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Computed Tomography Practices in the Diagnosis of Pulmonary Embolism at the University Hospital Center (CHU-RN), N'Djamena, Chad

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Abstract: Pulmonary embolism is the third most common cardiovascular and respiratory disease after myocardial infarction and stroke. It remains one of the leading causes of death. Although very dangerous, its incidence has declined in recent decades. This is confirmed by longitudinal autopsy studies showing that in 70% of deaths from pulmonary embolism, the diagnosis was not made during the patient's lifetime.

This was a descriptive study with both retrospective and prospective components. It focused on patient records and patients who came to the Radiology Department for chest pain and suspected pulmonary embolism at the National Central Reference Hospital in N'Djamena (HGRN). It covers the last three years, which is retrospective, and the four months from June to September 2023, which is prospective, entitled "The use of computed tomography in the diagnosis of pulmonary embolism". Data collection was carried out using structured and semi-structured questionnaires, which enabled information to be gathered from these patients.

Keywords*: Computed Tomography, Diagnosis, Pulmonary Embolism.*

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I. INTRODUCTION

Computed tomography (CT) or scanography, also known as computerized tomography in English-speaking countries, is a radiological imaging technique that produces axial slices reconstructed from the X-ray attenuation coefficient in the scanned volume. Thanks to continuous improvements in its technical performance, CT has experienced considerable growth over the past 20 years, justified by its diagnostic value [1].

CT is one of the most effective modern medical imaging methods, both in terms of diagnosis and interventional radiology; its medical use in the 1970s revolutionized medical diagnosis. [2]. Pulmonary embolism is the third most frequent cardiovascular and respiratory disease after myocardial infarction and stroke and remains one of the leading causes of death [3]. Longitudinal autopsy studies have demonstrated that in nearly 70% of deaths caused by pulmonary embolism, the diagnosis was not established during the patient's lifetime [4].

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In Europe, the prevalence of pulmonary embolism ranges from 17% to 42.6%, with reported rates varying between 8% and 52%, including necropsy findings [5]. In Côte d'Ivoire, a study conducted in the intensive care unit of the Abidjan Institute of Cardiology reported a mortality risk of 13% related to pulmonary embolism [6].

In Burkina Faso, pulmonary embolism accounted for 3.8% of cardiovascular and respiratory manifestations among patients with HIV infection [7]. In Chad, a study conducted in the cardiology department of the Renaissance University Hospital reported a prevalence of pulmonary embolism of 12.1% in 2021 [8].

Given the magnitude and severity of this public health problem, we undertook the present study entitled: "Computed Tomography Practices in the Diagnosis of Pulmonary Embolism at the National General Reference Hospital of N'Djamena, Chad."

What CT imaging procedures and practices are used for the diagnosis of pulmonary embolism in the Radiology and Medical Imaging Unit of the National General Reference Hospital of N'Djamena, and how can CT practice be optimized to improve the detection rate of this condition?

➢ *General Objective*

To study the procedures and practices of pulmonary CT angiography used in the Radiology and Medical Imaging Unit of the National Reference General Hospital in N'Djamena (CHAD) and investigate how to optimize these practices in order to improve the detection of this pathology.

➢ *Specific Objectives*

- To study the socio-professional characteristics of patients in the Radiology and Medical Imaging Unit at HGRN.
- To study the protocols defined and analyze the practices of CT angiography personnel in the Radiology Unit of the HGRN in N'Djamena.
- To highlight the shortcomings and associated factors in the Radiology and Medical Imaging Unit of the National General Reference Hospital in N'Djamena.

II. METHODOLOGY

A. Location and Setting of Study:

This study was conducted in the Radiology and Medical Imaging Unit of the National General Reference Hospital of N'Djamena (HGRN), located in the political capital of Chad, (Djambal-Barh district).

B. Type of Study:

This is a retrospective and prospective study.

C. Period and Duration of Study:

Our retrospective study period covered the last three years, namely 2020, 2021, and 2022, and the prospective part covered the four months from June to September 2023.

