

Evaluation of the Thoracic Angio Scanning Technique at the Medical Imaging Department of the University Hospital “Point-G”

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Abstract

Introduction: Thoracic CT angiography is the gold standard for investigating thoracic vascular emergencies, particularly in cases of suspected pulmonary embolism. This study aims to evaluate its use, technical performance, and diagnostic results at the Point G University Hospital. **Methods:** This is a descriptive study of thoracic CT angiograms performed during the study period. The parameters analyzed included epidemiological data, indications, technical modalities, and diagnostic results. **Results:** Of 2777 imaging examinations, 780 CT scans were performed, including 63 thoracic CT angiograms (8.1%). The mean age of the patients was 58 ± 12 years, with a female predominance (56%). The majority of patients were hospitalized (76%). The main indication was suspected pulmonary embolism (48%). Examinations were performed according to standardized protocols with a technical success rate of 96.8%. Pulmonary embolism was found in 38% of cases, followed by aortic dissection (30%). **Conclusion:** Thoracic CT angiography appears to be a reliable and effective modality in our setting. Despite limited resources, the technical quality and diagnostic yield are satisfactory. Improved accessibility and further studies could optimize the management of thoracic vascular emergencies.

Keywords

Thoracic CT Angiography, Pulmonary Embolism, Aortic Dissection,

1. Introduction

The development of cross-sectional imaging has significantly improved the management of cardiovascular diseases in sub-Saharan Africa, particularly in Mali. Among the available techniques, thoracic CT angiography (calculated tomography pulmonary angiography, CTPA) has become the reference modality for the investigation of thoracic vascular pathologies [1]. Based on multidetector computed tomography after intravenous injection of iodinated contrast medium, it allows for a rapid, precise and non-invasive assessment of potentially fatal vascular emergencies [2].

Thoracic vascular diseases represent a major cause of morbidity and mortality worldwide. Pulmonary embolism is the third leading cause of cardiovascular death after myocardial infarction and stroke, while aortic dissection remains a medical-surgical emergency whose prognosis depends directly on the early diagnosis and management [3].

In Mali, the epidemiological transition, marked by an increase in non-communicable diseases (hypertension, diabetes, obesity), coupled with increasing urbanization and life expectancy, has led to a significant rise in the indications for chest CT angiography. Furthermore, the COVID-19 pandemic, due to the hypercoagulable state it induces, has reinforced the use of this examination in the evaluation of thromboembolic complications [4].

In high-resource countries, the use of thoracic CT angiography relies on standardized protocols to ensure optimal image quality and controlled radiation protection. However, in resource-limited settings such as Mali, several persistent constraints remain, including the availability and maintenance of equipment, the heterogeneity of acquisition protocols, the management of contrast agents, and the optimization of delivered doses [5].

At the University Hospital Center (CHU) of Point G, a national reference institution, thoracic CT angiography is performed routinely in clinical practice. However, local data systematically evaluating the technical quality of the examinations and their compliance with international recommendations remain limited.

In this context, the present study aims to evaluate the technical quality of performing thoracic CT angiography at the University Hospital of Point G, by analyzing the acquisition protocols, the injection parameters, the quality of the vascular opacification, as well as the diagnostic performance, in a resource-limited environment.

2. Materials and Method

2.1. Study Framework

This was a prospective cross-sectional descriptive observational study, carried out

within the radiology and medical imaging department of the University Hospital Center (CHU) of Point G, a national reference university hospital.

2.2. Study Period

The study took place over a period of three months, from October 15 to December 31, 2025.

2.3. Study Population

Patients with suspected pulmonary embolism underwent a dedicated CTPA protocol acquired during the pulmonary arterial phase. Patients with suspected acute aortic syndrome underwent a dedicated thoracic aortic CTA protocol with acquisition optimized for aortic opacification. Both protocols were included under the term thoracic CT angiography.

Inclusion criteria

All patients who underwent thoracic CT angiography with injection of iodinated contrast medium during the study period were included, without age or sex restrictions.

Exclusion criteria

The following were excluded:

- Scans without injection of contrast agent;
- Patients who refused to participate or for whom essential data were missing;
- Examinations carried out outside the study period.

2.4. Data Collection

The data were collected prospectively using a standardized and anonymized form, completed from medical prescriptions, radiological records and information collected from patients and/or accompanying persons.

The variables included:

Sociodemographic data:

Age, sex, socio-professional category, origin of requests (referring service), and place of residence.

