

EARLY FLUID RESUSCITATION IN THE MANAGEMENT OF MAJOR BURNS: TEN YEARS EXPERIENCE IN TABUK, SAUDI ARABIA

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ABSTRACT: During the period from January 1992 up to the end of July 2001, the Burns Unit in King Khalid-C-Hospital treated 1735 cases of burns. The burns cases were of varying causes, age groups, degree, 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 administered for the first 3 days post burn 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 or the third day. Colloids were given by the end of the third or even the fourth day and according to the individual patients' needs. The results of this treatment regime significantly avoided renal complications and ensured patient rehydration. (JUMMEC 2002; 2:127-131)

KEYWORDS: Major burns, fluids resuscitation

Introduction

Pathophysiology: 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:

Loss in ml/hour = (25 + % BSA) X BSA(13) prevented by resuscitation and H₂ blockers. (1,13,18)

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.(1&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, 4,10)

3-The need for I.V. Fluids: body fluids lost as exudates need to be compensated for the following reasons to

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restore body fluid volumes for normal organ perfusion, to get ride 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 study is a retrospective review of 1735 burn cases. The cases were of different age groups varying in etiology and extent.

Patients

This study included 1735 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 (78%); only 375 cases were non-Saudis.

The age distribution is shown in Table 1. Among the burns cases, 57% were males and 43% were females.

Table 1. Age distribution of burns in years

up -1	1-2	2-4	4-12	12-20	20-45	45-60	>60
20	80	350	200	270	485	250	80

From the series 49 cases came as old burns, 6 cases from which were severely infected, one pregnant lady with old flame burn 60% and she had MRSA. Several cases came a few days after the burn with treatment by what is called Arabic medicine. Patients tend to come to the hospital when their conditions start to deteriorate. The number of major cases according to the American definition were 950 cases.

The types of burns are shown in table 3. Female to male ratio was 750/ 985. Female formed 43%, and males formed 57% of the total number. The number of Saudi patients were 1360 cases representing 78.4% and non Saudi patients were 375 cases representing 21.6%. There were 750 cases of scald burns (43.2 %). Flame burn cases represented 25.9% (450 cases), contact burn cases was 11.8% (205 cases), electric burn cases was 9.8%

Table 3. Type of burns and number of patients

Scald	Flame	Electric	Contact	Chemical	Steam
750	450	170	200	100	60

(170 cases) while steam burns was only 3.5%.

Methods

The fluid which was given early to all cases was crystal-

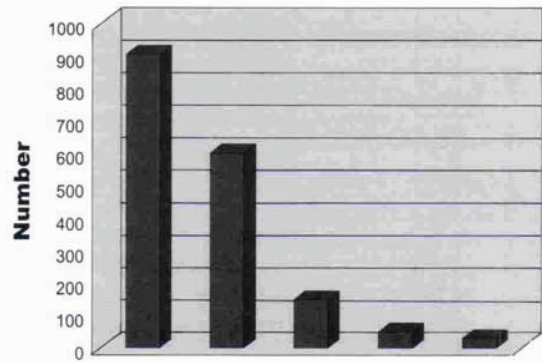


Figure 1. Percentage of burns

Table 4. Summary of the total number of cases and their fate

Total number	Female	Male	DAMA	Transfer	Death	Completely Cured	Major
1735	750	985	135	65	50	1485	950

loid in nature. Parkland formula was administered on the first, second and third days and crystalloid fluid was continued.

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 stabilize cellular functions. Edema was very evident, especially in cases with corticosteroids therapy and in extensive partial thickness burns. 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 biology 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 35 GM /L, and albumen level was 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. But in most cases it took a time of 2 to 3 days to reach those levels. Oral intake was encouraged by the second or maximally third day provided that the patient was well hydrated and put on H2 blockers.

