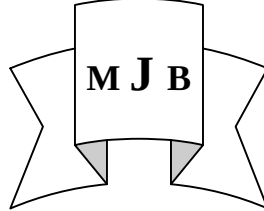


Some Physiological Changes in Burn Patients

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Abstract

This study was designed to estimate some physiological changes to the burn patients, since the levels of these substances are very important in letting the health care team to know how the body is responding to the different therapies that being provided and this will help the medical staff for proper management with less morbidity and mortality. The study lasted from November/2007 to May/2008. There are 125 patients and 100 healthy controls (clinically assessed by specialist doctor) are taken in this study. The patients are classified in 5 groups. The ages of these groups were divided as follows: the first group (1-<3 years); the second group (3-<5 years); the third group (5-<10 years); the fourth group (10 - <18 years); and the fifth group (18 - 58 years old). Those patients were admitted to the burn unit at Al-Hilla General Teaching Hospital. They were suffering from second to third degree (flame and scald) burn injury.

Concerning the hematological parameters, it is found that hemoglobin (Hb) and packed cell volume (PCV) shows significant decrease ($p < 0.01$) in comparison with healthy controls. Regarding the biochemical parameters, it was found that the total serum protein, albumin and globulin of male and female burn patients shows significant decrease ($p < 0.01$) for all age groups except the males of fourth and fifth groups and the females of fifth group which show significant decrease at level $p < 0.05$. The serum electrolytes, serum sodium and potassium shows a significant decrease ($p < 0.01$) before resuscitation and significant increase ($p < 0.01$) within 2 days duration after resuscitation for male and female burn patients of all age groups. Finally, the serum of calcium, copper and zinc shows significant decrease ($p < 0.01$) for males and females of all age groups except the males of first and fourth groups and the females of first and third group which show significant decrease at $p < 0.05$ for zinc only in comparison with healthy controls.

In view of the changes summarized, the increase or decrease in some hematological and biochemical parameters may be attributed to hyper metabolic state which arises mainly due to increase of adrenaline release, loss of fluid and electrolytes, hemolysis and sepsis.

الخلاصة

تضمنت هذه الدراسة معرفة التغيرات التي تحدث لبعض المعايير الدموية والكيميوية لدى مرضى الحروق وذلك لأهميتها في مساعدة الفريق الطبي لمعرفة كيفية استجابة الجسم للعلاج المعطى مؤدياً إلى علاج أفضل. استمرت هذه الدراسة من تشرين الثاني (٢٠٠٧) إلى أيار (٢٠٠٨) وقد تضمنت ١٢٥ مصاباً بالحروق و ١٠٠ من غير المصابين (السيطرة) من كلا الجنسين. وقد تم تقسيم المرضى المصابين بالحروق (بالمقارنة مع الأشخاص الأصحاء) إلى خمسة مجاميع عمرية حيث أن أعمار المجموعة الأولى تتراوح بين ١- >٣ سنة و المجموعة الثانية ٣- >٥ سنة و المجموعة الثالثة ٥- >١٠ سنة و المجموعة الرابعة ١٠- >١٨ سنة و المجموعة الخامسة ١٨- >٥٨ سنة. حيث تم إدخال هؤلاء المرضى إلى ردهة الحروق في مستشفى الحلة التعليمي العام والذين يعانون من الحرق الحراري (حروق اللهب أو السماط) وبدرجة ثانية أو ثالثة. تميز الأشخاص المصابين بالحروق فيما يخص المتغيرات الدموية بانخفاض معنوي ($p < 0.01$) لكل من خضاب الدم (Hb) وحجم الخلايا المضغوط (PCV) لكل المجاميع العمرية ومن كلا الجنسين عند مقارنتها بالأصحاء

أما بخصوص المتغيرات الكيميائية فقد لوحظ انخفاض معنوي ($p < 0.01$) لقيم البروتين المصلي الكلي (total serum protein) و الألبومين (albumin) والكلوبولين (globulin) لكل المجاميع العمرية ومن كلا الجنسين (عدا كل من المجموعتين الرابعة و الخامسة من الذكور والمجموعة الخامسة من الإناث حيث شهدت انخفاضا معنوياً على مستوى $p < 0.05$ لمتغير الكلوبولين فقط) عند مقارنتها بالأصحاء. بينما كانت أقيام كل من الصوديوم البوتاسيوم مرتفعة معنوياً ($p < 0.01$) قبل تزويد المرضى بالمحاليل الوريدية و منخفضة معنوياً ($p < 0.01$) بعد إعطائهم تلك المحاليل. كما شهدت العناصر النادرة (النحاس والزنك) والكالسيوم انخفاضا معنوياً ($p < 0.01$) لكل المجاميع العمرية ومن كلا الجنسين (عدا كل من المجموعتين الأولى و الرابعة من الذكور والمجموعة الأولى والثالثة من الإناث حيث شهدت انخفاضا معنوياً $p < 0.05$ لمتغير الزنك فقط) عند مقارنتها بالأصحاء.

