

Epidemiology, Clinical and Paraclinical Presentations of Pulmonary Embolism: A Cross-Sectional Study in a Sub-Saharan Africa Setting

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Abstract

Background: Venous thromboembolic (VTE) disease burden is increasing worldwide, representing a major cause of cardiovascular death and public health problem. Pulmonary embolism (PE) is the most serious clinical presentation of VTE. Epidemiological and clinical data on PE are still lacking in Africa, particularly in Cameroon. This study aimed at determining the clinical features as well as imaging presentation and outcome of pulmonary embolism. **Methods:** A cross-sectional study was carried out in three hospitals in Douala. We retrospectively reviewed patient records admitted for PE from January 2009 to May 2017. We collected data on epidemiology, clinical presentation, venous Doppler/pulmonary computed tomographic angiography (CTA), and outcome. **Results:** We included 103 patients (56 males) with PE. Their median age was 52 years. The main risk factors were obesity (49.5%), hypertension (35.0%), long trip (24.3%) and cancer (18.4%). The most frequent clinical presentations were dyspnoea (83.4%), chest pain (78.6%), and cough (40.8%). Additionally, pleural effusion (32.8%), atelectasis (25.7%) and pulmonary hyperlucency (20.0%) were the most frequent findings on chest X-ray. The main abnormalities found in electrocardiogram were sinus tachycardia (63.4%), S1Q3T3 aspect (37.6%) and right axial deviation (28.7%). Moreover, right cavities dilatation (26.0%), pulmonary artery hypertension

(35.0%) and pulmonary artery dilatation (21.0%) were the main echocardiographic findings. Low-molecular-weight heparin (LMWH) was the initial anticoagulant in all cases. There were 19 (18.4%) in-hospital deaths, and the mean hospital stay was 8.5 ± 5 days. **Conclusion:** PE is not rare in our setting. Obesity, long trip and cancer are the main risk factors, while dyspnoea, chest pain and respiratory distress are the main clinical presentation for PE. LMWH remains the therapeutic agent of choice. Lastly, in-hospital mortality is very high.

Keywords

Epidemiology, Africa, Venous Thromboembolism, Symptoms

1. Introduction

Venous thromboembolic (VTE) disease is a public health problem worldwide. Pulmonary embolism (PE), which is the most serious presentation of VTE, is the third most common cause of death from cardiovascular disease after heart attack and stroke [1] [2]. It is still undiagnosed, due to the lack of suspicion and availability of appropriate diagnostic testing such as multi-detector computed tomographic angiography (CTA), especially in low resource setting [3] [4] [5]. Moreover, it has a 30-day mortality rate between 9% and 11% [2]. Incidence of PE is growing worldwide, particularly in high income countries [6] [7] [8] [9]. The clinical presentation of pulmonary embolism is non-specific. Symptoms may vary from mild chest pain to shock due to right ventricular failure in patients with massive PE. However, patients with PE sometimes present without any symptoms, the diagnosis being coincidentally when investigating for other conditions [10]. Major risk factors for PE include recent surgery or trauma, lower limb fractures and joint replacements, and spinal cord injury, immobilization, malignancy. However 30% of patients with PE have no detectable provoking factors [11]

In Sub-Saharan Africa, preliminary studies have shown that PE was scarce [5] [12] [13] [14] [15]. Recent studies on the continent have reported more cases, but the limited resources, especially the access to CTA, still contribute to the reduced number of PE cases reported [16] [17] [18] [19] [20]. Despite this situation, the increase in the prevalence of risk factors of VTE suggests that pulmonary embolism will be more frequent in Sub-Saharan Africa. The present study aimed at determining the clinical features as well as imaging presentation and outcome of pulmonary embolism.

2. Methods

2.1. Study Design and Setting

This is a descriptive study which was carried out in the intensive care unit and medical services of three hospitals in Douala. Douala is a city of 3 million inha-

bitants and the economic capital of Cameroon. The three hospitals were selected for the study: 1) Douala General Hospital (DGH), a tertiary care level and teaching hospital; 2) Douala Military Hospital (DMH), a second level hospital; and 3) the Centre des Maladies Respiratoires (CMR), a private clinic in charge of patients who present respiratory problems. These three medical centres easily have access to chest X-ray and computed tomographic angiography, as well as to intensive care unit.

