Scientific Research Publishing

Open Journal of Radiology, 2026, 16(3), 119-129
https://www.scirp.org/journal/ojrad
ISSN Online: 2164-3032
ISSN Print: 2164-3024

Computed Tomography Findings in Bronchiectasis at the Bouaké Imaging Centre: A Report on 101 Cases

Malick Soro[1,2*], Claudia Michelle Gadji[1], Sara Carole Sanogo[1,2], Brou Lambert Yao[1,2], Dogo Hermann Bélé[1], Yah Céline Yao[1], Bouassa Davy Mélaine Kouakou[1,2], Allou Florent Kouadio[1,2], Kesse Emile Tanoh[1,2], Kouamé Paul Bon-Fils Kouassi[1,2], Issa Konate[1,2]

[1]Department of Radiodiagnostics and Medical Imaging, Bouaké University Hospital, Bouaké, Ivory Coast
[2]Faculty of Medical Sciences, Alassane Ouattara University, Bouaké, Ivory Coast
Email: *soro.malick92@gmail.com

How to cite this paper: Soro, M., Gadji, C.M., Sanogo, S.C., Yao, B.L., Bélé, D.H., Yao, Y.C., Kouakou, B.D.M., Kouadio, A.F., Tanoh, K.E., Kouassi, K.P.B.-F. and Konate, I. (2026) Computed Tomography Findings in Bronchiectasis at the Bouaké Imaging Centre: A Report on 101 Cases. *Open Journal of Radiology*, **16**, 119-129.
https://doi.org/10.4236/ojrad.2026.163013

Received: July 18, 2026
Accepted: August 30, 2026
Published: September 2, 2026

Abstract

Introduction: Bronchiectasis has been little described on computed tomography (CT) scans in sub-Saharan Africa, a region with high tuberculosis endemicity. We have described their CT characteristics and associated thoracic lesions in Bouaké. **Methods:** A retrospective descriptive study was conducted at the Bouaké Imaging Centre (Ivory Coast) from January 2020 to December 2024, including 101 patients whose chest CT scans revealed BBD, out of 986 chest CT scans performed during the period. The scans, performed on a 16-slice CT scanner without a high-resolution protocol, were reviewed by three radiologists; the morphological type was classified according to Reid. Comparisons were made using chi-squared tests (exploratory analyses, $p < 0.05$). **Results:** The mean age was 48.1 ± 15.4 years, with a slight predominance of males (sex ratio 1.24). A history of tuberculosis noted on the scan request form was the primary reason for the CT scan (32.7%). The cystic form was the most common (60.4%), followed by the cylindrical (28.7%) and varicose (10.9%) forms. The condition was most often bilateral (59.4%) and of mixed distribution (57.4%). At least one associated parenchymal lesion was present in 47.5% of patients. No statistically significant association was observed between the morphological type and demographic variables or the history of tuberculosis reported on the referral form. **Conclusion:** The bronchiectasis cases examined in Bouaké were characterised by a predominance of cystic forms and a tendency towards bilateral involvement, in a population where a history of tuberculosis reported on the referral form was the primary reason for examination. This profile, interpreted in the light of local technical constraints and the lack

of aetiological confirmation, warrants prospective studies combining optimised imaging with aetiological investigation.

Keywords

Bronchiectasis, Computed Tomography, Pulmonary Tuberculosis, Ivory Coast, Sub-Saharan Africa

1. Introduction

Bronchiectasis is defined as a permanent and irreversible increase in the calibre of the bronchi, first described by Laennec in 1819 [1]. It results from a vicious cycle involving chronic bronchial infection, inflammation and destruction of the airway wall [2] [3]. Chest computed tomography (CT) is the gold standard for confirming the diagnosis and characterising the condition; the main diagnostic criterion is a broncho-arterial ratio greater than 1, producing the classic "cat's eye" appearance [4]. Morphologically, three types are traditionally distinguished according to Reid: cylindrical, varicose and cystic [5].

The prevalence of bronchiectasis not associated with cystic fibrosis is increasing worldwide, largely due to the growing use of chest CT scans [1] [6] [7], which has prompted the publication of dedicated international guidelines [8].