إن التغيرات في المعايير الدموية والكيميائية الحاصلة لمرضى الحروق يمكن ان تعزى بصورة رئيسية إلى ارتفاع معدل الايض بسبب الإفراز العالي لهرمون الأدرنالين و فقدان السوائل والأملاح وتكسر خلايا الدم الحمراء و تسهم الدم.

Introduction

The skin is one of the largest and most versatile organs of the body. It has surface area of 1.5 to 2 square meters, and form the major interface between the internal organs and the external environment. As the body the first line of defense, the skin is continuously subjected to potentially harmful environmental agents, including solid matter, liquids, gases, sunlight, and microorganisms. The skin also serves as immunological barrier. The langerhans cells detects foreign antigens, playing an important part in allergic skin conditions and skin graft rejection [1,2].

Burn is one of the most common and devastating forms of trauma [3]. It is an injury to the skin that damages or destroys skin cells and tissue. It is generally caused when skin makes contact with flames, chemicals, electricity, or radiation. Thermal burns are caused by intense external sources of heat, such as flames, scalding liquids, or steam. Burns resulting from an impaired driving crash are most likely thermal burns [1].

The severity of any burn injury is related to the size and depth of the burn, and to the part of the body that

has been burned. Burns are the only truly quantifiable form of trauma. The single most important factor in predicting burn-related mortality, need for specialized care, and the type and likelihood of complications is the overall size of the burn as a proportion of the patient's total body surface area (TBSA) [3]. Burns are classified according to increasing depth as epidermal, first-degree; superficial and deep partial-thickness, second degree; full-thickness third-degree; and full thickness with underlying structure fourth-degree [4].

Although burn injuries are frequent in our society, many surgeons feel uncomfortable in managing patients with major thermal trauma because of high morbidity and mortality. Advances in trauma and burn management over the past three decades have resulted in improved survival and reduced morbidity from major burns. Improved results are due to advancements in resuscitation, surgical techniques, infection control and nutritional support [1]. Thermal injury is among the most severe forms of trauma and its effects are both local and systemic. Response to thermal injury includes cellular protection

mechanisms, inflammation, hypermetabolism, prolonged catabolism, organ dysfunction and immunosuppression [5].

Burn patients commonly manifest an inflammatory process involving the entire organisms ;the term systemic inflammatory response syndrome (SIRS) summarizes these conditions. SIRS with infection (ie. ,sepsis syndrome) is a major factor determining morbidity and mortality in thermally injured patients[4]. Severe burn injury is characterized by a marked hypermetabolic response and hypermetabolism and even more markedly by loss of lean body mass. This hypermetabolic response is accompanied by a progressive decline of host defenses via immunological abnormalities [6]. Significant thermal injuries induce a state of immunosuppression that predisposes burn patients to infectious complications [3].

The Aim of the study

This study is aimed to estimate some hematological and biochemical changes to the burn patients who are admitted to the burn unit at Al-Hilla General Teaching Hospital because this will help the medical staff for proper management with less morbidity and mortality . So this study is designed to determine the following:

- (1):- Hb and PCV.
- (2):- Serum of total protein , albumin and globulin.
- (3):-Serum of sodium and potassium and their benefits of estimation in fluid resuscitation Serum calcium, zinc and copper

Materials and Methods

This study lasted from November/ 2007 to May / 2008. There are 125 patients and 100 healthy controls (clinically assessed by specialist doctor) are taken in this study . The patients are classified into 5 groups and each group composes of 25 patients , while each control group composed of 20 subjects .The ages of these groups were divided as follows: the first group (1-<3 years) ; the second group (3-<5 years) ; the third group (5-<10 years); the fourth group (10- <18 years);and the fifth group including the adults (18- 58) years old (Gill & Obrien ,1988 ;Behrman *et al* ,2004) . Those patients were admitted to the burn unit at Al-Hilla General Teaching Hospital. They were suffering from second to third degree ,(flame and scald) burn injury, with TBSA range between 20 -35 % and with no infection or sepsis.

The collection of blood was done in burns` ward in Hilla teaching hospitals at 9 A.M. Five ml. of blood are drawn for each hematological and biochemical studies .The blood samples for biochemical studies are drawn within 2 days duration after burn, while for hematological studies are drawn within 7 days duration . Two groups of labeled tubes were used; the first tubes contain EDTA as anti- coagulants to prevent clotting of blood to be used for hematological studies. The second group tubes were without anti-coagulant as plain tubes, for blood to be used for preparing sera for subsequent biochemical tests. Each sample was labeled and given a serial number together with the patient name. The serum samples were frozen at -20°C for biochemical analysis[7].

A cyanomethemoglobin method was used to estimate the hemoglobin contents of the blood. The method was based on Drabkins cyanide-ferricyanide solution. The results were estimated by using Hb meter at 540 nanometer (nm) wave length [8]. Microhematocrit method was used to determine PCV heparinized capillary tubes used [7].

