

**HRCT v/s MDCT: IN DETECTION OF BRONCHIECTASIS**Sowmya M<sup>1</sup>, Sandeep Ballal<sup>2</sup>, Pravan Kumar Reddy<sup>3</sup>, Shilpa Patel<sup>4</sup>**HOW TO CITE THIS ARTICLE:**

Sowmya M, Sandeep Ballal, Pravan Kumar Reddy, Shilpa Patel. "HRCT v/s MDCT: In Detection of Bronchiectasis". Journal of Evolution of Medical and Dental Sciences 2014; Vol. 3, Issue 47, September 25; Page: 11338-11343, DOI: 10.14260/jemds/2014/3483

**ABSTRACT: OBJECTIVE:** This study was conducted to determine whether there is superior diagnostic accuracy for the detection and exclusion of bronchiectasis using 16-slice CT of the chest (1 mm) compared with conventional high-resolution CT (HRCT) of the chest (10 mm). **MATERIALS AND METHODS:** A prospective study was carried out in the department of radiology KIIMS Bangalore over a one-year period during June 2012 – July 2013 in patients who were referred for chest CT from medicine department and pulmonologist for the investigation of bronchiectasis. All scans were performed using a 16-slice CT scanner. In addition to contiguous 1 mm slices, conventional HRCT images (1.25 mm slice every 10 mm) were prepared. Both datasets were dual read. **RESULTS:** There were 40 patients with a median age of 59 years (range, 52– 73 years), comprising 13 males and 27 females. 7 of 40 scans had no bronchiectasis in either dataset. 29 patients had bronchiectasis diagnosed on both HRCT and 1 mm scans. Two patients had tubular bronchiectasis on the HRCT scans, which was not confirmed on the 1 mm scans. Four patients had confirmed tubular bronchiectasis on the 1 mm scans, which was not identified on HRCT scans. 24 extra lobes demonstrated bronchiectasis on the 1 mm vs. the HRCT scans; of these, half were labeled as definite bronchiectasis on the 1 mm scan. There was a 32.8% increased confidence with the 1 mm scans compared with conventional HRCT of the chest in the diagnosis of bronchiectasis (p, 0.001). In conclusion, there is improved diagnostic accuracy and confidence for diagnosis and exclusion of bronchiectasis using 16-slice chest CT (1 mm cuts) compared with conventional HRCT of the chest.

**KEYWORDS:** - Bronchiectasis, HRCT, MDCT.

**INTRODUCTION:** Bronchiectasis is a disease in which there is permanent enlargement of parts of the airways of the lung it is a result of chronic inflammation compounded by an inability to clear mucoid secretions. This can be a result of genetic conditions resulting in a failure to clear sputum (Primary ciliary dyskinesia), or resulting in more viscous sputum (cystic fibrosis), or the result of chronic or severe infections. Inflammation results in progressive destruction of the normal lung architecture, in particular the elastic fibres of bronchi.<sup>1</sup> Tuberculosis. Endobronchial tuberculosis commonly leads to bronchiectasis, either from bronchial stenosis or secondary traction from fibrosis. Bronchiectasis may be diagnosed clinically or on review of imaging patients should have bronchial dilatation at least greater than the associated arterial vessel.<sup>2,3</sup> The British Thoracic Society recommends all non-cystic-fibrosis-related bronchiectasis be confirmed by CT.<sup>4</sup> CT may reveal tree-in-bud abnormalities, dilated bronchi, and cysts with defined borders may show associated bronchial wall thickening and mucus plugging High-resolution computed tomography (HRCT) of the chest is the gold standard for the diagnosis of bronchiectasis.<sup>5</sup> The extent of bronchiectasis is determined by the number of lobes involved. Other investigations typically performed at diagnosis include blood tests, sputum cultures, and sometimes tests for specific genetic disorders.<sup>5</sup>

## ORIGINAL ARTICLE

---

The aim of this study was to assess whether there is any advantage in determining the extent and severity of bronchiectasis and degree of confidence in diagnosis the same, using 16-slice CT of the chest using 1 mm contiguous slices compared with conventional HRCT using 1.25 mm slices every 10 mm.

**METHODS AND MATERIALS:**

**STUDY SETTING:** Department of radiology, KIMS, Bangalore.

**STUDY DESIGN:** A cross sectional study.

**STUDY DURATION:** - Study was conducted over a period of 1year, from September 2012 to August 2013.

**STUDY PARTICIPANTS:** Patients who were referred for chest CT from medicine and pulmonology department for the investigation of bronchiectasis during study period.

**INCLUSION CRITERIA:** Patients who were referred for chest CT from medicine and pulmonology department for the investigation of bronchiectasis during study period and willing to participate in the study, with written consent

**EXCLUSION CRITERIA:** Patients who were unwilling to participate in the study & those who refused to give written consent.

