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The Value of MLPR, NLR, and RDW in the Assessment of Combined Pulmonary Embolism in Elderly Patients with AECOPD

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Abstract: *Objective:* To investigate the diagnostic value of the monocyte-to-large-platelet ratio (MLPR), neutrophil-to-lymphocyte ratio (NLR), and red blood cell distribution width (RDW) for pulmonary embolism (PE) in patients with acute exacerbation of chronic obstructive pulmonary disease (AECOPD). *Methods:* A total of 60 elderly AECOPD patients were enrolled and divided into embolus group (12 cases) and thrombus group (48 cases) according to whether they were combined with pulmonary embolism and the MLPR, NLR, and RDW values of the two groups were determined respectively. *Results:* The patients in the two groups had different degrees of vascular structural and functional abnormalities, and the MLPR, NLR, and RDW in the embolus group were significantly higher than those in the thrombus group ($P < 0.05$); while the differences in NLR and RDW between the two groups were not significant. *Conclusion:* MLPR, NLR, and RDW can provide an objective basis for assessing PE in elderly AECOPD patients.

Keywords: Monocyte-to-large-platelet ratio (MLPR); Neutrophil-to-lymphocyte ratio (NLR); Red blood cell distribution width (RDW); Acute exacerbation of chronic obstructive pulmonary disease (AECOPD); Pulmonary embolism

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1. Introduction

Chronic obstructive pulmonary disease (COPD) is a chronic respiratory disease with high morbidity and mortality worldwide, which brings heavy economic burden and mental pressure to patients and families. Acute exacerbation of chronic obstructive pulmonary disease (AECOPD) is an important sign of deterioration of COPD, and patients often seek medical attention due to symptoms such as worsening dyspnea and increased cough and sputum. Among the complications of AECOPD, pulmonary embolism (PE) has become an important factor affecting the prognosis of AECOPD patients due to its insidious and highly fatal nature. Monocyte/large platelet ratio (MLPR), neutrophil-to-lymphocyte ratio (NLR), and red blood cell distribution width (RDW), as biological indices that have gradually gained attention in recent years, have demonstrated unique value in the diagnosis, severity assessment, and prognosis prediction of various diseases. It has been shown that these indicators are closely related to the occurrence, development and prognosis of AECOPD combined with PE. However, there is still a lack of in-depth research on their specific application in the assessment of combined

pulmonary embolism in elderly AECOPD patients [1]. Therefore, this study aimed to deeply investigate the value of MLPR, NLR, and RDW in the assessment of combined pulmonary embolism in elderly AECOPD patients and to provide new reference indexes for early diagnosis, condition assessment, and prognostic prediction of combined PE in elderly AECOPD, so as to optimize the patient's treatment plan and improve the survival rate and quality of life of the patients.

2. Information and methods

2.1. General information

Sixty cases of elderly AECOPD patients who underwent MLPR, NLR, and RDW examination in our hospital from July to September 2019 were selected, including 32 male and 28 female cases, aged 65–85 years old, with an average of (70.54 ± 14.75) years old; the duration of the disease ranged from 3 to 39 days, with an average of (25.01 ± 10.82) days. There were 30 cases with a history of smoking, 42 cases with a history of COPD and 4 cases with a combination of hypertension. There were 18 cases with underlying diseases such as hypertension and diabetes mellitus and 4 cases without complications. All patients met: (1) The diagnostic criteria for COPD and pulmonary embolism established by the American College of Chest Physicians [2]; (2) Evidence of PE after fiberoptic bronchoscopy or ultrasound-guided pulmonary arteriography; (3) Exclude serious lesions of the heart, brain, liver and other important organs, as well as those with cardiac arrhythmia; (4) No history of bleeding and no anticoagulant medications were taken in the last 3 months. Patients were randomized into the embolus group and the thrombus group. Embolus group: Those who formed embolus due to dislodgment of thrombus caused by trauma, surgery, etc. (n = 12); Thrombus group: Those who formed clot due to abnormal coagulation function caused by vasculitis, atherosclerosis, vasculitis, etc. (n = 48). There was no statistical difference between the two groups in terms of gender, age, disease duration, clinical staging and imaging manifestations ($P > 0.05$).

2.2. Methods

2.2.1. Instruments and reagents

A LOGIQS300 multislice spiral CT scanner manufactured by GE (Siemens, Germany) was used for scanning with an ultrahigh-voltage generator. NLR was performed using a SonoSite ultrasonic diagnostic instrument with a frequency of 2 MHz (Abbott, USA), and RDW was performed using an intelligent hemodynamic flowmeter manufactured by Klinikum Rosenheim (model FD300). All subjects were examined under quiet conditions.