Serum protein concentration was determined by Cupric ions react with protein in alkaline solution to form a purple complex. The intensity of color was measured photometrically at 546 nm wave length, by using spectrophotometer recommended by the total serum protein kit from Human company ,Germany)[9;10], to procedure serum albumin in the presence of bromocresol green at slightly acid pH, produces yellow - green to green blue color. The intensity of color was measured by using (according spectrophotometer at 630 nm wave length (albumin kit from the Human company ,Germany) [9;10]. Serum globulin was determined by subtracting albumin from total serum protein and the results represented the values of serum globulin [11].

Serum sodium was recorded during precipitated Mg - uranyl acetate ; the uranyl ions remaining in suspension form a yellow-brown complex with thioglycolic acid (sodium kit from the Human company ,Germany) [10;12]. Serum potassium ions in a protein-free alkaline medium react with sodium tetraphenylboron to produce a finely turbid suspension of potassium tetraphenylboron. The turbidity produced is proportional to the potassium concentration and read

photometrically (potassium kit from Human company ,Germany) [12; 13]. Serum calcium in the sample, reacts with O-cresolphthaleine at alkaline pH. The intensity of the color was measured photometrically by using spectrophotometer at 570 nanometer (nm) wave length (to according procedure recommended by the serum calcium from Human company, Germany)[10;14].

Atomic absorption spectrophotometer method was used to determine the trace elements (copper and zinc) in serum samples. The samples were injected into auto sample cup of atomic absorption spectrophotometer to read emitted lights. Standard curves were done for both copper and zinc[10].

All values were expressed as means $\pm$ SE. The data were analyzed by using of computer SPSS program and taking $p < 0.05$ as the lowest limit of significant. Student's t - test was used to examine the differences between different groups. Both t test and ANOVA test were applied to determine the differences between group and another and among all group and within group [15].

Results

Hematological studies

The table 1 shows the Hb and PCV values for male and female burn patients within 7 days duration and their statistical analysis .

Hb

The results of Hb for all age groups of male and female burn patients are significantly ($p < 0.01$) decreased in comparison with healthy controls .

PCV

The values of PCV for all age group of male and female burn

patients are significantly ($p < 0.01$) decrease in comparison with healthy controls.

Table 1 The changes in Hb and PCV for males(M) and females(F) burn patients within 7 days duration and controls.

AGE Years	SEX	Hb g/dl		PCV L/L	
		Patients	Control	Patients	Control
(1 –< 3)	M	* 11.523 ± 0.613	* 13.65 ± 0.367	* 0.343 ± 0.018	* 0.399 ± 0.011
	F	* 10.459 ± 0.514	* 13.77 ± 0.332	* 0.313 ± 0.016	* 0.403 ± 0.01
(3 –< 5)	M	* 9.525 ± 0.527	* 13.37 ± 0.365	* 0.28 ± 0.016	* 0.392 ± 0.011
	F	* 8.8 ± 0.288	* 13.38 ± 0.296	* 0.255 ± 0.009	* 0.393 ± 0.009
(5 –< 10)	M	* 9.36 ± 0.552	* 13.91 ± 0.398	* 0.272 ± 0.016	* 0.41 ± 0.012
	F	* 10.038 ± 0.599	* 13.91 ± 0.462	* 0.288 ± 0.018	* 0.412 ± 0.014
(10 –<18)	M	* 11.289 ± 0.665	* 13.84 ± 0.399	* 0.33 ± 0.019	* 0.408 ± 0.011
	F	* 9.221 ± 0.339	* 13.05 ± 0.28	* 0.27 ± 0.009	* 0.386 ± 0.009
(18 - 58)	M	* 9.8 ± 0.51	* 14.47 ± 0.335	* 0.284 ± 0.014	* 0.429 ± 0.011
	F	* 9.531 ± 0.515	* 13.27 ± 0.251	* 0.278 ± 0.016	* 0.393 ± 0.007

-Values are mean ± SE (standard error).

-* $p < 0.01$

Biochemical studies

Total serum protein

The values of total serum protein for males and female burn patients of all

age groups are significantly ($p < 0.01$) decrease in comparison with healthy control (table 2).

Table 2 The changes in total serum protein of males and females for burn patients within 2 days duration and controls .

AGE YEAR	SEX	Total serum protein g/L	
		Patients	Controls
(1 – < 3)	M	* 44.923 ± 1.559 *	* 70.5 ± 1.36 *
	F	47.75 ± 1.508	70.9 ± 1.178
(3 – < 5)	M	* 44.076 ± 0.824 *	* 70.5 ± 1.708 *
	F	47.83 ± 1.696	70.8 ± 1.254
(5 – < 10)	M	* 46.846 ± 1.556 *	* 71.7 ± 1.136 *
	F	46.75 ± 1.388	71.1 ± 1.703
(10 – < 18)	M	* 45.846 ± 3.606 *	* 70.4 ± 1.477 *
	F	46.667 ± 2.13	71.2 ± 1.205
(18 - 58)	M	* 44.769 ± 1.925 *	* 70.5 ± 1.833 *
	F	52.833 ± 2.633	70.7 ± 1.932

-Values are mean ± SE (standard error).