In regions with high tuberculosis endemicity, the aetiological profile differs significantly from that in high-income countries. Pulmonary tuberculosis is a major risk factor for chronic respiratory disease in these regions, and post-tuberculosis sequelae are a common cause of bronchiectasis: on cross-sectional imaging, the prevalence of bronchiectasis following anti-tuberculosis treatment varies from 35 to 86% depending on the study [9]. This burden is particularly high in sub-Saharan Africa, where high prevalences of both tuberculosis and HIV infection coexist [10] [11], and where both diagnosis and management remain challenging and are often delayed in resource-limited settings [12].

Published African data most often focus on the clinical, aetiological or functional aspects of bronchiectasis [13]-[16] and rarely on their CT findings, including in Ivory Coast, where the condition frequently affects young people with a history of tuberculosis [17]. The systematic description of CT findings, which is nevertheless essential for diagnosis and guides the search for the cause, remains poorly documented in this context. The aim of this study was to describe the CT characteristics of dilations and the main associated thoracic lesions in patients examined in Bouaké.

2. Materials and Methods

This was a retrospective descriptive study conducted at the Bouaké Medical Imaging Centre (Ivory Coast) over a five-year period, from January 2020 to December 2024.

The target population consisted of patients who had undergone a chest CT scan at the Bouaké Medical Imaging Centre during the study period; the study population comprised patients whose chest CT scans revealed bronchiectasis. All reports of chest CT scans performed during the period were reviewed to identify scans showing evidence of bronchiectasis. All patients, regardless of age or sex, in whom the scan showed evidence of bronchiectasis according to the selected diagnostic criteria, were included. Patients with unusable reports, defined as reports that did not provide data for all the variables under study, were not included. Sampling was exhaustive and non-probabilistic, with consecutive recruitment of all patients meeting the eligibility criteria during the study period. The final sample comprised 101 patients.

The scans were performed on a 16-slice computed tomography (CT) scanner. Acquisition was helical and carried out during inspiratory breath-hold, from the lung apices to the pleural recesses. The images were reconstructed as 3 mm-thick axial slices with a 3 mm reconstruction interval, *i.e.*, contiguous slices without overlap, using parenchymal and mediastinal filters. The technical facilities did not permit the implementation of a dedicated high-resolution (HR) acquisition protocol. The images were analysed using parenchymal and mediastinal windows. The scans were performed without contrast enhancement and then with iodinated contrast medium, as indicated. The interpretation of the scans was shared between three radiologists; each scan was interpreted by a single reader, and no scan was subject to double reading.

The diagnosis of bronchiectasis was based on the standard CT criteria (broncho-arterial ratio > 1, absence of bronchial tapering towards the periphery, visibility of bronchi within 1 cm of the costal pleura) [4], and the morphological type was classified according to Reid as cylindrical, varicose or cystic [5].

For each patient, the following data were collected: sociodemographic variables (age, sex, age group); the indication for the examination; the characteristics of the bronchiectasis (morphological type, distribution along the broncho-pulmonary axis, laterality, thickening of the bronchial walls, air-fluid levels); and associated thoracic lesions (pulmonary nodule, alveolar consolidation, interstitial thickening, pleural effusion with location and volume, mediastinal lymphadenopathy with location, pericardial effusion). The data were collated on a standardised form and then entered into a spreadsheet. All data were extracted retrospectively from the department's reports and records. The indication for the examination was recorded exactly as stated on the request form completed by the prescribing clinician, with each examination assigned to a single indication category. A history of tuberculosis thus refers to previously treated pulmonary tuberculosis, reported by the prescriber on the request form, based on the patient's statements or the clinical records available at the time of prescription. This history could not be cross-checked against either bacteriological confirmation (microscopic examination, Xpert MTB/RIF or culture) or anti-tuberculosis treatment records, which were not accessible from the imaging department. It was therefore analysed as a rec-

orded clinical indication rather than as a documented previous diagnosis, and treated in the exploratory analyses as a binary variable (mentioned or not) derived from this field.

