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ORIGINAL ARTICLE

Impact of Fluid Resuscitation Regimes in Relative Risk of Mortality in Burned Patients

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Abstract

Background; Some studies have supported the opinion that patients who get greater volumes of resuscitation fluids are at a higher chance of edema, complications, and probably bad outcomes. In the results of the International Society of Burn Injuries approximately half (49.5%) added colloid before 24h.

This study aims to analyze the relative risk for mortality comparing resuscitation in the first 24 hours with Parkland and resuscitation with the use of Colloids.

Material and Methods; This was an observational prospective cohort study conducted in the Service of Burns of the University Hospital Centre "Mother Teresa" in Tirana (UHCT), Albania. The study includes adult patients with critical burns > 40% TBSA, hospitalized in the Intensive Care Unit of the service during the period 2014 to 2019. Resuscitation in the first 24 hours is done with Ringer Lactate according to Parkland and with Ringer Lactate with the addition of colloids after 12 hours.

Results; The data for organ dysfunction and organ insufficiency were the same in the two groups without statistical significance. Mortality in the RL group was 48% (24 deaths of 50 patients) while in the RL + Colloid rehydrated group was 46% (23 deaths of 50 patients). Patients which have 40-60% burns and are rehydrated with RL + Colloids have a risk of death 0.4 times less than those rehydrated with RL.

Conclusions; Resuscitation with Ringer lactate and Colloids in the first 24 hours of thermal damage is a rehydration alternative for the treatment of burn shock. This therapy especially helps patients with major burns > 40% TBSA who during rehydration require large amounts of fluids and are associated with severe plasma hypoalbuminemia. Number Need to Treat (NNT benefit) is 10 so 1 in 10 patients can benefit in lowering the risk of death with RL + Colloid rehydration.

Keywords: Burns, Mortality, resuscitation fluids, complications, burn shock

Introduction

Fluid resuscitation after burns in adults with Parkland formula using crystalloid in the form of lactated Ringer's solution has remained unchanged since their introduction in the 1970s [1]. An increasingly recognized concern is that many patients are found to receive considerably more resuscitation fluid than predicted by the formulas [2]. Some studies have supported that patients who get greater volumes of resuscitation fluids are at a higher chance of edema, complications, and probably bad outcome [3]. Because of this many burn centers are using colloids in the first 24 hours for their oncotic properties. In the results of the International Society of Burn Injuries approximately half (49.5%) added colloid before 24h [4].

A 1998 Cochrane meta-analysis exclusively of randomized trials suggested increased mortality attributable to albumin among critically injured patients, including those with burns [5]. Importantly, no excess mortality related to albumin has been found in three subsequent large-scale randomized trials of critically injured patients [6, 7, 8]. This study aims to analyze the relative risk for mortality comparing resuscitation in the first 24 hours with Parkland and resuscitation with the use of Colloids.

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Material and Methods

This was an observational prospective cohort study conducted in the Service of Burns of the University Hospital Centre "Mother Teresa" in Tirana (UHCT), Albania. The study includes adult patients with critical burns > 40% TBSA, hospitalized in the Intensive care Unit of the service of burns during the period 2014 to 2019. The study was approved by the Institutional Board of the Ministry of Health and Social Support.

For this, two groups of critically burned patients resuscitated in the first 24 hours after burns were studied:

1. The first group (Group RL) with isotonic RL solutions where the administration of fluids has been according to the recommendations of the Parkland formula with monitoring depending on diuresis.

2. The second group (Group RL + Colloids) with isotonic solutions Parkland formula and colloids where the delivery of liquids is done according to a protocol which is applied by many authors with the monitoring of diuresis and Central Venous Pressure (CVP) [9, 10, 11]. Children and non- burn-related admissions (Stevens-Johnson/toxic epidermal necrolysis, necrotizing fasciitis and chronic wounds) were excluded from the study.

Statistical Analysis

SPSS 23.0 and Microsoft Excel were used for data analysis. Continuous data were presented at the mean value and standard deviation. Discrete data were presented in absolute value and percentage. Tables and graphs were used to present the data.

To compare two mean sizes between two different groups, the Student's "t" test was used for two independent samples. Statistically significant differences between the proportions were analyzed by the Chi-square test. Logistic regression was performed to see the effect of predictors (age, burn area, respiratory burn) on prognosis. The Kaplan Meier curve was used to see survival in time. Values of $p < 0.05$ (5%) were considered significant.