-* p < 0.01

Serum Albumin

The values of serum albumin for all age groups of male and female burn patients are significant (p < 0.01) decrease in comparison with healthy controls (table 3) .

Serum Globulin

The results of male burns' patients show significant (p < 0.01) decrease

in all age groups except the fourth and fifth groups which show significant decrease at p<0.05 in comparison with healthy controls . The females also show significant p<0.01 decrease except the fifth group which is only significant at p < 0.05 (table 3) .

Table 3 The changes in serum albumin and globulin of males and females for burn patients within 2 days duration and controls .

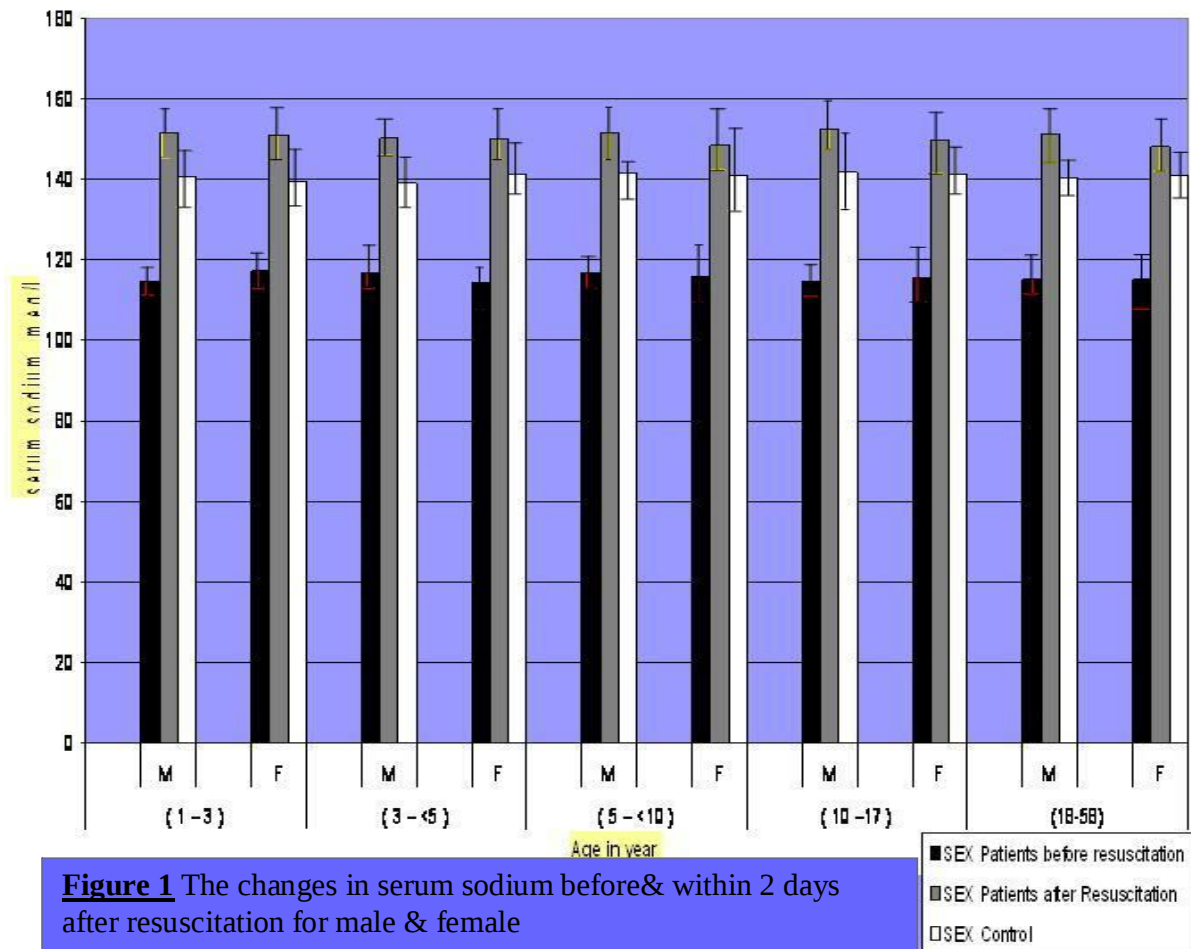
AGE YEAR	SEX	Serum albumin g/L		Serum globulin g/L	
		Patients	Controls	Patients	Controls
(1 – <3)	M	* 20.769 ± 1.105	* 40.6 ± 1.127	* 24.153 ± 0.9187	* 28.9 ± 1.129
	F	22.75 ± 1.634	* 41.4 ± 3.92	* 25 ± 0.835	* 31.2 ± 1.254
(3 – <5)	M	* 25.133 ± 0.945	* 41.7 ± 1.528	* 22.7 ± 1.566	* 28.8 ± 0.573
	F	* 21.615 ± 1.206	* 40.4 ± 1.284	* 22.462 ± 1.333	* 30.4 ± 0.792
(5 – <10)	M	* 22.077 ± 0.977	* 41.3 ± 1.044	* 24.769 ± 0.856	* 30.4 ± 0.67
	F	* 20.25 ± 1.008	* 41.6 ± 1.194	* 26.5 ± 0.744	* 30.5 ± 1.327
(10 – <18)	M	* 19 ± 1.41	* 40.7 ± 0.858	** 26.077 ± 0.812	** 29.7 ± 0.882
	F	* 21.5 ± 1.564	* 40.7 ± 1.359	* 24.333 ± 0.873	* 30.5 ± 0.778
(18-58)	M	* 19.308 ± 1.379	* 42.5 ± 1.5	** 24.923 ± 0.644	** 28 ± 0.83
	F	* 24.667 ± 1.662	* 40.9 ± 1.362	** 26.417 ± 1.227	** 29.8 ± 1.052