2.2. Study Participants

Patients admitted for a pulmonary embolism between January 2009 and May 2017 were included in the study. Patients aged less than 18 years were excluded as well as patients whose medical records were lacking data on the finding of thoracic CTA. Ethics approval was obtained from the ethical Review Board of the University of Douala.

2.3. Data Collection

Patients were identified using the registers of the services. The medical files were retrieved from the archives and the following data were extracted: sociodemographic factors (age and sex), clinical presentation (chest pain, dyspnoea, haemoptysis, cough, syncope, pulse rate and blood pressure), comorbidities and risk factors of VTE, as well as the results of chest X-ray, electrocardiogram, echocardiography and CTA. The diagnosis of PE was defined by the identification of a thrombus in the pulmonary artery or any of its branches. The following risk factors were investigated: obesity (body mass index of 30 kg/m^2), cancer, previous VTE, HIV infection, pulmonary tuberculosis, myocardiopathy, vascular trauma, chronic kidney disease, recent long trip (duration > 4 hours within the last 4 weeks), pregnancy/early post-partum or post-abortum (< 6 weeks) and recent surgery (< 4 weeks). Immobilisation was defined as bed rest for more than three consecutive days in preceding month, irrespective of the cause. Additionally, the medication used for the initial anticoagulant treatment and the hospitalisation outcome were recorded. The possible outcomes were death, discharge and complications (lung infection, bleeding and bed sores).

2.4. Statistical Analysis

Data were entered and analysed using IBM SPSS Statistics 20 software. Continuous variables were expressed as mean \pm standard deviation. Dichotomous variables were expressed as counts and percentages.

3. Results

During the study period, 130 patients were identified with a diagnosis of pulmonary embolism. Twenty-seven of them were excluded because of missing or incomplete medical records. Finally, a total of 103 cases of PE were included in the study. Among them, 56 (54.4%) were males, and the median age was 52 years

(interquartile range: 41 - 63). Participants aged 50 to 59 years were the most represented (26.2%). **Table 1** shows the baseline characteristics of the study population.

Obesity (49.5), hypertension (35.0%) and cancer (18.4%) were the most common underlying comorbidities. The risk factors of venous thromboembolism found in this study are shown in **Table 2**. Obesity (49.5%), hypertension (35.0%), recent long travel (24.3%), cancer (18.4%), immobilisation (16.5%) and recent surgery (15.5%) were the most common risk factors. Moreover, **Table 3** shows that the most frequent symptom in patients with PE was dyspnoea (83.4%). Eight patients (7.8%) presented signs of cardiogenic shock, while syncope was seen in 6 patients (5.8%). Signs of deep venous thrombosis were found in 27 patients (24.3%).

At presentation, electrocardiography was performed for 101 patients. Among them, 16 patients (15.5%) had a normal electrocardiogram. Sinus tachycardia (63.4%) was the most common finding. The S1Q3T3 pattern was seen in 38 patients (37.6%) and the right bundle branch block in 11 patients (10.9%). Among the 68 patients whose oxygen saturation (SpO₂) was noted upon arrival at the hospital, 23.5% (16 patients) had SpO₂ less than 90%. The median SpO₂ was 96% (interquartile range: 91 - 98).

Table 1. General characteristics of study population (N = 103).

Variables	Frequency (%)
Gender	
Male	56 (54.4)
Female	47 (45.6)
Age (years)	
Median age (IQR*)	52 (41 - 63)
<30	8 (7.8)
30 - 39	12 (11.7)
40 - 49	23 (22.3)
50 - 59	27 (26.2)
60 - 69	21 (20.4)
≥70	12 (11.7)
Admission service	21 (22.6)
Internal Medicine	83 (80.6)
Intensive care unit	20 (19.4)
Origin	
Home	53 (52.4)
Referred from other hospitals	41 (39.9)
Transferred from other wards	9 (8.7)

(*) interquartile range.

Table 2. Venous thromboembolism risk factors in the study population (N = 103).

