The correlation between serum creatinine and burn severity and its predictive value

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ABSTRACT

This study aimed to explore the correlation between serum creatinine and burn severity and the value of predicting the outcome of patients. For this purpose, a total of 268 burn patients (BUP) were collected. According to the burn area, they were divided into mild group (MIG) (n = 125, burn area 30% - 49%), moderate group (MOG) (n = 80, burn area 50% - 79%) and severe group (SEG) (n = 63, burn area ≥ 80%). According to the prognosis, they were divided into survival group (SUG) (n = 170) and death group (DEG) (n = 98). At the same time, the control group (COG) was selected from the physical examination center of our hospital. 5 mL of fasting venous blood was collected from all BUP on the first, seventh, 14th and 21st days after admission. 5 mL of fasting venous blood was collected from the COG. Creatinine (CRE) level was measured by enzyme method. Cholinesterase (CHE) level in serum was measured by improved Ellman method. The changes of CRE and CHE in serum were compared among all groups to explore the correlation between serum creatinine and burn severity and its prediction Measure the value of patients' outcomes. Results showed that except for the first day after burn, the level of serum CRE in BUP was raised than that in the COG, and the level of serum CHE in BUP was reduced than that in the COG (P<0.05). The serum CHE level of BUP in all groups increased at first and then decreased, and the highest level was on the first day after injury. At the same time, the level of CRE in SEG was raised than that in MIG and MOG, and the level of CRE in MOG was raised than that in MIG (P<0.05). The serum CHE level of BUP in all groups decreased at first and then increased, and the lowest level was on the first day after injury. At the same time, the level of CRE in SEG was reduced to that in MIG and MOG, and the level of CRE in MOG was reduced to that in MIG (P<0.05). The level of CRE in serum of BUP in both groups increased at first and then decreased, and the level was the highest on the first day after injury. At the same time, the level of CRE in the DEG was raised than that in the SUG (P<0.05). The level of CHE in serum of BUP in both groups decreased at first and then increased, and the level was the lowest on the first day after injury. At the same time, the level of CRE in the death group was reduced than that in the SUG (P<0.05). Logistic regression analysis showed that there was statistical significance in the regression coefficients on the 1st, 7th, 14th and 21st day after burn, and on the 1st and 21st day after-burn. ROC curve analysis shows that CRE and CHE have certain value in diagnosing the prognosis of BUP, and the diagnostic value of CRE is higher. Cre level increases with the aggravation of burn patients, and ChE level decreases with the aggravation of BUP. In conclusion, Cre and ChE have certain value in diagnosing the prognosis of BUP and can be widely used in clinical practice.

Introduction

Burn is a type of tissue damage caused by heat such as hot liquids, vapours, hot gases, flames, incandescent metallic liquids, or solids (1), mainly referring to damage to the skin and (or) mucous membranes, but in severe cases also to subcutaneous or (and) submucous tissues, inducing serious complications such as infection, lung disease, renal failure, coagulation dysfunction, tissue ischaemia and hypoxia, stress ulcers and shock, endangering patients' lives (2). As one of the key research projects in the Department of Burn Surgery, the disease of burn develops rapidly with a high mortality rate and has attracted people's attention for a long time (3). All burn patients (BUP) have different degrees of renal injury after burn, so the detection of renal function is important for the treatment of BUP and the improvement of prognosis (4). Creatinine (CRE) is mainly excreted from the body by glomerular filtration, and changes in its level can reflect the filtration function of glomeruli (5,6). Recent studies have found that Cre is abnormally expressed in the serum of BUP, but its mechanism has not been deeply explored (7). Cholinesterase (CHE) is a glycoprotein synthesized by the liver, whose level changes are closely related to liver function. Recent studies have found that CHE is abnormally expressed in the serum of BUP, which may be related to the severity of BUP (8). This paper further explored the correlation of serum CRE and CHE with burn severity and their value

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in predicting the outcome of patients, so as to provide a reference for the diagnosis and treatment of clinical BUP.