D. Study population:

The study included all patient records who underwent CT scans for pulmonary embolism and patients who came in or underwent CT scans for chest pain or suspected pulmonary embolism at the Medical Imaging Radiology Unit of the National General Reference Hospital in N'Djamena.

E. Sampling

F. Sampling Size

The minimum sample size was calculated using the Lorentz formula, as follows:

$N=P.\ (1-P).\ Zo^2\ /d2$. N is the minimum required sample size. P is the prevalence of pulmonary embolism, estimated at 12.1% [8]. Z_0 corresponds to the significance threshold of 1.96, representing a 95% confidence level. D is the margin of error, set at 5%; N=163 subjects

- It is a consecutive sampling
- The final study sample consisted of 70

G. Inclusion Criteria:

Our study included all patient records who underwent CT scans for pulmonary embolism and patients who came in or underwent CT scans for suspected pulmonary embolism or chest pain in the Radiology and Medical Imaging Department at the National General Reference Hospital in N'Djamena during our study period.

H. Exclusion Criteria:

All patient files and patients who came for or had undergone other CT scans in the Radiology Unit during our study were excluded from our study.

I. Study Procedure

We used three techniques: documentary research, survey research, and observational research.

➢ *Documentary Research: This Enabled Us to:*

- Determine the socioeconomic status and characteristics of patients meeting the inclusion criteria.
- Identify the protocols defined for CT angiography in the diagnosis of pulmonary embolism.

➢ *Survey: This was Conducted Among Staff to Determine:*

- Are they familiar with standard protocols?
- What do they think of them?
- What difficulties do they encounter in implementing the protocols as defined and in relation to standard protocols?

Observational study: this allows the findings obtained during the study to be confirmed or refuted. It should be noted that our technical data sheet will include the data obtained from these three research elements, which are: the documentary study, the survey, and the observational study.

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J. Study Materials

We used a number of materials to assist us in our study, such as: technical data sheets, pens, correction fluid, notepads, reams of paper, USB drives, laptops, and finally, Internet keys.

➢ *Method:*

Protocol for performing a scan for suspected embolism or chest pain.

A 64-slice Fuji Film Scenaria View scanner. Preparation for the examination consisted of welcoming the patient and explaining the procedure, duration, benefits, and contraindications of the examination. The placement of a 20. Peripheral venous line was necessary for cases involving the injection of iodinated contrast medium.

➢ *Acquisition:*

The examination was initially performed in frontal scout view, covering the region from the lung apices to the posterior costophrenic angles. In some cases, a lateral scout view was also used to enable automatic dose modulation. The table movement direction was craniocaudal.

➢ *Dose Settings:*

- 100kV for thin patients weighing less than 50kg, 120kV for patients of normal build, and 140kV for patients weighing more than 90kg.
- Dose modulation, maintaining a good signal-to-noise ratio for good intravascular contrast analysis.
- Acquisition Parameters
- Field of view determined in radio mode.
- Apnea after deep inspiration, avoiding the Valsalva maneuver.
- Slice thickness close to one millimeter.

➢ *Filters*

- The filter optimizing density resolution for the study of pulmonary vessels,
- The filter optimizing special resolution for the study of pulmonary parenchyma and bronchi.

➢ *Contrast Medium Injection*

we first took the route: Generally at the crease of the right or left elbow with a 20g Teflon-coated needle.

- *The Parameters were:*

✓ Volume: 70−90ml on a multibar device,
✓ Concentration: 300 mg iodine/ml,
✓ Delay: 15 seconds or visual trigger or automatic contrast detection software. The region of interest (KING) could be positioned in the right atrium for caudo-cranial acquisition or in the pulmonary artery trunk for craniocaudal acquisition.
✓ Flow rate: 3−4 mL/s

For elderly patients, a lower flow rate of 2 mL/s with a longer delay of 35 seconds was used.