The data were analysed using SPSS software. Qualitative variables were expressed as frequencies and percentages; quantitative variables as mean ± standard deviation, median and extremes. Comparisons were carried out on the complete tables, including all their categories. To enable the estimation of an effect size, a binary contrast was defined for each variable with more than two categories: cystic forms versus non-cystic forms, age under 40 years versus 40 years and over, and bilateral involvement versus unilateral involvement. The corresponding odds ratios are presented with their 95% confidence intervals. Where the conditions for application were met, Pearson's chi-squared test was used; otherwise, Fisher's exact test was employed. The significance threshold was set at $p < 0.05$. The association analyses were exploratory in nature; no correction for multiple comparisons was applied and, given the small size of certain subgroups, their results should be interpreted with caution, as hypotheses.

This retrospective study was conducted in accordance with the principles of the Declaration of Helsinki. It was approved by the Medical and Scientific Directorate of the Bouaké Medical Imaging Centre, acting as the local authorising body. Given its retrospective nature and the exclusive use of anonymised data from the department's reports and records, informed consent was not obtained from patients. Patient confidentiality and anonymity were maintained at all stages of the study.

3. Results

3.1. Epidemiological Characteristics

During the study period, 986 chest CT scans were performed at the Bouaké Imaging Centre. Bronchiectasis was observed in 134 patients, representing 13.6% of the chest scans performed. Thirty-three patients were excluded due to an unusable report, and 101 patients were included in the analysis: 56 men (55.4%) and 45 women (44.6), with a male-to-female ratio of 1.24. The mean age was 48.1 ± 15.4 years (median 48 years; range 6 - 75 years). The 40 - 60 age group was the most common (49 patients; 48.5%), followed by those aged 60 and over (27 patients; 26.7%), those aged 20 - 40 (22 patients; 21.8%) and those under 20 (3 patients; 3.0%).

3.2. Indications for Computed Tomography

A history of tuberculosis, as stated on the referral form, was the most common indication (33 patients; 32.7%), followed by investigation of a pulmonary parenchymal abnormality (17 patients; 16.8%) (Table 1).

3.3. CT Presentation of Bronchiectasis

Morphologically, the cystic form was clearly predominant, observed in 61 patients (60.4%), followed by the cylindrical form in 29 patients (28.7%) and the varicose

form in 11 patients (10.9%). In terms of the broncho-pulmonary axis, the involvement was mixed in 57.4% of cases, peripheral in 33.7% and central in 8.9% of cases. In terms of laterality, the condition was asymmetrical bilateral in 56.4% of cases and unilateral in 40.6% (Table 2). Furthermore, bronchial wall thickening was observed in 25.7% of cases and air-fluid levels in 18.8%.

Table 1. Breakdown by CT scan indication (n = 101).

Indications	Frequency (n)	Percentage (%)
History of tuberculosis	33	32.7
Pulmonary parenchymal abnormality	17	16.8
Atelectasis	16	15.8
Haemoptysis	10	9.9
Cough	5	5.0
Dyspnoea	5	5.0
Chest pain	4	4.0
Pleural abnormality	4	4.0
COPD assessment	4	4.0
Fibrosis	2	2.0
Mediastinal syndrome	1	1.0

Table 2. Topographical distribution of bronchiectasis (n = 101).

Characteristic	Type	Frequency (n)	Percentage (%)
Distribution (axis)	Mixed	58	57.4
	Peripheral	34	33.7
	Central	9	8.9
Lateralisation	Asymmetrical bilateral	57	56.4
	Unilateral	41	40.6
	Symmetrical bilateral	3	3.0

3.4. Associated Thoracic Lesions

At least one associated parenchymal finding (nodule, consolidation or interstitial thickening) was present, either in combination with other findings or on its own, in 48 patients (47.5%). Interstitial thickening was the most common lesion (22.8%). A pleural effusion was noted in 12 patients (11.9%), most often of small volume and located on the right side, and mediastinal lymphadenopathy in 12 patients (11.9%). Pericardial effusion was rare (1.0%) (Table 3).

Table 3. Associated thoracic lesions (n = 101).

