VALUE OF CTA COMBINED WITH NT-PROBNP IN THE DIAGNOSIS OF ACUTE PULMONARY EMBOLISM

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ABSTRACT

Objective: *To explore the value of computed tomography angiography (CTA) combined with N-terminal B-type natriuretic peptide (NT-proBNP) in the diagnosis of acute pulmonary embolism (APE).*

Methods: *A retrospective analysis of the clinical data of 192 APE patients in our hospital from March 2016 to May 2020. To evaluate the clinical value of CTA, plasma NT-proBNP and their combined detection in the diagnosis of APE.*

Results: *In 192 patients with APE, 174 cases were positive by pulmonary artery CTA, 18 cases were missed, and the positive rate was 90.63%; 154 cases with plasma NT-proBNP>125pg/mL, the positive rate was 80.21%; the combination of two inspection methods detected APE positive 188, 4 cases were missed, and the positive rate was 97.92%. The positive rate of APE diagnosed by pulmonary artery CTA was higher than that of plasma NT-proBNP (P<0.05), and the positive rate of APE diagnosed by pulmonary artery CTA and plasma NT-proBNP was higher than that of single test (P<0.05).*

Conclusion: *Plasma NT-proBNP screening combined with pulmonary artery CTA qualitative examination is of high value in the diagnosis of APE, and it is an effective non-invasive examination method.*

Keywords: *Acute pulmonary embolism, CTA, NT-proBNP, combined diagnosis.*

DOI: 10.19193/0393-6384_2023_1_9

Received *March 15, 2022;* ***Accepted*** *October 20, 2022*

Introduction

Acute pulmonary embolism (APE), as a common clinical cardiovascular disease, has the characteristics of rapid onset, rapid disease progression, and high mortality rate, so timely and accurate diagnosis is necessary[1, 2]. Pulmonary angiography is the gold standard for the diagnosis of APE, but it is an invasive test, which limits its clinical application[3-5]. In recent years, serological indicators have developed rapidly in diagnostics. Among them, N-terminal B-type natriuretic peptide (NT-proBNP) is a common indicator for diagnosing heart failure[6]. Some scholars have also proposed that NT-proBNP can also play an important role in screening for APE[7-9]. However, serological indicators cannot provide localized diagnostic information. Computed tomography angiography (CTA), as a non-invasive examination, can not only observe the shape of the pulmonary artery, but also evaluate the size and blockage of the thrombus, and the diagnosis of APE is more accurate[10-12]. However, there is also a certain percentage of missed diagnoses despite the advantages of CTA in the diagnosis of APE.

This study retrospectively analyzed the clinical data of 192 APE patients to evaluate the single and combined diagnostic value of CTA and plasma NT-proBNP, which may provide new ideas for clinical APE diagnosis and treatment.

Patients and methods

Patients

Retrospective analysis of the clinical data of 192 APE patients in our hospital from March 2016 to May 2020.

Inclusion criteria:

• Confirmed by pulmonary angiography and met the APE diagnostic criteria in the "Acute Pulmonary Embolism Diagnosis and Treatment Chinese Expert Consensus (2015)";

• Patients did not receive thrombolytic anticoagulation therapy before pulmonary artery CTA;

• Image quality of imaging examination was good;

• Clinical data complete.

Exclusion criteria:

• Combined with acute myocardial infarction, acute coronary syndrome, chronic obstructive pulmonary disease;

• History of neuropsychiatric disease;

• Accompanied by immune dysfunction;

• Combined with liver and kidney insufficiency.

192 cases of APE patients were 98 males and 94 females; aged 35-74 (57.13±9.86) years old; 116 cases (60.42%) with clinical symptoms were dyspnea, 86 cases (44.79%) with tachycardia, and 58 cases (30.21%) with chest pain, 38 cases of syncope (19.79%), 20 cases of shock (10.42%), and 18 cases of hemoptysis (9.38%). The more general information of patients can see Table 1.

Methods

Pulmonary artery CTA:

• Using 64-slice spiral CT machine (General Electric Company, Model: Lightspeed 64), scanning range from bilateral lung apex to costophrenic angle, scanning after the patients take a deep breath and hold the breath;

• Enhanced scanning after iodine phosphorol injection (manufacturer: Jiangsu Hengrui Pharmaceutical Co., Ltd., specification: 50ml/33.9g, approval number: H20067895), 75 mL of ioverol was injected through the elbow vein at an injection rate of 4.5 mL/s, 20s delay scan, slice thickness 1mm, slice distance 1mm;

• The image is transmitted to the supporting workstation to complete reconstruction techniques such as maximum density projection, multi-plane reconstruction and volume reconstruction.

Plasma NTproBNP

Collect the fasting peripheral venous blood of the patients upon admission, and use electrochemiluminescence method (Roche, Germany) to detect plasma NT-proBNP level.

