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Clinical and Demographic Predictors of Acute Pulmonary Embolism in Central Africa Using 64-Rows Multi-Detector Computed Tomography Angiography

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Abstract

Background: Acute pulmonary embolism is a life-threatening entity. Its diagnosis remains a challenge for clinicians and it is important to be aware of factors that increase risks of the disease. In this study, we access the clinical and demographic predictors of pulmonary embolism using 64-rows multi-detector Computed Tomography Angiography in central Africa.

Methods: From 01 January to 30 July 2016, the data record of patients who underwent chest 64-rows multi-detector Computed Tomography Angiography indicated for clinical suspicion of acute pulmonary embolism at Biamba Marie Mutombo Dikembe Hospital were retrospectively were revisited and analyzed using logistic regression models.

Results: Sixty-five consecutive patients (age range, 24 to 84 years and mean age 56.8 ± 14.9 years) were included with a female predominance. Pulmonary embolism was formerly detected in 17 patients (26.2% of cases). Age ≥ 65 years (OR = 9.5 CI 95%:14.74, 60.79, p = 0.018) and obesity (OR = 40.8 CI 95%:2.85, 58.44, p = 0.006) were the predictors of pulmonary embolism. Heart disease and pneumonia were the main pathologies associated and the main alternative diagnoses.

Conclusion: This study shows that age and obesity were independent predictors of PE. In central Africa where Computed Tomography machine is not widely available, aged and obese patients with a clinical suspicion of pulmonary embolism should be dealt with as a higher suspicion of true pulmonary embolism.

Keywords

Pulmonary Embolism, multi-detector computed tomography angiography, central Africa

1. Background

In Central Africa, a resource-poor environment, the diagnosis of acute Pulmonary Embolism (PE) based on clinical symptoms, chest X-ray and results of the electrocardiogram is nonspecific. In practice, findings from above parameters are combined to establish a clinical probability score of Well and revised score of PE. The laboratory tests as D-dimer provides additional probability elements and realization of a chest Multidetector Computed Tomography Angiogram (MDCTA) has the advantage of visualizing the embolus and confirming the final diagnosis (Louzir et al., 2012; Tapson, 2012; Raya et al., 2015; Murthy et al., 2015).

The use of this modality in sub-Saharan countries which have limited medical resources is yet to be improved. In recent years elsewhere in Africa, studies concerning detection of PE by MDCTA have been conducted and they found that PE is not uncommon (Owusu, 2009; Ongeng'o et al., 2011; Tambe et al., 2012). PE is a preventable disease and it is necessary to be aware of factors associated with this cause of sudden death. The aim of the present study was to determine the clinical and demographic predictors of PE in central Africa using 64 rows MDCTA in patients suspected of PE, which may be dealt with as a higher suspicion of true PE. And to the best of our knowledge, this is the first study carried out in this part of sub-Saharan Africa to investigate the epidemiology of PE using 64 rows MDCTA.

2. Methods

The medical record of patients from the emergency department who visited the department of radiology of Biamba Marie Mutombo Dikembe Research Center and Hospital, Kinshasa City in the Democratic Republic of the Congo from 01 January to July 2016 for clinical suspicion of acute PE were revisited. Data concerning age and gender of patients, clinical symptoms and predisposing factors such as obesity (with BMI ≥ 30 kg/m^2), chronic hypertension and heart disease were registered.

All patients were examined using a 64 rows MDCTA machine (Siemens Medical System, Sensation, Erlangen, Germany) with an automatic injector (Medrad, Bayer Healthcare, Pittsburgh, Pa, USA) for contrast media. Three radiologists reviewed CT images of all patients. A consensus was used to solve disagreements. Following parameters were searched in each CT examination: the accuracy of diagnosis of PE, the characterization of vascular lesions, the presence of associated parenchyma lesions and presence of mimicking lesions (i.e., the discrimination with other pathologies). Proximal PE was defined as thrombi visualized in the main trunk of the pulmonary artery and/or in the right or left main pulmonary arteries. Distal PE was defined as thrombi located exclusively in segmental or subsegmental pulmonary arteries (Martinez et al., 2016).