Clinical data:

Clinical indications for the examination and clinical information recorded on imaging requests.

2.5. Image Acquisition (Protocol Technique)

The examinations were performed on a 32-slice multi-slice scanner.

Acquisition parameters were standardized according to the clinical indication. Examinations were performed using a tube voltage of 120 kVp with automatic tube current modulation. Detector collimation was 32×0.6 mm, with a pitch ranging from 1.0 to 1.2. Images were reconstructed with a slice thickness of 1 mm and an increment of 0.7 mm using a standard vascular reconstruction kernel.

For suspected pulmonary embolism, acquisition was performed during the pul-

monary arterial phase. For suspected acute aortic syndrome, a dedicated thoracic aortic CT angiography protocol was used with acquisition optimized for aortic enhancement.

Bolus tracking was used for acquisition synchronization. The triggering threshold was set at 120 HU in the main pulmonary artery for CTPA studies and in the ascending aorta for aortic CTA studies.

2.6. Variables Evaluated

The parameters analyzed included:

Technical success

Technical success was defined as an examination providing sufficient image quality for diagnostic interpretation without requiring repeat acquisition.

Quality of vascular opacification

Vascular opacification was assessed by measuring attenuation values within the main pulmonary artery or the ascending thoracic aorta according to the indication. Adequate vascular enhancement was defined as attenuation ≥ 250 Hounsfield Units (HU).

Image quality

Image quality was evaluated according to the presence of respiratory motion artifacts, streak artifacts, and adequacy of acquisition timing.

Diagnostic performance

Diagnostic performance was assessed according to the ability of the examination to confirm or exclude the suspected vascular pathology and to identify alternative diagnoses when present.

All examinations were independently reviewed by two radiologists experienced in thoracic imaging.

The iodinated contrast medium used was predominantly Omnipaque® (iohexol) 350 mgI/mL in 87% of examinations ($n = 55$).

2.7. Statistical Analysis

The data were entered and analyzed using Microsoft Excel 2016 and IBM SPSS Statistics version 22. Qualitative variables were expressed as counts and percentages, while quantitative variables were described by mean $\pm$ standard deviation or median with interquartile range according to their distribution.

2.8. Ethics Statement

This prospective study was conducted in accordance with the principles of the Declaration of Helsinki.

The study protocol was approved by the Institutional Ethics Committee of the University Hospital Center of Point G (Approval Number: 123/2017).

Written informed consent was obtained from all participants or their legal representatives before inclusion in the study.

2.9. Reference Management

Bibliographic references were managed using Zotero software.

3. Results

During the study period, 2777 imaging examinations were performed in the radiology and medical imaging department of the Point G University Hospital. These examinations included conventional radiography ($n = 1253$; 45.1%), ultrasound ($n = 744$; 26.8%), and computed tomography (CT) scans ($n = 780$; 28.1%). Among the CT scans, 63 were thoracic CT angiograms (pulmonary CT scans). Angiography (CTPA) was performed, representing 8.1% of CT scans and 2.3% of the overall activity of the department over the period studied.

The patients' ages ranged from 30 to 90 years, with a mean of 58 ± 12 years. The age distribution showed a predominance of the 61 - 70 year age group (32%), followed by the 51 - 60 year and 71 - 80 year age groups. Patients over 50 years of age represented the majority of cases. Females were predominant, comprising 56% ($n = 35$) of patients, compared to 44% ($n = 28$) of males.

Regarding the method of care, 76% of patients were hospitalized ($n = 48$), while 24% ($n = 15$) were examined on an outpatient basis. Hospitalized patients came primarily from the pulmonology, cardiology, and emergency-surgical departments.

The clinical indications for CTPA were dominated by chest pain associated with suspected pulmonary embolism, found in 48% of cases ($n = 30$). Other indications included suspected aortic pathology (dissection or acute aortic syndrome), unexplained acute dyspnea, and suspected thromboembolic complications in an infectious or post-infectious context. The majority of requests for the examination came from the pulmonology department (88%, $n = 55$), followed by the emergency and cardiology departments.

From a technical standpoint, peripheral venous access was primarily achieved via the back of the hand in 46% of cases ($n = 29$), while other sites included the antecubital fossa and forearm, depending on the patients' venous status. An 18 G intravenous catheter was used in the majority of cases, allowing for an injection rate suitable for thoracic angiography protocols. In the remaining cases, 20 G or 22 G catheters were used when venous access was limited.