**METHOD OF DATA COLLECTION:** The CT scans were all performed using a 16-slice CT scanner (GE). Two sets of images were formed and saved individually onto discs. These were contiguous 1 mm slices (1 mm set) and 1.25 mm slices every 10 mm, analogous to conventional HRCT (10 mm set). Each disc was interpreted randomly by two radiologists who have an interest in chest radiology, and a consensus reached. If there was no initial agreement in interpretation, then a third radiologist was used to help form a consensus. We used lung windows with a width of 1500 and depth of 2750. Observers were blinded to the corresponding clinical information or report.

The CT scans were scored using six lobes: right upper lobe, right middle lobe, right lower lobe, left upper lobe, left lower lobe and the lingula, which was counted as a separate lobe in this study. They were graded as 0 for no bronchiectasis, 1 for tubular bronchiectasis, 2 for varicose bronchiectasis and 3 for cystic bronchiectasis, with one extra mark per lobe if central bronchiectasis was present.

The score per scan could range from 0 (no bronchiectasis) to 24 (most severe case of bronchiectasis). When more than one type of bronchiectasis was present, the more severe type was recorded. The degree of confidence in the diagnosis of bronchiectasis was also recorded per lobe as “possible”, “probable” or “definite”. By assigning a value of 0 for possible bronchiectasis, 1 for probable bronchiectasis and 2 for either definite absence or presence of bronchiectasis, a confidence rating could be calculated.

**STATISTICAL ANALYSIS:** The data were tabulated and analyzed using SPSS version 16. The data are presented as the median (interquartile range). A Wilcoxon paired test was used to compare the two groups. Fisher’s exact test was used to compare confidence ratings. A two tailed p-value, 0.05 was considered statistically significant.

**RESULTS:** A total of 40 patients were included. Their median age was 59 years (range, 52–73 years). 13 were male and 27 were female.

## ORIGINAL ARTICLE

The concordance between scans is shown in Table 1. The 1 mm dataset therefore upgraded the diagnosis of bronchiectasis in 4(10%) patients and downgraded the diagnosis in 2(5%) patients.

HRCT (10mm)		1mm	
Y	29	Y	29
Y	2	N	0
N	7	N	7
N	0	Y	4

**Table 1: Presence of bronchiectasis in the HRCT (10 mm) vs. the 1 mm dataset**

Y- bronchiectasis; N- no bronchiectasis; HRCT- high-resolution CT.

Total number of patients = 40.

The concordance between HRCT and 1 mm scans is shown in Table 2 for each lobe. In total, there were 240 lobes and bronchiectasis was diagnosed in 83 lobes on HRCT and 105 lobes on 1 mm scans. There was agreement between the scans in 199/240 (82.91%) lobes. The 1 mm scans downgraded from bronchiectasis to no bronchiectasis in 12/240 (5%) lobes and upgraded from. no bronchiectasis to bronchiectasis in 24/240 (10%) (Table 2).

	RUL	RML	RLL	LUL	LNG	LLL
<b>YES</b>	11	17	13	10	12	10
<b>NO</b>	23	16	20	26	17	24
<b>DOWNGRADED</b>	1	4	5	0	0	2
<b>UPGRADED</b>	4	3	2	4	7	4

**Table 2: Concordance in the diagnosis of bronchiectasis**

RUL, right upper lobe; RML, right middle lobe; RLL, right lower lobe; LUL, left upper lobe; LLL, left lower lobe; LNG, lingula. Concordance is graded as yes (bronchiectasis in both scans); no (no bronchiectasis in either scan); downgraded (bronchiectasis on HRCT to no bronchiectasis on 1 mm); upgraded (no bronchiectasis on HRCT to bronchiectasis on 1 mm scans).

The median CT scores per patient were higher for the 1 mm dataset (5; range, 2.0–10.5) compared with the HRCT dataset (4; range, 2.0–7.5) (p= 0.012).

On those scans with bronchiectasis diagnosed on both HRCT and 1 mm scans, there was increased confidence of diagnosis (change from “possible” to “probable” or “definite”) in 24/73 (32.8%) of the 1 mm scans (Table 3) (p, 0.001).