Values are mean ± SE, * p < 0.01 , ** at p < 0.05 .

Sodium

The values of serum sodium before resuscitation for male burn patients are : 114.769 ± 1.638 ; 116.667 ± 1.524 ; 116.769 ± 1.392 ; 114.615 ± 1.61 and 115.167 ± 1.618 meql / l respectively , and for females are : 117.167 ± 1.342 ; 114.154 ± 1.523 ; 115.83 ± 1.694 ; 115.667 ± 1.635 and 115.15 ± 1.556 meql/l respectively. Both their results are significantly (p < 0.01) decrease for all age groups in comparison with healthy controls (figure 1) . While the results of Na

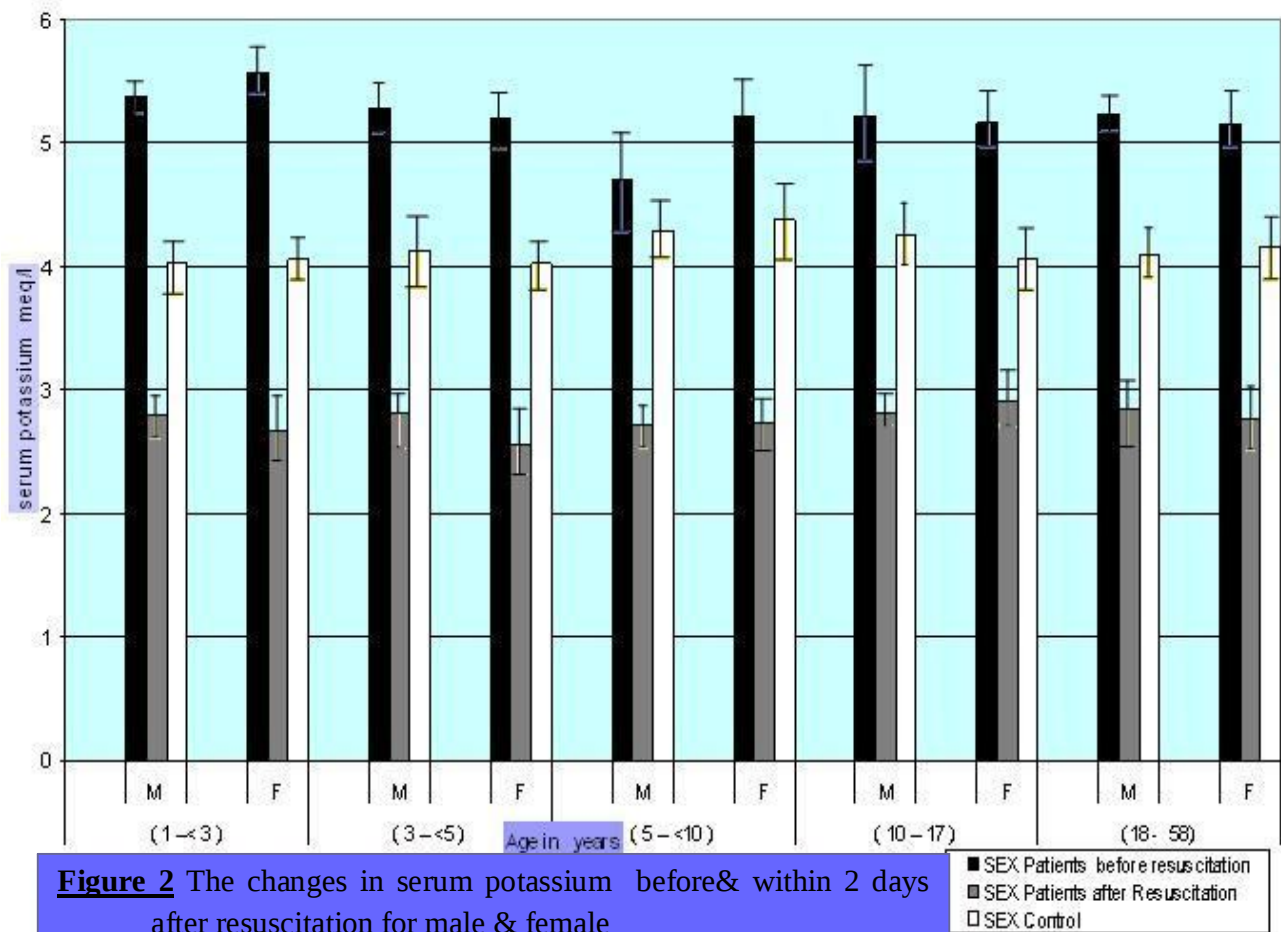
within 2 days duration after resuscitation for male burn patients are : 151.838 ± 1.164 ; 150.167 ± 1.043 ; 151.538 ± 1.164 ; 152.462 ± 1.113 and 151.333 ± 1.245 meql / l respectively , and for females are : 150.917 ± 1.708 ; 150.077 ± 1.238 ; 148.462 ± 1.426 ; 149.75 ± 1.371 and 148.077 ± 1.456 meql / l respectively. Both their results show significant (p< 0.01) increase in comparison with controls(figure1).