The iodinated contrast agent used was primarily Omnipaque® (iopamidol) at 350 mg/mL in 87% of examinations ($n = 55$), while other non-ionic iodinated contrast agents were used occasionally. The mean injected volume was 94 ± 18 mL, varying according to body weight, renal function, and acquisition protocol. The injection rate ranged from 3 to 5 mL/s, depending on the caliber of the venous access and the protocol used.

All examinations were performed using automated injection with a dual-syringe injector, allowing sequential administration of the contrast agent followed by a bolus of saline. Acquisition synchronization was ensured by the bolus tracking technique, with automatic triggering of the center on the pulmonary artery trunk after

reaching the opacification threshold defined by the local protocol.

Acquisitions were performed in helical mode, during inspiratory breath-hold, with pulmonary arterial phase reconstruction. Images were reconstructed in thin axial slices as well as in coronal and sagittal multiplanar reconstructions (MPR). Additional maximum intensity projection (MIP) reconstructions were used when necessary for analysis of the pulmonary vascular tree.

Image analysis focused primarily on the pulmonary artery trunk in 92% of cases ($n = 58$), as well as on the lobar and segmental branches when the opacification quality allowed. The evaluation also included the thoracic aorta, right heart chambers, and lung parenchyma to search for associated diagnoses.

The technical success rate was 96.8% (61/63 examinations). Two examinations were considered non-diagnostic because of insufficient vascular opacification and respiratory motion artifacts.

Among the 61 diagnostic examinations, pulmonary embolism was identified in 24 patients (39.3%). **Figure 1** illustrates a case of massive bilateral pulmonary embolism demonstrated by CT angiography, showing bilateral filling defects on axial images (**Figure 1(a)** and **Figure 1(b)**) and coronal reconstruction (**Figure 1(c)**). Aortic dissection was diagnosed in 19 patients (31.1%). **Figure 2** shows a Stanford type B aortic dissection on CT angiography, visualized on the axial image (**Figure 2(a)**) and sagittal reconstruction (**Figure 2(b)**). The remaining examinations were either normal or revealed alternative diagnoses.

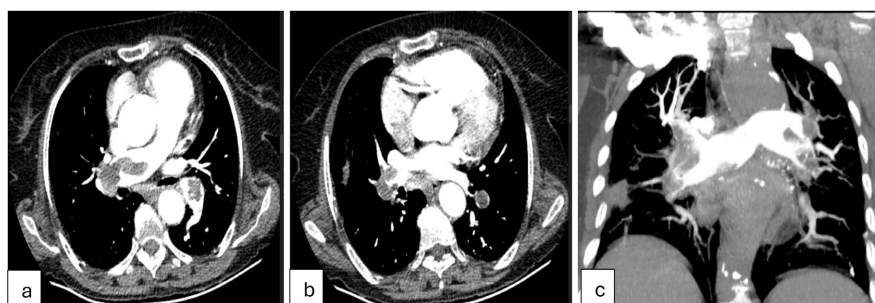


Figure 1. CT angiography demonstrating massive bilateral pulmonary embolism in a 53-year-old patient: (a) and (b) Axial slice; (c) Coronal reconstruction.

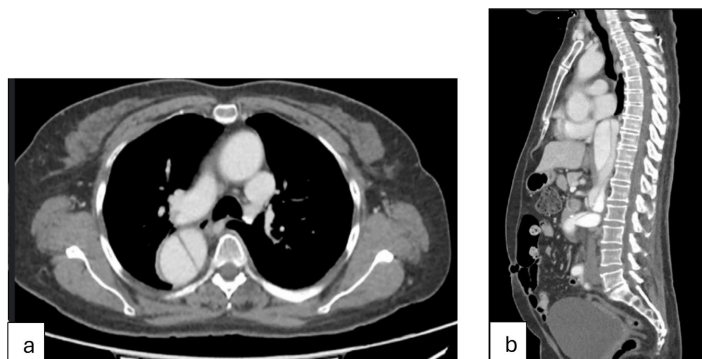


Figure 2. CT angiography demonstrating Stanford type B aortic dissection: (a) Axial slice; (b) Sagittal reconstruction.

4. Comments and Discussion

This study has several limitations. First, it was conducted in a single tertiary referral center, which may limit the generalizability of the findings. Second, the sample size was relatively small and the recruitment period was limited to three months. Third, no independent external review of imaging findings was performed. Finally, the descriptive design did not allow assessment of the impact of thoracic CT angiography on clinical outcomes.