Associated lesion	Frequency (n)	Percentage (%)
Interstitial thickening	23	22.8
Alveolar consolidation	21	20.8
Pulmonary nodule	16	15.8
Pleural effusion	12	11.9
Mediastinal lymphadenopathy	12	11.9
Pericardial effusion	1	1.0

3.5. Exploratory Analysis of Associations

The sample sizes for each category, the effect estimates with their confidence intervals, and the p-values are set out in (Table 4). No statistically significant association was found between morphological type and sex (p = 0.248), age group (p = 0.171) or history of tuberculosis (p = 0.976). A history of tuberculosis was also not associated with laterality (p = 0.119) or the presence of air-fluid levels (p = 0.130). The odds ratios estimated for the binary contrasts ranged from 0.51 to 2.18, with wide confidence intervals that all included the value 1, indicating insufficient statistical power to rule out associations of moderate magnitude.

Table 4. Exploratory analysis of associations (n = 101).

Morphological type based on patient characteristics					
Feature	**Terms and conditions**	**Cystic n (%)**	**Non-cystic n (%)**	**OR (95% CI)**	**p**
Sex	Women (n = 45)	30 (66.7)	15 (33.3)	1 (reference)	
	Men (n = 56)	31 (55.4)	25 (44.6)	0.62 (0.27 - 1.40)	0.248
Age group	40 years and over (n = 76)	43 (56.6)	33 (43.4)	1 (reference)	
	Under 40 years (n = 25)	18 (72.0)	7 (28.0)	1.97 (0.74 - 5.28)	0.171
History of tuberculosis	history TB: no (n = 68)	41 (60.3)	27 (39.7)	1 (reference)	
	history TB: yes (n = 33)	20 (60.6)	13 (39.4)	1.01 (0.43 - 2.37)	0.976
CT scan findings according to history of tuberculosis					
Feature	**Terms and conditions**	**Present n (%)**	**Absent n (%)**	**OR (95% CI)**	**p**
Bilateral involvement	history TB: no (n = 68)	44 (64.7)	24 (35.3)	1 (reference)	
	history TB: yes (n = 33)	16 (48.5)	17 (51.5)	0.51 (0.22 - 1.19)	0.119
Air-fluid levels	history TB: no (n = 68)	10 (14.7)	58 (85.3)	1 (reference)	
	history TB: yes (n = 33)	9 (27.3)	24 (72.7)	2.18 (0.79 - 6.02)	0.130

OR: odds ratio; 95% CI: 95% confidence interval; history TB: history of tuberculosis; n: sample size.

4. Discussion

This retrospective study described the CT findings of bronchiectasis in 101 patients at a hospital in Ivory Coast. The study population consisted mainly of adults of average age (48.1 ± 15.4 years), with a slight predominance of males (male-to-female ratio = 1.24). This distribution is consistent with that of several recent North African series [15], although other studies have found a predominance of females [13]. The mean age observed is higher than that of strictly post-tuberculosis cohorts, where the disease affects younger individuals [17] [18].

Bronchiectasis was predominantly of the cystic type (60.4%). This distribution differs from that observed in some studies where the cylindrical type was the most common [4]. It is, however, similar to the profiles reported in settings with high tuberculosis prevalence. In a hospital series where tuberculosis was the main aetiology, the cystic form accounted for 75% of cases [18], and a comparable radiological profile has been reported in other countries with a high tuberculosis burden [19].

These series, however, had a documented aetiological diagnosis, which is not the case in ours: the similarity of the morphological profiles does not allow us to infer a common aetiology. In our series, the morphological type was not associated with a history of tuberculosis reported on the examination request form ($p = 0.976$).

This predominance may reflect disease diagnosed at an advanced and destructive stage, in a context where access to imaging, particularly CT, and to early diagnosis remains limited. Some variability may be linked to interpretation conventions, as the distinction between cystic and varicose forms is open to interpretation. Furthermore, scanning on a 16-slice CT scanner without a high-resolution protocol constitutes a specific technical limitation that helps explain this result; lower spatial resolution may have hindered the detection of early-stage cylindrical bronchiectasis, thereby contributing to the over-representation of cystic forms, which are more easily identifiable. High-resolution CT remains the gold standard for the characterisation of bronchiectasis [4] [8].