Variables	
Age(year)	
Mean ± SD	57.13±9.86
Range	35-74
Sex (male/female)	98/94
Dyspnea (n,%)	116 (60.42%)
Tachycardia (n,%)	86 (44.79%)
Chest pain (n,%)	58 (30.21%)
syncope(n,%)	38 (19.79%)
shock(n,%)	20 (10.42%)
hemoptysis(n,%)	18(9.38%)
Risk Factors for PE (n,%)	
Prior DVT	135(70.34%)
Malignancy	49(25.62%)
Recent surgery	45(23.21%)
Obesity	128(66.56%)
Previous CVE	33(16.98%)
Oral contraceptive use	16(8.14%)
Smoking	144(75.12%)
Unknown	18(9.38%)
Mean LVEF (%)	46% ± 9%
Mean SPAP (mmHg)	61.8 ± 4.6

Table 1: The characteristics of patients.
CVE=cerebrovascular event; DVT = deep venous thrombosis; LVEF=left ventricular ejection fraction; SD=Standard deviation; SPAP=systolic pulmonary artery pressure.

Criteria for outcomes analysis

Pulmonary artery CTA

Judging from direct signs and indirect signs. Direct signs include partial and complete pulmonary artery lumen filling defects. When the embolus is located in the center of the lumen, it appears as a strip of low-density contrast with high-density contrast medium on both sides, which is called a double track sign. The complete type means that there is no contrast medium filling in the enhanced lumen and the lumen is enlarged.

The indirect signs include sparse local lung texture, widened pulmonary artery, pulmonary infarction, pleural effusion, and pleural hypertrophy.

The normal range of plasma NT-proBNP is 0~125pg/mL. Plasma NT-proBNP>125pg/mL is judged to be APE positive, and 125pg/mL<plasma

NTproBNP≤375pg/mL is a slight increase, and plasma NT-proBNP>375pg/mL is a significant increase.

Combined judgment

The results of the above two mentioned methods were recorded, and the positive situation was determined by at least three professional physicians discussion.

Statistical analysis

The data was analyzed using SPSS19.0 statistical software. Quantity data is expressed by mean ± SD, using t-test. Counting data is expressed by example or percentage n(%) and the χ^2 test was performed. P<0.05 indicates that the difference is statistically significant.

Results

Analysis of the value of pulmonary artery CTA in the diagnosis of APE

192 APE patients were found to have pulmonary embolism by pulmonary angiography. A total of 1234 pulmonary artery CTA were detected (83.27%). Among them, the detection rate of main pulmonary embolism was 97.37% (148/152). The detection rate of lobar pulmonary embolism was 92.28% (478/518). The detection rate of segmental pulmonary artery was 80.07% (474/592). The detection rate of subsegment pulmonary artery was 60.91%(134/220). Among 192 APE patients, 174 cases were positive for pulmonary artery CTA, 18 cases were missed, and the positive rate was 90.63%. See Table 2.

Pulmonary artery CTA	Pulmonary angiography				Total
	Main pulmonary embolism	Lobar pulmonary embolism	Segment pulmonary artery	Sub-segment pulmonary artery	
Number of detected branches (n)	148	478	474	134	1234
The detection rate(%)	97.37	92.28	80.07	60.91	83.27

Table 2: Analysis of the value of pulmonary artery CTA in the diagnosis of APE.

Analysis of the value of plasma NT-proBNP in the diagnosis of APE

In 192 patients with APE, there were 154 cases with NT-proBNP>125pg/mL, and the positive rate was 80. 21%. Among them, 125 pg/ml <plasma NT-proBNP≤375pg/mL was 52 cases (27.08%), plasma NT-proBNP> 375pg/mL were 102 cases (53.13%) with 375pg/mL. See Table 3.

Plasma NT-proBNP	Slightly elevated	Significantly increased	Negative	Positive
Number of cases (n)	52	102	38	154
Proportion (%)	27.08	53.13	19.79	80.21

Table 3: Analysis of the value of plasma NT-proBNP in the diagnosis of APE.

The combined diagnostic value of pulmonary artery CTA and plasma NT-proBNP in the diagnosis of APE

188 patients were diagnosed APE positive by combining pulmonary artery CTA and plasma NT-proBNP. The missed diagnosis was 4 cases. In a summary, the positive rate was up to 97.92%.

Comparison of the single and combined value of pulmonary artery CTA and plasma NT-proBNP

The positive rate of pulmonary artery CTA in the diagnosis of APE is higher than that of plasma NT-proBNP (χ^2=4.181, P<0.05). Combined with pulmonary artery CTA and plasma NT-proBNP, the positive rate of APE by testing was higher than that of single testing (χ^2=4.725, 15.452, P<0.05). See Table 4.

Item	Pulmonary artery CTA	Plasma NT-proBNP	Combined detection	χ^2
Positive(n)	174	154	188	16.298
Positive rate(%)	90.63	80.21	97.92	

Table 4: Analysis of the value of plasma NT-proBNP in the diagnosis of APE.

Case analysis

Huang, male, 55 years old, was admitted to the emergency department with dyspnea. CTA showed embolus formation and low-density filling defect in the pulmonary artery (Figure 1A , B).