Type of colloids that were given:

- 1-plasma proteins 5% & 20% concentration.
- 2- human albumen 50%.
- 3- fresh frozen plasma.
- 4- parenteral nutritive agents as intralipids, amino-acid mixtures were used except in a few cases who were suffering from malnutrition. Once the patient was stabilized plasma proteins and albumin 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 1735 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 1485 cases. All the 950 severe cases in this study were resuscitated by the same method. A total of 135 patients (7.8%) discharged themselves against medical advice. A number of 65 patients (3.7%) were transferred to the nearby military hospital, as they were military dependents. Fifty cases (2.9%) died. The exact number of patients who completed their treatment was 1485 (85.6%).

Complications during and after treatment included:

- A) severe contractures requiring needed surgery: 35 cases (children and adults)
- B) hypertrophied scarring requiring follow up in 50 cases.
- C) one referred patient had exposure of the wrist tendon and gangrene (electrical burn).
- D) disarticulation of the whole right upper limb in a patient, 5 years old, with electric burn due to high tension and electric circuit burn.
- E) amputation of toes in a 4 year old child with contact burn with burning coal.
- F) amputation of fingers of in a one-year-old female child with direct contact burn with burning coal; she came to the hospital one week after the burn.

The net number of cases discharged as cured patients were 1485 cases, 97 cases needed follow up either for dressings, or for surgical interference. The duration of stay for the cured major cases ranged from 8 days up to three months (in cases above 60% deep burns).

Special problems during the management

(I)- Infections:

- 1)-Pseudomonas aeruginosa: wound sepsis was seen in

some cases early in the start of work in the unit. Pseudomonas aeruginosa was the first organism to be seen, and after study, the source was identified to be the hospital water. Pseudomonas aeruginosa was the main organism in infected cases. Another source was also identified from the patient himself as (autoinfection).

2)- Methicillin resistant Staphylococcus aureus (MRSA):

Six cases were identified to have bacteriological evidence of MRSA.

Two cases with old flame burns came to the unit with this infection. The remaining four cases were admitted as fresh cases to the unit but the visitors which represent a big problem up to the date, were giving Arabic medicine, in the form of creams in most of cases or something for drinking, without informing the attending doctor or nurses.

Some of recorded infection was due to autoinfection, coming from the patient himself. This was proved by discovery of the organisms in their stool, or in the nose. Others (3 recorded cases) were due to iatrogenic causes, from the nurses through the intravenous line itself.

(II)- Transient DAMA: (Discharge Against Medical Advice):

The relatives insist to put an escort with the patient, if they fail to do they take the patient against medical advice. Later on, they bring the patient with sepsis, dehydration and even shock, which adds an extra load of work to the burn unit staff.

(III)-Cardiac arrest:

50 deaths were recorded, all had cardiac arrest, resuscitated, but expired. One female patient (flame burn 60%) developed cardiac arrest, for unknown cause, she was prepared for discharge after cure. She was resuscitated after more than hour arrest, and she completed her treatment and was discharged with complete cure.

(IV)- Gastro-intestinal problems:

In the study, out of 1485 cases, 5 cases had bowel problems. One 4 year old child with 60% deep flame burn got bowel perforation. The other 4 cases got peptic ulceration along their course of treatment. Two of them expired from other causes and the other two cases were cured by treatment.

Discussion

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.²

The type of fluid infused to those patients remained controversial for as long time.

Bortolani (1996) reported use of Baxter (Ringer Lactated Saline, RLS), Monaflo (1970, Hypertonic Lactated Saline, HLS), with good results, with low incidence of deaths with RLS.

Sorensen and Sejrnsen (1965) treated 32 cases with deep extensive burns using only normal saline. (3, 16, 18)

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. (1, 2, 3, 4, 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 ride 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.^{1,18} Hydrocortisone injection can early give rest to the gland and helps to prevent this complication.¹⁵ 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.

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 leading to marked edema. The plasma proteins should not be less than 35 G/L (66 – 87G/L), and albumen should not be less than 20G/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. 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 especially in infants below 12 months of age with burns >30%. We tried every effort in all cases to excise the eschars as early as possible. But this was done only after stabilization of the general condition. Oral feeding started, in our cases, as early as possible, by the 2nd or the 3rd day in children, and the 3rd to the 4th day in the adults with major burns. 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 (17).

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) to our patients. Colloids were 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.

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