ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN – POLONIA
VOL. LXIV, N 1, 1 SECTIO D 2009

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Clinical analysis of thirty-three patients with pulmonary embolism in correlation with the Quanadli Index

Pulmonary embolism (PE) is a serious and difficult clinical problem. In USA, the annual incidence is 575,000 cases. PE causes 50,000 to 200,000 deaths a year. The autopsy studies showed that even 2/3 of clinically significant pulmonary embolism cases are not diagnosed intravitally (1, 2).

There are no studies that define the basic epidemiology of pulmonary embolism in Poland. By extrapolation, it can be estimated that more than 25,000 patients are hospitalized every year because of pulmonary embolism. According to several authors the real incidence of the disease is 10 times higher than that derived from the clinical diagnosis.

The mortality related to acute pulmonary embolism decreases, although it is still extremely high – the average level is 15% during the first two weeks (1). Clinical manifestations of pulmonary embolism are non-specific and cause many diagnostic difficulties (1, 3). The introduction of spiral computed tomography provided clinicians with a non-invasive method enabling quick and accurate diagnosis. The multi-slice tomography in angiographic option allows to detect the thrombi in pulmonary arteries unto to the 6th branch and to assess quantitatively the severity of vascular lesions and features of right ventricular overload, which may be used for standardization of evaluation of the severity of the patent's condition and facilitate the communication between the radiologist and clinician (2–9).

The analysis of clinical parameters in patients with diagnosed pulmonary embolism and comparison with the extent of lesions detected on spiral computed tomography on the basis of the Quanadli Index and right ventricular overload indices.

MATERIAL AND METHODS

The analysis included 33 consecutive patients (20 females and 13 males) hospitalized in the Department of Pneumology, Oncology and Allergology, Medical University of Lublin with CT-confirmed diagnosis of pulmonary embolism. The age range was 23–80 years (mean 54.5). The clinical analysis assessed: risk factors of PE in patients and the clinical manifestations reported by them, moreover the physical findings and results of additional examinations (chest X-ray, electrocardiogram, D-dimer level in blood, using monoclonal antibodies and the turbidimetrical method, MSCT angiography of pulmonary arteries) were analysed. MSCT was performed using the 8-row scanner LightSpeed Ultra (GE) after the administration of an intravenous contrast medium bolus with collimation 0.6 mm and delay determined by the SmartPrep technique. The CT evaluation included the presence and type (acute and chronic) of embolic lesions in the pulmonary arteries, their

extent measured with the Quanadli Index (8, 10) and features of right ventricular dysfunction on the basis of the right to left ventricle transverse dimensions ratio measured in 4-cavity projection – 4CH-RV D/LVD (Quiroz et al., Circulation 2004)) and the diameter of the pulmonary trunk. The analysis of MSCT was performed by one not related person.

The group examined was divided into subgroups according to the following criteria: D-dimer level >500 μg/l and <500 μg/l, abnormal gasometry (hypoxaemia, hypoxaemia with hypocapnia, hypocapnia, normal), changes in ECG and X-ray of the chest, presence of at least 3 clinical symptoms, substantial risk factors, shock index > =1, CT-detected features of acute and chronic embolism. The statistical analysis was carried out using the Spearman rank test and the significance of differences was calculated by the Mann-Whitney test.

RESULTS

In the examined group: substantial risk factors were found in 22 patients (66.7%) (neoplastic diseases – 8 (24.2%), fractures and immobilization – 4 (12.1%), venous embolism in the lower limbs – 2 (6%), post-labour condition – 1 (3%), post-Caesarean section condition – 3 (9%), past pulmonary embolism – 3 (9%), post-major surgery condition – 1 (3%); low risk factors were observed in 11 patients (33.3%) (oral contraceptives – 3 (9%), circulatory diseases – 6 (18.2%), Chronic Obstructive Pulmonary Disease – 1 (3%), obesity – 1 (3%).

