

Clinical-pathological correlation of pulmonary thromboembolism in cardiovascular surgery

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COPD: chronic obstructive pulmonary disease

PTE: pulmonary thromboembolism

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ABSTRACT

Introduction: Pulmonary thromboembolism is the condition generated by the interruption of the blood supply to a portion of the lung by a blockage of an afferent vessel.

Objective: To compare the clinical-pathologic correlation of the diagnosis of pulmonary thromboembolism in patients undergoing surgery and to describe some related variables.

Method: A descriptive-retrospective study was conducted. The sample consisted of 26 patients who had clinical or post-mortem diagnosis of pulmonary thromboembolism.

Results: All patients (100%) had tachycardia and tachypnea. Bronchopneumonia and chronic obstructive pulmonary disease (40% respectively) were the main causes of misdiagnosis. In the majority of cases (45.4%), the involvement was at the level of the thin branches. Clinical diagnosis was confirmed in 34.8% of patients. The main risk factors that were identified included: major surgery, the need for prolonged bed rest (81.8% respectively), the use of cardiopulmonary bypass and the occurrence of shock (72.7% respectively). Among patients with confirmed diagnosis, 72.7% had an adequate therapeutic dose of heparin.

Conclusions: Pulmonary thromboembolism was a rare complication in cardiovascular surgery, and clinical suspicion exceeded the actual existence of the disease, therefore the clinical-pathological correlation was poor.

Key words: Pulmonary thromboembolism, Cardiac surgery, Clinical-pathological correlation

Correlación clínico-patológica del tromboembolismo pulmonar en la cirugía cardiovascular

RESUMEN

Introducción: El tromboembolismo pulmonar es el estado generado por la interrupción del riego sanguíneo a una porción del pulmón por obstrucción de un vaso aferente.

Objetivo: Comparar la correlación del diagnóstico clínico-patológico del TEP en los pacientes intervenidos quirúrgicamente y describir algunas variables relacionadas.

Método: Se realizó un estudio descriptivo-retrospectivo. La muestra estuvo integrada por los 26 pacientes que tuvieron diagnóstico clínico o necrópsico de tromboembolismo pulmonar.

Resultados: Todos los pacientes (100 %) presentaron taquicardia y taquipnea. La bronconeumonía y la enfermedad pulmonar obstructiva crónica (40 % respectivamente), fueron las principales causas de diagnóstico erróneo. En la mayoría de los casos (45,4 %) la afectación estuvo a nivel de las ramas finas. El diagnóstico clínico fue confirmado en el 34,8 % de los enfermos. Los principales factores de riesgo identificados fueron: la cirugía de gran envergadura, la necesidad de encamamiento prolongado (81,8 %), el uso de circulación extracorpórea y la presencia de *shock* (72,7 %). En los pacientes con diagnóstico confirmado el 72,7 % tenía una dosis terapéutica adecuada de heparina.

Conclusiones: El tromboembolismo pulmonar fue una complicación infrecuente de la cirugía cardíaca y la sospecha clínica superó la existencia real de la enfermedad, por lo que la correlación clínico-patológica fue escasa.

Palabras clave: Tromboembolismo pulmonar, Cirugía cardíaca, Correlación clínico-patológica

INTRODUCTION

The oldest possible references to pulmonary thromboembolism (PTE) are found in Hippocratic texts which speak of sudden death, but it was not until necropsies were started that the first proven cases of clots in the vessels of the respiratory system and in the venous circulation of the lower limbs and pelvis were described^{1,2}.

The actual incidence of thromboembolic disease is unknown. Rudolf Virchow, founder of cellular pathology, is regarded as the first to discover PTE. In mid-1800 Virchow first enunciated the basic principles of the pathogenesis of pulmonary embolism which are currently accepted and constitute the so-called Virchow's triad (endothelial injury, stasis of blood flow and hypercoagulability)³.

Definitive diagnosis requires instruments that are only available in some hospitals, therefore most of the patients will be referred to these institutions to confirm or rule out a suspected diagnosis. Some patients have more than one thrombophilia, and it commonly coexists with a factor V Leiden and another abnormality, because this factor is the one that most fre-

quently occurs^{3,4}.

The biggest drawback to correctly diagnose this process is predominantly based on the absence of specific symptoms and signs in each individual¹. In clinical practice there are problems in the clinical-pathological correlation, which is why we aimed at doing research that may allow us to know the magnitude of the problem, in order to improve diagnosis as well as clinical-pathological correlation and treatment of this disease.

