Research Paper

The Association between the Location and Extent of Pulmonary Embolism and Pulmonary Artery Pressure in Elderly Patients with Gastric Cancer

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To explore the relationship between pulmonary artery pressure and embolization area and embolization site in elderly patients with gastric cancer and pulmonary embolism. 118 patients with gastric cancer and acute pulmonary embolism who were hospitalized in Harrison International Peace Hospital from August 2017 to August 2020 were selected as the research objects. Doppler echocardiography was used to assess the pulmonary artery pressure of the patients and the patients were divided into two groups: pulmonary hypertension and non-hypertension groups. The differences in general information, blood gas analysis, D-dimer, coagulation indexes, typical clinical symptoms and the location and area of pulmonary embolism between the two groups were compared. The relationship between different levels of pulmonary artery pressure and the area and location of pulmonary embolism were investigated. The age and heart rate of patients in the pulmonary hypertension group were significantly higher than those in the non-high pressure group and the systolic blood pressure was significantly lower than that in the non-high pressure group; the level of the D-dimer in the high pressure group was significantly higher than that of the non-high pressure group; the levels of partial pressure of oxygen and partial pressure of carbon dioxide in the high pressure group were significantly lower than non-high pressure group; the incidence of syncope and hemoptysis in the high pressure group was significantly higher than that of the non-high pressure group; the proportion of large area embolism and multilateral embolism in the high pressure group was significantly higher than that of non-high pressure group; the severity of pulmonary artery pressure was severe or moderate; severe-large area embolism and multilateral embolism account for a larger proportion. Patients with pulmonary hypertension are more likely to have large area embolism and multilateral embolism and patients with moderate and severe pulmonary hypertension are more likely to have large area embolism and multilateral embolism, which may indicate a more serious condition and a poor prognosis.

Key words: Pulmonary embolism, gastric cancer, pulmonary artery pressure, partial pressure of oxygen, partial pressure of carbon dioxide

The incidence of gastric cancer in China accounts for 47 % of the total number of the world's population and the incidence rate is second in the malignant tumor. The treatment and complications of treatment are important problems that cannot be ignored clinically[1]. Pulmonary embolism (PE) is a pathological and clinical condition caused by the blockage of blood supply of tissue caused by the impaction of material into the pulmonary artery and its branches[2]. The risk of PE in patients with malignant tumor is increased by 4 times due to tumor compression of blood vessels, thrombosis caused by medical treatment, destruction of blood vessels by surgical treatment and other factors[3]. Postoperative complications such as pulmonary infection, abdominal pain and abdominal distension often occur in patients with gastric cancer, which leads to the masking of clinical symptoms of PE, increased possibility of missed diagnosis and misdiagnosis, affects the prognosis of patients and even leads to death of patients[4]. In this study, gastric cancer patients with PE were selected as the research object and the pulmonary artery pressure was evaluated by Doppler echocardiography to explore the relationship between pulmonary artery pressure and the area and location of PE. We try to explore the pulmonary artery pressure to prompt the severity of the disease in order to prompt the prognosis, so as to provide scientific basis for clinical timely treatment measures, improve the prognosis of patients and reduce the risk of death.

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MATERIALS AND METHODS

General information:

A total of 118 patients with gastric cancer and acute PE admitted to Harrison international peace hospital from August 2017 to August 2020 were selected as the research objects. All patients were over 60 y old and were diagnosed by computed tomography pulmonary angiography (CTPA) or/and radionuclide pulmonary ventilation/perfusion. Patients with suspected, but undiagnosed, incomplete clinical data, pulmonary heart disease and pulmonary hypertension were excluded. All patients were given anticoagulant or thrombolytic therapy after diagnosis. Among the 118 patients, 88 (74.58 %) were complicated within 1 mo after surgery and 25 (21.19 %) were complicated during or after chemotherapy and radiotherapy; 5 (4.24 %) patients were diagnosed with gastric cancer due to PE symptoms. All patients were examined by color Doppler ultrasound before anticoagulant drugs were used. According to the results of pulmonary artery systolic pressure (PASP), the patients were divided into high pressure group and non-high pressure group. All patients voluntarily participated in the study and signed informed consent.

Research method:

Collect the basic data of all subjects, including age, gender, heart rate, respiratory rate and systolic blood pressure.

