Biomedical Research 2017; 28 (22): 9718-9721 *ISSN 0970-938X*
www.biomedres.info

Predictive value of early lactate dynamic monitoring index in prognosis of sepsis and septic shock patients.

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Abstract

Objective: To investigate the value of early lactate dynamic monitoring index in predicting prognosis of patients with sepsis and septic shock.

Methods: From November 2013 to November 2016, 62 cases of sepsis and septic shock patients enrolled in our hospital were selected as the objects. The basic personal information of all patients was recorded immediately after their admission followed by APACHE score. Blood lactate tests were performed at 6 h after admission. After 28 d of treatment, the treatment outcome was documented, according to which the patients were divided into success group and failure (death) group, the prediction effect on the prognosis of the patients of lactic acid dynamic monitoring was compared between the two groups.

Results: The statistical data and comparative analysis showed that 28 d after admission, 19 from 62 patients died. The SOFA and APACHE score of failure group both increased and lactate clearance rate was moderately low, and in the stage of T24, the concentration of lactic acid turned out to increase significantly while the corresponding lactate clearance rate greatly decreased in which the difference was statistically significant (P<0.05). The result of logistic regression analysis showed the main risk factors associated with the prognosis of patients were the lactic acid clearance rate and APACHE II score in T24.

Conclusion: The early lactate dynamic monitoring index has high value in predicting the prognosis of sepsis and septic shock patients, thus worth popularizing.

Keywords: Sepsis, Septic shock, Lactic acid, Dynamic monitoring, Prognosis.

Accepted on October 3, 2017

Introduction

Sepsis is very dangerous with its mortality rate far higher than that of myocardial infarction and it has become the main cause for the death of non-heart disease patients in intensive care units [1]. Even in recent years, with continuous improvement of clinical medicine technology, medical measures to combat infection continue to be developed but the mortality rate of sepsis patients still amounts to about 30%~70% [2,3]. The disease control in patients with sepsis has been the focus of the clinical medicine based on the high-risk condition of sepsis, which will increase the treatment difficulty, cause great consumption of medical resources, enhance the treatment cost and threaten the health of patients [4,5]. Thus, the problem of how to timely judge the condition of sepsis patients and take corresponding treatment measures becomes important factors influencing disease control, pain alleviation and improvement of the patients' quality of life [6,7]. Current clinical medicine expresses that in patients with sepsis and septic shock, early recovery treatment and valuable prognostic indicators can effectively raise survival rate of the patients, at present, and it has been proved by medical research that the mortality of sepsis is closely associated to the level of lactic acid [8,9]. For this reason, we selected 62 sepsis and septic shock patients enrolled in our hospital from November 2013 to November 2016 to actively study the lactic acid dynamic monitoring index as well as its value of prognosis prediction and has achieved excellent results reported as follows.

Materials and Methods

From November 2013 to November 2016, 62 cases of sepsis and septic shock patients enrolled in our hospital were selected as the objects, including 43 males and 19 females aged 25~81 with the average age of 51.03 ± 1.47. Among them, there were 12 cases of malignant tumor, 16 cases of coronary heart disease, 8 cases of pulmonary infection, 15 cases of abdominal diseases, 6 cases of blood diseases and 5 cases of other

diseases. All patients and their family members signed informed consent form and volunteered to join the experimental study.

Exclusion criteria

(1) the patient was younger than 18; (2) the patient was pregnant; (3) the patient had contraindications of central venous catheter; (4) the patient after being diagnosed was required to undergo conventional surgery within 6 h; (5) the patient was subjected to serious organ damages; (6) the patient suffered from hepatic insufficiency; (7) the patient required intervention treatment of continuous blood pressure purification; (8) the patient suffered from renal insufficiency.

Methods

All patients in the intensive care unit were treated with central venous catheters. The subclavian vein was chosen to place main central venous catheter (double-cavity central venous catheter against infection) and the internal jugular vein could also be chosen for the replacement in accordance with the patients' actual condition as well as corresponding treatment plan [10,11]. The patient's vital signs including heart rate, MAP, blood oxygen saturation (Center), body temperature, and respiration were closely examined [12]. The patients were treated accordingly according to the actual monitoring results. If the central venous pressure was less than 8 mmHg, the patients were given intravenous infusion of isotonic crystalloid fluid; if the average artery pressure was less than 65 mmHg, the patients could be given intravenous infusion of isotonic crystalloid fluid followed by dopamine treatment; if the oxygen saturation (central venous) failed to meet 70% of the overall level and meanwhile the hematocrit was below 30%, the patients could be treated with concentrated red blood cells, if the oxygen saturation (central venous) value did not reach the standard level but the hematocrit was beyond 30%, the patients could be given intravenous infusion of dobutamine [13,14].The patients were divided into success group (n=43) and failure (death) group (n=19) according to actual treatment outcome.

Observation index

Monitoring index: the central venous oxygen saturation ($ScvO_2$) and the change of central venous oxygen saturation ($ScvO_2$ variation) were closely monitored followed by the observation on concentration level of lactic acid and lactate clearance rate.

Monitoring time: four main time periods were selected for monitoring, namely pre-fluid resuscitation (T0) and post fluid resuscitation (T6, T12 and T24).

Statistical analysis

The data were processed by SPSS20.0 software. The enumeration data were expressed by "%" and assessed by chi square test. The measurement data were expressed by mean ± standard deviation and assessed by t-test. $P<0.05$ indicated there was significant difference of statistical significance.

