VALUE OF EARLY DIAGNOSIS OF STROKE-RELATED PNEUMONIA IN SERUM SCD163, C-RE-ACTIVE PROTEIN, LEUKOCYTES, PROCALCITONIN AND CLINICAL PULMONARY INFECTION SCORING SYSTEM

Zhu Tian, Yanmin Wang, Huancheng Wu, Shijun Zhang, Qunliang Hu[*]
Department of Neuro Intensive Care Unit, Tianjin Beichen Hosipital, Tianjin, PR China

ABSTRACT

Objective: To study the value of serum soluble scavenging receptor 163 (sCD163), C-reactive protein (hs-CRP), leukocyte (WBC), procalcitonin (PCT) and clinical pulmonary infection scoring system (CPIS) in the early diagnosis of stroke-associated pneumonia ((SAP)).

Methods: From October 2018 to October 2019, 158 patients with SAP were divided into mild group (n=90) and severe group (n=68) according to their condition. 30 healthy people selected at the physical examination center at the same time were selected as the control group. The general data of age, sex, type of stroke and previous history of stroke were collected and all the subjects were scored by CPIS score. The fasting venous blood of the subjects was 5ml, the level of sCD163 was measured by double antibody sandwich enzyme-linked immunosorbent assay (Elisa), the level of WBC was measured by automatic biochemical analyzer, the level of hs-CRP was detected by hypersensitive latex enhanced immunoturbidimetry, and the level of serum PCT was detected by electrochemical luminous method. The value of SAP was judged by ROC curve analysis of sCD163, hs-CRP, WBC, PCT and CPIS score.

Results: The levels of sCD163, hs-CRP,WBC,PCT and CPIS in mild group and severe group were higher than those in control group, and the sCD163, hs-CRP, WBC, PCT level and CPIS score in severe group were significantly higher than those in mild group (P<0.05). The sCD163, hs-CRP, WBC, PCT level and CPIS score in the death group were significantly higher than those in the survival group (P<0.05). Multivariate Logistics regression analysis showed that sCD163, hs-CRP, WBC, PCT and CPIS scores were independent risk factors for prognosis of patients with SAP (P<0.05). Roc curve analysis showed that the AUC of sCD163 in the diagnosis of SAP was 0.889, the best cut-off value was 1.56 mg/l, and the sensitivity and specificity were 79.26% and 78.22%, respectively. The AUC of hs-CRP in the diagnosis of SAP was 0.725, the best cut-off value was 68.13 mg/l, sensitivity and specificity was 66.42% and 69.26%, respectively. The AUC of SAP in the diagnosis of WBC was 0.652, the best cut-off value was 12.11×109 mg/l, sensitivity and specificity was 58.58% and 68.25%, respectively. The AUC of PCT in the diagnosis of SAP was 0.606. And the sensitivity and specificity of PCT were 53.18%, 67.43% and 6.00, respectively. The sensitivity and specificity of this point were 62.44% and 68.18%, respectively. The AUC of SAP was 0.778%, the best cut-off value was 6.00, and the sensitivity and specificity of this point were 62.44% and 68.18%, respectively.

Conclusion: the level of sCD163, hs-CRP, WBC, PCT and the score of sCD163, hs-CRP, WBC, PCT in patients with SAP are significantly higher than those in healthy people. SCD163, hs-CRP, WBC, PCT and CPIS scores are valuable in the diagnosis of SAP, and the diagnostic value of sCD163 is better than that of hs-CRP, WBC, PCT and CPIS, which plays an important role in the diagnosis of SAP.

Keywords: sCD163, C-reactive protein, leukocytes, calmodulin, clinical pulmonary infection scoring system, early diagnosis, stroke-associated pneumonia.