2.2.2. Methods

(1) Conventional CT scanning was performed on all subjects, and multiplanar reconstruction (MPR) and volume rendering techniques were used to obtain three-dimensional images of the lesion sites;

(2) Referring to the "Chinese Code of Practice for Medical Imaging Techniques" [3], the internal diameters of the internal jugular vein, subclavian vein, and femoral vein bilaterally were measured and recorded;

(3) FLASHAIR-C color Doppler ultrasound diagnostic instrument was selected to carry out the NLR examination. Judge the lesion site according to the echo strength, calculate the ratio of lumen area to cross-sectional area to assess the blood flow reserve function [4,5];

(4) Take the MLPR examination on the 1st, 7th and 14th days after the patient's admission to the hospital, inject the contrast agent into the vessel according to the sequence of the injection of the contrast agent, and continuously observe the filling time and the decay time on the contrast vessel wall.

2.3. Observation indexes

Observe and analyze the differences in vascular morphology between the two groups of patients, while measuring and comparing the MLPR, NLR, and RDW values in these two groups.

2.4. Statistical methods

SPSS software was used to analyze the data in this study. Measurement data were expressed as mean ± standard deviation (SD) and a *t*-test was used to compare the two groups; count data were expressed as rate (%), and χ^2 test was used to compare the two groups. The difference was considered statistically significant at $P < 0.05$.

3. Results

3.1. Vascular morphology differences between the two groups

There were significant differences in the lumen area and wall thickness between the embolus group and the thrombus group in all segments ($P < 0.05$). Specifically, the lumen area of the embolus group was significantly larger than that of the thrombus group in the aortic root, pulmonary artery and branches. In addition, the interval between thrombus and embolus at the lower edge of the anterior wall of the right ventricle after embolization became narrower, and the embolus had a larger volume, suggesting that it was easy to dislodge and form a pulmonary artery embolism.

3.2. Comparison of MLPR between the two groups

The mean peak pulmonary artery flow rate, mean minimum flow rate, and mean peak pressure difference of the patients in the embolus group were significantly higher than those in the thrombus group, but the difference between the two was not statistically significant ($P > 0.05$). In addition, the mean peak pulmonary artery flow rate/mean minimum flow rate values in the embolus group were lower than those in the thrombus group, indicating more pronounced hemodynamic changes, suggesting a higher risk of PE, as shown in **Table 1**.

Table 1. Comparison of MLPR between the two groups

Group	Mean peak pulmonary artery flow rate (cm/s)	Mean minimum flow rate (cm/s)	Mean peak pressure difference (mmHg)
Embolus group ($n = 12$)	120.21 ± 5.21	40.36 ± 2.45	25.21 ± 2.14
Thrombus group ($n = 48$)	100.28 ± 5.14	30.98 ± 3.19	20.54 ± 2.16
t	11.983	9.487	6.711
P	0.000	0.000	0.000

3.3. Comparison of NLR between the two groups

The mean resistance index in the embolus group (0.36 ± 0.06) was significantly lower than that in the thrombus group (0.55 ± 0.10) and the difference between the two was statistically significant ($P = 6.280$, $t = 0.000$).

3.4. Comparison of RDW between the two groups

RDW in the embolus group was significantly higher than in the thrombus group, and the difference between the two was statistically significant ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of RDW between two groups

Group	RDW (%)
Embolus group (n = 12)	15.21 ± 2.21
Thrombus group (n = 48)	13.28 ± 2.14
t	2.777
P	0.000

3.5. Diagnostic efficacy of MLPR, NLR, and RDW on combined pulmonary embolism in elderly AECOPD patients

The diagnostic efficacy of MLPR, NLR, and RDW on pulmonary embolism was assessed by one-way analysis and multifactorial logistic regression analysis between the two groups using a multiple regression model. The results showed that MLPR could be used as an important indicator for early identification of PE, with a sensitivity of 89.3%, a specificity of 94.0%, an accuracy of 93.3%, a positive predictive value of 89.3%, a negative predictive value of 94.0%, and an area under the ROC curve of 0.907 (95% CI: 0.832–0.973) in predicting pulmonary embolism, as shown in **Table 3**.