Topographically, the involvement was most often bilateral (59.4%) and of mixed distribution (57.4%). This predominantly diffuse and bilateral pattern is consistent with that reported in other African series [13] [17]. Bilateral involvement is consistent with a diffuse sequelae-related aetiology, particularly post-tuberculous, but it does not constitute specific evidence of this and is observed in many non-localised causes. Moreover, our data do not support such a link, as laterality was not associated with a history of tuberculosis reported on the referral form ($p = 0.119$). This hypothesis therefore remains an unconfirmed interpretation.

A history of tuberculosis was the primary reason for CT scanning (32.7%). This finding is consistent with data placing tuberculosis as the leading cause of bronchiectasis in endemic areas [9] [11] [15]. Post-tuberculous bronchiectasis is recognised as the main cause of non-cystic fibrosis bronchiectasis in sub-Saharan

Africa [10] [20]. It should be emphasised, however, that this proportion reflects the indication stated on the request for the scan and not a documented or bacteriologically confirmed diagnosis. As this history is self-reported and could not be cross-checked against microbiological data or treatment records, misclassification remains possible in both directions: some patients may have reported an episode that was never confirmed, whilst others, with an undocumented history, may have been recorded under a different indication. This figure should therefore be interpreted as the frequency with which tuberculosis was cited as the reason for imaging, and not as the prevalence of post-tuberculous bronchiectasis in our sample. Our methodology does not allow us to confirm that the bronchiectasis is post-tuberculous in nature.

Associated lesions were predominantly parenchymal abnormalities, present in nearly half of the patients. However, these findings lack specificity. Interstitial thickening, alveolar consolidation and nodules may be due to a concurrent infection, fibrotic sequelae or a thoracic condition unrelated to bronchiectasis. The same applies to pleural effusion and mediastinal lymphadenopathy, each observed in 11.9% of patients. In the absence of clinical, laboratory and follow-up data, these abnormalities cannot be attributed to a complication or interpreted as evidence of advanced disease. They constitute useful accompanying findings for aetiological assessment on CT scans [4], the significance of which must be assessed in the light of the clinical context. The exploratory analysis did not reveal any significant association between the morphological type of bronchiectasis and demographic variables or a history of tuberculosis. This finding, which should be interpreted with caution, suggests that the morphology of bronchiectasis cannot be predicted by these variables alone and that a reliable aetiological characterisation would require additional clinical, microbiological and functional data [8] [21] [22].

Our study has several limitations. Its retrospective and single-centre nature leaves it open to selection bias. The main weaknesses include the lack of aetiological confirmation, the absence of a CT severity score (such as the Bhalla or Reiff score) and, above all, the lack of high-resolution imaging. In particular, a history of tuberculosis was recorded solely on the basis of the indication stated on the examination request form, without access to bacteriological confirmation or to anti-tuberculosis treatment registers; the aetiological burden of tuberculosis in this series may therefore be either overestimated or underestimated. Although the sample size was larger than that of several published African series [13] [16], it remains modest for subgroup analyses. Furthermore, as each examination was interpreted by a single radiologist, without a second reading or cross-reading, inter-observer agreement could not be assessed; inter-reader variability, which is likely to affect morphological classification in particular (distinguishing between cystic and varicose forms), cannot be ruled out.

Future studies should ideally be based on high-resolution chest imaging, dual radiological reading with assessment of inter-observer agreement, the use of a CT

severity score, and the prospective collection of clinical, microbiological, respiratory function and therapeutic data. Such an approach would enable a clearer distinction to be made between post-tuberculous bronchiectasis and those of other aetiologies and would allow the clinical implications of the observed CT profiles to be assessed.

5. Conclusion

The dilations examined in Bouaké were characterised by a clear predominance of cystic forms, predominantly bilateral involvement and frequent associated parenchymal lesions, in a population predominantly referred due to a history of tuberculosis reported on the referral form. This study does not allow this profile to be linked to a tuberculous aetiology, due to the lack of diagnostic confirmation. This finding, combined with local technical constraints, highlights the need for prospective studies combining optimised imaging, double radiological reading and aetiological investigation to better characterise the disease in West Africa.

Acknowledgements

We would like to express our sincere thanks to all those (medical and paramedical staff) who made this study possible.

Funding

This research did not receive any specific funding from public, commercial or non-profit organisations.

Author Contributions

All authors contributed to the drafting, review and approval of the final version of the manuscript.

Conflicts of Interest

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

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