DOI: 10.19193/0393-6384_2020_6_586

Introduction

Cerebral apoplexy associated pneumonia ((Stroke associated pneumonia, SAP) refers to the clinical complications of infectious pulmonary parenchyma inflammation in stroke patients, which is the main cause of death in acute phase of stroke[1]. SAP patients can have symptoms such as immune deficiency, dysphagia and neurological deficit, which seriously threaten the lives of patients. It is found that the incidence of SAP in China is as high as 5.6% ≤53.6%, and there is an upward trend year by year[2]. Once the treatment period of SAP, stroke is prolonged, the hospitalization time and hospitalization cost are increased, a lot of manpower and material resources are consumed, and even the life

of the patient is endangered[3]. Therefore, early diagnosis and early treatment are of great significance to improve the effect of SAP and improve the prognosis of patients. At present, the incidence and development of SAP patients are evaluated by detecting the levels of C-reactive protein (hs-CRP) and white blood cell (WBC), procalcitonin (PCT)), but the sensitivity to the early diagnosis of SAP is low and the result is not ideal[4]. Soluble scavenging receptor 163 (Soluble scavenger receptor 163 (sCD163) is a kind of transmembrane glycoprotein, which is specifically expressed on monocyte macrophage cell membrane and can remove hemoglobin released from blood due to hemolysis or erythrocyte senescence[5].

In recent years, it has been found that sCD163 has a high sensitivity in the diagnosis of infectious diseases such as SAP[6]. Clinical pulmonary infection scoring system (Clinical pulmonary infection score system, CPIS) is a common clinical index to evaluate the severity and prognosis of patients with pulmonary infection[7].

The purpose of this study was to evaluate the value of sCD163, hs-CRP, WBC, PCT and CPIS score in early diagnosis of SAP, and to provide reference for clinical early diagnosis of SAP.

Material and methods

General information

158 patients with SAP admitted to ICU in our hospital from October 2018 to October 2019 were collected.

The inclusion criteria were as follows:
• All patients were diagnosed as stroke by brain CT and MR examination;
• All patients met the diagnostic criteria of SAP published by the Chinese Medical Association for the diagnosis and treatment of Stroke-associated pneumonia[8], that is, the main criteria were that the patients found new or progressive pulmonary invasive lesions by imaging examination, the secondary criteria were as follows:
• The patients had cough, expectoration or aggravation of primary respiratory diseases;
• The body temperature of the patients was above 38 °C;
•Pulmonary consolidation symptoms and/or wet rales were found in the patients;
• The white blood cell count in the serum of the patients was ≥10×109/l or ≤4×109 /l, and the diseases similar to the clinical manifestations of pneumonia were excluded.

Patients who met the main criteria and had more than 2 secondary criteria were diagnosed as SAP; 3 patients and their families informed and signed informed consent.

Exclusion criteria:
• Patients with malignant tumors;
• Patients with pulmonary tuberculosis, non-perceptual interstitial diseases and other diseases similar to the clinical manifestations of pneumonia;
• Patients with brain death or cardiac pause on admission;
• Patients with other infections except pulmonary infection;
• Patients died at 24 h;
• Patients refused the trial or took poor compliance.

According to the condition of the patients, the patients were divided into mild group (n=90) and severe group (n=68). There were 90 cases in mild group, 51 males and 39 females, with an average age of (45.10±9.12) years, an average BMI value of (20.05±1.10) years, an average BMI value of (20.05±1.10) years, 38 males and 30 females, with an average age of (45.05±10.11) years and an average BMI value of (20.02±1.04) years.

According to the prognosis of the patients, the patients were divided into survival group (n=108) and death group (n=50). There were 108 patients in survival group, 56 males and 52 females, with an average age of (45.11±9.05) years, an average BMI value of (20.01±1.06) years, 33 males and 18 females, with an average age of (45.10±9.75) years and an average BMI value of (20.10±0.86) years. At the same time, 30 healthy people, 18 males and 12 females, with an average age of (45.15±10.25) years and an average BMI of (20.07±1.01) Kg/m^2., were selected as the control group. There was no significant difference in age, sex and BMI in each group (P>0.05).

Observed indicators
Serum examination
Collected 10 ml urine for the first time in the morncollect 5 ml of fasting venous blood in the morning of all subjects, centrifuge at 2500 r/min at low temperature, carefully separate the serum, put in -80°C environment refrigerated reserve, avoid repeated freezing and thawing.

Full automatic blood analyzer was used to detect the WBC level of patients. The level of sCD163 was detected by double antibody sandwich enzyme-linked immunoassay. The hs-CRP level was detected by hypersensitive latex enhanced immune

turbidimetry and the serum PCT level was detected by electrochemiluminescence. The patients were scored CPIS with reference to body temperature, white blood cell count, secretion, oxygenation index and X-ray infiltration. See table 1.