Results

Mortality data in the two study groups are given in Table 1. Mortality in the RL group was 48% (24 deaths of 50 patients) while in the RL + Colloid rehydrated group was 46% (23 deaths of 50 patients). The data for organ dysfunction and organ insufficiency were the same in the two groups without statistical significance. If we look at the distribution of deaths, we see that there are similarities

Table 1- Data for morbidity and mortality in adult patients with burns ≥ 40% TBSA (n=100)

	RL Group (n=50)	RL + Colloids Group (n=50)	P
Organ Insufficiency, Groups, % (n)			
No. patients with burn	27(54.3)	26(52.7)	0.91
• 1 organ	16(32.1)	15(30)	0.89
• 2 organs	5(8.9)	7(13.9)	0.67
• > 3 organs	2(4.7)	2(3.4)	1
28 days Mortality			
• Survivors -no/ total	26/50	27/50	0.91
• Deaths -no/ total	24/50	23/50	0.91
• Mortality, % (n)	48(24)	46(23)	0.84
Time of deaths, % (n)			
• The first two days	62(15)	52(12)	0.31
• First week	17(4)	38(9)	0.01
• Second week	13(3)	0(0)	0.008
• Third week	4(1)	5(1)	0.81
• More than a month	4(1)	5(1)	0.81
Deaths in TBSA % Groups, %(n)			
• 40-60%	30(9)	17.3(4)	0.13
• 61-80%	50(4)	60(9)	0.31
• 81-100%	91.6(11)	83.3(10)	0.21

for the first two days for the deaths in the third week and more than a month. Concretely deaths in the first two days occurred in 62% of patients in the RL group and 52% of patients in the RL+Colloids group. On the other side in the first week deaths were almost double in the RL+Colloid group (p=0.01), while in the second-week deaths were only in the RL group(p=0.008).

If we look at the distribution of deaths according to the burn surface, we see that out of 24 deaths in total in the group with RL 15 deaths were patients with severe burns with burn size more than 60% TBSA and only 9 were in the group with burns 40-60% TBSA. On the other hand, from 23 deaths in total in the group with RL + Colloids 19 deaths were with a burn surface above 60% TBSA and only 4 cases are deaths with burns 40-60% TBSA.

Mortality in 40-60% TBSA group burns was 30% (9 deaths from 30 patients) in the RL group and 17.3% (4 deaths from 23 patients) in the RL + Colloid group but without statistical significance.

Because we have seen that fact, we decided to make a further statistical analysis we performed Relative Risk for mortality which we have presented in table 2.

Table 2 - Relative risk for mortality in patients with burns ≥ 40 % TBSA(n=100)

Patients with Burn	RL Group (n=50)	RL+ Colloids Group (n=50)	RR (Relative Risk) (95% CI)	OR (Odds Ratio)	NNT (Numbers need Treat)	P
• Survivors - no/ total	26/50	27/50	1.04 (0.70;1.54)	0.92	50	0.841
• Deaths - no/ total	24/50	23/50	0.96 (0.63;1.45)	0.92	50	0.841
• Mortality, % (n)	48(24)	46(23)				
Time of deaths, % (n)						
• The first two days	62(15)	52 (12)	0.8 (0.41;1.53)	0.74	50	0.5
• First week	17(4)	38 (9)	2.25 (0.74;6.83)	2.52	10	0.15
• Second week	13(3)	0 (0)				nan
• Third week	4(1)	5 (1)				1
• More than a month	4(1)	5 (1)				1
Deaths in TBSA % Groups, %(n)						
• 40-60%	30(9)	17.3 (4)	0.44 (0.14;1.34)	0.4	10	0.15
• 61-80%	50(4)	60 (9)	2.25 (0.74;6.83)	2.52	10	0.15
• 81-100%	91.6(11)	83.3 (10)	0.91 (0.42;1.94)	0.89	50	0.8

We have analyzed Relative risk as to the probability of death in the group RL + Colloid divided by the probability of death in the group with RL where if RR is = 1 then it does not matter.

As far as deaths in the two groups are concerned, the risk is close to 1.0, so it is little or no difference in risk and the incidence is the same.

For deaths in the first two days, the RR = 0.8, so the risk is 20% lower in the RL + Colloid rehydrated group than in the RL rehydrated group. For deaths in the first week, the RR = 2.2 so there is a 120% increase in risk in the RL + Colloid rehydrated group than in the RL rehydrated group.

Patients which have 40-60% burns and are rehydrated with RL + Colloids have a risk of death 0.4 times less than those rehydrated with RL or otherwise the risk is 60% lower. Patients which have 61-80% TBSA burns and are rehydrated with RL + Colloids have a 2.2 times higher risk than those rehydrated with RL or the risk is 120% higher. Patients with 81-100% TBSA burns have almost the same risk as when rehydrated with RL + Colloids and RL.

The table also gives NNT (Number Need to Treat) which is an epidemiological indicator that shows us how many people on average if exposed to a factor in our case rehydration with RL + Colloids versus RL can benefit or be harmed. If NNT is <5 then the benefit is large while when it is> 15 it has no value. For cases with burns 40-60% TBSA, NNT (benefit) is 10 so 1 in 10 can benefit with RL + Colloid rehydration, while for burns 61-80% TBSA NNT (harm) is 10 so 1 in 10 can be damaged from RL + Colloid rehydration.

