

**COMPARATIVE STUDY OF COMPUTED TOMOGRAPHY (CT) AND FIBEROPTIC BRONCHOSCOPY IN DIAGNOSIS OF CANCER IN PATIENTS WITH HEMOPTYSIS**<sup>1</sup>Ravi Bhaskar, <sup>2\*</sup>Seema Singh, <sup>3</sup>Pooja Singh, <sup>4</sup>Sanchit Tiwari, <sup>5</sup>Amit Bhagat<sup>1,3</sup>Department of Pulmonary Medicine, Career Institute of Medical Sciences, Lucknow, India.<sup>2</sup>Department of Respiratory Medicine, King Georges Medical University, Lucknow, India.<sup>4</sup>Department of Biochemistry, Saraswati Medical College, Unnao, U.P.<sup>5</sup>Department of Orthopedic Surgery, King Georges Medical University, UP, Lucknow, India.**\*Corresponding Author: Dr. Seema Singh**

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**ABSTRACT**

**Background:** Computed chest tomography (CT) is a widely available roentgenographic procedure that is often performed in the evaluation of patients with the unexplained thoracic disease. **Objectives:** A prospective study was performed to compare results of computed tomography (CT) and Fiberoptic bronchoscopy in the diagnosis of cancer in hemoptysis patients. **Methods:** A total of 50 patients with hemoptysis underwent thin-section CT and Fiberoptic bronchoscopy. **Results:** Subjected patients presenting with complaints of hemoptysis were enrolled in the study. In the present study, CECT revealed a high burden of carcinoma (33) followed by bronchiectasis (13). In one case peripherally located mass and in another mediastinal mass was observed. Remaining 2 cases were found to be normal. In their CT study of 16 patients, none of the cases were found to have malignancy. It was found that bronchiectasis was more common in young age group (<30 years) while older age group was more commonly associated with carcinoma (30-50 years and >50 years). **Conclusion:** The initial examination should be bronchoscopy when there is high clinical suspicion of carcinoma and relevant radiographic abnormality, and CT when strong clinical suspicion of carcinoma is not substantiated at bronchoscopy in patients with normal findings on chest radiographs.

**KEYWORDS:** CT, Fiberoptic bronchoscopy, hemoptysis, lung cancer.**BACKGROUND**

Hemoptysis is an alarming and important symptom and requires thorough investigation, even though in many cases no cause is found.<sup>[2-4]</sup> Published guidelines for the management of hemoptysis, often based on the findings of retrospective studies and case reports, have emphasized the role of fiberoptic bronchoscopy. The value of both conventional and thin-section CT in the diagnosis of central and peripheral airways disease is established<sup>[5-9]</sup>, although the role of CT in the examination of patients with hemoptysis is uncertain and somewhat controversial.<sup>[4, 10, 11]</sup> Technical advancements have improved the diagnostic potential with the use of modern scanners, and this study was undertaken to compare prospectively the value of bronchoscopy and CT in the examination of patients with hemoptysis.<sup>[12]</sup> The physical properties of computed tomography (CT) facilitate more accurate mapping of position and physical density of structures within the thorax than conventional chest radiographs and fibrotic bronchoscopy<sup>[13,14]</sup>, and this procedure has been suggested as a further mode of investigation from patients with hemoptysis in carefully chosen circumstances.<sup>[10,15]</sup> We wished to ascertain

whether CT has a role in the investigation of patients with unexplained hemoptysis (normal chest X-ray or evidence of chronic airflow limitation alone, fiberoptic bronchoscopy normal or only showing blood in the bronchial tree), both as a diagnostic aid and to establish which patients require long-term medical supervision.

**Procedure****Study Design**

This is cross-sectional study and it was carried out in the Department of Pulmonary Medicine, Career Institute of Medical Sciences, Lucknow. All the patients attending the Department of Pulmonary Medicine, presenting with symptoms of hemoptysis (streaking to frank) were enrolled in the study after fulfilling the inclusion and exclusion criteria. Permission to carry out the study was obtained from Institutional Ethical Committee. Informed consent was obtained from all the participants. Inclusion Criteria: Cases presenting with an episode of hemoptysis, Both males, and females aged >20. Exclusion Criteria: Patients having complaints of hemoptysis following trauma, Pregnant women, Patient with blood dyscrasias,

thrombocytopenia, having known cardiac disease and sputum positive for AFB.

## METHODS

All the subjects qualifying as study population was invited to participate in the study. The procedure to be carried out during the course of study was explained to all the participants and an informed consent was obtained. After obtaining the informed consent and ensuring that they meet the inclusion criteria and not falling into the domain of exclusion criteria. Only those subjects falling in the sampling frame were enrolled in the study.