Item	0 score	1 score	2 score
White blood cell count (×10⁹/L)	4-11	11-17	<4 or >17
Secretion (24H)	No phlegm or little	Medium-large nonpurulent	Medium-large nonpurulent
Body temperature (°C)	36-38	38-39	<36 or >39
PaO²/FiO²	>33		<33
X-ray infiltration	No phlegm or little	Patchy	Confluent

Table 1: CPIS scoring criteria.

Statistical methods

The data of this study were analyzed by SPSS20.0 software package.

All the measurement data were expressed by ($\bar{x}\pm s$), t test was used to compare the data between groups, and the percentage of counting data was expressed by percentage test, and the comparison between groups was compared with each other. Ridit test was used to compare the grade data. Multivariate Logistics regression was used to analyze the prognostic factors of SAP patients, and ROC curve was used to analyze the value of sCD163, hs-CRP, WBC, PCT and CPIS score in the diagnosis of SAP. $P<0.05$ was considered statistically significant.

Results

Comparison of sCD163, hs-crp, WBC, PCT level and CPIS score in each group

SCD163, hs-CRP, WBC, PCT levels and CPIS scores in the mild and severe groups were higher than those in the control group, while sCD163, hs-CRP, WBC, PCT levels and CPIS scores in the severe group were significantly higher than those in the mild group, with statistically significant differences ($P<0.05$). Are shown in table 2.

Group	n	sCD163 (mg/l)	hs-CRP (mg/l)	WBC (×10⁹/l)	PCT (ng/ml)	CPIS (score)
Control group	30	0.30±0.12	30.15±5.16	10.46±1.46	0.20±0.08	3.00±1.00
Mild group	90	0.72±0.21ᵃ	46.73±18.41ᵃ	12.03±2.16ᵃ	0.31±0.12ᵃ	5.00±2.00ᵃ
Severe group	68	2.45±1.05ᵃᵇ	83.46±30.15ᵃᵇ	12.46±2.13ᵃᵇ	0.53±0.15ᵃᵇ	7.00±3.00ᵃᵇ

Table 2: comparison of sCD163, hs-crp, WBC, PCT level and CPIS score in each group ($\bar{x}\pm s$).
Note: a means compared with the control group, ᵃP<0.05; b means compared with the mild group, ᵇP<0.05.

Comparison of sCD163, hs-CRP, WBC, PCT level and CPIS score in SAP patients with different prognosis

The levels of sCD163, hs-CRP, WBC, PCT and CPIS in the death group were significantly higher than those in the survival group, with statistically significant differences ($P<0.05$). See table 3.

Group	n	sCD163 (mg/l)	hs-CRP (mg/l)	WBC (×10⁹/l)	PCT (ng/ml)	CPIS (score)
Survival group	108	0.86±0.25	48.15±20.33	12.06±2.25	0.32±0.15	5.00±1.00
Death group	50	2.16±1.02ᵃ	80.16±31.46ᵃ	12.30±2.30ᵃ	0.50±0.14ᵃ	7.00±3.00ᵃ

Table 3: Comparison of sCD163, hs-CRP, WBC, PCT level and CPIS score in patients with different prognosis.
Note: a means compared with the control group, ᵃP<0.05.

Independent risk factors affecting the prognosis of patients with SAP were analyzed

Multiple factors Logistics regression analysis, sCD163, hs-CRP, WBC, PCT and CPIS score are the independent risk factors affecting the prognosis of patients with SAP, ($P<0.05$). See table 4.

Factor	OR	95%CI	P
sCD163	1.031	1.012-0.108	0.014
hs-CRP	2.43	1.643-3.158	0.001
WBC	1.55	1.263-1.951	0.012
PCT	2.03	1.532-3.015	0.001
CPIS Score	1.28	1.056-1.502	0.032

Table 4: Affect the prognosis of patients with SAP prognostic analysis of the independent risk factors.

The value analysis of each index in the diagnosis of SAP

ROC curve analysis showed that the AUC of sCD163 in the diagnosis of SAP was 0.889, the sensitivity and specificity of sCD163 in the diagnosis of SAP were 79.26%, 78.22% and 78.22%, respectively. The sensitivity and specificity of the best cut-off value were 66.42% and 6926%, and the sensitivity and specificity of the best cut-off value were 66.42% and 69.26%, respectively. The AUC of WBC in the diagnosis of SAP was 0.652, and the best cut-off value was 12.11×10⁹ /1.

