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Study of Metabolism Alteration in Burn Patients

KEYWORDS: Burn, Capillary permeability, Total protein, Cellular edema, Hypoalbuminemia

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ABSTRACT Severe burn causes a catabolic response with profound effects on protein metabolism. Our aim is to determine changes of metabolism and biochemical parameters like Total protein, albumin, globulin, A/G ratio, urea, creatinine and uric acid levels and if their level can predict extent of injury and severity in different types of burn patients. One hundred and five burn patients were included in this study and compared with fifty healthy subjects. A significant differences ($p<0.0001$) between burn patients and control group were observed in total protein, albumin, globulin, A/G ratio, urea, creatinine and uric acid. On the other hand a non significant difference ($p>0.05$) between burn degrees in same parameters were observed. We conclude from the present study that the biochemical and metabolic changes occur in patients with different types of burns and its values didn't depended on burn degree or types, although its values can be use to predict the extent of injury and severity of burn patients

INTRODUCTION

Burn injuries are among the most destructive of all injuries and a major global public health problem [1]. Burn injuries pose a high burden of fatalities on the health systems worldwide. About 90% of burn incidents occur in low to middle income countries, areas that are deficient in the essential means to decrease the rate and intensity of such injuries [2]. When we speak of burns, we not only mean just superficial, localized injuries but also injuries involving all systems of the human body [3].A severe burn injury may interfere with all functions of the skin. In addition, the burn injury frequently has a profound effect on other organ systems and functions. The intensity of extensive burns causes loss of fluid from circulation as exudates which have a composition similar to plasma. Therefore, the metabolic changes are reflected as biochemical changes in blood. In major burns, intravascular volume is lost in burned and unburned tissues. This process is due to an increase in vascular permeability, increased interstitial osmotic pressure in burn tissue, and cellular edema. The extent of this process depends on the severity of shock and can be minimized by early restoration of perfusion in the injured tissues. Failure to achieve this can cause widespread organ dysfunction. Local vascular changes of great importance occur in the burned areas. Capillary permeability is greatly increased and through the injured walls plasma, rich in proteins, pours out in great quantity and this pouring continues as there is no stasis in cases of burns. It is the extent of the burned area rather than its depth which is responsible for the loss of protein-rich fluid in such a great quantity [4]. Lisher, Elman and Davey (1945), pointed out that plasma, albumin and globulin changes differ according to the severity of the burn. Immediately following a burn the total amount of plasma protein in the vascular system is drastically reduced [5]. The use of prognostic factors has been attempted in burn patients, such as sex, age, total burned body surface area (BSA), full-thickness injuries, and serum levels [6-7]. However early identification of patients with the greatest risk is essential for their management, and their overall treatment [8]. Hypoalbuminemia is a common clinical deficiency in burn patients and is associated with complications related to increased extravascular fluid, including edema, abnormal healing, and susceptibility to sepsis [9]. Urea is a measure of the major end product of protein metabolism [10]. As reported persistently elevated serum creatinine is a risk factor for progression of chronic kidney diseases to kidney failure [11]. Uric acid is more toxic to tissue than xanthine or hypoxanthine [12]. The objective of our current study is to assess the effect of cause of different types of burn cases. The purpose of this study was to determine changes of biochemical parameters like Total protein, serum albumin, globulin, A/G ratio, urea, creatinine and uric acid levels and if their level can predict extent of injury and severity in different types of burn patients.

MATERIALS AND METHODS

A total of 105 patients with burn admitted in Burn Ward of Department of Surgery, S.R.G. Hospital, Jhalawar were participated in this study. We obtained general information about each patient, including age, sex, etiology, location of burns and degree burn. As a control subjects 50 healthy individual were included in this study. One hundred and five patients with 20 - 90% (TBSA%) of different types of burns were selected for the study. Sixty-one of the patients were male and 44 were female, their ages ranging from 18 to 60 years. Blood sample was taken from the normal healthy controls and from the most accessible site in burned patients, shortly after admission to Hospital. No specimen was obtained immediately after a fluid resuscitation or surgical procedure. All Chemical analyses were performed on non hemolyzed serum. Total protein was measured by Biuret method, and albumin levels were measured by (Bromo Cresol Green) BCG method. The statistical software (SPSS 20.0 software; trail Version) was used. The data were analyzed using paired *t*-test, one way ANOVA (Analysis of Variance) with Tukey's HSD test.

RESULTS

Demographic study of burn patients presented that among 105 burn patients 42% were female, 58% were male of 18-60 years age. Including different types of burn patients of Total body surface area (TBSA%) involved were 20%- 90%. Burn wounds were caused by flame in 50 cases, Scald by hot liquid and objects in 35 cases, by electricity in 20 cases (Table 1).

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Hypermetabolic response in burn patients occurs by altering the physiological and biochemical environment characterized by increased metabolic rates, multi-organ dysfunction, muscle protein degradation, blunted growth and insulin resistance [13]. Total protein concentration was measured in the serum of control and burn patients according to biuret method.