Serum potassium

The results of serum potassium before resuscitation for males burn patients are: 5.377 ± 0.089 ; 5.283 ± 0.099 ; 4.696 ± 0.586 ; 5.215 ± 0.367 and 5.233 ± 0.126 meql / l respectively , and for females are : 5.567 ± 0.0 ; 5.192 ± 0.156 ; 5.208 ± 0.145 ; 5.161 ± 0.16 and 5.154 ± 0.176 meql / l respectively . Both of males and females potassium values show significant ($p < 0.01$) increase for all age groups in comparison with healthy controls (figure 2) .While the

values of serum potassium within 2 days duration after resuscitation for males are : 2.8 ± 0.083 ; 2.808 ± 0.078 ; 2.708 ± 0.09 ; 2.815 ± 0.078 and 2.842 ± 0.116 meql / l respectively, and for females are : 2.667 ± 0.098 ; 2.554 ± 0.115 ; 2.733 ± 0.144 ; 2.908 ± 0.1 and 2.762 ± 0.095 meql / l respectively . Both of males and females values after resuscitation are significantly ($p < 0.01$) decrease in comparison with healthy control (figure 2).



Serum calcium

The values of serum calcium for both males and females burn patients

are significant ($p < 0.01$) decrease in comparison with controls (table 4) .

Table 4 The changes in serum of calcium, of males and females for burn patients within 2 days duration and controls.

AGE Year	SEX	Serum calcium mmol /l	
		Patients	controls
(1 – <3)	M	* 1.823 ± 0.052 *	* 2.408 ± 0.049 *
	F	1.808 ± 0.061	3.379 ± 0.05
(3 – <5)	M	* 1.825 ± 0.045 *	* 2.358 ± 0.036 *
	F	1.823 ± 0.034	2.462 ± 0.013
(5 – <10)	M	* 1.815 ± 0.037 *	* 2.415 ± 0.027 *
	F	1.767 ± 0.043	2.283 ± 0.051
(10-<18)	M	* 1.792 ± 0.043 *	* 2.331 ± 0.063 *
	F	1.723 ± 0.053	2.317 ± 0.071
(18 -58)	M	* 1.808 ± 0.043 *	* 2.317 ± 0.061 *
	F	1.746 ± 0.039	2.223 ± 0.062

Values are mean $\pm$ SE

* (p < 0.01).

Serum copper

It is founded in this study the results of serum copper for males and females burn patients are significantly (p < 0.01) decrease in comparison with controls(table 5).

Serum zinc

The values of serum zinc for male and females burn patients are significantly (p < 0.01) decrease except the males of first and fourth groups and the females of first and third group which show significant decrease at p<0.05 in comparison with healthy controls (table 5) .

Table 5 The changes in serum of copper and zinc of males and females for burn patients within 2 days duration and controls .

AGE Year	SEX	Serum copper part per million		Serum zinc part per million	
		Patients	controls	Patients	controls
(1 – <3)	M	* 0.0334 ± 0.022	* 0.0646 ± 0.002	** 0.0228 ± 0.005	** 0.0736 ± 0.011
	F	* 0.0356 ± 0.002	* 0.0660 ± 0.005	** 0.0250 ± 0.003	** 0.0640 ± 0.008
(3 – <5)	M	* 0.0352 ± 0.003	* 0.0654 ± 0.005	* 0.0554 ± 0.006	* 0.0778 ± 0.004
	F	* 0.0356 ± 0.002	* 0.0646 ± 0.006	* 0.0546 ± 0.006	* 0.0784 ± 0.004
(5 – <10)	M	* 0.0700 ± 0.006	* 0.1198 ± 0.012	* 0.0514 ± 0.005	* 0.0888 ± 0.004
	F	* 0.0768 ± 0.005	* 0.1220 ± 0.012	** 0.0482 ± 0.004	** 0.0840 ± 0.0035
((10-<18))	M	* 0.0860 ± 0.01	* 0.1430 ± 0.1430	** 0.0240 ± 0.004	** 0.0650 ± 0.003
	F	* 0.0860 ± 0.01	* 0.1458 ± 0.018	* 0.0304 ± 0.005	* 0.0628 ± 0.0026
	M	* 0.0700 ± 0.005	* 0.1700 ± 0.018	* 0.0202 ± 0.005	* 0.0720 ± 0.005
	F	* 0.0728 ± 0.002	* 0.1610 ± 0.013	* 0.0188 ± 0.003	* 0.0710 ± 0.0048

Values are mean ± SE.