The sensitivity, specificity of WBC in the diagnosis of SAP were 58.58%, 68.25%. The AUC of the PCT diagnosed SAP was 0.606, the best cut-off value of PCT was 0.41 ng/ml, the sensitivity and specificity of AUC were 53.18% and 67.43% respectively. The AUC of CPIS score in the diagnosis of SAP was 0.778, and the best cut-off value was 6.00. The sensitivity and specificity of this score were 62.44% and 68.18% respectively. See Table 5.

Test rating	AUC	95%CI	Optimal cutoff value	Sensitivity	Specificity
sCD163	0.889	0.819-0.973	1.56	79.26%	78.22%
hs-CRP	0.725	0.652-0.782	68.13	66.42%	69.26%
WBC	0.652	0.5676-0.751	12.11	58.58%	68.25%
PCT	0.606	0.545-0.682	0.41	53.18%	67.43%
CPIS Score	0.778	0.705-0.832	6.00	62.44%	68.18%

Table 5: Value Analysis of each Index in the diagnosis of SAP.

Discussion

Stroke is one of the three major diseases that currently cause human death, and is the main cause of neurological dysfunction in adults[9]. SAP is one of the most commonly used complications in patients with acute stroke. The incidence of SAP is as high as 10%, which seriously affects the health of patients[10]. The progress of SAP is fast, and at present, early diagnosis and early treatment are of great importance in the treatment of SAP. SCD163 is a transmembrane molecule present only on the cell membrane of the mononuclear-macrophage system, and is a member of the scavenger receptor family with abundant cysteine. Higher diagnostic value[11].

Hs-CRP is a C-reactive protein in plasma, and its abnormal expression is closely related to stroke-associated pneumonia, cardiovascular disease, neonatal bacterial infection and renal transplantation[12]. PCT is a procalcitonin-propeptide substance, which is mainly produced by the C-cells of the thyroid, has a strong stability and is in a low-expression state under normal conditions, and the level of the serum PCT is increased[13] in the presence of a bacterial infection in the body. PCT reflects the severity of the inflammatory response of the body, the level of which is closely related to the size and type of the infected organ, the type of bacteria, the degree of inflammation and the state of the immune response. WBC is a very important type of blood cell in human blood, which can be used for phagocytosis of foreign bodies, producing antibodies, curing the body damage, resisting the invasion of pathogens, and playing an important role in the immune resistance of the disease.

The elevation of its level can reflect the inflammatory response of the body[14]. The CPIS score is a system for evaluating the degree of infection of patients by clinical manifestation, imaging and microbiology, and is widely used in the aspects of diagnosis, treatment and prognosis of infectious diseases[15]. In this study, the levels of sCD163, hs-CRP, WBC, PCT and CPIS in mild and severe group were higher than those in the control group. The scores of sCD163, hs-CRP, WBC, PCT and CPIS in the severe group were significantly higher than those in the mild group (P<0.05). The levels of sCD163, hs-CRP, WBC, PCT and CPIS in the death group were significantly higher than those in the survival group (P<0.05). The results suggested that the levels of sCD163, hs-CRP, WBC, PCT and CPIS were closely related to the occurrence, development and prognosis of stroke-associated pneumonia.

In order to further explore the relationship between sCD163, hs-CRP, WBC, PCT level and CPIS score and stroke-associated pneumonia, the results of multivariate Logistics regression analysis showed that both sCD163, hs-CRP, WBC, PCT and CPIS scores were independent risk factors of SAP (P<0.05). ROC curve analysis showed that the AUC of sCD163 in the diagnosis of SAP was 0.889, the best cut-off value was 1.56 mg/l and the sensitivity and specificity was 79.26% and 78.22%. The AUC of hs-CRP was 0.725, the best cut-off value was 68.13 mg/l, the sensitivity was 66.42% and the specificity was 69.26%. The AUC of SAP was 0.652, the best cut-off value was 68.13 mg/l. The sensitivity and specificity of SAP were 58.58% and 68.25%, respectively.

The AUC of PCT in the diagnosis of SAP was 0.606. The sensitivity and specificity of PCT were 53.18%, 67.43% respectively and the best cut-off value was 0.41 ng/ml. The AUC of SAP was 0.778%, the best cut-off value was 6.00 and the sensitivity and specificity of this point were 62.44% and 68.18%, respectively. It is suggested that sCD163, hs-CRP, WBC, PCT level and CPIS score are closely related to the prognosis of stroke-associated pneumonia, and they are valuable in the diagnosis of stroke-associated pneumonia, among which sCD163 has the highest diagnostic value.