In cases of inadequate contrast enhancement, a repeat acquisition was performed after identifying the cause of failure and reinjecting contrast medium, provided that renal function was adequate.

K. Ethical Considerations:

This research project has been submitted to the ethics committee for approval. Authorization for the study has been obtained from the Director General of the National General Reference Hospital in N'Djamena. We have ensured the confidentiality of the information collected, and all files and records have been consulted only in the Radiology and Medical Imaging Unit of the National Reference General Hospital in N'Djamena or in the archives of the HGRN Radiology and Medical Imaging Unit.

L. Data Processing and Analysis

Data were collected using questionnaires and patient medical records. Variables were coded prior to data entry into Epi Info version 3.5.3 (2011). Appropriate consistency checks were performed using algorithms to minimize data entry errors. The data were subsequently exported to Microsoft Excel 2010. Thus, some inconsistencies were corrected. Statistical indicators were calculated according to the type of variables analyzed. Text processing was carried out using Microsoft Word 2007.

III. RESULTS

➢ *Socio-Demographic Characteristics*

- *Sex*

We conducted a retrospective study of patient records in the radiology department of the HGRN in N'Djamena from 2020, 2021, and 2022, as well as a prospective study covering four months from June to September 2023. We collected 563 files of patients who were admitted to the Radiology and Medical Imaging Department of the HGRN in N'Djamena, including 70 patients with suspected pulmonary embolism.

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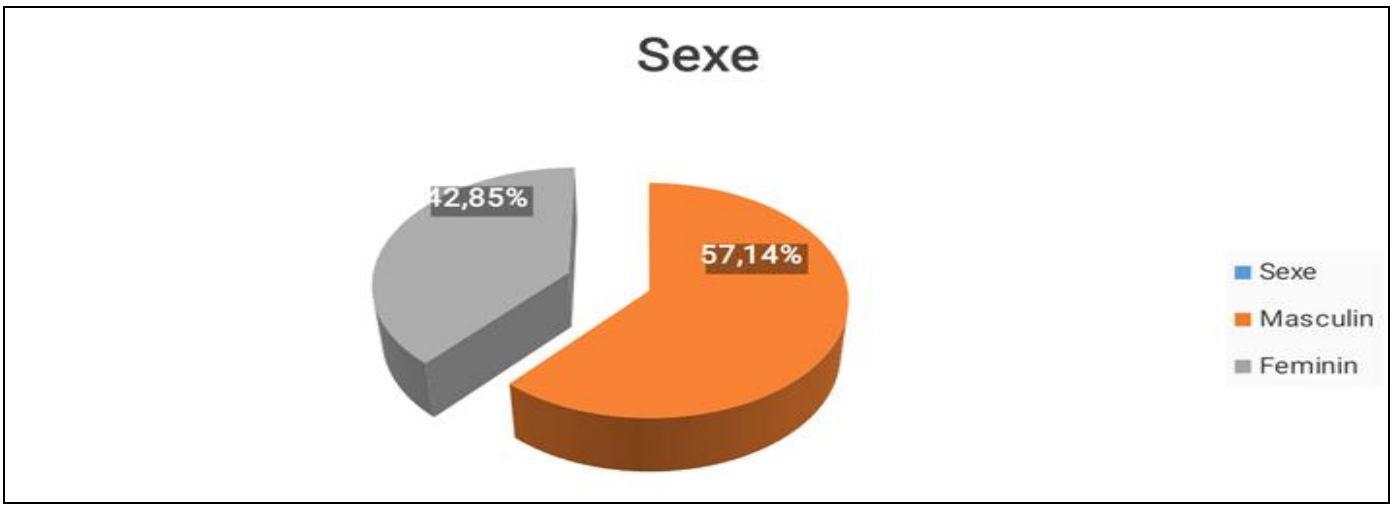

Fig 1 Distribution of Patients According to Sex

The above table and the pie chart show that males were in the majority with (40) or 57.14% and a gender ratio (M/F) of 1.60.