CONFIDENCE	RUL	RML	RLL	LUL	LNG	LLL
NO CHANGE	8	11	10	6	7	7
DECREASE	0	0	0	0	1	1
INCREASE	2	5	3	5	6	3

**Table 3: Confidence in diagnosis of bronchiectasis using 1 mm scans**

## ORIGINAL ARTICLE

---

RUL, right upper lobe; RML, right middle lobe; RLL, right lower lobe; LUL, left upper lobe; LLL, left lower lobe; LING, lingula. Change in confidence with 1 mm scans compared with HRCT for scans with bronchiectasis diagnosed on both HRCT and 1 mm scans

**DISCUSSION:** This study confirms improved diagnostic accuracy for the diagnosis and exclusion of bronchiectasis using 16- slice chest CT (1 mm cuts) compared with conventional HRCT of the chest. Reconstructed HRCT images generated from multidetector CT (MDCT) scanner data acquisition have been shown to be of comparable quality to images obtained using conventional HRCT,<sup>7</sup> and so this approach was considered the best way to compare HRCT and MDCT, whilst limiting the radiation dose and not subjecting the patients to two scans.

The radiation dose for MDCT of the chest is known to be higher than that for HRCT.<sup>8,9</sup>

In our institution, the average effective dose for MDCT of the thorax is 7 mSv (dose-length product (DLP) 5 394 mGy cm), whereas HRCT of the thorax on the same 16-slice scanner gives a lower effective dose of 5 mSv (DLP 5 282 mGy cm).

The sensitivity of conventional HRCT, however, is limited owing to the 10 mm gaps between the non-contiguous slices and image degradation owing to motion artefact.

The presence of data gaps on HRCT means that relatively small areas of bronchiectasis may be missed between sections.<sup>10</sup> This occurs particularly if the bronchiectatic segment runs in the axial plane, predominantly in the middle lobe and lingula. Misinterpretation of broncho-arterial ratio may also result if the scan plane lies close to bifurcations in the vessels or bronchi, as these two levels may not coincide.

The introduction of MDCT scanners has allowed assessment of the chest with thin-section collimation and rapid acquisition, often in a single breath-hold, thus improving spatial resolution.<sup>11</sup> Improved resolution also along the z-axis allows multiplanar reformatting, so that images can be interrogated in any plane.<sup>12</sup>

These factors should reduce motion artefact, improve image quality and therefore increase sensitivity for the detection and exclusion of bronchiectasis. Dodd et al<sup>13</sup> confirmed that helical 16-slice MDCT was superior to HRCT in 10-mm intervals at showing the presence and extent of bronchiectasis, and Chooi et al<sup>12</sup> showed that the use of multiplanar image reconstruction further improves the confidence in diagnosing bronchiectasis. Despite having the capability in this study to use multiplanar reformatting to interrogate the 1 mm dataset, we opted not to use this function so that the two datasets were analyzed and compared in the same axial plane.

This study also showed improved confidence in the diagnosis of bronchiectasis with MDCT.

In conclusion, there is improved diagnostic accuracy and confidence for the diagnosis and exclusion of bronchiectasis using 16-slice chest CT (1 mm cuts) compared with conventional HRCT of the chest. The improved diagnostic accuracy therefore justifies the higher radiation dose incurred by performing a volume acquisition rather than performing the previously accepted gold standard HRCT of the thorax.

### REFERENCES:

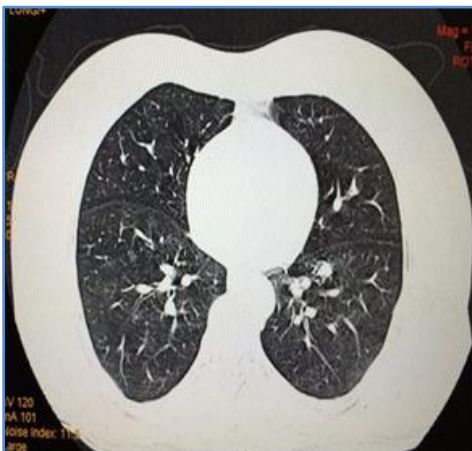
1. National Institute for Health and Care Excellence (August 2010). "Bronchiectasis"
2. Davidson's principles and practice of medicine. (21st ed.). Edinburgh: Churchill Livingstone/Elsevier. 2010. p. 676