Materials and Methods

General information

A total of 268 patients admitted to the Department of Burn Surgery in our hospital from August 2020 to June 2021 were collected. The inclusion criteria were as follows: ① 6 the burn area of all patients was more than 30% of the total surface area; ② the patients were immediately given anti-shock, anti-infection and debridement dressing at the same time, urgent serum examination; ③ patients were given nutritional support, operation, metabolism and immune conditioning treatment during hospitalization, and their compliance was strong. ④ the patients and their families knew and signed the informed consent form. Exclusion criteria: ① Severe thoracic and abdominal organ injury; ② Craniocerebral injury; ③ Severe infection on admission; ④ Serious basic lesions such as heart, liver and renal dysfunction; ⑤ Poor compliance or refusal of this test; ⑥ Give up treatment halfway. According to the burn area, the patients were divided into a mild group (MIG), moderate group (MOG) and severe group (SEG). There were 125 patients in MIG, 72 males and 53 females. The average age was (45.26±20.48) years, and the average BMI value was (20.03 ±1.05) kg/m². There were 80 patients in MOG, 45 males and 35 females, the average age was (45.21±20.33) years, and the average BMI was (20.10 ±1.04) kg/m². There were 63 patients in the SEG, including 35 males and 28 females, with an average age of (45.31 ±21.00) years and an average BMI of (20.11 ±0.89) kg/m². According to the prognosis, the patients were divided into survival group (SUG) and death group (DEG). In the SUG, there were 91 males and 79 females, with an average age of (45.25 ±21.21) years and an average BMI was (20.05 ±0.99) kg/m². 98 patients died, 54 males and 44 females, with an average age of (20.04 ±1.06) kg/m². In the same period, 30 healthy people in the physical examination center of our hospital were selected as the control group (COG), including 17 males and 13 females, with an average age of (45.11 ±20.26) years and an average BMI of (20.08 ±1.2) kg/m². Age, sex and BMI among the three groups were no different (P>0.05).

Observation index

The morning fasting venous blood 5 mL of all BUP was collected on the 1st, 7th, 14th and 21st day after admission, and the morning fasting venous blood 5 mL of the COG was collected. The serum was carefully separated by centrifugation at the speed of 3000r/min, and frozen in the refrigerator of -80 degrees to avoid repeated freezing and thawing. The levels of CER in all subjects were measured by the enzymatic method, and the level of CHE in serum was detected by the modified Ellman method.

Statistical method

The data of this study are analyzed by SPSS 20.0 software, the measurement data are compared by (x±s), the comparison between groups is expressed by t-test, the counting data is expressed by percentage, and the comparison between groups is expressed by χ² test. Ridit test was used to compare the grade data. Logistic regression was used to analyze the independent risk factors of burn seve-

rity, and the ROC curve was used to analyze the value of Cr in predicting the outcome of BUP. The statistical results were statistically significant (P<0.05). And a means compared to the control group, ªP<0.05; b means compared to 1st-day post-burn, ᵇP<0.05; c means compared to 1st-day post-burn, ᶜP<0.05; d means compared to 14th-day post-burn group, ᵈP<0.05.

Results

Comparison of serum CRE and CHE levels in each group

Except for the first day after burn, the level of serum CRE in BUP was raised than that in the COG, while the level of serum CHE in burn patients was reduced than that in the COG (Table 1).

Comparison of serum CRE and CHE levels in patients with different burn area

The serum CRE level of BUP in all groups increased at first and then decreased, and the highest level was on the first day after injury. At the same time, the level of CRE in SEG was raised than that in MIG and MOG, and the level of CRE in MOG was raised than that in MIG.

The serum CHE level of BUP in all groups decreased at first and then increased, and the lowest level was on the first day after injury. At the same time, the level of CRE in SEG was reduced to that in MIG and MOG, and the level of CRE in MOG was reduced to that in MIG (P<0.05) (Table 2).

