

Study of the changes in some serum electrolytes and trace elements levels in patients with burn injuries

دراسة التغيرات لبعض الشوارد الكهربائية والعناصر النادرة في مصل الدم لاصابات الحروق

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المستخلص:

تضمنت هذه الدراسة معرفة التغيرات التي تحدث لبعض الشوارد الكهربائية والعناصر النادرة لدى مرضى الحروق وذلك لأهميتها في مساعدة الفريق الطبي لمعرفة كيفية استجابة الجسم للعلاج المعطى للوصول إلى علاج أفضل . بدأت هذه الدراسة من تشرين الثاني 2008 واستمرت إلى نيسان 2009 و قد تضمنت 125 مصابا بالحروق و 100 من غير المصابين (السيطرة) من كلا الجنسين . تم تقسيم المرضى المصابين بالحروق (بالمقارنة مع الأشخاص الأصحاء) إلى خمسة مجاميع عمرية حيث أن أعمار المجموعة الأولى تتراوح بين 1- <3 سنة و المجموعة الثانية 3- <5 سنة و المجموعة الثالثة 5- <10 سنة و المجموعة الرابعة 10- 18 سنة و المجموعة الخامسة 18- 58 سنة . إذ تم إدخال هؤلاء المرضى إلى ردهة الحروق في مستشفى الحلة التعليمي العام والذين يعانون من الحرق الحراري (حروق اللهب أو السمات) وبدرجة ثانية أو ثالثة . فقد وجد انخفاضا معنويا ($p < 0.01$) في قيم الصوديوم قبل تزويد المرضى بالمحاليل الوريدية وارتفاعا معنويا بعد إعطائهم تلك المحاليل . بينما كانت قيم البوتاسيوم مرتفعة معنويا قبل تزويد المرضى بالمحاليل الوريدية و منخفضة معنويا بعد إعطائهم تلك المحاليل . كما شهدت العناصر النادرة (النحاس والزنك) والكالسيوم انخفاضا معنويا ($p < 0.01$) لكل المجاميع العمرية ومن كلا الجنسين (عدا كل من المجموعتين الأولى و الرابعة من الذكور والمجموعة الأولى و الخامسة من الإناث إذ شهدت انخفاضا معنويا $p < 0.05$ لمتغير الزنك فقط) عند مقارنتها بالأصحاء

ABSTRACT :

This study was designed to estimate the changes in some electrolytes and trace elements in serum of patients with burn injuries ,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 October /2008 to April /2009. There are 125 patients and 100 healthy controls (clinically assessed by specialist physician) are taken in this study .The patients were classified in 5 groups according to age group and each group composed from 25 patients .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 with 20 -25 % degree of burn . They were suffering from second to third degree (flame and scald) burn injury . Regarding the serum electrolytes , serum sodium shows a significant decrease before resuscitation and significant increase within 2 days duration after resuscitation while the serum potassium exhibits significant increase before resuscitation and shows significant decrease 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 for males and females of all age groups except the males of first and fourth groups and the females of first and fifth group which show significant decrease for zinc only in comparison with healthy controls .

Introduction:

Sodium ,potassium and calcium are blood electrolytes .They are maintain osmotic pressure ,acid –base balance . These functions affected after burn (1) . (2) show that serum sodium decreased post –burn and increased after resuscitation in burn patients . (3) show that hypokalaemia is well recognized after burn and this due to combination of the effect of adrenaline and insulin (4) . (5,6) referred to hypocalcaemia post burn. (7) reported that there is relationship between vitamine D and magnesium also shaw that calcium play a role for therapy during the intial phase of burn resuscitation .

The trace elements are incorporated into structure of proteins ,enzymes an complex carbohydrates . Zinc and copper are especially active in metabolic and biochemical processes in the recovery phase of the wounds. In burns ,there is an increase in metabolic processes such as tissue repair , wound healing ,microcirculation and oxygenation. The trace elements taking part in these processes are of primary importance to burn patients (8) .

So the this study aaimed to :

- 1- Estimate of serum Na ,K Levels before and after resuscitation .
- 2- Estimate of serum Ca ,Zn and copper Levels .