The patients reported the following clinical symptoms: dyspnoea 81%, chest pains 42.4%, cough 27.2%, fainting 18.18%, palpitations 15%, fever 15%. In 24 patients (72.7%) there were 1–2 of the above-mentioned symptoms, in 9 (27.3%) – 3–4. The chest X-ray-detected changes: no changes – 42.4%, fluid in the pleura 21.2%, infiltration lesions 15.5%, others (higher diaphragm, disseminated changes, symptoms of pulmonary haemostasis, widened hila) 21.12%. Abnormalities in gasometry: hypoxaemia 63.6%, hypoxaemia with hypocapnia 36.3%, hypocapnia 9%, normal findings 15.15%. D-dimer levels – < 500 μg/l in 14 (43.7%), > 500 μg/l in 18 (56.25%). The values ranged from 50 μg/l to 3600 μg/l. The shock index was analysed defined as the ratio of heart rate to systolic pressure – in 10 patients it was above 1. In the whole CT-evaluated group the shock index was found to be significantly higher in patients with the D-dimer level > 500 μm/l, higher Quanadli Index and widened pulmonary trunk indices were observed in patients with abnormal ECG recordings.

There were no significant differences in the remaining parameters. In the group of 19 patients with CT-diagnosed acute and sub-acute pulmonary embolism, the positive correlation was demonstrated between the Quanadli Index and right ventricular overload while negative correlations were observed between the Quanadli Index and saturation (Fig. 1).

The significance of differences in the whole group was presented in Table 1 – in brackets – the level of significance in the group of 19 patients with acute embolism.

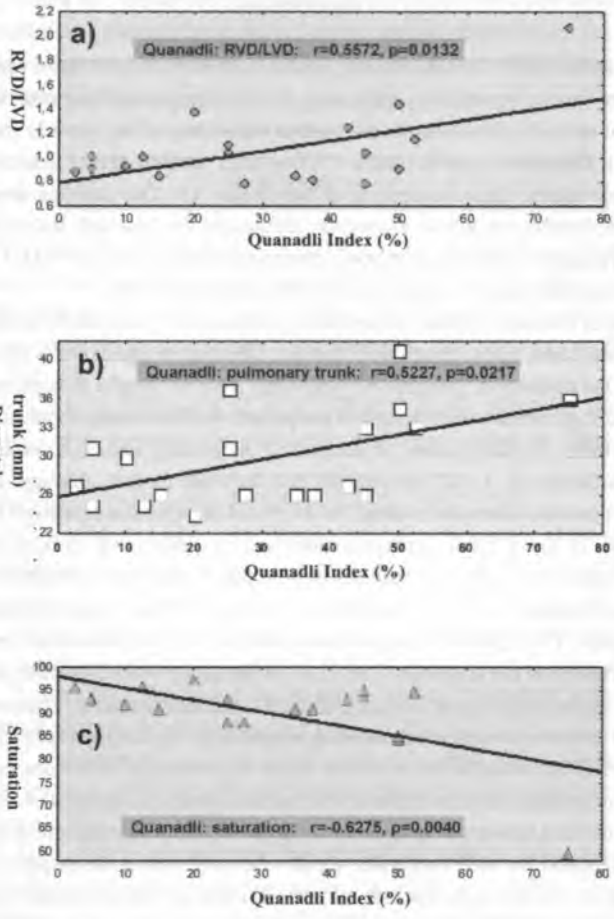

Fig. 1. Correlation between the Quanadli Index and right ventricular overload (a), the Quanadli Index and diameter of pulmonary trunk (b) as well as the Quanadli Index and saturation (c)

Table 1. The significance of correlations between different parameters analyzed in the whole group and in the group of 19 patients with acute embolism – in brackets

	Min. 3 syndromes	D-dimer >500 µg/l	Quanadli Index	Diameter of the pulmonary trunk	Index RV_D/LV_D
Age	p=0.05		(p=0.0009)		
Saturation	p=0.01		p=0.08 (p=0.004)		
Abnormalities in gasometry	p=0.01				
Shock index		p=0.05 (p=0.03)		p=0.02	p=0.04 (p=0.06)
Substantial risk factors		p=0.05 (p=0.05)			
Changes in ECG			p=0.04 (p=0.02)	p=0.02 (p=0.0009)	