To sum up, the level of sCD163, hs-CRP, WBC, PCT and the score of sCD163, hs-CRP, WBC, PCT in SAP patients were significantly higher than those in healthy people. SCD163, hs-CRP, WBC, PCT and CPIS scores were valuable in the diagnosis of SAP, and the diagnostic value of sCD163 was better than that of hs-CRP, WBC, PCT and CPIS, which played an important role in the diagnosis of SAP.

References

1) Kudlac M, Sabol J, Kaiser K, Kane C, Phillips RS. Reliability and Validity of the Berg Balance Scale in the Stroke Population: A Systematic Review. Phys Occup Ther Geriatr 2019; 37: 1-26.

2) Wang Q, Xing HJ, Bao N, Kong LJ, Jia YJ, et al. Data Mining-revealed Characteristics of Clinical Application of Scalp Acupuncture. Zhen Ci Yan Jiu 2018; 43: 199-203.

3) Johnston LE, Kirby JL, Downs EA, LaPar DJ, Ghanta RK, et al. Postoperative Hypoglycemia Is Associated with Worse Outcomes After Cardiac Operations. Ann Thorac Surg 2017; 103: 526-532.

4) Han Q, Chen C, Hu HQ, Shen J, Yang G, et al. Effect evaluation on use of bedside fiber bronchoscope in treating stroke-associated pneumonia. Top Stroke Rehabil 2018; 25: 459-466.

5) Zhi Y, Gao P, Xin X, Li W, Ji L, et al. Clinical significance of sCD163 and its possible role in asthma (Review). Mol Med Rep 2017; 15: 2931-2939.

6) Bao HL, Liao FJ, Fang L, Zhong F, Liu W, et al. Effect and mechanism of PCSK9 on lectin-like oxidized low-density lipoprotein receptor-1 mediated oxidized low-density lipoprotein uptake by THP-1 derived macrophages. Chin J Cardiol 2019; 47: 367-373.

7) Liu ZP, Zhang Y, Bian H, He XR, Zhou YJ, et al. Clinical application of rapid B-line score with lung ultrasonography in differentiating between pulmonary infection and pulmonary infection with acute left ventricular heart failure. Am J Emerg Med 2016; 34: 278-281.

8) China Association of Integrative Medicine Professional Committee of Medical Emergency. Expert consensus of Chinese and Western medicine emergency treatment for acute ischemic stroke in China. Chin Crit Care Med 2018; 30: 193-197.

9) Bartlett RS, Thibeault SL. Insights into Oropharyngeal Dysphagia from Administrative Data and Clinical Registries: A Literature Review. Am J Speech Lang Pathol 2018; 27: 868-883.

10) Umemoto G, Furuya H. Management of Dysphagia in Patients with Parkinson's Disease and Related Disorders. Intern Med 2020; 59: 7-14.

11) Verbij FC, Sorvillo N, Kaijen PHP, Hrdinova J, Peyron I, et al. The class I scavenger receptor CD163 promotes internalization of ADAMTS13 by macrophages. Blood Adv 2017; 1: 293-305.

12) Zhou Y, Han W, Gong D, Man C, Fan Y. Hs-CRP in stroke: A meta-analysis. Clin Chim Acta 2016; 453: 21-27.

13) Cheng L, Liu DL, Yin XX, Wang MN, Liu W, et al. The clinical significance of experimental indexes in the prognosis of exertional heat stroke. China Trop Med 2019; 19: 471-475.

14) Yang QY, Fu ZZ, Chen LF. CLINICAL VALUE OF SERUM PCT, IL-6 AND HS-CRP IN THE EARLY DIAGNOSIS OF NEONATAL PNEUMONIA. Chin J Coal Industry Med 2019; 2:140-145.

15) Liao XL, Kang Y. Reappraisal of the role of procalcitonin and clinical pulmonary infection score in diagnosis and treatment of ventilator-associated pneumonia. Zhonghua Nei Ke Za Zhi 2018; 57: 368-369.

––––––––––

Corresponding Author:
Qunliang Hu
Email: nvm2mt@163.com
(China)