- *Place of Residence*

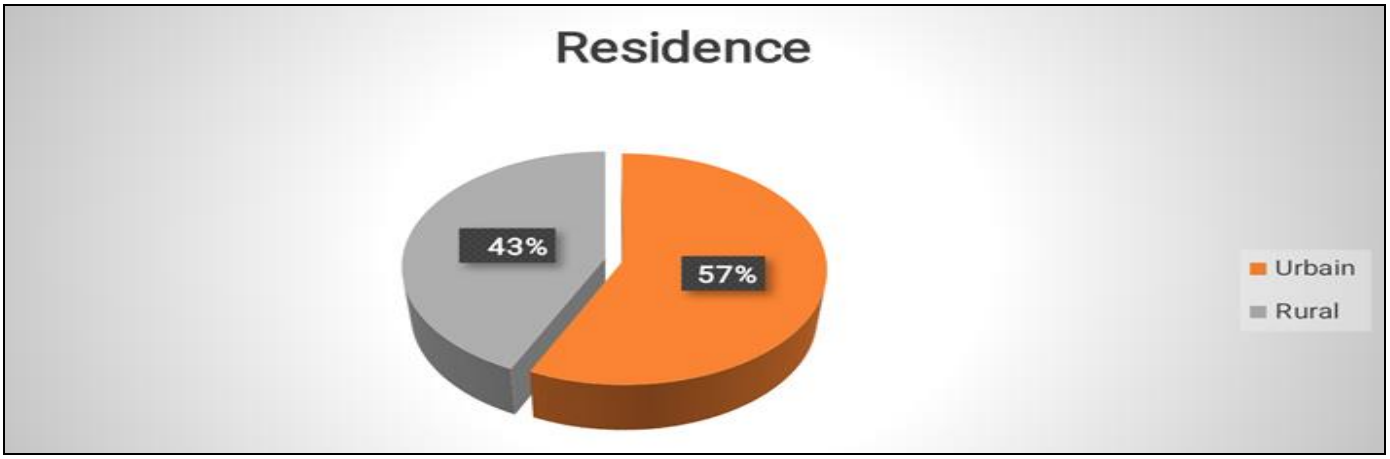

Fig 2 Distribution of Patients According to Place of Residence

It shows that the majority of our patients lived in urban areas, i.e., 57.14%.