DISCUSSION

Pulmonary embolism is a life-threatening condition, however it may have various clinical forms, ranging from very severe immediately indicating the life threatening condition to asymptomatic or oligosymptomatic ones (1, 3). Even severe central embolism of big vessels may be sporadically asymptomatic (1). Therefore up to 60–80% of PE-related sudden deaths detected on autopsies are not diagnosed and without clinical suspicion of the disease. (1). Our analysis involved patients with spiral CT-confirmed embolism whose extent was defined by the Quanadli Index (8, 9). The majority of the patients on diagnosis were in quite good general condition, in 4 (11.7%) CT was performed for other reasons without the tentative suspicion of pulmonary embolism.

The analysis of clinical symptoms reported by patients confirmed that the commonest complaints included: dyspnoea, chest pains, cough and fainting, which is in agreement with the results of other authors (1, 3). In the majority of patients the symptoms were not single. In some cases the symptoms were non-specific, e.g. increased dry cough in the patient with remitting neoplastic disease.

All algorhythms of management in suspected pulmonary embolism stress the necessity of analysing the risk factors (1, 3). All our patients had such risk factors, although in 32.3% they were low (e.g. obesity) and therefore not evident. In 45.5% of the examined patients ECG did not reveal any abnormalities, in the remaining patients their nature varied: arrhythmias, ischaemic features, tachycardia; in 6 patients (17.6%) the features of pulmonary heart were detected.

The levels of D-dimers in blood ranged from 50 μg/l to 3600 μg/l. According to the literature, this Index is non-specific. The high level does not prove the diagnosis of embolism, however its low level facilitates the exclusion of the diagnosis (2, 4, 5, 6). In the group with CT-confirmed embolism 43.7% of patients had D-dimer levels below 500 μg/l, which is considered negative. There are various methods of conducting these examinations, some showing significantly higher specificity (2, 4). Therefore, the low D-dimer level alone cannot be the exclusion factor of pulmonary embolism, especially in patients with risk factors of venous thrombo-embolic disease and clinical symptoms (4, 5).

At present, the best non-invasive method to diagnose pulmonary embolism is spiral CT (1–9). It provides safe, quick and accurate diagnosis, which often determines the patient's life. The Quanadli Index (8, 9) is used to determine the intensity of embolic changes in the pulmonary artery ramifications on the basis of the number of the branches affected. It evaluates the lumen of 10 segmental arteries: 0 – normal contrast, 1 – partial and 2 – complete occlusion. The loss of contrast proximal to segmental arteries gives the number of points which equals the number of distal branches. The advantage of the scale used is its quick evaluation and simplicity of calculations compared to the Mastory and colleagues as well as Miller and colleagues scales (10). In our group the Quanadli Index correlated with decreased saturation and ECG abnormalities, which accompanied the severe condition of the patient.

MSCT enables parametric evaluation of the features of right ventricular overload, which is essential for prognosis and qualification of patients for thrombolytic therapy. The measurements of the pulmonary trunk diameter and the ratio of ventricle sizes are easy and well correlated with the shock index and pulmonary artery pressure. To date, the function of the right ventricle was assessed only by echocardiography; however the method is not 24 h available in all centres and CT evaluation may replace this examination.

CONCLUSIONS

1. Among the clinical parameters examined in our group of patients, only abnormalities in ECG and saturation plus increased shock index might have indicated extensive embolic lesions assessed by the Quanadli Index.

2. Spiral CT should be considered in symptomatic patients with risk factors, even without typical changes in additional examinations, to exclude or confirm embolism.

3. The Quanadli index may be used as a valuable parameter to evaluate the intensity of lesions in acute pulmonary embolism.