The aim was to establish the correlation of the clinical diagnosis with the anatomical-pathological findings of PTE in patients who have undergone cardiovascular surgery.

METHOD

A descriptive and retrospective study was conducted in patients operated at the Cardiocentro Ernesto Che Guevara of Santa Clara, Cuba, from January 2000 to January 2010.

At that stage, 4,846 patients were operated for valvular, congenital and coronary heart diseases. There

were 333 deaths and 266 of them were necropsied. The sample consisted of 26 patients who had clinical or post-mortem diagnosis of pulmonary thromboembolism.

For this research, the necropsy records of the Department of Pathology of the Surgical Intensive Care Unit and those of the Department of Statistics were reviewed; as well as death certificates and clinical histories of patients, from where the necessary information for analysis was extracted. Data were processed using SPSS version 15 and the results are summarized in tables.

RESULTS

Of the 266 autopsies performed (79.8% of total deaths), 26 (9.8% of total necropsies) where there was pre or post-mortem diagnosis of PTE were selected. The age of the deceased was over 65 and myocardial revascularization was the most frequently performed surgery.

All patients (100%) showed tachycardia and tachypnea (**Table 1**). In those with confirmed PTE, 72.7% equally experienced venous hypertension and hypoxemia; 54.5% hypotension, and 27.3% cyanosis. Wheezes, with statistical significance ($p < 0.05$) were found more in those in whom PTE was clinically diagnosed (40.0%), but not confirmed.

The conditions that most frequently led to misdiagnosis of PTE (**Table 2**) were bronchopneumonia and chronic obstructive pulmonary disease (COPD) with 6 patients each (40%). They were followed in order of frequency by cardiogenic shock (26.8%), multiorgan failure (20.0%) and heart failure (20.0%).

Table 3 shows the anatomopathological diagnosis in connection with the occluded pulmonary artery. Of the 11 patients with confirmed pulmonary embolism, 3 (27.2%) had occlusion of thick branches, and as many of medium branches, and in 5 deaths (45.4%) involvement was at the level of thin branches, 3 of them were only diagnosed by pathology, so they were an autopsy finding.

By analyzing the relationship between the clinical and pathological diagnosis of PTE (**Table 4**) it was found that of the 23 patients in whom the disease was suspected, 8 (34.8%) had necropsy confirmation, and

Table 1. Clinical signs and PTE diagnosis.

Clinical signs	PTE diagnosis				p
	Confirmed (n=11)		Not confirmed (n=15)		
	Nº	%	Nº	%	
Tachycardia	11	100	15	100	0.467
Tachypnea	11	100	15	100	0.467
Venous hypertension	8	72,7	11	73,3	0.348
Hypoxemia	8	72,7	11	73,3	0.348
Hypotension	6	54,5	5	33,3	0.348
Fever	1	9,1	1	6,7	0.358
Cyanosis	3	27,3	4	26,7	0.506
ECG alterations	2	18,2	2	13,3	0.150
Wheezes	2	18,2	6	40,0	0,022

Fuente: Historia clínica y registro de Anatomía Patológica

Table 2. Clinical situations that led to misdiagnosis of PTE (n=15).

Diagnosis	Nº	%
Bronchopneumonia	6	40,0
COPD	6	40,0
Cardiogenic shock	4	26,7
Multiorgan failure	3	20,0
Heart failure	3	20,0

Source: Personal medical records

Table 3. Anatomopathological diagnosis of PTE, according to occluded pulmonary arteries.

Occluded arteries	Nº	%
Thick branches	3	27,2
Medium branches	3	27,2
Thin branches	5	45,4
Total	11	100

Source: Records of the Department of Pathology

in 15 (65.2%) the diagnosis was not confirmed; and there were 3 patients who had necropsy confirmation and whose disease was not suspected before death

Table 4. Clinical diagnosis of PTE and autopsy finding.

Diagnosis	Confirmed		Not confirmed	
	Nº	%	Nº	%
Suspected (n=23)	8	34,8	15	65,2
Not suspected (n=3)	3	100	-	-
Total	11	42,3	15	57,7

Source: Personal medical records and those from the Department of Pathology.
p=0,018

Table 5. Risk factors in patients with confirmed PTE.

Risk factors	Nº	%
Surgery	9	81,8
Use of cardiopulmonary bypass	8	72,7
Shock	8	72,7
Prolonged bed rest	9	81,8
Total	11	100

Source: Personal medical records and those from the Department of Pathology.

(autopsy finding). In total, of the 26 patients studied, PTE at necropsy was found in 42.3%.