3. Statistical Analysis

The statistical analysis was performed using commercially available software (SPSS version 21). Based on MDCTA results, patients were divided into two groups: PE positive and PE negative. First, we conducted univariate analysis using Chi-squared test or Student's t-test to evaluate whether there is any difference between the two groups of patients regarding demographic, clinical items and predisposing factors. Next, we conducted a multivariate logistic regression to detect data independently predicting the presence of PE. For that, only items which were associated with the presence of PE in univariate analysis were put into the multivariate model. A probability value of $p < 0.05$ was considered as statistically significant.

The approbation by local research ethics committee was obtained.

4. Results

Sixty-five consecutive patients clinically-suspected PE were enrolled into the present study with 54% women, ranged in age from 24 to 84 years (mean, 56.8 ± 14.9 years). PE was formerly diagnosed in 26.2% of cases. More than half of these patients were aged > 65 years. The difference in age was statistically significant ($p = 0.017$). Clinical data of the 2 groups of patients (PE positive and PE negative) are presented in Table 1. On univariate analysis (Table 2), the following variables were associated with the PE: age ≥ 65 years ($p = 0.022$), obesity ($p = 0.001$) and heart disease ($p = 0.036$). Results of multivariate analyses are shown in Table 3, age ($p = 0.018$) and obesity ($p = 0.006$) were the two independent predictors of PE. MDCTA data on the characterization of the lesion are summarized in the Figure 1. Heart disease, pneumonia and malignancy are the main alternative diagnoses without statistical significance.

5. Discussion

Acute PE is responsible for 100,000 to 300,000 deaths per year in the United States and it is a major cause of mortality, morbidity, and hospitalization in Europe (Insenser, 2014). In this study conducted in Central Africa to assess patients clinically suspect of PE using a 64 rows MDCTA, 17 patients formerly diagnosed with PE in seven months advocate that PE seems to be a rare disease in Sub-Saharan Africa. The number of cases may be very high in our region, but the low socioeconomic status of the general population (with no access to adequate health care with out of hospital death of subjects) and the number CT machines may limits how serious the disease may be as recently found by others authors (Tambe et al., 2012).

In this series, classical symptoms as noted by clinicians were dyspnea, chest pain and cough (Table 1). Tapson in the USA (2012) reported dyspnea and chest pain to be the most common symptoms of acute PE.

The mean age of the patients with acute PE was 64.1 ± 13.8 years old and was significantly higher compared to this of patients without PE with 52.2 ± 14.6 years old (p = 0.01). In the series of Ogeng'o

et al. in Eastern Africa (2011), the mean age was 40.8 years (range 5-86 years) with a peak between 30 and 50 years. In the study of Tambe et al. in Cameroon (2012), the mean age of the patients was 47.6 ± 10.5 years (age range from 33 to 65 years).

The difference was statistically significant for the two group concerning age, dyspnea, obesity, chest pain and cough (Table 1).

Table 1. Clinical Data of the 2 Groups of Patients (PE Negative versus PE Positive)

Variables	PE negative (n = 48)	PE positive (n = 17)	All (n = 65)	p
Age (mean ± SD), years old	54.2 ± 14.6	64.2 ± 13.8	56.8 ± 14.9	0.017
≤ 35	4(8, 3%)	1(5, 9%)	5(7, 7%)	
36-45	9(18, 8%)	1(5, 9%)	10(15, 4%)	
46-55	15(31, 3%)	3(17, 6%)	18(27, 7%)	
56-65	10(20, 8%)	3(17, 6%)	13(20, 0%)	
≥ 65	10(20, 8%)	9(52, 9%)	19(29, 2%)	
Gender				0.567
Male	22(45, 8%)	8(47, 1%)	30(46, 2%)	
Female		9(52, 9%)	35(43, 1%)	
Dyspnea	18(37, 5%)	10(58, 8%)	28(43, 1%)	0.002
Obesity	1(2, 1%)	7(41, 2%)	8(12, 3%)	0.007
Chest pain	15(31, 3%)	7(41, 2%)	22(33, 8%)	0.032
Cough	0(0, 0%)	4(23, 5%)	4(6, 2%)	0.028
Venous thromboemolism	1(2, 1%)	0(0, 0%)	1(1, 5%)	0.738
Arterial hypertension	3(6, 3%)	0(0, 0%)	3(4, 6%)	0.396

The difference were statistically significant for the two group concerning age, dyspnea, obesity, chest pain and cough.

