Fluid Resuscitation Early In Major Burns: Ten Years Experience In Saudi Arabia
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Citation

Abstract
In the period from January 1992 up to the end of July 2001, the Burns Unit in King Khalid-C-Hospital in the North West of Saudi Arabia received 735 cases of burns. The cases had various causes, age groups, degrees, depth and extent. The formula used in treating these burns patients was a modification of Parkland formula. The fluid used was Ringer lactate solution. This fluid was continuously administered until the general condition of the patient was stabilized. Early oral intake was encouraged in all patients and was started as early as the second day in most cases. Colloids were given once the patient is stabilised, and according to the individual patients' needs. The results of this treatment regime significantly avoided renal complications and ensured perfect patient rehydration.

INTRODUCTION
Many IV fluid formulas had been postulated, and most of them had a lot of recorded complications. In this study we used modification of Parkland formula on the majority of our patients to see its effectiveness in rehydrating, maintaining vital organs of our patients.

PATIENTS
This study included 735 patients, who were admitted to the Burn Unit in King Khalid-C-Hospital in the North West of Saudi Arabia during the 10 year period from January 1992 up to the end of July 2001. The majority were Saudi patients 650 (87%); only 35 cases (13%) were non-Saudis. The age distribution is shown in Table 1. Among the burns cases, 60% were males and 40% were females, Table (1).

From the series 50 cases came as old burns, 6 cases from which were severely infected, one pregnant lady with old flame burn 60% and she had severe MRSA infection. Several cases came a few days after onset of the burn and after using traditional Arabic medicine. Patients were obliged to come to the hospital when their conditions started to deteriorate.
Majority of cases were children and young adults, table 2. The percentage of burns related to the total body surface is shown in table (3). There were 300 cases of scald burns (40%), 15 cases from which had steam burns. Flame burn cases represented 40% (300 cases), 20 cases from which had contact burn. Electric burns represented (70 cases) equal to 9%. Chemical burns showed 65 cases representing around 8.5%, table 4.

**Figure 4**
Table 3: Percentage of total burn surface area

<table>
<thead>
<tr>
<th>Below</th>
<th>21%</th>
<th>41%</th>
<th>61%</th>
<th>71%</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>40%</td>
<td>60%</td>
<td>70%</td>
<td>100%</td>
</tr>
<tr>
<td>285</td>
<td>225</td>
<td>125</td>
<td>65</td>
<td>35</td>
</tr>
</tbody>
</table>

**Figure 5**
Table 4: Type Of Burns And Number Of Patients

<table>
<thead>
<tr>
<th>SCA</th>
<th>STE</th>
<th>FLA</th>
<th>CONTA</th>
<th>CHEMIC</th>
<th>ELECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD</td>
<td>AM</td>
<td>ME</td>
<td>CT</td>
<td>AL</td>
<td>RIC</td>
</tr>
<tr>
<td>285</td>
<td>15</td>
<td>280</td>
<td>20</td>
<td>65</td>
<td>70</td>
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</tbody>
</table>

**METHODS**
The fluid which was given early to all cases was crystalloid in nature. Parkland formula was used starting from the first day of burn, continued on a half base on the second day and third day.

In extensive cases (> 25% deep burns in children and >50% deep burn in adults) and also in cases of old infected burns with systemic infection.

Hydrocortisone was used effectively to help to stabilize cellular functions. Edema was evident in some cases. In severe burns > 70%, blood transfusion was given with severe restrictions in the early period if RBCs count was very low, (which means increased destruction of these cells) even with high hemoglobin percentage. This was done after enough IV fluid infusion. After cellular stabilization colloid therapy was started according to the plasma protein and albumin deficits, as it was shown by the biochemistry report.

This cellular stabilization in cases below 60% of TBS was reached in a fair degree by the third day post burn.

In children, the biologic reserve was so small that the tolerability of plasma protein and albumen deficiencies was small. So the lowest possible limits of plasma protein were not exceeded in these early three days. It was kept at or above the level of 20 GM/L. (normal levels: total plasma proteins = 66-87GM/L., serum albumen = 38-50 GM/L).

If this level was reached by the second day, colloids were started in small amounts, as it might be from dilution effect of rehydration. But in most cases it took a time of 2 to 3 days to reach those low levels.

Oral intake was encouraged by the second day in majority of cases provided anti-ulcer therapy. Type of colloids that were given included plasma proteins 5% & 20% concentration, human albumen 50%, fresh frozen plasma, and sometimes, parenteral nutritive agents as intralipids, amino-acid mixtures. Once the patient was stabilized plasma proteins and albumen were rapidly and steadily compensated. Otherwise the size of eschars would increase, and the burn would progress to the deeper degree.