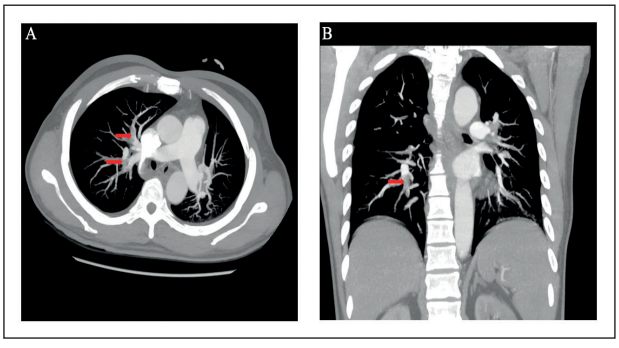

Figure 1: Pulmonary CTA performed after admission showing pulmonary artery thrombosis (red arrows).

Discussion

Pulmonary angiography can accurately display APE lesions with high sensitivity and specificity, but its invasiveness also limits its application[4, 13]. After the onset of APE, it not only causes an increase in pulmonary circulation resistance, but also causes corresponding pathophysiological changes in the heart and cardiac insufficiency[6-14]. The more severe the myocardial injury, the worse the prognosis[15, 16]. Therefore, it is speculated that the myocardial injury index-NT-proBNP is beneficial to the diagnosis of APE[17]. In addition, pulmonary artery CTA is also an important examination method for the diagnosis of APE, but there is also a certain percentage of missed diagnoses despite the advantages of CTA in the diagnosis of APE. In this regard, this study analyzes the diagnostic value of pulmonary artery CTA, plasma NT-proBNP and their combined detection for APE, in order to explore more valuable APE diagnostic methods.

The results of this study showed that the positive detection rate of plasma NT-pr o BNP to APE was 80.21%. It is suggested that plasma NT-proBNP has a certain role in screening APE. Xu et al found that the plasma NT-proBNP level is significantly correlated with the prognosis of APE patients, and can be used as a predictor of prognosis. However, the focus of Xu's study is only on the diagnostic efficacy of APE, and patient prognosis data was not collected. Therefore, the diagnostic value of plasma NT-proBNP for the condition and prognosis of APE still needs to be confirmed by subsequent studies. In addition, plasma NT-proBNP cannot observe the characteristics of the lesion, and it needs to be diagnosed together with imaging methods.

This study also found that the positive detection rate of pulmonary artery CTA for APE was 90.63%, which was significantly higher than that of plasma NT-proBNP. Analysis of the reason may be related to the pulmonary artery CTA that can be used to observe the complete shape of the pulmonary vascular tree through planar reconstruction technology, and display the truncation of the surrounding vascular branches, thereby positioning emboli[3, 6, 18]. Not only that, among the 1482 pulmonary embolisms found by pulmonary angiography in 192 APE patients, 1234 pulmonary artery CTAs were detected with a positive rate of 83.27%, which was similar to the previous results. It is also confirmed that pulmonary artery CTA can play its role in observing the pulmonary artery lumen, accurately discovering the lesion, and providing guidance for subsequent clinical treatment. Besides, in the present study, the detection rate of pulmonary artery CTA for main pulmonary embolism is as high as 97.37%. It shows that when the embolus is located in the large blood vessel, the filling defect is large, the pulmonary artery CTA is easy to find, and the detection rate is high. In addition, when the main pulmonary artery and other large arteries are embolized, the blood flow would be severely blocked. At emergency, clinical thrombolysis or interventional therapy is required in time and the pulmonary artery CTA examination could provide conditions for timely clinical treatment.

However, there is still a missed diagnosis of pulmonary artery CTA in the diagnosis of APE, especially the missed diagnosis rate of segmental pulmonary artery and subsegmental pulmonary embolism[19], which is also consistent with the research results of Song. It also suggests that in the clinical application of pulmonary artery CTA examination, attention should be paid to adjusting the window width and window position, through a variety of planar reconstruction techniques, step by step inspection, to reduce the missed diagnosis of small emboli and inferior pulmonary emboli. Some researchers have found that common images may not provide detailed information of the lowest cross-sectional image, which is also an important reason for missed diagnosis of small arterial emboli or small emboli. In a word, the clinic should pay attention to the missed diagnosis of pulmonary artery CTA to APE, and try to check carefully to avoid missed diagnosis. Interestingly, the present results showed that the combined detection of pulmonary artery CTA and plasma NT-proBNP has a higher positive rate (up to 97.92%) in the diagnosis of APE than a single test, which indicated that the screening of plasma NT-proBNP and the one-by-one inspection of pulmonary artery CTA can effectively improve the diagnostic accuracy.

In summary, timely and accurate diagnosis for APE is necessary. The present work indicated that pulmonary artery CTA combined with plasma NT-proBNP examination can effectively diagnose APE than that of single test, which could be as an attractive approach for clinical promotion.

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