In Africa, age has a pronounced influence and the incidence increases steadily after the age of 40 (Elegbeleye et al., 1975). The obese patients in this study had an adjusted relative risk of 41 (95% CI: 2.85, 58.44, $p = 0.006$) suggesting that this finding bears important clinical significance. The relevance of obesity with regards to PE was widely reported by some European and American published series (Heit et al., 2010; Duriseti et al., 2010; Goldhaber et al., 1983; Goldhaber, 2010). For Goldhaber et al. (1983, 2010), obesity is an important long-term factor for significant PE at autopsy, and maintaining lower weight might decrease the risk of pulmonary embolism. Stein et al. (2015) noticed that obesity is a risk factor for venous thromboembolic disease in men as well in women. In addition, Hansson et al. (1999) showed that abdominal obesity is an independent risk factor for venous thromboembolism. In Africa, the study of Kingue et al. in Cameroon (2002) and Shimi Maha et al. in Tunisia (2014) reported

this predisposing factor. Our study emphasizes obesity as predicting factor of PE in clinically-suspected patients (Tables 2 and 3).

Table 2. Factors Associated with PE in Univariate Analysis

Variables	ß	p	OR	CI 95%	
Age (< 65 years versus ≥ 65 years)	1.34	**0.022**	3.85	1.21	12.23
Gender (male vs female)	0.04	0.931	1.05	0.35	3.18
Obesity (yes vs no)	3.73	**0.001**	41.78	4.64	376.20
Cardiopathy (yes vs no)	1.00	**0.036**	2.73	1.31	24.00
Arterial hypertension (yes vs no)	1.16	0.181	3.21	0.58	17.75

Table 3. Factors Associated with PE on Multiple Logistic Regressions

Variables	ß	P	OR	CI 95%	
Age (< 65 years vs ≥ 65 years)	2.25	**0.018**	9.5	1.47	60.78
Obesity (yes vs no)	3.71	**0.006**	40.8	2.85	58.44

In this work, no association was observed between the gender and the presence of PE. This result which disagrees reports from some western countries (Di Minno et al., 2016; Panigada et al., 2016), is consistent with other Africans series (Ongeng'o et al., 2011; Tambe et al., 2012). We believe that the discrepancy of results between African and western series may be due to the relative lack of wide used of oral contraceptive in African female. This lack could be explained by African culture barriers. This assumption is supported by the fact that, although living in developed countries, female African Americans have been reported to use less oral contraceptive than their peers Caucasians (Heit et al., 2010).

In this series, the PE was diagnosed formally in 26.2% of cases. Tambe et al. in Cameroon recorded a rate of 32% of the positive angiogram. For our patients, 64.7% of cases of diagnosed PE presented as a complete filling defect of low attenuation on CTA and 35.3% showed a partial filling defect (Figure 1). The distribution of complete filling and localization of the emboli are similar to prior reports (Martinez et al., 2016) with 47% of emboli located proximally and 53% distally.