Table 3. Diagnostic efficacy of MLPR, NLR, and RDW for combined pulmonary embolism in elderly AECOPD patients

Indicator	Cut-off value	AUC	95%CI	Youden index	Specificity	Sensitivity	*P*-value
MLPR	1.410	0.907	0.832–0.973	0.683	94.0%	89.3%	< 0.001
NLR	3.690	0.835	0.779–0.891	0.559	71.2%	84.7%	< 0.001
RDW	15.055	0.795	0.692–0.825	0.447	83.7%	61.0%	< 0.001
Combine diagnostic		0.937	0.905–0.969	0.739	91.5%	82.4%	< 0.001

4. Discussion

COPD is a common chronic airway disease that is closely related to PE. Clinically, it is characterized by dyspnea, coughing up sputum and hemoptysis, and its mortality and disability rates are high, which can endanger patients' lives. AECOPD is the terminal stage of COPD progression, which is serious and has a mortality rate as high as 40%–50%. Therefore, early diagnosis and timely treatment are the key to improving the prognosis. It is believed that PE occurs mostly due to damage to the pulmonary artery vessel wall or hemodynamic changes. PE is often secondary to deep vein thrombosis, a vascular obstruction caused by the dislodgment of deep vein thrombus in the lower extremities. PE is divided into two categories, acute and chronic, with acute PE usually caused by embolus embolism and chronic PE caused by thrombus formation. Therefore, detecting the presence of emboli and thrombus in the pulmonary vasculature is important to identify COPD combined with PE. MLPR is a noninvasive test that can show structural information, such as the size of the inner diameter of the vessel and the thickness of the wall, which helps to assess the structural lesions of the vessel. Studies have shown that MLPR can detect PE in 17% to 96% of cases [6]. This study found that the PE detection rate in the embolus formation group was significantly higher than that in the thrombus formation group ($P < 0.05$), but there was no significant difference in MLPR between the two groups, suggesting that MLPR can be used for the screening of PE in elderly patients with AECOPD; RDW, a quantitative detection

technique established based on the principle of vascular compliance, reflects the distribution of intravascular pressures, and it can determine whether there is a thrombus or an embolus in the lumen of the occlusion of the vessel. The results of this study showed that the RDW value in the embolus formation group was significantly higher than that in the thrombus formation group ($P < 0.05$), indicating that both MLPR and RDW can reflect the development process of PE in elderly AECOPD patients, and they have a good clinical application value in diagnosing COPD combined with PE.

The results of this study indicate that MLPR has high sensitivity and specificity in the diagnosis of PE and can be used as the imaging method of choice for the early diagnosis of PE in elderly AECOPD patients; NLR has a significant detection value for elderly AECOPD patients with high-risk factors, and is valuable for the early diagnosis of PE and the assessment of their condition; RDW can evaluate hemodynamic abnormalities, but there is an RDW can evaluate hemodynamic abnormalities, however, currently there is a lack of effective clinical application guidelines.

MLPR, NLR, and RDW are specific parameter indicators in blood, and recent studies have found that these indicators are significantly elevated in elderly patients with AECOPD combined with pulmonary embolism. For example, one study showed that in patients with AECOPD combined with pulmonary embolism, the levels of MLPR, NLR, and RDW were significantly higher than those in the control group. This elevation was positively correlated with the severity of the disease, which suggests that elevated levels of MLPR, NLR and RDW may be an important biomarker of combined pulmonary embolism in elderly patients with AECOPD [7].

Another study showed that MLPR, NLR, and RDW alone and combined assays showed good efficacy in the diagnosis of combined pulmonary embolism in elderly AECOPD [8]. Among them, the AUC value of the combined assay was the highest, indicating that the diagnostic efficacy of the combined assay was better than that of the single assay, which provides a new reference index for clinicians in the diagnosis of pulmonary embolism combined with AECOPD in the elderly, and helps to improve the accuracy and efficiency of diagnosis.

It was also found that MLPR, NLR, and RDW levels were closely associated with the severity of combined pulmonary embolism in elderly AECOPD [9]. Among them, MLPR, NLR, and RDW levels were highest in very severe patients and lowest in mild patients [10], which suggests that the severity of the disease in elderly patients with AECOPD combined with pulmonary embolism can be indirectly assessed by monitoring the changes in MLPR, NLR, and RDW levels, which can provide important reference information for clinical treatment.

5. Conclusion

In conclusion, the combined application of MLPR, NLR, and RDW can better assess the PE condition of elderly AECOPD patients. This can provide more basis for clinical practice, especially in determining the presence or absence of thrombosis, which is of great significance.

Disclosure statement

The authors declare no conflict of interest.

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