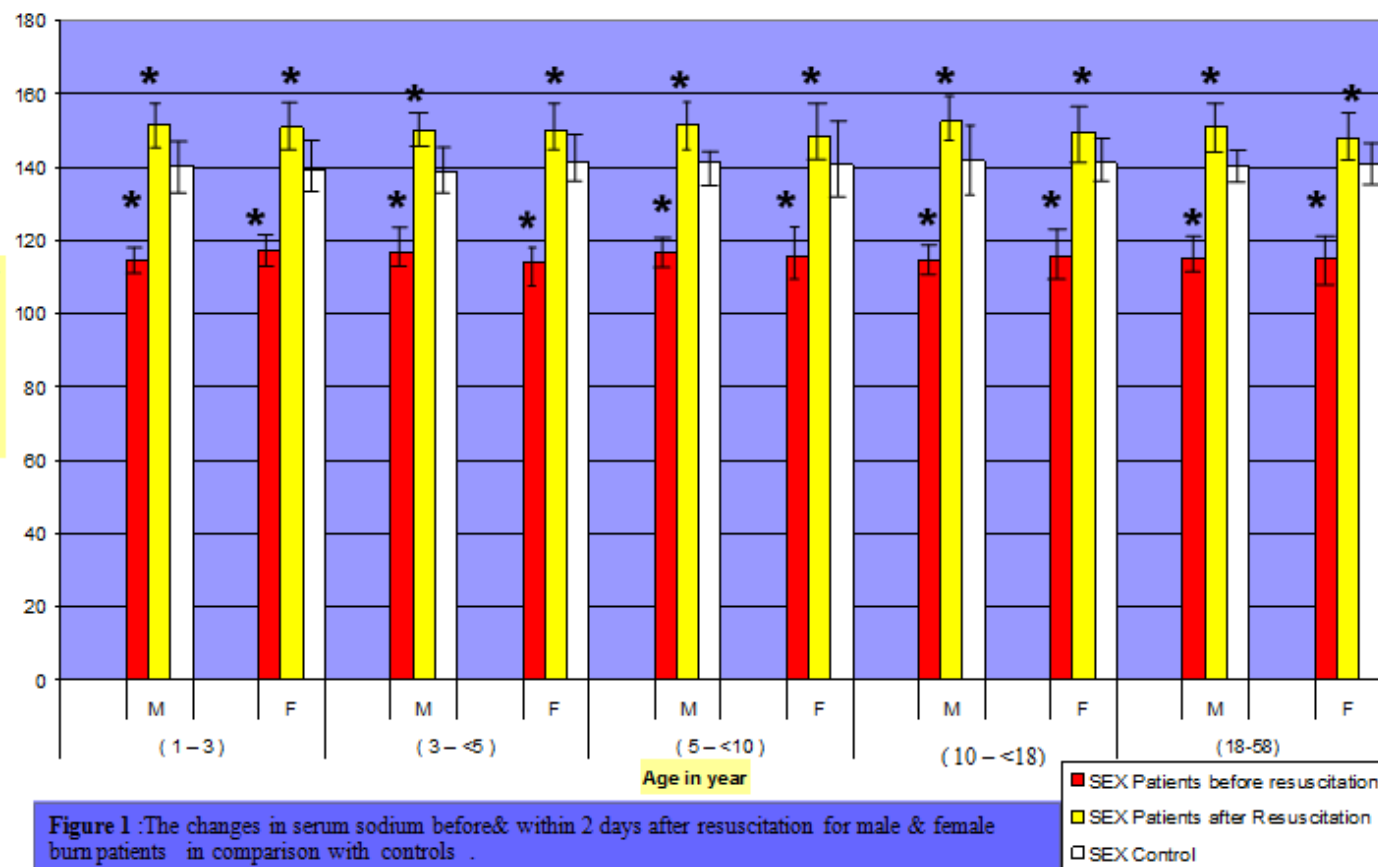
Materials and Methods :