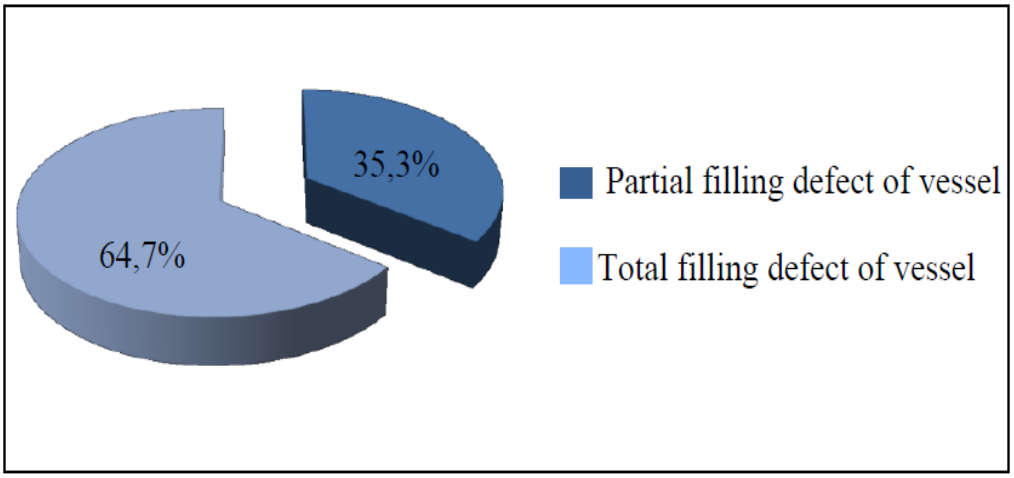

Figure 1. Characterization of PE at MDCTA. Partial Filling Defect of Vessel was Seen in 35.3% and Complete Defect in 64.7%

Pneumonia is a frequent infectious disease under the tropics (Ho, 2014). In our series, some PE patients had concomitant diagnoses of pneumonia and heart disease in a proportion of 29.4%. Heart disease ($p = 0.032$) were significantly higher in patients with pulmonary embolism, and pneumonia had not reached the threshold of statistical significance. We suggest that in low setting area, radiological diagnosis of basal alveolar opacity should not be linked only to infectious pneumonia but also in the context of a non-infectious syndrome and in failure to respond to antibiotic treatment, clinicians have to evocate a thromboembolism event, perform laboratory test as age-adjusted D-dimer cutoff and quickly order therapy to reduce morbidity and mortality.

The discrimination with other pathologies was assessed. Alternative diagnoses were identified in 55.4% and distributed as follows: 30% reported as infectious pneumonia, 7.7% of heart diseases and 4.3% of malignancy. For Tambo and coworkers, significant findings in PE negative patients included lung consolidation, pleural effusion and aneurysms of the thoracic vessels.

6. Limitations

Our analysis has several limitations. A first bias may be the small sample size of this monocentric study and the second was that several factors associated with PE under tropics as parasitic and HIV/AIDS infections endemic in our area weren't accessed in the study. Recently, the first case of PE associated with malaria was documented in Kampala (Musoke et al., 2014). And the association of PE with HIV/AIDS infection and with tuberculosis have been described (Ekukwe, 2014; Ramlakhan et al., 2017; Park et al., 2017; Gupta et al., 2017).

Despite these limitations, this study carried out in Central Africa and based on 64 rows MDCTA, seems to be the first one as far as we are aware. It reports that age and obesity were independent predictors of PE in patients clinically suspected after multivariate analysis. The cost of the current approach of

diagnosis, the mortality and the morbidity of PE make it a burden disease. What is of interest in the geographic area where CT machine is not widely available, is that aged and obese patients should be dealt with as a higher suspicion of true PE among patients with a clinical suspicion of PE. This study may provide valuable information on the selection of patient undergoing CT angiography test, highlighting the value of this publication.

6.1 Further Research Directions

A multicentric study with a sufficient number of patients identified as high-risk group in-hospital, has to be conducted, taking into account the role of parasitizes, tuberculosis and HIV/AIDS infection associated with PE under tropics.

A second investigation with usual method of diagnosis of PE and MDCTA the gold standard test need to be undertaken to illustrate a potential gap in diagnosis probability and to see if the MDCT findings can be correlated to the clinical probability score. The study will define the utility of this test in the population of central Africa. Finally, the opinion that possession of hemoglobin S disposes to PE in Africans (Elegbeleye et al., 1975) has to be verified.

7. Conclusion

In this resource-poor environment, MDCTA is of paramount diagnostic utility to improve the detection of PE and determining that age and obesity were independent predictors of PE in clinically suspected patients. They should be dealt with as a higher suspicion of true PE, among patients with a clinical suspicion.

8. Declaration

Ethics approval and consent to participate: This retrospective study was approved by our institutional review board. The requirement for patients' provision of informed consent was waived. All authors consented to participle to the work.

- Consent for publication: All authors consented to publication.
- Availability of data and material: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.
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- Author's contribution: Florent WETSHOKONDA LOMAMBA: acquisition of data and reviewed CT images of all patients. Jean MUKAYA TSHIBOLA: supervise the field activities and designed the study's analytic strategy and reviewed CT images of all patients. Michel LELO TSHIKWELA: reviewed CT images of all patients, revised article and conducted final approval of the version to be sent to the journal.
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