**RESULTS**
The following are the results observed for the 735 burns cases who were treated during the 10 year period from 1-1-1992 to July 2001 G.

The number of patients who were treated effectively and were discharged from the unit were 656 cases. A total of 35 patients (4.9%) discharged themselves against medical advice. A number of 25 patients (3.4%) were transferred to the nearby military hospital, as they were military dependents. Nineteen cases died (2.6%). The exact number of patients who completed their treatment was 656 (89.4%).

**Figure 6**
Table 5: Summary of the total cases and fate.

<table>
<thead>
<tr>
<th>Complications during and after treatment included</th>
<th>NUMBER</th>
<th>DAMAGED</th>
<th>TRANSFER</th>
<th>DEATH</th>
<th>CURED</th>
<th>MAJOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>735</td>
<td>35</td>
<td>25</td>
<td>50</td>
<td>605</td>
<td>450</td>
<td></td>
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</tbody>
</table>

Deaths were 19 cases, patients required amputations were 18 cases, severe infections with multiresistant organisms were 75 cases, contractures developed in 35 cases, hypertrophied scars developed in 55 cases.
DISCUSSION

Cellular damage due to thermal energy is in the form of coagulative necrosis. The affected area and the surrounding cells show a response similar to that of the triple response.

1-Cell damage: The damaged cells start to liberate toxins such as histamine, immunosuppressive polypeptides 10,000 D (PP-D), Complement degradation products, immunoglobulins degradation products, breakdown products of coagulation and fibrinolytic system, and prostaglandins. The other main toxins are the breakdown products of the cells that had been coagulated to form eschar i.e. cellular components.1

2-Volume deficit: It is due to fluid loss in the form of profuse exudation of fluid from the damaged tissues because of increased microvascular permeability triggered by the released toxins. Histamine plays an important role. Pre-burn injection of (Polymyxin- B) inhibits release of histamine and edema formation. Other factors are thromboxane A₂ and leukotriens, substance (P) from sensory nerve endings, fibrin degradation products, and activated proteases.

The outcome of volume deficit are decreased cardiac output, increased hematocrit, increased viscosity and cardiac depression due to decreased ATP in the myocardium. Fluid loss can be estimated by the equation:

\[
\text{Loss in ml/hour} = (25 + \% \text{ BSA}) \times \text{BSA}_{13} \text{ prevented by resuscitation and H2 blockers}_{14,15}\]

Specific problems seen during treatment:

Activation of the immune system causes increase in the microvascular permeability by the released products of the complement activation, lysosomal enzymes, increased
xanthine oxidase activity, oxygen radicals, and activated killer lymphocytes. Other vaso-active cytotoxic agents are IL-1, inhibitors of fibrinolysis, 11,13

All the above toxic agents are released and found in the exudate, and can cause damage to the tissues underlying the exudate (blisters). The exudate analysis showed total protein 5gm%, albumin 3.7% and globulin 1.3%. Normal plasma contains proteins (6.5gm%),

Changes in the capillary permeability pressure: Pitt and associates found that any increase in the capillary pressure leads to three fold increase in filtrate and also in the capillary pore size. 1

Rate of edema formation is greatest immediately after burn and reaches its maximum 3 to 24 hours later. Rate of recovery depends upon restoration of the capillary integrity. Diminished blood volume and cardiac output leads to decreased renal blood flow and glomerular filtration rate. 1,10

3-The need for I.V. Fluids: body fluids lost as exudates need to be compensated for the following reasons to restore body fluid volumes for normal organ perfusion, to get rid of toxic products of burns as rapid as possible and to restore the electrolyte balance and blood profile as well.

Objectives: the type of fluid essential in the management of burn patients in the early critical period of resuscitation is still a major issue of controversy. Many patients die because a wrong fluid regime was selected. Many burn therapists used colloids in the early periods, with subsequent recorded renal hazards. This study clarifies the probable fluid regime that can be followed to achieve the best results. The cases were of different age groups varying in etiology and extent.

The corner stone in treating any major burn is the early resuscitation with the proper amount of intravenous fluids.

Early fluid resuscitation in the management of major burns is a crucial factor. Large amount of intravenous fluids should be given in the first few hours following the burn. 4 The type of fluid infused to those patients remained controversial for as long time.