Comparison of serum CRE and CHE levels in patients with different prognosis

The serum CRE level of BUP in both groups increased at first and then decreased, and the highest level was on the

Table 1. Comparison of serum levels of CRE and CHE in BUP and COG ($\bar{x}\pm s$).

Group	Time	Cre	chE
COG		64.45±44.12	8.15±1.14
BUG	1d	64.13±52.16	7.95±1.26
	7d	70.15±57.41ᵃᵇ	6.48±1.23ᵃᵇ
	14d	78.17±51.11ᵃᵇᶜ	5.81±.41ᵃᵇᶜ
	21d	75.15±52.46ᵃᵇᶜᵈ	6.80±1.34ᵃᵇᶜᵈ

Table 2. Comparison of serum levels of CRE and CHE in patients with different burn sizes ($\bar{x}\pm s$).

Group	Time	Cre	chE
SEG	1d	67.12±51.11	7.89±1.16
	7d	69.47±51.11	6.28±1.57
	14d	76.45±52.31	5.21±1.53
	21d	74.66±54.71	7.28±0.99
MOG	1d	68.12±52.43ᵃ	7.22±1.62ᵃ
	7d	70.12±53.16ᵃ	6.24±1.56ᵃ
	14d	78.46±58.43ᵃ	5.45±1.22ᵃ
	21d	75.46±48.73ᵃ	6.78±1.15ᵃ
MIG	1d	67.55±50.31ᵃᵇ	7.80±2.03ᵃᵇ
	7d	72.45±254.12ᵃᵇ	6.22±1.66ᵃᵇ
	14d	80.34±53.16ᵃᵇ	4.86±1.14ᵃᵇ
	21d	78.76±54.73ᵃᵇ	5.21±0.86ᵃᵇ

Table 3. Comparison of serum levels of CRE and CHE in patients with different regressions ($\bar{x}\pm s$).

Group	Time	Cre	chE
SUG	1d	62.15±26.71	7.65±1.45
	7d	68.21±25.33	6.44±1.45
	14d	70.22±26.15	4.83±1.25
	21d	61.85±25.45	5.32±1.33
DEG	1d	63.51±25.31[a]	7.95±1.46[a]
	7d	86.31±75.45[a]	6.85±1.86[a]
	14d	96.78±71.55[a]	4.42±1.26[a]
	21d	94.55±58.75[a]	4.98±1.77[a]

first day after injury. At the same time, the level of CRE in the DEG was raised than that in the SUG.

The level of CHE in the serum of burn patients in both groups decreased at first and then increased, and the lowest level was on the first day after injury. At the same time, the level of CRE in the DEG was reduced to that in the SUG (Table 3).

Logistic regression analysis of CRE and CHE in diagnosing the prognosis of Burn patients

Logistic regression analysis was performed with the prognosis of the patients as dependent variables and serum CRE and CHE as independent variables. The regression coefficients were statistically significant on the 1st, 7th, 14th and 21st day after burn, and on the 1st and 21st day after burn (Table 4).

Analysis of the value of predicting the outcome of burn patients

ROC curve analysis shows that CRE and CHE have a certain value in diagnosing the prognosis of burn patients, and the diagnostic value of CRE is higher (Table 5).

Discussion

BUP can have different degrees of liver and kidney injury, which seriously affect the recovery and prognosis of patients (9). Therefore, monitoring changes in liver and kidney function in burn patients is of great significance in adjusting the treatment plan and improving the prognosis of burn patients.

CRE is a serum indicator of renal function (10). In this study, the level of CRE in BUP increased in varying degrees and showed a trend of increasing at first and then decreasing, which may be related to the loss of a large amount of body fluid, decrease of blood volume, contraction of renal vessels and renal dysfunction. Therefore, close observation of the changes in serum CRE level in BUP and timely regulation of renal function are of great significance in improving the prognosis of NUP. The level of serum CRE increased with the increase of burn area and the level of DEG was raised than that of SUG, suggesting that the more serious the condition of burn patients is, the more serious the damage to renal function is, the lower the level of serum CRE is, and the prognosis of patients is poor, which is similar to the results of Osuka et al (11).