The patients were grouped as follows

Group I: Non-smoker/Control SI=0

Group II: Light smoker SI=1-100

Group III: Moderate smoker SI=101-300

Group IV: Heavy smoker >300

Demographic information from all the patients was obtained. A history of chief complaints with duration was obtained. A history of smoking or any occupational risk was enquired. In case of a passive smoking history, a detailed inquiry regarding the type of smoking, duration, and grade of smoking was taken, General physical examination, followed by thorough chest examination, cardiovascular, abdominal and central nervous system was done. Hematological (Hb, TLC, DLC, ESR, Platelet count, GBP, PT, BT & CT) and biochemical (RBS, Blood urea, S. Creatinine) were carried out. Sputum specimen was collected and evaluated for AFB positivity. All the patients were then subjected to chest X-ray (PA view). Electrocardiography was obtained and 2D- ECHO was done wherever needed. For the confirmatory diagnosis, contrast-Enhanced Computed tomography (CECT) chest was performed using a 16-Slice Multidetector CT scan unit (GE Medical System). The CT images were reported by the team of Radiologists from the Department of Radiology, career institute of Medical Sciences. All those cases in which no confirmatory diagnosis could be made out by computed tomography were subjected to fiberoptic bronchoscopy (FOB). The bronchoscopic evaluation was done by a team of chest physicians at Career Institute of Medical Sciences, Lucknow.

## RESULTS

In the present study, we have tried to evaluate the usefulness of CT as a diagnostic modality for causes of hemoptysis and its limitations by carrying out fiberoptic bronchoscopy wherever CT evaluation failed to deliver a confirmative diagnosis. For this purpose, a total of 50 patients presenting with complaints of hemoptysis were enrolled in the study. A maximum number of patients n=23, 46% were aged>50 years followed by those aged 30-50 years (n=21: 42%) there were only 6 cases (12%) aged<30 years. Thus the present study showed that hemoptysis was more common in adults and elderly. In the present study, the majority of patients were Hindus (58%), remaining patients were Muslims (42%). These figures are quite close to population proportion and thus do not indicate any specific religion-related risk. In the present study, the majority of patients were farmers (n=34; 58%). All the females were housewives. The presenting complaints in the majority of patients included hemoptysis (n=50; 100%) followed by a cough (78%), breathlessness (64%), expectorant (60%) and chest pain (48%). History of smoking/ past-smoking was common in 84% cases. In present study, CECT revealed a high burden of carcinoma (n=33; 66%) followed by bronchiectasis (n=13; 26%). In one case peripherally located mass and in another mediastinal mass was observed. Remaining 2 (4%) cases were found to be normal. In their CT study of 16 patients, none of the cases were found to have malignancy. In their study, the diagnosis was bronchiectasis (6), tuberculosis (6), Pneumonia (2), Bronchial carcinoid (1) and allergic bronchopulmonary aspergillosis in 1 case. One of the reasons for a high burden of carcinoma in the present study could be a high prevalence of smoking and biomass fuel smoke exposure and exclusion of sputum AFB positive cases in the present study. It was found that finding such as bronchiectasis were more common in young age group (<30 years) while older age group was more commonly associated with carcinoma (30-50 years and>50 years). Male were also more commonly associated with carcinoma (68.3%) as compared to female (55.6%).But both these indicating were associated with high smoking exposure.

**Table 1: distribution of demographic profile, presenting clinical complaints, smoking history, contrast enhanced computed tomographic findings, Fiberoptic bronchoscopic findings, histopathological findings.**

S.No	Characteristics	No. of Patients	Percentage
1.	age		
	<30 years	6	12
	30-50 years	12	42
	>50 years	23	46
2.	gender		
	male	41	82
	female	9	18
3.	religion		
	Hindu	29	58
	Muslim	21	42