Risks factors	Frequency (%)
Medical risk factors	
Hypertension	36 (35)
Cancer	19 (18.4)
Past history of deep venous thrombosis	15 (14.6)
Myocardopathy	10 (9.7)
Diabetes	9 (8.7)
HIV infection	8 (7.8)
Arrhythmia	7 (6.8)
Chronic Kidney disease	5 (4.9)
Autoimmune disease	3 (2.9)
Recent infection	3 (2.9)
Sickle cell disease	2 (1.9)
Stroke	1 (1)
Pulmonary tuberculosis	1 (1)
Varicose veins	1 (1)
Surgical and gynecological risk factors	
Recent surgery	16 (15.5)
Post partum	2 (1.9)
Pregnancy	1 (1)
Abortion	1 (1)
Other risk factors	
Obesity	51 (49.5)
Long trip	25 (24.3)
Smoking	18 (17.5)
Immobility	17 (16.5)
Hormone therapy replacement	6 (5.8)

Table 3. Clinical and para-clinical presentation of pulmonary embolism.

Variables	Frequency (%)
Signs and symptoms (n = 103)	
Dyspnea	86 (83.4)
Chest pain	81 (78.6%)
Cough	42 (40.8)
Hemoptysis	11 (10.7)
Right heart failure	24 (23.3)
Cardiogenic shock	8 (7.8)

Continued

Syncope	6 (5.8)
Signs of deep venous thrombosis	27 (24.3)
Chest X-ray finding (n = 70)	
Pleural effusion	23 (32.8)
Atelectasis	18 (25.7)
Pulmonary hyperlucency	14 (20)
Pulmonary artery enlargement	12 (17.1)
ECG (n = 101)	
Sinus Tachycardia	64 (63.4)
S1Q3T3 pattern	38 (37.6)
Right axis deviation	29 (28.7)
T-wave inversion in leads V1-V4	26 (25.7)
Right bundle branch block	11 (10.9)
Cardiac echography (n = 100)	
Right ventricle dilatation	26 (26)
Elevated pulmonary systolic pressure	35 (35)
Pulmonary artery enlargement	21 (21)
Right ventricle hypokinesis	13 (13)
Mobile right heart thrombi	9 (9)

Chest X-ray was available in 70 patients, and the main findings were pleural effusion (32.3%) and atelectasis (25.7%). Transthoracic echocardiography was performed in 101 patients. Right ventricle dilatation (26.0%) and elevated pulmonary systolic pressure (35.0%) were the most frequent echocardiographic findings. The pulmonary CTA showed a bilateral pulmonary embolism in 40 patients (38.8%) and a proximal location of pulmonary embolism in 75 participants (72.8%).

Anticoagulant therapy was commenced in all cases with Low-molecular-weight heparin (LMWH) and followed with vitamin K antagonists (VKA) in 92 (89.3%) and a new oral anticoagulant (rivaroxaban) in 11 (10.7%) cases. Complications were mostly represented by pulmonary infection in 31 (30.1%) patients and cardiogenic shock in 14 (13.6%). Median duration of the hospital stay was 7 days (interquartile range: 5 - 11), while the in-hospital mortality rate was 18.4%.

4. Discussion

This study is part of the rare studies on pulmonary embolism in Sub-Saharan Africa. It presents the key findings with regard to clinical characteristics and outcome of patients with PE. We found that PE mostly affects a younger popula-

tion, with a median age of 52 years. In the northwest region of Cameroon, Abah *et al.* found a mean age of 56 years among patients with a diagnosed venous thromboembolism [21]. Similar results were noted in previous studies in other Sub-Saharan African countries [12] [16] [22] and in Asia [23] [24]. On the contrary, PE population consists of middle age to elderly people in western countries [2] [25]. Knowing that the risk of pulmonary embolism increases with age, the higher prevalence in developed countries is probably due to the increase of the life expectancy in these countries [26] [27].