- * (p < 0.01).

Discussion

This study is aimed to estimate some hematological and biochemical changes to the burn patients, since the levels of these substances are very important in letting the health care team to know how the body is

responding to the different therapies that being provided .

Hematological Studies

Hb and PCV

The values of Hb concentration and packed cell volume (PCV) of male and female burn patients are

significantly decrease in comparison with control (table 1). This study agrees with EI-Sonbaty & EI-Otiefy [16], who pointed out that hemoglobin concentrations and hematocrit showed significantly high levels immediately after the burn, especially in the non-survivors. This high level decreased gradually to below control level by day 4 post-burn in the non-survivors and by day 6 post-burn day in the survivors. As well as other study states that the high hematocrit values are common in the first 24 hours after serious burn injuries, even with adequate fluid administration. The decreasing of hematocrit are to be expected with adequate fluid resuscitation, but may also be a hallmark of occult bleeding [17] . Demling et al . , [18] found that hematocrit either increased due to plasma volume decreases while circulating red blood cell volume remains relatively constant; or hematocrit decreased because of either plasma volume replacement in case of hemolysis from prolonged heat exposure and/or major loss of blood from non-burn injury; pre-existing anemia; or hypervolemia.

Biochemical studies

Total serum protein ,albumin ,and globulin

Total serum protein was found that there was significant decrease in the total serum protein for all age groups for both male and female burn patients in comparison with healthy controls(table 2). This study was supported by Demling ,[18] who recorded that a marked decreased in plasma proteins occur early post burn . Other study also pointed out that burns injury results in dramatic

changes in plasma proteins in which the concentration of protein was significantly lower in serum of patient than the control [19] . As well as , this study is consistent with Samuelsson *et al .* ,[20] who states that there is loss of homeostatic control as a result of massive losses of fluid and protein during the first 24 hours. The massive amount of fluid needed during resuscitation, particularly in larger burns, creates a generalized edema that is caused both by the volume of fluid itself and the decreased colloid osmotic pressure that will develop secondary to the resuscitation fluid given and to proteins lost from the circulation. This may compromise tissue perfusion in both injured and uninjured tissues of the burn-injured patients. These results occur because local inflammatory cytokines enter the circulation and result in systemic inflammatory response. As burns approach 25 % of TBSA , this will lead the microvascular leak to become generalized and permit the loss of fluid and protein from the intravascular compartment to the extravascular compartment and finally they are lost through the wound [4].

The results of serum albumin of both males and females for all age groups show significant decrease in comparison with healthy controls(table 3) .These results are in agreement with Ge *et al .* ,[21] who states that serum albumin concentration decreased gradually after resuscitation. As well as, other study hypothesized that initial serum albumin level may be useful as an indicator for prognosis and severity of injury in burned patients. Depressed

serum albumin level is associated with an increase in mortality rate in the major burn patients. In addition, hypoalbuminemia may result in impaired wound healing and predisposing to sepsis. However, it has not been clear whether hypoalbuminemia itself can be used as an independent predictor of mortality in major burns [22]. The reason for obtaining these results is thought that stress (ex. trauma, infection or others) has always been associated with hypoalbuminemia in either animals or humans [23; 24]. A reduction of plasma albumin concentration in general can be the consequence of various factors, including a change in its rate of synthesis, an increased catabolic rate, and/or a redistribution of albumin from plasma to interstitial compartment. While in burn, plasma albumin is well known to decrease in response to inflammation [25]. They also refer to that the depressed plasma levels of albumin were not associated with a reduced hepatic albumin synthesis. Such results could have potential clinical implications. Since the intravascular compartment which is easily accessible, represents <35% of the total exchangeable albumin pool and they observed no decrease of plasma albumin synthesis rate during the acute phase, hypoalbuminemia could be due to an increase in either catabolism or escape of the protein from the plasma pool in the extravascular space [25]. Therefore in the colloid fluid resuscitation for burn patients, protein should not be given between 8 to 12 hours post burn because of the massive fluid shifts during this periods

, after this the protein should be used [4]. The results of s. globulin of both male and female burn patients show significant decrease in comparison with control (table 3). This study also consistent with Rothenbach et al. [26] who pointed that burn injury induced a rapid decrease in globulin values. As well as, the production of immunoglobulin G (IgG) in response to T-cell-dependent antigens is also impaired after serious injury [3].