Before anticoagulant therapy, fasting venous blood was collected for blood gas analysis, coagulation function and D-dimer examination.

PASP was measured by tricuspid regurgitation differential pressure method to evaluate the change of pulmonary artery pressure. Before anticoagulant therapy, all patients were examined by echocardiography to check whether there was tricuspid regurgitation. The probe angle and continuous wave Doppler sampling line were adjusted to make it consistent with the direction of regurgitation. The maximum velocity of tricuspid regurgitation was measured. The differential pressure of regurgitation was 4×2 (maximum tricuspid regurgitation velocity), PASP=differential pressure of regurgitation+mean pressure of right atrium, PASP>30 mmHg is pulmonary hypertension, when PASP is 31-50 mmHg is mild; when PASP was 51-70 mmHg, it was moderate; 71 mmHg is severe.

Evaluation of the severity of PE: Massive PE; shock and hypotension were the main clinical manifestations, systolic blood pressure <90 mmHg and lasted for more than 15 min and the decrease of blood pressure caused by arrhythmia, left ventricular dysfunction, hypovolemia, infection and poisoning or bradycardia (heart rate <40 beats per min with shock) were excluded.

Massive embolism-Patients with systolic blood pressure ≥90 mmHg, combined with right ventricular dysfunction, one of the following conditions exists: Right ventricular dilatation, echocardiography results show that the ratio of right ventricular diameter to left ventricular diameter is greater than 0.9 or right ventricular systolic dysfunction; the ratio of right ventricular diameter to left ventricular diameter was greater than 0.9; brain natriuretic peptide >90 pg/ml, or N-terminal pro brain natriuretic peptide >500 pg/ml; electrocardiogram (ECG) changes; new, complete or incomplete right bundle branch block, ST segment elevation or depression in precordial lead, T wave inversion; troponin I>0.4 ng/ml; troponin T>0.1 ng/ml; non large area embolization exclude large area embolization and sub large area embolization. In this paper, sub massive embolism and massive embolism were classified as massive embolism group.

According to the location of embolism, the location of PE can be divided into unilateral on the left or right side and bilateral on the left and right sides.

Statistical analysis:

All data were analyzed by statistical package for the social sciences (SPSS) 22.0. The measurement data such as age, heart rate and respiratory rate were calculated by mean±standard deviation. The differences between groups were analyzed by t test. Counting data such as gender, chest pain or chest tightness was expressed by rate and differences between groups were analyzed by chi square test, $p<0.05$ means the difference is statistically significant.

RESULTS AND DISCUSSION

Comparison of general information between the two groups was observed. The age and heart rate of patients in pulmonary hypertension group were significantly higher than those in non-hypertension group, but the systolic blood pressure was significantly lower than that in non-hypertension group, as shown in Table 1.

Comparison of blood gas analysis results between the two groups was done. Partial pressure of oxygen (PaO_2), partial pressure of carbon dioxide ($PaCO_2$) values of pulmonary hypertension group were significantly lower than those of non-hypertension group and the difference was statistically significant, as shown in Table 2.

TABLE 1: COMPARISION OF BASIC DATA BETWEEN GROUPS

	High pressure group (n=54)	Non-high pressure group (=64)	Statistics	p
Age (y)	68.7±4.9	64.6±4.4	4.787	<0.001
Gender (male/female)	23/31	27/37	0.002	0.965
Heart rate (times/min)	90.5±9.7	84.6±9.4	3.478	0.001
Respiratory rate (times/min)	23.4±2.9	22.9±3.0	0.916	0.362
Systolic pressure (mmhg)	124.5±14.7	134.8±15.2	3.723	<0.001

TABLE 2: COMPARISON OF BLOOD GAS ANALYSIS

	High pressure group (n=54)	Non-high pressure group (n=64)	Statistics	p
PaO_2 (mmHg)	70.44±9.54	79.12±9.43	4.955	<0.001
$PaCO_2$ (mmHg)	34.16±4.19	37.37±4.33	4.072	<0.001

Comparison of D-dimer and coagulation index between two groups was done. The level of D-dimer in pulmonary hypertension group was significantly higher than that in non-hypertension group. There was no significant difference in coagulation indexes between the high pressure group and the non-high pressure group, as shown in Table 3.