The main risk factors in this study were obesity, hypertension, recent long trip, cancer, immobilisation and recent surgery. These results were similar to those found in previous reports in Sub-Saharan Africa [12] [15] [17] [18], Europe and Asia [25] [26]. The main symptoms at presentation in this study were dyspnoea, followed by chest pain and cough. These findings are similar to those found in other African countries [12] [16] [22] and in other parts of the world [2] [28] [29]. Syncope was the reason of admission in 5.8%. A similar result was noted by Bakebe *et al.* in Democratic Republic of Congo [16]. A systematic review on PE in Europe showed a variation of syncope frequency from 6% to 39% [28]. This heterogeneity is probably due to the fact that syncope is usually present in severe PE, which had various frequencies in different reports. The proposed mechanisms of syncope in PE includes 1) reduction of cerebral blood flow due to the decrease in cardiac output, 2) the vasovagal reflex and 3) cardiac arrhythmia and conduction disturbances due to right ventricle overload [30].

Signs of deep venous thrombosis were noted in 24.3%, which is also found in previous reports [10] [31]. On the chest X-ray, pleural effusion, atelectasis and pulmonary hyperlucency were the most common findings, as reported in the literature [12] [16] [28]. It is established that chest X-ray is not a sensitive and specific tool for the diagnosis of PE [32], which was normal in 24.3% in our study. Moreover, chest X-ray is a non-invasive diagnostic assessment that can be used for the differential diagnosis of pulmonary embolism. Unsurprisingly, sinus tachycardia was the most observed on electrocardiography.

Pulmonary CTA was the diagnostic tool for PE. Its advent has been a major progress in the diagnosis of pulmonary embolism, especially in developing countries where the ventilation/perfusion scan is not available. Pulmonary CTA is known to have a good sensitivity and specificity for proximal PE, but less sensitive for distal location [33]. We found a proximal location of PE in 72.8% of participants. Similar result was found by Calvin Davidsingh *et al.* in India [32].

The most frequent abnormality on electrocardiogram (ECG) was sinus tachycardia, as found also in previous reports [12] [25] [32]. Although ECG can be normal in PE, other findings in PE include SIQ3T3 pattern, ST and T wave changes in anterior leads, RBBB, axis changes, transition zone shift to the right, P-pulmonale and atrial arrhythmia in severe PE. Cardiac echography findings were similar to the reports by Houenassi *et al.* and Bakebe *et al.*, where right cavities dilatation and pulmonary arterial hypertension were the most frequent

anomalies (13, 16). On the other hand, paradoxical septum, right ventricular dysfunction and right ventricular hypokinesis were noted by other previous reports. This discrepancy is probably due to the fact that in the latter reports, the proportion of severe PE was more important [2] [12] [32].

The in-hospital mortality rate of patients diagnosed with pulmonary embolism varies, depending on the setting of the studies. The 18.4% mortality rate found in our study is consistent with data reported by Kingue *et al.* [15] and Houenassi *et al.* [13]. However, Bakebe *et al.* found a mortality rate of 7.0% in Kinshasa [16]. The difference in severity of PE and the relatively low sample sizes of studies in Sub-Saharan Africa could explain the variability of the mortality rate. A remarkably low mortality rate of 3.4% was noted in a large study conducted in emergency department setting in the United States of America [2]. This difference in mortality rate could be explained by the fact that the length of stay in emergency department is usually lower than in conventional medical ward.

Although the present study is among the first multicentre report on PE in Sub-Saharan Africa, some limitations could be noted. First, the retrospective design used could be a source of recall bias. Herein, data were extracted from the medical records, and the findings could be underestimated, depending on the documentation of the records by physicians. However, a standardised data collection sheet was used in this study. Second, the reduced sample size in our study, compared to other studies in western countries, could be another limitation.

5. Conclusion

Obesity, long trip and cancer are the main risk factors for PE in Cameroon. Symptoms and imaging are similar to those of previous reports. In our setting, in-hospital mortality remains very high. Further studies with larger sample size are thus needed for a detailed description in Sub-Saharan Africa with a focus on the outcome.

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Authors' Contribution

Conception and Design: MNBH, KF; Data collection: CN; Data analysis and Interpretation: MNBH; Drafting of the manuscript: NSRS. Reviewing the manuscript: DA, ESA, TB, KLF, MNY, MS, NHR, LNH. All authors read and approved the final draft for publication.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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