- *Marital Status*

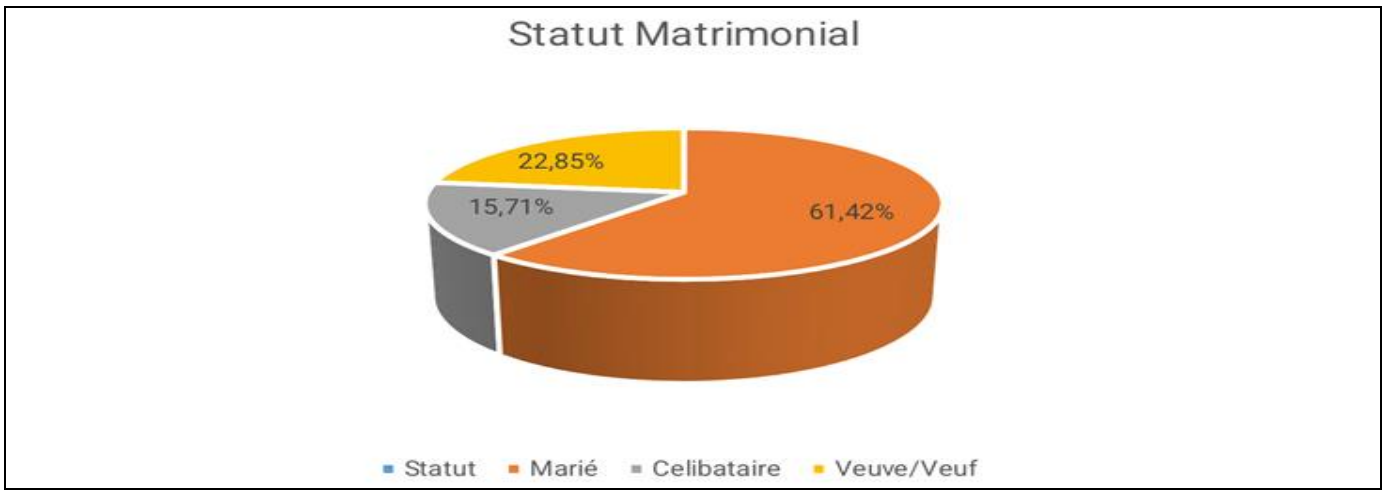

Fig 3 Distribution of patients according to marital status

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Most patients were married, representing 61.42% of the sample.

- *Occupation*

Civil servants predominated, with 28, or 40%.

Table 1 Distribution of Patients According to Occupation

Occupation	Number	Percentage (%)
Civil Servant	28	40
Student	5	7.14
Housewife	10	14.28
Driver	11	15.71
Retired	16	22.85
Total	70	100

- *Risk Factors for Pulmonary Embolism*

The most frequent risk factor identified was hypertension, observed in 43 patients (61.42%).

Table 2 Distribution of Patients According to Pulmonary Embolism Risk Factors

Risk Factors	Number	Percentage (%)
Hypertension	43	61.42
Diabetes	20	28.57
Lower limb thrombophlebitis	7	10
Total	70	100

- *Referring Departments*

The cardiology department accounted for the highest number of referrals, with 32 cases (45.71%), followed by pulmonology with 20 cases (28.57%).

Table 3 Distribution of Patients According to Referring Departments

Service	Number	Percentage (%)
Cardiology	32	45.71
Pulmonology	20	28.57
Neurology	5	7.14
Intensive Care	13	18.57
Total	70	100

- *Age*

Table 4 Distribution of Patients According to Age Group

Age Group	Number	Percentage (%)
21−30	2	2.85
31−40	6	8.57
41−50	11	15.71
51-60	15	21.42
61-70	22	31.42
71-80	14	20
Total	70	100

- *Distribution According to CT Examination Findings*

This table, accompanied by the pie chart, shows that pathological examinations were the most common (45), accounting for 64.28%.

Table 5 Distribution of Patients According to CT Examination Findings

CT Examination Result	Number	Percentage (%)
Normal Examination	25	35.71
Pathological Examination	45	64.28
Total	70	100

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From this table and the pie chart, it appears that pathological examinations were the most common (45), accounting for 64.28%.

- *Clinical Presentations*

Dyspnea was the most common presenting symptom, reported in 31 patients (44.28%).

Table 6 Distribution of Patients According to Clinical Signs

Clinical Sign	Number	Percentage (%)
Chest Pain		
Dyspnea		
Suspected Pulmonary Embolism		
Tachycardia		
Hemoptysis-Associated Cough		
Total		

IV. DISCUSSION

➢ *Distribution of Patients According to Age and Sex*

A total of 70 patients were included in this study. The most represented age group was 61−70 years, accounting for 31.42% of cases. This finding is higher than that reported by Moise Dakouo in Mali, who identified the 45–50 age group as the most affected [18], and also differs from Ousmane Diallo, who reported a predominance of the 51−60 age group (30.77%) [19].

In our study, we noted a male predominance of 57.14%. This result is close to the rate of 61,7% reported by Adam Ahamat Ali and al, in Tchad 2021[8].

➢ *Distribution According to Place of Residence*

In this study, 57% of participants resided in urban areas. This may be explained by the limited accessibility of medical imaging centers, which are predominantly located in urban settings, making access more difficult for individuals living in rural areas.

The study showed that 40% of participants were civil servants, followed by retirees (22.85%). Fofana Daouda reported 24.10% civil servants and 48.30% housewives in Mali in 2009 [20]. These findings may be partly explained by the increasing burden of cardiovascular diseases in the population.