<b>4.</b>	<b>occupation</b>		
	farmer	34	68
	housewife	9	18
	businessman	4	8
	labourer	1	2
	employee	2	4
<b>5.</b>	<b>Clinical parameters</b>		
	cough	39	78
	expectoration	30	60
	breathlessness	32	64
	Chest pain	24	48
	hemoptysis	50	100
<b>6.</b>	<b>History of smoking</b>		
	smoker	34	68
	Non-smoker	8	16
	Ex-smoker	8	16
<b>7.</b>	<b>Type of smoking</b>		
	cigarette	2	4
	bidi	40	80
	hookah	0	0
	Ex to biomass	8	16
<b>8.</b>	<b>Grade of smoking</b>		
	Non smoker	8	16
	Current smoker	10	20
	Moderate smoker	15	30
	Heavy smoker	17	34
<b>9.</b>	<b>Age at start of smoking</b>		
	<15 years	13	26
	16-30 years	29	58
	31-45 years	0	0
	>46 years	0	0
	Not applicable	8	16
<b>10.</b>	<b>CECT FINDINGS</b>		
	bronchiectasis	13	26
	carcinoma	33	66
	others	2	4
	normal	2	4
<b>11.</b>	<b>Fiberoptic bronchoscopic findings</b>		
	Apparently normal	8	16
	Growth with obstruction	21	42
	Growth without obstruction	8	16
	Not done	13	26
<b>12.</b>	<b>Histopathological findings</b>		
	adenocarcinoma	3	9.1
	Squamous cell carcinoma	22	66.7
	Small cell carcinoma	5	15.2
	Non small carcinoma	0	0
	Others	3	9.1

Maximum number of subjects were aged >50 years (n=23; 46%) followed by those aged 30-50 years group.

**Table 2: Association between contrast enhanced computed tomographic findings with demographic, clinical and other diagnostic findings.**

S.No	factors	Bronchiectasis (n=13)		Carcinoma (n=33)		Others (n=2)		Normal (n=2)		Statistical significance	
		no	%	no	%	no	%	no	%	X <sup>2</sup>	p-value
1	Age									28.84	<0.001
	<30 years	4	66.7	0	0.00	0	0.00	2	33.3		
	30-50 years	7	33.3	14	66.7	0	0.00	0	0.00		
	>50 years	2	8.7	19	82.6	2	8.7	0	0.00		
2	Gender									2.50	0.476
	Male	9	22.0	28	68.3	2	4.9	2	4.9		
	Female	4	44.4	5	55.6	0	0.00	0	0.00		
3	Religion									6.69	0.082
	Hindu	10	34.5	17	58.6	0	0.00	2	6.9		
	Muslim	3	14.3	16	76.2	2	9.5	0	0.00		
4	Occupation									54.30	<0.001
	Farmer	9	26.5	23	67.6	2	5.9	0	0.00		
	Housewife	4	44.4	5	55.6	0	0.00	0	0.00		
	Businessman	0	0.00	4	100.0	0	0.00	0	0.00		
	Laborer	0	0.00	1	100.0	0	0.00	0	0.00		
	Employee	0	0.00	0	0.0	0	0.00	2	100.		
5	Clinical com.									17.97	<0.001
	Cough	9	69.2	30	90.9	0	0.00	0	0.00		
	Expectoration	7	53.8	23	69.7	0	0.00	0	0.00		
	Breathlessness	5	38.5	25	75.8	2	100	0	0.00		
	Chest Pain	3	23.1	21	63.6	2	100	0	0.00		
	Hemoptysis	13	100.0	33	100.0	2	100	2	100.		

**Table 3: Association between contrast enhanced computed tomographic findings and smoking habits.**

S. No	Factors	contrast enhanced computed tomographic findings								Statistical significance	
		Bronchiectasis (n=13)		Carcinoma (n=33)		Others (n=2)		Normal (n=2)		X <sup>2</sup>	p-value
		no	%	no	%	no	%	no	%		
1.	History of smoking									33.72	<0.001
	smoker	5	38.5	29	87.9	0	0.00	0	0.00		
	Non-smoker	4	30.8	4	12.1	0	0.00	0	0.00		
	Past -smoker	4	30.8	0	0.00	2	100.0	2	100.0		
2.	Type of smoking									52.87	<0.001
	cigarette	0	0.00	0	0.00	2	100.0	0	0.00		
	bidi	9	69.2	29	87.9	0	0.00	2	100.0		
	hookah	0	0.00	0	0.00	0	0.00	0	0.00		
	Ex to biomass smoke	4	30.8	4	12.1	0	0.00	0	0.00		
3.	Grade of smoking									32.57	<0.001
	Non smoker	4	30.8	4	12.1	0	0.0	0	0.00		
	Current smoker	5	38.5	1	3.0	2	100.0	2	100.0		
	Moderate smoker	4	30.8	11	33.3	0	0.00	0	0.00		
	Heavy smoker	0	0.00	17	51.5	0	0.00	0	0.00		
4.	Age at start of smoking									9.89	0.130
	<15 years	2	15.4	9	27.3	0	0.00	2	100.0		
	16-30 years	7	53.8	20	60.6	2	100.0	0	0.0		
	31-45 years										
	>46 years										
	Not applicable	4	30.4	4	12.1	0	0.00	0	0.00		