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SUMMARY

The aim of this study was to compare clinical parameters of pulmonary embolism to extensiveness of abnormalities showed in spiral computed tomography expressed as the Quanadli Index. The study population consisted of 33 patients with pulmonary embolism hospitalized in the Department of Pneumology, Oncology and Allergology in 2003. Risk factors of pulmonary embolism, clinical symptoms, and results of chest radiographs, electrocardiographs, gasometry, and D-dimer level in blood were estimated. The results of these examinations were compared to the value of the Quanadli Index. In the examined group we observed the risk factors of pulmonary embolism in all patients, moreover, low factors were found in 33.3% patients. In 15.5% we did not find any abnormalities in gasometry. The normal level of D-dimer in peripheral blood was estimated in 43.7% of patients. In the whole CT-evaluated group the shock index was found to be significantly higher in patients with the D-dimer level> 500 μm/l, higher Quanadli Index and widened pulmonary trunk indices were observed in patients with abnormal ECG recordings. In the group of 19 patients with CT-diagnosed

acute and sub-acute pulmonary embolism, the positive correlation was demonstrated between the Quanadli Index and right ventricular overload while negative correlations were observed between the Quanadli Index and saturation. Conclusions: 1. Abnormalities of electrocardiograms, gasometry and increased level of shock index may indicate the extensiveness of pulmonary embolic changes evaluated by the Quanadli Index value. 2. In symptomatic patients with high risk of embolism spiral CT should be performed to exclude or confirm pulmonary embolism. 3. Quanadli Index is a diagnostic tool with a high sensitivity and specificity for the detection of acute pulmonary embolism and for evaluation of its intensification.

Analiza kliniczna 33 pacjentów leczonych z powodu zatorowości płucnej w korelacji ze wskaźnikiem Quanadliego

Celem pracy była analiza parametrów klinicznych zatorowości płucnej oraz porównanie ich z rozległością zmian stwierdzanych w spiralnej tomografii komputerowej na podstawie wskaźnika Quanadliego. Badaniem objęto 33 chorych hospitalizowanych w Klinice w roku 2003 z powodu zatorowości płucnej. Analizowano czynniki ryzyka zatorowości, objawy kliniczne, zmiany w badaniach Rtg klp, Ekg, gazometrii, stężenia D-dimerów w surowicy krwi. Czynniki porównywano ze wskaźnikiem Quanadliego – oceny zaawansowania zmian zatorowych w spiralnej tomografii komputerowej. W badanej grupie u wszystkich pacjentów stwierdzono występowanie czynników ryzyka zatorowości płucnej, w tym małe czynniki ryzyka u 33,3% pacjentów. U 15,5% chorych badanie gazometryczne było prawidłowe, a prawidłowy poziom D-dimerów w surowicy krwi stwierdzono u 43,7% pacjentów. W grupie pacjentów ocenianych w KT stwierdzono istotnie wyższy wskaźnik wstrząsowy u chorych, z poziomem D-dimerów przekraczającym 500 μg/l, oraz wyższe wskaźniki Quanadliego i poszerzenie pnia płucnego u chorych z nieprawidłowym zapisem Ekg. W grupie 19 pacjentów, którzy spełniali w KT kryteria ostrej i podostrej zatorowości płucnej, stwierdzono dodatnią korelację miedzy wskaźnikiem Quanadliego a wskaźnikami przeciążenia prawej komory (RVD /LVD, szerokość pnia płucnego), a także ujemne korelacje między wskaźnikiem Quanadliego a saturacją. 1. W badanej grupie stwierdzono, że jedynie nieprawidłowości zapisu Ekg, saturacji i podwyższony wskaźnik wstrząsowy mogą wskazywać na rozległe zmiany zatorowe, oceniane poziomem wskaźnika Quanadliego. 2. U objawowych pacjentów z czynnikami ryzyka należy rozważyć wykonanie spiralnej tomografii komputerowej w celu wykluczenia lub potwierdzenia zatorowości. 3. Wskaźnik Quanadliego może być wykorzystywany jako wartościowy parametr oceny nasilenia zmian w ostrej zatorowości płucnej.