➢ *Distribution According to Occupation*

The study showed that 40% of participants were civil servants. This result could be explained, on the one hand, by the exponential growth of risk factors for EP in the African context.

➢ *Distribution According to Risk Factors*

Hypertension was the most commonly observed risk factor, accounting for 61.42% of cases. Our results differ from those of Owono Etoundi p et al, who found 54.43% of cardiovascular cases, 30.23% of obesity cases, and 25.58% of hypertension cases, respectively [21]. High blood pressure (HBP) is a condition that can lead to complications such as pulmonary embolism, with contributing factors such as a sedentary lifestyle, obesity, and diabetes identified in our study [7].

➢ *Distribution According to Clinical Presentation*

Dyspnea and chest pain were the most frequently reported clinical signs, observed in 44.28% and 22.85% of cases, respectively. These findings are consistent with those reported by Moise Dakouo [18], who found dyspnea in 44.18% of cases, chest pain in 18.60%, and suspected pulmonary embolism in 16.27%.

➢ *Distribution According to Referring Departments*

In our study, referrals were mainly from the cardiology and pulmonology departments, accounting for 45.71% and 28.57%, respectively. These findings differ from those of Zeh Odile F. et al., who reported 27.2% of referrals from pulmonology and 18.2% from general medicine in Cameroon in 2009 [22].

➢ *Distribution According to CT Examination Findings*

Pathological CT findings were observed in 64.28% of cases, whereas 21.42% had normal examinations. The results of this study differ from those of AKANNI Djivédé et al., in 2021 in Benin, who found 41.1% normal examinations and 57.9% pathological examinations [23].

In our study, we found that our results differ from those of Jérôme Gaillard in France, who found that 60.3% were women and 39.6% were men aged 75−90. [24]. These results differ from those reported by Florence Vincent in Paris, where 37.2% were men and 62.8% were women [25].

The same results were found in the records of 1,379 patients hospitalized in the cardiology department of the Point G University Hospital Center in Mali in 2018, which reported a hospital prevalence of 1.37% with a predominance of women (89.47%) and a sex ratio of 0.11 in favor of women [26]. These results differ from our study, in which men accounted for 57.14% and the male-to-female ratio was 1.60%.

These results are similar to those of SALMA RHAZZANE in Morocco in 2020, where we observed that 35% of patients were women and 65% were men, meaning that two-thirds of patients were predominantly male [27].

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In our study, our results differ from those of MINH KHOA TRUONG, who reported a pulmonary embolism incidence of 8.1% in Lausanne in 2013.[28].These results differ from those of SAMAKE KARIM, which we observed in 2021 in Mali. Hypertension was the most common underlying condition, accounting for 44.18% of cases, and males were predominant, accounting for 55.26% of cases [29].

V. RECOMMANDATIONS

Based on the findings of this study, the following recommendations are proposed:

➢ *To Health and Administrative Authorities*

- To equip healthcare facilities nationwide with qualified personnel for the management of cardiovascular and respiratory diseases;
- To strengthen technical platforms through the acquisition of modern diagnostic tools, including pulmonary scintigraphy and pulmonary angiography;

➢ *To Healthcare Professionals*

- To refer all cases of cardiovascular and respiratory diseases to specialized healthcare facilities.
- To adhere to international guidelines for the prevention and management of cardiovascular and respiratory diseases.

➢ *To the General Population*

- To adopt healthy lifestyle and dietary practices in order to prevent cardiovascular and respiratory diseases.
- To enroll in mandatory health insurance schemes to facilitate access to appropriate medical care

VI. CONCLUSION

Our study shows that pulmonary embolism is a serious condition; dyspnea and chest pain are the two early symptoms, and a definitive diagnosis is made by chest CT angiography, which has high sensitivity and specificity. These conditions are the main causes of high morbidity and mortality. Managing risk factors is an effective means of prevention. Their diagnoses rely on medical imaging for treatment.

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