Result

Comparison of $ScvO_2$ at different time between two groups

Statistical analysis of data showed that there was no obvious difference in $ScvO_2$ and $ScvO_2$ variation between failure group and success group of no statistical significance ($P>0.05$, Table 1).

Table 1. *Comparison of $ScvO_2$ at different time between two groups.*

Index	Success group (n=43)	Failure group (n=19)
$ScvO_2$ (T0, %)	54.03 ± 2.19	52.94 ± 3.42
$ScvO_2$ (T6, %)	72.58 ± 5.74	71.03 ± 5.69
$ScvO_2$ (T12, %)	73.46 ± 4.98	72.53 ± 5.08
$ScvO_2$ (T24, %)	73.88 ± 4.57	71.94 ± 4.87
$ScvO_2$ variation (T6, %)	15.58 ± 9.12	14.69 ± 9.26
$ScvO_2$ variation (T12, %)	15.62 ± 9.58	14.36 ± 9.23
$ScvO_2$ variation (T24, %)	14.79 ± 10.47	15.47 ± 9.25

Comparison of lactic acid concentration and lactate clearance rate at different time in two groups

Statistical analysis of data showed that in failure group the concentration of lactic acid effectively increased in T24 and at the same time the lactate clearance rate decreased in T12 as well as T24 period with significant difference from success group ($P<0.05$); There was no significant difference between the two groups in lactate clearance rate in T6 period of no statistical significance ($P>0.05$), There was no significant difference between the two groups in lactic acid concentration in TO, T6, and T12 period of no statistical significance ($P>0.05$, Table 2).

Table 2. *Comparison of lactic acid concentration and lactate clearance rate at different time in two groups.*

Index	Success group (n=43)	Failure group (n=19)
Lactic acid concentration (T0, mmol/L)	4.03 ± 0.74	4.05 ± 0.64
Lactic acid concentration (T6, mmol/L)	1.87 ± 0.52	1.74 ± 0.93
Lactic acid concentration (T12, mmol/L)	1.64 ± 0.87	1.52 ± 0.98
Lactic acid concentration (T24, mmol/L)	1.57 ± 0.69	2.79 ± 1.36
Lactate clearance rate (T6, %)	39.15 ± 15.41	40.15 ± 14.58
Lactate clearance rate (T12, %)	43.53 ± 17.24	15.48 ± 54.17

Lactate clearance rate (T24, %)	43.26 ± 17.03	3.85 ± 18.49

Comparison of multivariate logistic regression analysis between two groups

The results of logistic regression analysis showed that the major risk factors associated with the prognosis of patients were the lactic acid clearance rate of patients in T24 and the APACHE II score, Table 3.

Table 3. *Comparison of multivariate logistic regression analysis between two groups.*

Index	P value	OR value	95% confidence interval	
			Upper limit	Lower limit
Lactic acid concentration				
T0	0.39	1.59	0.48	4.34
T6	0.42	0.76	0.23	4.15
T12	0.23	0.87	0.51	10.03
T24	0.19	0.36	0.58	2.37
Lactic acid clearance rate				
T6	0.58	2.38	1.19	6.01
T12	0.18	9.76	0.25	0.81
T24	0.025	3.02	0.63	21.52
APACHE II score	0.033	0.37	0.04	0.72
SOFA score	0.074	0.99	0.91	1.21
Mechanical ventilation	0.52	1.21	0.94	1.36

Discussion

Sepsis is an infectious syndrome with a high morbidity and mortality in clinical practice. Some patients while being treated are vulnerable to bacterial infection and then cause obvious inflammatory response of the whole body, thus exerting certain adverse effects on the disease control and threatening life safety of patients [15].

In this study, lactic acid dynamic monitoring result showed in patients with sepsis and septic shock the initial lactic acid concentration of the dead was far higher than that of the survival, which suggests that it can improve the survival rate of patients if the lactic acid concentration of patients is lowered quickly within 24 h after admission to ICU. It is also indicated that within 24 h after admission to ICU, the monitoring of lactate clearance rate and concentration level can predict the prognosis of the patients. And the study also found that after performance of recovery treatment, the change of central venous oxygen saturation was not associated with the prognosis of sepsis and septic shock patients in any period (T0, T6, T12 or T24) of no predictive value ($P>0.05$). This is because: (1) arterial lactic acid is the product of anaerobic metabolism of patients and its index changes can directly reflect whether there is oxygen deficiency in patient's tissues [16,17]. Sepsis and septic shock patients have serious tissue hypoxia and elevated lateral lactic acid with the development of the disease, thus resulting in further damages to the patients' body [18]. Therefore, the detection of dynamic changes in arterial lactic acid enables to determine the actual condition of the body injury to assess the prognosis of the patients [19,20]. (2) In fact, central venous oxygen saturation level is one of main reference indexes in the process of early resuscitation treatment, but after the treatment it has been unable to be used as a single reference indicator. Moreover, in this study we adopted dobutamine and conventional infusion therapy in our hospital, thus affecting the predictive value of central venous oxygen saturation directly or indirectly.

To sum up, in patients with sepsis and septic shock the lactic acid clearance rate within the first 24 h after admission has the best correlation with the prognosis of highest assessment value and application value. More than six hours after admission, the lactic acid clearance rate can still serve as the main basis for the treatment of the patients.

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