The main risk factors identified in patients with PTE (Table 5) included: major surgery and need for prolonged bed rest (81.8% respectively), and use of cardiopulmonary bypass during the operation and presence of shock in the postoperative period, both present in 72.7% of the deceased with necropsy confirmation of PTE.

Table 6 shows the relationship between heparin

Table 6. Diagnosis of PTE and treatment with heparin.

Treatment	Diagnosis				Total	
	Confirmed		Not confirmed			
	Nº	%	Nº	%	Nº	%
No treatment	1	9,1	2	13,3	3	11,5
Inadequate drug dosage	2	18,2	4	26,7	6	23,1
Therapeutic dose	8	72,7	9	60,0	17	65,4
Total	11	100	15	100	11	100

Source: Personal medical records and those from the Department of Pathology

treatment and diagnosis of PTE. Of the patients who had a confirmed diagnosis only 1 (9.1%) had no treatment, 2 (18.2%) had inadequate drug dosage and 8 (72.7%), an adequate therapeutic dose. In patients with no confirmed diagnosis during the pathological study, 2 (13.3%) had no anticoagulation treatment, 4 (26.7%) received inadequate doses and 9 (60.0%) an adequate therapeutic dose. In general, 65.4% of patients were prescribed therapeutic doses of heparin.

DISCUSSION

During CPB there is a slowing of blood flow and an increase in blood viscosity due to vasoplegia and hemoconcentration phenomena associated with this type of procedure and the surgery as such².

The results show that the clinical diagnosis of PTE did not have a high degree of certainty, so it was often considered a suspicion or a probability, acting upon the particular characteristics of each patient, who in turn was influenced by the regime of strict anticoagulation imposed on these patients during cardiopulmonary bypass³.

Despite this, we found an overdiagnosis of PTE because the clinical-pathological correlation was low, which we attribute to the difficulty in diagnosing this disease, which in classical medical books is known as "the great imitator"⁴. Moreover, there were patients in whom the diagnosis was not given, but their PTE was that of thin branches, which explains, to some extent, the mistake. Furthermore, it is known that death by PTE and death with PTE⁵ is not the same. It is evident that the diagnostic agreement between clinicians and pathologists is most accurate when PTE affects medium and thick branches^{6,7}.

Ahmad *et al.*⁸ state that the success in the clinical diagnosis of PTE is complicated, especially when there are simultaneously heart or lung diseases, and very inaccurate when it is only based on clinical manifestations. In fact, it is estimated that 2 out of 3 patients with suspected deep vein thrombosis or pulmonary embolism do not have these disorders⁹.

Some authors^{10,11} agree that the classic symptoms of dyspnea, tachycardia and chest pain

are found in almost all patients, so their sensitivity is very high, but its specificity, very low. That same lack of specificity applies to physical examination and basic paraclinical tests such as chest radiograph, electrocardiogram, and arterial gasometry, much more when it comes to patients in the postoperative period of a cardiovascular surgery. The specificity of symptoms and signs increases depending on the affected pulmonary vascular bed (medium or thick branches), the degree of occlusion and the patient's cardiorespiratory reserve⁸⁻¹².

Our results are consistent with the literature reviewed^{5,6,9-12}, where PTE is described as not having pathognomonic signs and symptoms and it appears as a result of risk factors that generally lead to an extended hospital stay, with increasing trend in its incidence over the course of the days.

In this study, patients had prolonged stays and bed rest over 15 days due to the extreme severity of their conditions, with torpid evolution due to cardiorespiratory deterioration. The very heart surgery, especially CABG which was the most frequent, together with the required prolonged bed rest, were the most valuable risk factors to consider in the PTE of these patients.

The clinical symptoms and signs are not highly specific, they are only a guidance for the physician, as the suspected diagnosis may be favored by integrating them with additional tests^{5,6,9}.

Although in most such operations proper anticoagulation is needed, sometimes there are difficulties in the postoperative period, especially with the use of inadequate doses; and in other cases PTE occurs regardless the use of therapeutic doses of heparin; probably associated with hereditary hypercoagulable disorders or with the confluence of several risk factors. However, anticoagulant therapy was not a variable that had to do with the onset of PTE, as most patients had a correct treatment. This shows, once again, that anticoagulants use dare not completely safe in the prevention of PTE¹⁰⁻¹².

CONCLUSIONS

Pulmonary thromboembolism was a rare complication in cardiovascular surgery, and clinical suspicion exceeded the actual existence of the disease, therefore the clinical-pathological correlation was poor.

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