**Table 4: Association between contrast enhanced computed tomographic findings and Fiberoptic bronchoscopic findings.**

S.No	Fiberoptic bronchoscopic findings	contrast enhanced computed tomographic findings						Statistical significance	
		Carcinoma (n=33)		Others (n=2)		Normal (n=2)		X <sup>2</sup>	p-value
1.	Normal	4	12.1	2	100.0	2	100.0	16.26	0.003
2.	Growth with obstruction	21	63.6	0	0.0	0	0.00		
3.	Growth without obstruction	8	24.2	0	0.0	0	0.00		

**Table 5: Association between contrast enhanced computed tomographic findings and Histopathological findings.**

S.No	Histopathological findings	contrast enhanced computed tomographic findings				Statistical significance	
		Carcinoma (n=33)		Others (n=2)		X <sup>2</sup>	p-value
1.	Adenocarcinoma	3	9.09	0	0.00	21.29	<0.001
2.	Squamous cell carcinoma	22	66.67	0	0.00		
3.	Small cell carcinoma	5	15.15	0	0.00		
4.	Others	3	9.09	2	100.0		

## DISCUSSION

Hemoptysis is a manifestation of a spectrum of pathologies affecting the respiratory system and sometimes upper airway and gastrointestinal systems. Considering the variation in pathology, it is important that causes of hemoptysis are ascertained before the primary management approach is adopted. The diagnostic approaches for ascertaining the cause of hemoptysis include both invasive (bronchoscopy, biopsy) as well as non-invasive approaches (computed tomography and other imaging techniques). In the recent years, computed tomography modality has emerged as a useful diagnostic modality for diagnosis of causes of thoracic abnormalities and has shown promising results in the evaluation of hemoptysis. In the present study, we had tried to evaluate the usefulness of CT as a diagnostic modality for causes of hemoptysis and its limitations by carrying out fiberoptic bronchoscopy wherever CT evaluation failed to deliver a confirmative diagnosis. For this purpose, a total of 50 patients presenting with complaints of hemoptysis were enrolled in the study. Maximum no. of patients n=23, 46% were aged >50 years followed by those aged 30-50 years (n=21: 42%) there were only 6 cases (12%) aged <30 years. Thus the present study showed that hemoptysis was more common in adults and elderly. One of the reasons for the low prevalence of the patients in younger age group (<30 years) might be attributed to the inclusion criteria where we imposed a lower limit of 20 years for inclusion in the study. As such hemoptysis has been reported to be present in all age groups for varying pathologies. It has been reported in the pediatric population<sup>[16]</sup> young adults<sup>[17]</sup> and elderly<sup>[18]</sup> thus the high prevalence in age groups >50 years as observed in the present study is reflective of the design related age wise prevalence and not the age wise prevalence as a reflection of the community. In the present study, the majority of subjects were males (n=41; 82%), although no gender wise prediction to the risk of hemoptysis is reported in general. However, some studies have shown a higher prevalence of hemoptysis among female as compared to

males.<sup>[19]</sup> The reason for high prevalence of females in different studies could be attributed to different reasons. In the present study, we attribute this difference to two major factors-first, the high prevalence of smoking habits in males as compared to that in females; and secondly, a generalized low health seeking behavior of Asian women.

In the present study, the majority of patients were Hindus (58%), remaining patients were Muslims (42%). These figures are quite close to population proportion and thus do not indicate any specific religion-related risk. According to 2011 census of India, the proportion of Hindus and Muslims in lucknow is 62% and 26% respectively. Our facility is located in an area where the density of Muslim population is relatively higher and hence a slightly higher prevalence as compared to population proportion of two religions for the district is explanatory.

In the present study, the majority of patients were farmers (n=34; 58%). All the females were housewives. The findings indicate a high tobacco smoke and biomass fuel smoke exposure to be a major risk factor. It has been shown that smoking is an independent etiology of hemoptysis.<sup>[19]</sup>

In the present study, the presenting complaints in the majority of patients included hemoptysis (n=50; 100%) followed by a cough (78%), breathlessness (64%), expectorant (60%) and chest pain (48%). The clinical profile of the patients in the present study is in accordance with the reported clinical profile of the disease from various studies from India.<sup>[1, 20]</sup>

History of smoking/past-smoking was common in 84% cases. All the non-smokers were housewives having exposure to biomass fuel smoke. This smoke exposure was the omnipresent risk factor in the present study. Smoking has been reported to be an independent risk factor for hemoptysis and its severity and particularly to

malignant etiology of hemoptysis<sup>[21, 22]</sup> the more complicating thing in the present study was that most of the active smokers had a history of smoking of 16-30 years. Smoking directly stimulates various types of cells, in particular, macrophages<sup>[23, 24]</sup> and epithelial cells of the airways<sup>[25]</sup> thus contributing to the increased production of mediators and cytokines that participate in initiating the inflammatory reaction which might be responsible for hemoptysis.