Bortolani (1996) reported use of Baxter (Ringer Lactated Saline, RLS), Monafo(1970, Hypertonic Lactated Saline, HLS), with good results, with low incidence of deaths with RLS. Sorensen and Sejrsen (1965) treated 32 cases with deep extensive burns using only normal saline. 15,16

Muir and Jones (1976) reported low incidence of duodenal ulcer in burn patients in USA, compared with those in UK, and this was explained by use of crystalloids in USA, and colloids in UK. 19

Currently, burn therapists feel that early colloid infusion, is not suitable early in massive burn cases as a resuscitative fluid, and is accompanied with many hazards. These hazards are represented by renal, pulmonary, and metabolic disturbances. 17,23,9,10

The need for intravenous fluids is not only for compensation for fluid deficit, but also to correct the disturbed physiology of the human body which results from presence of large areas of skin and subcutaneous tissues which became strange to the immune system, and the body tries to overcome this stranger. These toxins add more load to the circulation and affect the vital organs. So, keeping these toxins into the circulation will be serious.

One method to get rid of these toxins is washing the circulation with an isotonic crystalloid fluid with the following characters, it can be easily excreted by the kidneys, it has an effective dilution action to the circulating blood, and it has the concentration of electrolytes similar to those of human plasma. Such fluid is Ringer lactate solution. Parkland formula was considered a revolution in burn therapy, but it needed some modification to be of more benefit on the long term of treatment course. The formula considers colloid therapy during the second 24 hours after burn, irrespective of stabilization of vital organs, which means continuation of organ disturbances and instability.

Our study shows that achieving cellular and organ stability is the main aim of early resuscitation. This can be realized by crystalloids together with other potent agents, which can combat the shock state, as Hydrocortisone, and other anti-inflammatory agents. Hydrocortisone is a main and potent agent, which provides cellular and organ stabilization provided with perfect compensation of volume deficit. In major burns, the suprarenal gland may undergo severe exertion to combat the stress condition by its medullary and cortical hormones. Oversecretion of these hormones may lead finally to gland exhaustion or even infarction. 13,48

Hydrocortisone injection can early give rest to the gland and helps to prevent this complication. 13 The cellular and organ stabilization was seen to occur in most of cases in our study in the first (2) to (4) days post burn. During this period, no colloids were administered in most of the cases unless it comes down to a very low level.
In severe deep and extensive cases over 60% in children, and 80% in adults where blood was needed if there was an evidence of extensive RBCs destruction, or RBCs sickness syndrome, blood was infused with great caution and in small amounts and after full rehydration of the patient. The plasma proteins and albumen were seriously decreased in some cases. The plasma proteins should not be less than 35 G/L (66 – 87 G/L), and albumen should not be less than 20 G/L (N= 38-50 G/L). The lowest levels may be reached by the 3rd , 4th , or 5th day post burn. The release of toxins at that time was declined, and the organs became more stable, with better performance.

At that time, we started to give colloids with the following benefits, it decreases the edema gradually, increases the immunity by the provided proteins necessary for synthesis of immune elements, brings the blood profile back to its real values to compensate for any hemoglobin deficit and fresh plasma provides fresh leukocytes and other coagulation elements.

If the plasma proteins and albumen were decreased below those indices, the wound was easy to change to the deeper degree, with excess exudate material overlying it. Hydrocortisone was withdrawn gradually starting from the 3rd or 5th day. By the 10th day it was stopped completely except in some cases we might continue it if the suprarenal medulla was proved to be affected. Potassium (K) was expected to be low, especially with Hydrocortisone therapy, and it was compensated and monitored daily until it became within the normal limits, then it was stopped. Daily complete blood profile and biochemistry were mandatory for a seriously burned patient. With determination of the patients’ needs of electrolyte adjustment, acid-base determination is also essential. Serum lactate and base deficit can suggest inadequate resuscitation. Early excision of eschars and closure of the burn areas, leads to avoidance of many complications of liberated toxins from the burn areas. We tried every effort in all cases to excise the eschars as early as possible. But this was done only after stabilising the patient. Oral feeding started, in our cases, as early as possible, by the 2nd day in all cases unless patient starts to vomit. We started to give normal diet once the condition of the patient was stabilized, H2 blockers and the effective early perfusion guarded the bowel.

Any delay in fluid therapy will lead to hazards of reperfusion injury due to release of all toxins listed before together with Oxygen free radicals leading to peroxidation injury especially to the intestinal mucosa, resulting in disruption of the mucosal barrier function and endotoxemia.

CONCLUSION
From our study, we concluded that early infusion of colloids in extensive burns could be hazardous to the patient. To avoid the possible complications, we early infuse crystalloid solution (Ringer Lactate). Colloids had been infused to our cases when their conditions became stable, which means cellular and organ stability. At that time the real needs of colloids solution is easily determined. Fresh plasma played an important role in pediatric burn cases. Early oral feeding was another important item in managing all burn cases.

References
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