Our results are in disagreement with Sheridan *et al.* [27] who state compensatory increase in acute-phase proteins reflected in plasma globulin. This is only true when we take the serum globulin as percentage to the total serum protein.

The serum sodium

The serum sodium of male and female burn patients before resuscitation are significantly decrease in comparison with healthy control (figure 1). This results are consistent with Huang et al. [28] who states that during the first 3 days after burn, serum sodium concentrations were moderately elevated in the patients. As well as, these results were supported by Ge *et al* [21] who pointed out that serum Na^+ decreased post-burn and increased after resuscitation. Other study found that the initial resuscitation period below 36 hours characterized by hyponatraemia. The explanation for these results are 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 most significant shifts occurring in the first hours. Hyponatraemia is frequent, and

the restoration of sodium losses in the burn tissue is therefore essential. While the hypernatraemia which is occur later on is caused by several mechanisms: intracellular sodium mobilization, reabsorption of cellular edema, urinary retention of sodium (because of the increase in renin, angiotensin, and ADH), and the use of isotonic or hypertonic fluids in the resuscitation phase [29].

The serum potassium

The results of serum potassium of males and females are significantly increase before resuscitation in comparison with healthy controls (figure 2). Our results is supported by other study which states that in major burns , the initial resuscitation period (between 0 and 36 h) characterized by hyperkalaemia because of the massive tissue necrosis[29].As well as, . Demling et al ., [18]state that potassium ions will increase if severe hemolysis has occurred or renal impairment is present.

While our values of the serum potassium after resuscitation are significantly decrease in comparison with healthy control (figure2).This results are in agreement with Rainer *et al.*,[30] who pointed out that hypokalaemia is well recognized after stress states and is due to a combination of the effect of adrenaline and insulin. Adrenaline stimulates receptors on skeletal muscle with consequent uptake of potassium from the circulation. It is probable that total body potassium is not reduced. As well as ,other study showed that the early post-resuscitation period between 2-6 days of burns' patients characterized by hypokalaemia. It may be due to increased potassium losses

(urinary-, gastric. fecal) and the intracellular shift of potassium because of the administration of carbohydrates [29].

Serum Calcium

The results of serum calcium ,copper and zinc in males and females for all age groups are significantly decrease in comparison with healthy controls (table 4).This is supported by Snider *et al.* [31]who pointed out that the mean serum calcium were significantly lower at the initial time of study than at discharge. Other study who states that there is decreased in serum calcium and they have shown that vitamin D metabolism is disturbed after burn injury. Vitamin D is essential for calcium and phosphorus homeostasis and skeletal bone integrity [32] .As well as, serum calcium concentrations remained significantly lower than values measured in shams 8 days after burn trauma in the absence of sepsis,[33]. This study is consistent with Yang *et al* .,[5] calcium contents were significantly decreased compared to control group. It is found that Ca^{2+} -ATPase activities, calcium uptake function and left ventricular contractile function decreased markedly. They conclude The cardiac renin-angiotensin system is activated rapidly after severe burns and inhibits the calcium transport function which may play an important role in cardiac contractile dysfunction following burns. Hypocalcemia is common among critically ill patients. It has been shown to correlate with increased mortality. Hypocalcaemia may be iatrogenically induced due to chelation of calcium by high concentrations of citrate in blood derived colloid (blood,

fresh frozen plasma, and human albumin solution). It may be a result of change in calcium binding due to change in blood pH, elevation of fatty acids, sepsis, hypoalbuminemia, renal failure and hypomagnesaemia [34].

Serum copper and zinc

Our results of serum copper and zinc (table 5) are supported by Marvaki et al .,[6] who they states that mean plasma concentrations of Cu and Zn were low at admission and discharge. Urinary Zn was elevated at admission, whereas Cu was elevated at both times. Wound Cu and Zn concentrations exceeded plasma concentrations, suggesting that inflammatory wound exudate was a primary route of loss. They demonstrate that burn injury in children results in low plasma levels of Cu and Zn that are inadequately compensated during hospitalization. These micronutrients are essential for bone matrix formation, linear growth, and wound healing. Other study consistent with our results found that there is a significant difference was shown. Irrespective of etiology, the serum trace element levels were lower in the burn patients than in the healthy individuals. Despite the marked difference in the percentage of body burns, trace element levels changed as a result of the systemic effect of the burns. The explanation for these results could be after the burn, trace element excretion was shown to occur from the wound surface and in the urine [35].

Conclusions

From the data of the present study ,we conclude that the increase or decrease in some hematological and

biochemical parameters may be attributed to hypermetabolic state which arise mainly due to increase of adrenaline release ,loss of fluid and electrolytes , hemolysis and sepsis . This may be due to the breach that are created by thermal injury in the surface of the skin which lead to affection of its function in the preservation of body fluid homeostasis, thermoregulation, and the host's protection against infection . As well as, immunological, neurosensory, and metabolic functions of the skin such as vitamin D metabolism are affected .

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