Comparison of the main clinical symptoms between the two groups was also observed. The incidence of syncope in the pulmonary hypertension group was significantly higher than that in the non-hypertension group and the incidence of hemoptysis in the hypertension group was significantly higher than that in the non-hypertension group, as shown in Table 4.

Comparison of the location and area of PE between the two groups was carried out. The proportion of patients with massive embolism in pulmonary hypertension group was significantly higher than that in non-hypertension group; the proportion of patients with multi-lateral embolism was significantly higher than that of patients without high pressure, as shown in Table 5.

The relationship between the location and area of PE and the degree of pulmonary hypertension was observed. Among the patients with severe pulmonary hypertension, 88.89 % had massive embolism and 100.00 % had bilateral embolism. Among the patients with moderate pulmonary hypertension, 66.67 % had massive embolism and 88.89 % had bilateral embolism. There were significant differences in embolism area and location among patients with different degrees of hypertension. Patients with large area and bilateral embolism had more severe pulmonary hypertension, as shown in Table 6.

TABLE 3: COMPARISON OF D-DIMER AND INDEXES OF COAGULATION

	High pressure group (n=54)	Non-high pressure group (n=64)	Statistics	p
D-Dimer (μg/ml)	1.87±0.27	1.26±0.23	13.254	<0.001
Prothrombin time (PT) (s)	13.32±1.24	12.97±1.32	0.126	0.900
Activated partial thromboplastin time (APTT) (s)	35.84±2.84	35.59±2.76	1.484	0.630
International normalized ratio (INR)	1.20±0.16	1.17±0.14	1.086	0.280

TABLE 4: COMPARISON OF MAIN CLINICAL SYMPTOMS

	High pressure group (n=54)	Non-high pressure group (n=64)	Statistics	p
Pectoralgia (n, %)	22 (40.74 %)	29 (45.31 %)	0.249	0.617
Chest tightness (n, %)	38 (70.37 %)	43 (67.19 %)	0.138	0.710
Dyspnea (n, %)	29 (53.70 %)	41 (64.06)	1.302	0.254
Shortness of breath (n, %)	19 (35.19 %)	23 (35.94 %)	0.007	0.932
Cough (n, %)	29 (53.70 %)	32 (50.00 %)	0.161	0.688
Syncope (n, %)	13 (24.07 %)	2 (3.13 %)	11.584	0.001
Palpitation (n, %)	14 (25.93 %)	16 (25.00)	0.013	0.908
Hemoptysis (n, %)	8 (18.81 %)	2 (3.13 %)	5.160	0.023
Swelling of lower limbs (n, %)	17 (31.48 %)	20 (31.25 %)	0.001	0.978
Pleural effusion (n, %)	20 (37.04 %)	23 (35.94 %)	0.015	0.902

TABLE 5: COMPARISON OF THE LOCATION AND AREA OF PE BETWEEN GROUPS

	High pressure group (n=54)	Non-high pressure group (n=64)	Statistics	p
Embolic area			4.372	0.037
Large area	28 (51.85 %)	21 (32.81 %)		
Non large area	26 (48.19 %)	43 (67.19 %)		
Embolic site			4.827	0.028
Multilaterally	43 (79.63 %)	39 (60.94 %)		
Unilateral	11 (20.37 %)	25 (39.06 %)		

TABLE 6: THE RELATIONSHIP BETWEEN THE LOCATION AND AREA OF PE AND THE DEGREE OF PULMONARY HYPERTENSION

	Degree of pulmonary hypertension		
	Mild (n=27)	Moderate (n=18)	Severe (n=9)
Embolic area			
Large area	8 (29.63 %)	12 (66.67 %)	8 (88.89 %)
Non large area	19 (70.37 %)	6 (33.33 %)	1 (11.11 %)
Statistics			11.868
p			0.003
Embolic site			
Multilaterally	18 (66.67 %)	16 (88.89 %)	9 (100.00 %)
Unilateral	9 (33.33 %)	2 (11.11 %)	0 (0.00 %)
Statistics			9.632
p			0.009