In present study, CECT revealed a high burden of carcinoma (n=33; 66%) followed by bronchiectasis (n=13; 26%). In one case peripherally located mass and in another mediastinal mass was observed. Remaining 2 (4%) cases were found to be normal. In their CT study of 16 patients, none of the cases were found to have malignancy. In their study, the diagnosis was bronchiectasis (6), tuberculosis (6), Pneumonia (2), Bronchial carcinoid (1) and allergic bronchopulmonary aspergillosis in 1 case. One of the reasons for a high burden of carcinoma in the present study could be a high prevalence of smoking and biomass fuel smoke exposure and exclusion of sputum AFB positive cases in the present study. Among smokers, the too high prevalence of heavy smokers enhanced the risk of cancer. Heavy smoking is a major risk for lung cancer not only for the active smokers but also for passive smokers around them.<sup>[26-29]</sup> In another study<sup>[22]</sup> lung cancer was found to be specifically associated with smoking. On histopathology of 33 cases diagnosed as carcinoma by CECT, all the case were confirmed to be carcinoma or suspected malignancy. Thus indicating a high specificity of CECT in the diagnosis of carcinoma. A high utility of CECT in the diagnosis of carcinoma and malignancy was also reported by Hahm *et al.*<sup>[30]</sup>

We also evaluated the association of different demographic, personal and clinical variables with CECT observations. It was found that finding such as bronchiectasis were more common in young age group (<30 years) while older age group was more commonly associated with carcinoma (30-50 years and >50 years). Male were also more commonly associated with carcinoma (68.3%) as compared to female (55.6%). But both these indicating were associated with high smoking exposure. As seen in our study, smoking was prevalent mainly in male and most of the smokers were moderate to heavy smokers starting smoking in the age group 16-30 years. Given the impression that smoking was a decisive risk in carcinoma cases, both male gender and older age could be seen as interrelated with a higher magnitude of smoking. The assessment of smoking habits against CECT finding revealed our inference to hold ground. We found moderate to the heavy grade of smoking and initiation of smoking at age 16-30 years showed a higher prevalence of carcinoma, thus corroborating our inference that these two characteristics led to the progression of lung carcinoma in older age group *i.e.*, 30-50 and >50 years. In the present study, most of the clinical symptoms were more prevalent in

carcinoma case as compared to another diagnosis. This might be attributed the older age and higher prevalence of smoking in this group of patients.

The present study did not show any additional role of Fiberoptic bronchoscopy. In fact, bronchoscopy provided normal finding in 4 cases which were diagnosed as carcinoma on CECT and were later confirmed on histopathology. The finding confirmed the observation that CT has a better sensitivity for lung cancer as compared to Fiberoptic bronchoscopy owing to its ability to provide deeper visualization while Fiberoptic bronchoscopy has a limitation in visualization the deeper pathologies and extra-luminal lesion. This present study showed that CECT was a useful and efficient diagnostic modality for diagnosis of the cause of hemoptysis. Although most of the studies in past have found the high prevalence of tuberculosis, however, no patient with tubercular etiology was found in present study, which might be attributed to the exclusion criteria where sputum positivity was one of the criteria for exclusion.

CT and bronchoscopy are complementary in maximizing the diagnostic yield for malignant disease and bronchiectasis in patients with hemoptysis. It is not possible to state the exact role of CT in the diagnostic triage of patients with hemoptysis from such a small series, as there may have been biasing against bronchoscopy yielding maximum information because the procedure was performed without knowledge of the CT findings. CT can be useful to the bronchoscopist (a) when tumors are not visible, (b) to guide transbronchial needle biopsy when required to diagnose predominantly extra bronchial lesions, (c) as a preliminary investigation to optimize the yield from bronchoscopic examination, and (d) to provide other important information such as stage of carcinomas. CT should be the primary investigation in patients in whom clinical suspicion of malignancy is relatively low and who have normal findings on chest radiographs, and in these circumstances, it may obviate bronchoscopy. The present study collaborated the observation of previous workers that computed tomography is a useful diagnostic modality in cases of hemoptysis and helps in the investigation the reason of unexplained hemoptysis. In the present study, we found that CECT provides excellent information and it should be used as a first diagnostic tool in evaluating the causes of hemoptysis as it is noninvasive in nature. Fiberoptic bronchoscopy improves the results of CECT especially in cases with intraluminal growth for making a histopathological diagnosis.

Conflict of interests

No conflict of interests.

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