## ORIGINAL ARTICLE

3. Catanzano, Tara (5 September 2005). "Primary Tuberculosis". E Medicine Specialties Encyclopedia. Connecticut: Web MD. Retrieved 2007-06-22.
4. Hill, Adam T; Pasteur, Mark; Cornford, Charles; Welham, Sally; Bilton, Diana (1 January 2011). "Primary care summary of the British Thoracic Society Guideline on the management of non-cystic fibrosis bronchiectasis". Primary Care Respiratory Journal 20 (2): 135
5. Phillips MS, Williams MP, Flower CD. How useful is computed tomography in the diagnosis and assessment of bronchiectasis? Clin Radiol 1986; 37: 321-5.
6. Grenier P, Maurice F, Musset D, Menu Y, Nahum H. Bronchiectasis: assessment by thin-section CT. Radiology 1986; 161: 95-9.
7. Studler U, Gluecker T, Bongartz G, Roth J, Steinbrich W. Image quality from high resolution CT of the lung: comparison of axial scans and of sections reconstructed from volumetric data acquired using MDCT. AJR Am J Roentgenol 2005; 185: 602-7.
8. Mayo JR, Jackson SA, Muller NL. High-resolution CT of the chest: radiation dose. AJR Am J Roentgenol 1993; 160: 479-81.
9. Yi CA, Lee KS, Kim TS, Han D, Sung YM, Kim S. Multidetector CT of bronchiectasis: effect of radiation dose on image quality. AJR Am J Roentgenol 2003; 181: 501-5.
10. Kang EY, Miller RR, Muller NL. Bronchiectasis: comparison of preoperative thin-section CT and pathologic findings in resected specimens. Radiology 1995; 195: 649-54.
11. Dawson P, Lees WR. Multislice technology in computed tomography. Clin Radiol 2001; 56: 302-309.
12. Chooi WK, Matthews S, Bull MJ, Morcus SK. Multislice helical CT: the value of multiplanar image reconstruction in assessment of the bronchi and small airways disease. Br J Radiol 2003; 76: 536-40.
13. Dodd JD, Souza CA, Muller NL. Conventional high-resolution CT versus helical high-resolution MDCT in the detection of bronchiectasis. AJR Am J Roentgenol 2006; 187: 41420.

**FIGURE 1a:** High resolution CT of chest (1.25mm)

**FIGURE 1b:** 16slice chest CT (1mm) upgrading from no bronchiectasis (a) to tubular bronchiectasis (b).



**Fig. 1a**



**Fig. 1b**

**FIGURE 2a:** High resolution CT of chest (1.25mm) **FIGURE 2b:** 16slice chest CT (1mm) upgrading from no bronchiectasis (a) to tubular bronchiectasis (b).

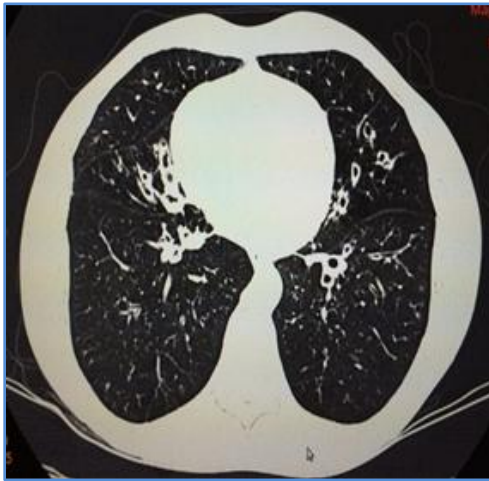


Fig. 2a

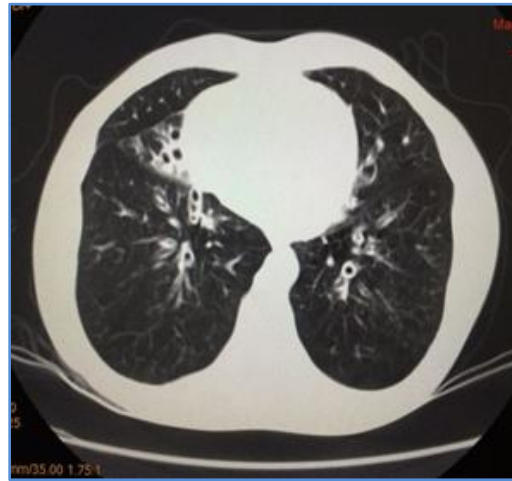


Fig. 2b

**AUTHORS:**

1. Sowmya M.
2. Sandeep Ballal
3. Pravan Kumar Reddy
4. Shilpa Patel

**PARTICULARS OF CONTRIBUTORS:**

1. Post Graduate, Department of Radiodiagnosis, Kempegowda Institute of Medical Sciences and Research Center, Bangalore.
2. Associate Professor, Department of Radiodiagnosis, Kempegowda Institute of Medical Sciences and Research Center, Bangalore.
3. Assistant Professor, Department of Radiodiagnosis, Kempegowda Institute of Medical Sciences and Research Center, Bangalore.

4. Post Graduate, Department of Medicine, Kempegowda Institute of Medical Sciences and Research Center, Bangalore.

**NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:**

Dr. Sowmya M,  
Department of Radiodiagnosis,  
KIMS Hospital,  
K. R. Road, V. V. Puram,  
Bangalore-560004.  
Email: sowmyagowda29@gmail.com

Date of Submission: 9/09/2014.  
Date of Peer Review: 10/09/2014.  
Date of Acceptance: 18/09/2014.  
Date of Publishing: 23/09/2014.