The causes of PE include pulmonary thromboembolism (PTE), fat embolism syndrome, tumor embolism, etc., of which the most common is PTE, accounting for more than 90 % of PE[5]. PTE is a disease caused by the obstruction of pulmonary artery or its branches due to the thrombosis of venous system, especially pelvic vein, lower extremity vein or right ventricle[6]. Although there is no significant clinical difference between PE caused by tumor patients and other causes, PE after gastric cancer surgery accounts for almost three-quarters of gastric cancer complicated with PE. Studies have shown that acute PE after gastric cancer surgery is a serious complication with serious consequences. If it is not treated in time, it will be life-threatening[7]. In the past, there was insufficient understanding of gastric cancer complicated with PE, especially in postoperative patients, often accompanied by pulmonary infection, abdominal pain, abdominal distension, anastomotic leakage and other complications to cover up symptoms. The possibility of misdiagnosis and missed diagnosis was as high as 70 % and the mortality caused by untimely treatment could be as high as 30 %[8-10]. Therefore, timely detection, timely diagnosis, timely prevention and treatment are effective means to reduce mortality.

Previous studies have shown that dyspnea, chest pain, cough, hemoptysis and syncope are common clinical symptoms of PE, but the specificity is low[11]. When the scope of pulmonary artery obstruction is large, the typical "triad" can appear in a short time, namely dyspnea, chest pain and hemoptysis, which indicates that the prognosis of patients is poor. Syncope occurred in patients due to cardiac insufficiency, decreased cardiac output caused by systemic circulation disorders and cerebral insufficiency[12]. In this study, the incidence of hemoptysis and syncope in pulmonary hypertension group was significantly higher than that in non-hypertension group, suggesting that pulmonary hypertension group was more serious. In addition, the age, heart rate and systolic blood pressure of pulmonary hypertension group were significantly higher than those of non-hypertension group. The incidence rate of PE gradually increased with age and 20 % of those aged over 60. And 90 % of fatal PE occurred in people over 50 y old[13].

D-dimer, as one of the degradation products of cross-linked fibrin, the rapid rise of D-dimer level indicates secondary hyperfibrinolysis, which is an important early warning of thrombotic tendency and hyperfibrinolysis *in vivo*[14]. When acute thrombosis occurs *in vivo*, it promotes thrombin production and activation of fibrinolytic system, leading to the increase of D-dimer level. D-dimer plays an important role in the early diagnosis of acute PE and is related to the risk of early death of PE[15,16]. In this study, the level of D-dimer in patients with pulmonary hypertension was significantly higher than that in patients without pulmonary hypertension, suggesting that the risk and prognosis of patients with pulmonary hypertension were worse than those in patients without pulmonary hypertension. In this study, the results of blood gas analysis showed that the levels of PaO_2 and $PaCO_2$ in patients with PE hypertension group were significantly lower than those in patients with non-hypertension group. During acute PE, hypoxemia may occur, the body's breathing deepens and speeds up to compensate, CO_2 exhalation increases and hypocapnia appears[17], indicating that the patient's condition is serious.

In this study, in the pulmonary hypertension group, the proportion of massive embolism and multi sided embolism was significantly higher than that in the non-hypertension group and there was a correlation between the area and location of embolism and the degree of hypertension. In patients with severe degree of hypertension, all were multi sided embolism and 88.89 % were massive embolism. The proportion of patients with moderate and severe hypertension is larger in patients with large area and multi-lateral embolism. The possibility of pulmonary artery pressure rising is also greater in patients with large surface area and large range of PE. Studies have shown that patients with massive PE have longer hospital stay, more serious condition and worse prognosis. The results of this study suggest that patients with high pulmonary artery pressure are more likely to have massive and multi-lateral embolism and their clinical prognosis is poor[18].

The clinical symptoms of PE are not typical and there are often missed diagnosis and misdiagnosis. The clinical operation of color Doppler echocardiography is convenient, noninvasive, repeatable and dynamic evaluation of pulmonary artery pressure. The degree of pulmonary hypertension is related to the area and location of embolism, which indirectly indicates the severity of the disease. In conclusion, there is a correlation between the degree of pulmonary hypertension and the area and location of PE. Monitoring pulmonary hypertension can indicate the severity of the disease and play a warning role in judging the prognosis.

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Conflicts of interest:

The authors report no conflicts of interest.

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