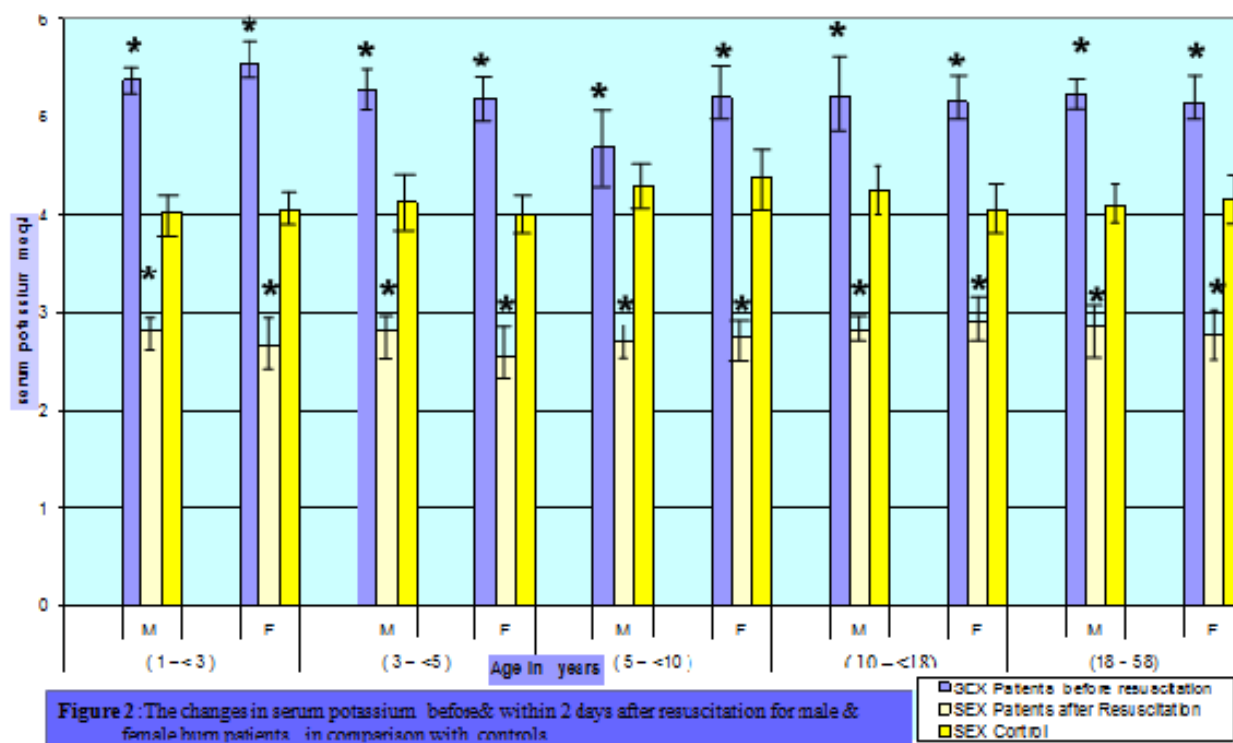
- 1.The collection of blood was done in burns' ward in Hilla teaching hospital by using scientific procedures as illustrated in Dacie and Lewis, practical hematology (9) . The chemical method was used for estimation of each of serum sodium ,potassium and calcium . the by using the procedure recommended by the sodium, potassium and calcium kits respectively that provided by Human company ,Germany . Atomic absorption spectrophotometer method was used to determine the trace elements(copper and zinc) in serum samples. according to what ?
2. Statistical analysis , 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 one way or two way test were applied to determine the differences between group and another and among all group and within group (10) .

The results and discussion :

The serum sodium of male and female burn patients before resuscitation were significantly decrease in comparison with healthy control as shown in figure 1 . (11) who states that the hyponatraemia in these cases results rarely from sodium deficit but usually from excess water retention and entry of sodium into the cells(11). These changes may in some patients be reversed by blood-transfusion, by insulin and glucose infusions, or by both together. Improvements in supportive therapy have reduced morbidity and mortality(11) . While the results after resuscitation which is done more than 48 hours , it is found that there is significant increased in comparison with controls (figure1 ,table 1). These results are consistent with (12) who states that during the first 3 days after burn, serum sodium concentrations were moderately elevated in the patients (12).As well as, these results were supported by (13) who pointed out that serum Na^+ decreased post-burn and increased after resuscitation(13) . Other study found that the initial resuscitation period below 36 hours characterized by hyponatraemia(14) . 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 oedema. The most significant shifts occurring withen the first hours(14). Hyponatraemia is frequent, and the restoration of sodium losses in the burn tissue is therefore essential.

While the hypernatraemia which is occur later is caused by several mechanisms: intracellular sodium mobilization, reabsorption of cellular oedema, 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 (14).





* P < 0.01

The results of serum potassium of males and females were significantly increased before resuscitation in comparison with healthy controls (figure 2). Our results are 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(14). As well as, (15) state that potassium ions will increase if severe hemolysis has occurred or renal impairment is present (15). While our values of the serum potassium after resuscitation were significantly decreased in comparison with healthy control (figure 2, table 1). This result is agreed with (16) who pointed out that hypokalaemia is well recognized after stress states and is due to a combination of the effect of adrenaline and insulin (16). 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 (urinary-, gastric and or faecal) potassium losses and the intracellular shift of potassium because of the administration of carbohydrates (16).