The change in CHE level reflects the ability of the liver to synthesize protein (12). When the liver function is damaged, the level of CHE decreases in varying degrees, and the greater the decline, the higher the mortality of patients. It is regarded as a serum index to reflect the state of liver function (13,14). In this study, the level of serum CHE in BUP decreased in varying degrees and then increased in the whole. In the early stage of burn, vascular

Table 4. Logistic regression analysis of the prognosis of patients with burns diagnosed by two indicators of CRE and CHE.

After burn time	Variables	β	S.E	Wals	OR	95% Lower limit	95% Upper limit	P
1d	Cre	0.597	234	6.45	0.821	1.48	2.865	0.005
	chE	0.023	0.011	6.278	1.021	1.004	1045	0.015
	variable	-0.325	1.913	0.028	0.712	/	/	0.856
7d	Cre	0.018	0.006	6.911	0.015	1.004	1.036	0.005
	chE	-0.002	0.148	0.000	0.989	0.745	1.335	0.995
	variable	-4.453	2.031	4.821	0.015	/	/	0.043
14d	Cre	0.041	0.012	13.412	1.044	1.021	1.052	0.001
	chE	-0.259	0.185	1.932	0.712	0.532	1.115	0.156
	variable	-2.541	2.221	1.264	0.076	/	/	0.254
21d	Cre	0.045	0.015	9.421	1.045	1.015	1.072	0.006
	chE	-0.052	0.258	4.721	0.563	0.342	0.945	0.008
	variable	-0.605	2.815	5.382	0.002	/	/	0.015

Table 5. Analysis of the value of predicting the regression of burn patients.

After burn time	Variables	AUC	95% CI Lower limit	95% CI Upper limit	SE	P
1d	CRE	0.721	0.589	0.841	0.058	0.003
	CHE	0.715	0.569	0.21	0.056	0.025
7d	CRE	0.712	0.606	0.815	0.053	0.001
	CHE	0.576	0.436	0.705	0.063	0.225
14d	CRE	0.780	0.682	0.891	0.065	0.002
	CHE	0.412	0.345	0.521	0.023	0.081
21d	CRE	0.785	0.681	0.911	0.058	0.000
	CHE	0.623	0.512	0.762	0.071	0.041

permeability increased, large substances exudated, and the level of serum CHE decreased. With the scab formation and allogenic skin rejection in BUP, the body's demand for energy increased, and serum CHE decreased significantly, reaching the lowest value on the 14th day, and then the wound recovered. The level of serum CHE increased. Therefore, while treating BUP, we should pay close attention to the changes in serum CHE levels and take corresponding measures to improve the prognosis of patients. The level of serum CHE decreased with the increase of burn area, and the level of patients in the DEG was reduced than that in the SUG, which may be related to the following aspects: ① severe hypoxic-ischemic injury, severe damage of liver function and decrease of CHE synthesis in severe burn patients; ② the inflammatory reaction in severe burn patients was more serious and the level of CHE decreased. Therefore, the lower the level of CHE, the more serious the patient's condition, the greater the risk of infection and the worse the prognosis, which is similar to the results of SeanJ (15).

For further study, Logistic regression analysis was carried out in this experiment, and it was found that the regression coefficients were statistically significant on the 1st, 7th, 14th and 21st day after burn, and on the 1st and 21st days after burn. ROC curve analysis shows that CRE and CHE have a certain value in diagnosing the prognosis of burn patients, and the diagnostic value of CRE is higher. It is suggested that CRE and CHE have a certain value in diagnosing the prognosis of burn patients, and the value of CRE is higher.

To sum up, the level of CRE increases with the severity of burn patients, while the level of CHE decreases with the severity of burn patients. CRE and CHE have certain value in diagnosing the prognosis of burn patients and can be widely used in clinics.

Fundings

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