of renal failure.

The mean urine output was 1.73, 2.08, and 2.38 ml/kg/h on PBD days 1, 2, and 3 respectively (Table II). There was a gradual increase in urine output on PBD 2 and 3, which indicated good excretion of oedema fluid (Fig. 1b). In the first 24 h post-burn, the urine output was relatively low because of the presence of increased ADH in the circulation, which is released from the adrenal cortex immediately after a burn trauma.1 In the first 24 h post-burn, the volume was the same as with the Haifa formula, while in the following 24 h the urine output was higher.

In this study, the mean haemoglobin level (13.39
gm/dl) was within normal range on PBD 1 and reached an average lower level of 11.99 gm/dl on PBD 3 (Table III). The mean haematocrit value remained higher on PBD 1 (48.15), particularly in patients with larger TBSA burns. The haematocrit value gradually decreased on PBD 3 (35.59) (Table III). A low haemoglobin and haematocrit level on PBD 3 (Figs. 2a,b) indicated that the haemoconcentration had returned to normal. This is desirable and indicates good resuscitation.

The serum Na⁺ and K⁺ level remained within the normal range of reference during the period of fluid resuscitation (Tables IV, V and Figs. 3a,b). This is desirable when fluid therapy is adequate.

The efficacy of any treatment of a potentially lethal injury is best measured by mortality. Mortality was considered in different ways in this study - as related to TBSA burn (Table V), to the patient’s age (Table VII), and to the time lag between the accident and the start of resuscitation (Table VIII). A total number of 53 patients (26.10%) ultimately died. The survival rate was significantly higher (91.46%) in patients with a smaller (10-20%) percentage of TBSA burns and lower (7.3% in more than 50% TBSA burn) in patients with larger percentage TBSA burns (Fig. 4). The overall survival rate was 64.53% and the mortality rate was 26.10% (Table V).

Regarding age, it was found that survival was significantly higher in the younger age group (Table VII). This is consistent with the reports of Baxter and Shires, Halle and Sorensen, and Monafo. In patients whose resuscitation started early (within 4 h) (Table VII) survival was higher (42.86%) than in patients whose fluid replacement initiated after more than 4 h (21.68%). In cases of delayed resuscitation, dehydration occurring at cellular level was not corrected even after the completion of resuscitation. Dehydrated cells are structurally intact, i.e. not yet necrotic. However, they are biochemically compromised and lose their integrity during reperfusion, which ultimately causes cell death. The possible mechanisms of cell death during reperfusion are the generation of oxygen free radicals, mitochondrial permeability transition, and the production of cytokines.

Considering all the 53 fatalities (26.10%), early mortality (in this study defined as within 4 days of the accident) occurred in only 8 patients (3.94%) (Table IX). According to Baxter and Shires, early death means death occurring within the first 7 days post-burn. Early mortality in our study was consistent with the reports by Ullmann et al. and by Baxter and Shires. Late mortalities (after more than 4 days) numbered 45 (22.16%) (Table IX). Mortality in the longer term did not depend only on fluid therapy but also on other factors such as the age of the patient, infection, nutrition, immunological status, and associated medical conditions (e.g. diabetes mellitus, heart disease). According to Bull and Fisher the expected mortality should have been 37.93%, i.e. 77 out of 203 patients, whereas the actual death toll was 53 (26.10%). This survival rate was therefore significantly higher than might have been expected, according to Bull and Fisher. Mortality in our study was also nearly the same as that reported by Halle and Sorensen.

Hospital stay varied according to the TBSA burn (Table VI). The larger the burn surface area, the longer the hospital stay. This may be due to the greater number of sessions of surgical intervention that are needed. On the other hand, in patients with more than 50% TBSA burn, hospital stay was only 10.7 days, but this shortness of stay was due to the large number of deaths in this group.

Goodwin also reported that the use of colloid solutions permitted haemodynamic stabilization with smaller amounts of fluid. However, he also noted an accumulation of fluid in the lungs of such patients on PBD 7. Halle and Sorensen found no extra advantage over crystalloid when colloid (Dextran 70) was used except for the smaller volume required. On the other hand, more weight was gained by the crystalloid group by infusion of a greater volume of fluid. Also, Halle and Sorensen preferred the use of crystalloid because of its clinical applicability and simplicity of administration. Monafo tried to reduce the volume infused by administering hypertonic saline, but this caused intracellular dehydration and numerous cases of renal failure and subsequent death.

The cost of fluid therapy was also calculated on the basis of a 50-kg adult patient with a 50% TBSA burn. The total cost of therapy in the first 48 h post-burn was only US$ 15.16, using Dhaka fluid therapy, while with the Parkland formula the cost of fluid therapy in the first 48 h post-burn was US$ 99.55 if plasma was used and US$ 34.76 if plasma substitute (Dextran, HAES-Steril) was used (Table IX). It is very clear that Dhaka fluid therapy costs far less than the Parkland formula.

**Conclusion**

Considering all the analytic results and the cost of therapy, we consider Dhaka fluid therapy to be an effective fluid regime for the resuscitation of burn patients in this region. At the same time there is scope for further evaluation and comparisons with other fluid therapies.
RESUME. S’il faut utiliser dans le traitement du choc du brûlé une solution coloïde, une solution exclusivement cristalloïde ou une préparation de solutions cristalloïdes et colloïdes est une question que l’on discute depuis longtemps. Il y a en conséquence beaucoup de formules, parmi lesquelles la formule de Parkland est largement utilisée. La formule proposée par les Auteurs se base sur les solutions cristalloïdes. Elle est administrée dans la mesure de 3-4 ml ¥ kg ¥ pourcentage de la surface corporelle totale (SCT) de la brûlure = ml de solution de Hartmann dans les premières 24 h après la brûlure. La moitié du volume est administrée dans les première 8 h et un quart du volume dans les secondes 8 h; le quart qui reste est administré dans les 8 h successives. Pendant les secondes 24 h après la brûlure, une solution légèrement hypertonique est infusée (5% dextrose salin) dans les adultes et dextrose salin à 50% dans les enfants. Le volume infusé est régulé pour obtenir une production urinaire de 0,5-1,5 ml/kg/h. Les patients âgés de moins de 12 ans atteints de brûlures dans plus de 10% de la SCT et les patients âgés de 12 ans atteints de brûlures dans plus de 15% de la SCT ont été inclus dans l’étude, tandis que les patients atteints de lésions dues à l’inhalation et de brûlures superficielles et les patients hospitalisés plus de 12 h après l’accident ont été exclus. Les patients ont été divisés en cinq groupes sur la base de l’extension de la brûlure, et les résultats ont été analysés en rapport à la quantité de liquides introduite et à la production urinaire, au niveau de l’hémoglobine et de l’hématocrite pendant les premiers trois jours, la dynamique du niveau de Na+ et de K+ plasmatique dans les premiers cinq jours, et les résultats du traitement sur la base de l’extension de la brûlure, l’âge du patient et l’intervalle entre l’accident et le commencement de la réanimation. Le coût de la liquide infusée pour la réanimation a été calculé. Dans le but de comparer leur traitement et de le différencier des autres traitements, comme aussi pour effectuer d’ultérieures évaluations, les Auteurs ont appelé leur formule la “thérapie liquide de Dhaka” pour la gestion des brûlures.

**BIBLIOGRAPHY**