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

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AGE Year	SEX	Serum calcium mmol /l		Serum copper part per million		Serum zinc part per million	
		Patients	controls	Patients	controls	Patients	controls
(1 – <3)		*	*	*	*	**	**
	M	1.823 ± 0.052	2.408 ± 0.049	0.0334 ± 0.022	0.0646 ± 0.002	0.0228 ± 0.005	0.0736 ± 0.011
	F	*	*	*	*	**	**
(3 – <5)		1.808 ± 0.061	3.379 ± 0.05	0.0356 ± 0.002	0.0660 ± 0.005	0.0250 ± 0.003	0.0640 ± 0.008
	M	*	*	*	*	*	*
	F	1.825 ± 0.045	2.358 ± 0.036	0.0352 ± 0.003	0.0654 ± 0.005	0.0554 ± 0.006	0.0778 ± 0.004
(5 – <10)		*	*	*	*	*	*
	M	1.823 ± 0.034	2.462 ± 0.013	0.0356 ± 0.002	0.0646 ± 0.006	0.0546 ± 0.006	0.0784 ± 0.004
	F	1.815 ± 0.037	2.415 ± 0.027	0.0700 ± 0.006	0.1198 ± 0.012	0.0514 ± 0.005	0.0888 ± 0.004
((10-<18))		*	*	*	*	**	**
	M	1.792 ± 0.043	2.331 ± 0.063	0.0860 ± 0.01	0.1430 ± 0.1430	0.0240 ± 0.004	0.0650 ± 0.003
	F	*	*	*	*	*	*
(18 -58)		1.723 ± 0.053	2.317 ± 0.071	0.0860 ± 0.01	0.1458 ± 0.018	0.0304 ± 0.005	0.0628 ± 0.0026
	M	*	*	*	*	*	*
	F	1.808 ± 0.043	2.317 ± 0.061	0.0700 ± 0.005	0.1700 ± 0.018	0.0202 ± 0.005	0.0720 ± 0.005
		*	*	*	*	*	*
	M	1.746 ± 0.039	2.223 ± 0.062	0.0728 ± 0.002	0.1610 ± 0.013	0.0188 ± 0.003	0.0710 ± 0.0048
	F	*	*	*	*	*	*

- Values are mean ± SE .

- * (p < 0.01).

- * (p < 0.05).

The results of serum calcium ,copper and zinc in males and females for all age groups were significantly decrease in comparison with healthy controls (table 1).

This results supported by (17)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 (7) .As well as, serum calcium concentrations remained significantly lower than values measured in shams 8 days after burn trauma in the absence of sepsis,(17). This study is consistent with (18) 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 (19) .

Our results of serum copper and zinc are supported by (20) 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 (21).

Table 1 the changes in serum sodium and potassium within 2 days duration after resuscitation for male and female burn patients :

AGE YEAR	SEX	SERUM SODIUM (meq/l)		SERUM POTTASIUM (meq/l)	
		patients	controls	patients	controls
1-<3	M	* 151.838±1.146	* 143.561±1.134	* 2.8±0.083	* 5.6±0.37
	F	* 150.917±1.708	* 140.711±1.408	* 2.667±0.98	* 5±0.88
3-<5	M	* 150.167±1.043	* 141.113±1.07	* 2.808±0.078	* 5.2±0.11
	F	* 150.077±1.238	* 141.567±1.088	* 2.554±0.0115	* 4.998±0.25
5-<10	M	* 151.838±1.164	* 143.667±1.002	* 2.708±0.09	* 5.318±0.16
	F	* 148.462±1.426	* 141.767±1.005	* 2.733±0.144	* 4.871±0.155
10-<18	M	* 152.462±1.113	* 144.125±1.076	* 2.815±0.078	* 5.9±0.224
	F	* 149.75±1.371	* 143.108±1.07	* 2.908±0.1	* 4.941±0.107
18-58	M	* 151.333±1.245	* 140.1.088	* 2.842±0.116	* 4.991±0.132
	F	* 148.077±1.469	* 141.981±1.238	* 2.762±0.095	* 4.71±0.114

-Values are mean ±SE

-mean with one asterisk are significantly different at (p<0.01).

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