In figure 3 we are giving the analysis of survival curves for the three groups of burn sizes where we notice that patients with burns 40-60% TBSA have survival of almost 80%

Discussion

The primary goal of resuscitation is to restore and preserve tissue perfusion. Appropriate fluid management of major burns directly improves the survival rates of burn patients. Although fluid resuscitation is the main question of acute burn care, the optimal type, timing, and amount of fluid for

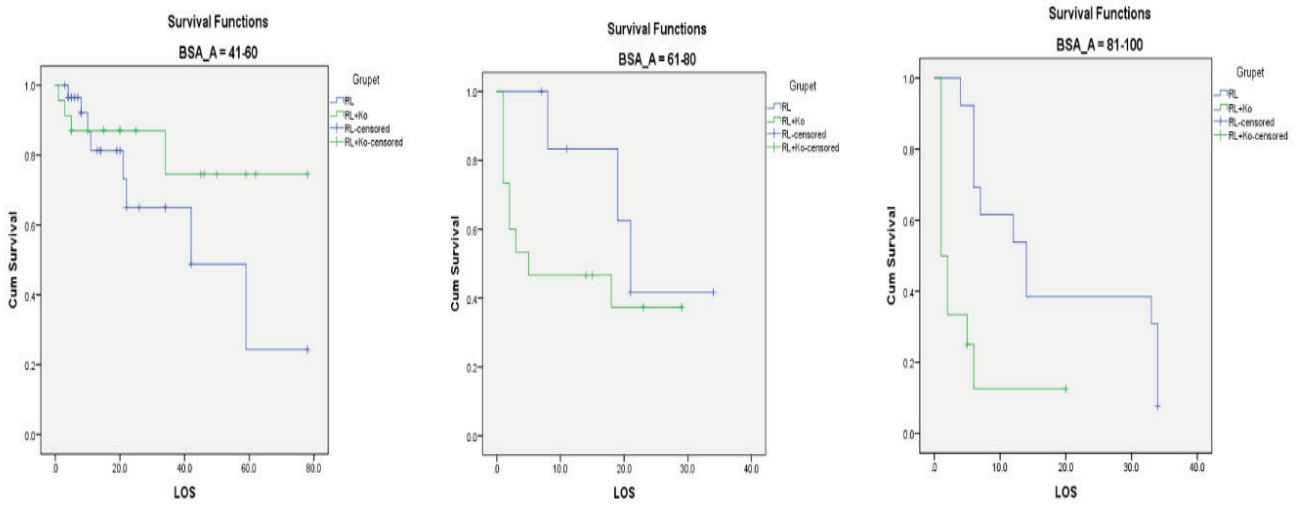

Figure 3 - Survival functions in different burn sizes (% TBSA)

burn shock remain inadequately investigated. Early burn resuscitation formulas of the 1940s and 1950s incorporated colloids, usually in the form of albumin-containing blood products, but also purified albumin [12, 13, 14].

In the first 24 hours after a burn, the Parkland formula calls for 4 ml/kg/ % TBSA burned. The phenomenon termed "fluid creep" by Pruitt in 2000, and excessive resuscitation has emerged as a significant problem in modern burn care [2, 15]. Colloids by their oncotic properties can better maintain intravascular volume than crystalloids and thus reduce fluid volume demands. The colloids predominantly used were purified albumin and fresh frozen plasma. Yet, the question of whether colloids can improve outcomes of burn shock resuscitation remains unsettled.

There are different opinions of burn experts regarding mortality after the use of colloids in the first 24 hours after-burn. According to the most recent recommendations of the American Burn Association, one option is to administer colloid-containing fluids between 12- and 24-hours post-injury to decrease overall fluid requirements during acute burn shock resuscitation [16].

Our opinion for the resuscitation period is that in the resuscitation period after the first 12 hours, colloids can help in maintaining colloid pressure and albumin levels in the blood. At the same time, this is accompanied by lesser total fluids needed for completing resuscitation and lesser edema. Mortality can't be affected because colloids are adjuvant therapy not the therapy per se. From the survival analysis patients with burn size, 40-60% TBSA have survival up to 80% if they are resuscitated with RL+ Colloids.

Conclusions

Resuscitation with Ringer lactate and Colloid solution (Human Plasma or Albumin) in the first 24 hours of thermal damage is a rehydration alternative for the treatment of burn shock. This therapy especially helps patients with major burns > 40% TBSA who during rehydration require large amounts of fluids and are associated with severe plasma hypoalbuminemia. In particular patients with burns, 40-60% TBSA had improvement in mortality and benefit or Number to Treat (NNT benefit) is 10 so 1 in 10 can benefit with RL + Colloid rehydration in the first 24 hours of burn shock.

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Conflict of Interest Statement

There is no conflict of interest

Authorship Contribution

The first author has done the conception or design of the work and data collection and analysis.

The second author has done the data analysis and interpretation as well as drafting the article and critical revision of the article.

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