The results in table 2 showed the presence of a highly significant decrease in protein concentration in serum of burn patients in comparison to that of the control group and this decrease was due to the overwhelming protein losses by bleeding, where with bleeding the protein is lost along with the blood so the more deeper the burn is, the more bleeding and more protein-rich fluid leaks from the open burn wounds causes a high decrease in protein concentration [14]. This result was agreement with the results reported in a study [15] that the low values of protein observed in burn patients are caused by several factors including microvascular hyper-permeability and inflammatory processes. A highly significant decrease of albumin level ($p<0.0001$) was observed in the present study in serum of burn patients compared to control group. These result shows the fact that skin is the major storage for albumin so whenever the skin got burned the albumin level will decrease [9]. Burns affecting >20% of the body surface cause a major loss of extracellular fluids, thereby inducing shock by increasing vascular permeability and reducing plasma albumin from the wound exudations [14]. The results of the present study was agreement with Aguayo- Becerra *et al*. [9] who suggests that hypoalbuminemia has a deleterious effect on patient survival but does have some limitations. Miquet-Rodríguez *et al*. [16] reported a mortality rate of <10% in severely burn patients (2/23) in whom hypoalbuminemia was frequently observed, demonstrating a significant association between the extent of the burn and the serum albumin level. Globulin level in this study showed a highly significant decrease ($p<0.0001$) in sera of burn patients compared to control group. This decrease is due to blood loss via damaged skin [17]. This result was agreement with Muhammad and Hayder [18] who found that the total serum protein, albumin and globulin of burn patients shows significant decrease ($p<0.0001$). Burns reduces the blood flow to the kidney which leads to, build up of nitrogen waste products, such as creatinine and urea in the body (azotemia). Prerenal azotemia is the most common form of kidney failure in hospitalized patients. Acute renal failure complicates burn patients and is related to the size and depth of burn and occurrence of septicemia [19]. A highly significant increase in urea level ($p< 0.0001$) was observed in the present study in sera of burn patients compared to control group. It was found that serum creatinine levels of burn patients increased prominently ($p>0.0001$) as compared to control group. These observations are in close agreement with the findings of Davis et al. [20]. Serum creatinine is the most quantitative estimate of kidney function. Creatinine is an inert substance formed from the dehydration of creatine in the muscle. This substance is not metabolized further and is excreted by the process of glomerular filtration by the kidney. The increased plasma creatinine demonstrated tubular insufficiency. Plasma creatinine estimation showed tendency to rise with progress of renal failure. The elevation of serum creatinine was related with severity of the disease and extent of the burn [21-23]. Uric acid results of the present study showed a significant increase ($p<0.0001$) in their levels in sera of burn patients in compared to control group. Nagane et al., indicated in their study significant increase of uric acid in burn patients due to increased activity of xanthine oxide [25]. Conflicting results for uric acid level in burns were observed where significant decrease of uric acid in burn patients due to increase in the fractional excretion of uric acid [26]. Similarly, Yadav MK, showed in his study a significant decrease in serum uric acid of burn patients as compared to control group [12]. The overall analysis of different parameters study in sera of different types of burn patients i.e. Flame burn, Scald burn and Electrical burn were presented in Table 3. As shown from the Mean values there were a fluctuation in total protein, albumin, globulin, A/G ratio, urea, creatinine and uric acid between these different types of burns.

CONCLUSION

We conclude from the present study that the metabolic and biochemical changes occur in patients with different types of burns and its values did not depended on burn degree or types, suggesting that its value can be used to predict the extent of injury and severity of burn patients.

Table 1. Demographic study of burn patients

CATEGORY	NUMBER (%)
Age in years	
Below 20	32(30.4)
21-40	55(52.4)
41-60	16(15.2)
Above 60	2(2)
Gender	
Male	61(58)
Female	44(42)
Etiology	
Flame	50(48)
Scald	35(33)
Electrical	20(19)

Table 2. Mean values of serum total protein, albumin, globulin, A/G ratio, urea, creatinine and uric acid.

Parameters	Control Mean±SD	Burn Patient Mean±SD	P Value
Total protein	6.97±0.51	5.72±0.88	p<0.0001
Albumin	59.48±4.67	24.04±5.97	p<0.0001
Globulin	40.41±4.66	33.01±5.03	p<0.0001
A/G Ratio	1.77±2.09	0.73±0.19	p<0.0001
Urea	25.72±6.63	39.39±21.51	p<0.0001
Creatinine	0.74±0.11	1.06±0.36	p<0.0001
Uric acid	3.15±0.36	3.58±0.58	p<0.0001

Table 3. Mean values of biochemical parameters in sera of different types of burn patients

Parameters	Flame Burn Patient Mean±SD	Scald Burn Patient Mean±SD	Electrical Burn Patient Mean±SD
Total protein	5.24±0.94	6.18±0.50	6.12±0.58
Albumin	20.16±4.79	26.14±3.75	29.9±5.12
Globulin	32.42±6.14	34.88±3.63	31.25±2.71
A/G Ratio	0.63±0.14	0.76±0.14	0.95±0.18
Urea	50.5±24.99	24.88±6.54	37±11.31
Creatinine	1.27±0.38	0.77±0.10	1.05±0.19
Uric acid	3.59±0.50	3.74±0.73	3.26±0.31

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