In our study, thoracic CT angiography accounted for 8.1% of all CT scans and 2.3% of the department's overall activity. This proportion remains lower than that reported in European and North American hospitals, where it generally ranges between 10% and 20% [6]. This difference may be explained by more limited access to CT scanning in our setting, as well as by stricter selection of indications, often reserved for the most clinically suspicious cases.

The mean age of our patients was 58 ± 12 years, with a predominance in the 61 - 70 age group (32%) and a majority of patients over 50 years of age. These results are consistent with data from the international literature, which places the mean age of patients investigated for suspected pulmonary embolism between 55 and 65 years [1]. This distribution confirms that thromboembolic and thoracic vascular diseases primarily affect an aging population, often with cardiovascular comorbidities. African studies, particularly in Senegal and Côte d'Ivoire, also report this predominance in individuals over 50 years of age [7].

We observed a female predominance (56%), contrasting slightly with some Western studies where a slight male predominance is described [8]. However, this trend is also found in several African studies [7]. It could be related to hormonal factors (contraception, pregnancy), metals (obesity), or even to specific hospital recruitment practices. This difference warrants further investigation through additional analytical studies.

In terms of patient management, the majority of patients were hospitalized (76%), primarily from the pulmonology, cardiology, and emergency departments. This predominance reflects the often acute and potentially serious nature of the pathologies investigated by thoracic CT angiography, particularly in the context of suspected pulmonary embolism or acute aortic syndrome.

The main indication for the examination was suspected pulmonary embolism (48%), followed by suspected aortic disease and unexplained acute dyspnea. This distribution is consistent with international recommendations, which position chest CT angiography as the gold standard examination in these situations [1]. The high proportion of requests originating from the pulmonology department (88%) underscores the central role of this specialty in diagnostic guidance.

From a technical standpoint, the examinations were performed according to a rigorous protocol including automated injection with a double syringe, a flow rate of 3 to 5 mL/s, and the predominant use of an iodinated contrast agent at 350 mgI/mL. The mean injected volume (94 ± 18 mL) and the acquisition parameters (helical mode, breath-hold, multiplanar reconstructions, and MIP) comply with

international standards. The recommendations of the European Society of Cardiology and the American College of Radiology emphasize a flow rate $\geq 3 - 4$ mL/s, an iodine concentration $\geq 300 - 350$ mgI/mL, and optimal bolus-acquisition synchronization [5] [8].

The use of bolus tracking with center triggering on the pulmonary artery trunk is consistent with recommended practices, with an opacification threshold generally between 100 and 150 HU [5] [8]. The pulmonary artery trunk was, in fact, the primary site of analysis in 92% of cases, reflecting a good match between the technical protocol and the diagnostic objective.

The technical success rate of the examinations was high (99%), with only two examinations left undiagnosed due to insufficient opacification or respiratory artifacts. This result is comparable to those reported in large international series ($>95\%$) [2]. Furthermore, optimal vascular enhancement (≥ 250 HU) is considered an essential quality criterion [8], achieved in the majority of our examinations. In European studies, optimal opacification rates vary between 85% and 95% [9], placing our results within the expected range.

From a diagnostic standpoint, pulmonary embolism was the most frequently observed pathology (38%), followed by aortic dissection (30%). The relatively high prevalence of pulmonary embolism compared to European series (15% - 25%) [1] could be explained by better clinical patient selection, limited access to testing reserved for highly suspected cases, and diagnostic delays leading to more severe presentations.

The high proportion of aortic dissections (30%) also appears higher than reported in Western literature ($<10\%$) [9] [10]. This finding could reflect a high prevalence of cardiovascular risk factors, particularly poorly controlled hypertension, as well as a recruitment bias related to the tertiary care nature of the hospital. It could also indicate a delay in the management of aortic pathologies due to the lack of early detection.

Image analysis was not limited to the search for pulmonary embolism, but also included evaluation of the thoracic aorta, right heart chambers, and lung parenchyma. This comprehensive approach is consistent with current recommendations and allows for the identification of alternative diagnoses, thus enhancing the diagnostic value of thoracic CT angiography [1].

5. Conclusions

Thoracic CT angiography is an essential diagnostic tool in the management of thoracic vascular pathologies at the Point G University Hospital.

Our study shows:

- Overall compliance with international technical standards;
- Satisfactory image quality;
- A significant contribution to the diagnosis of cardiovascular emergencies.

Conflicts of Interest

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

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