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Original Research Article

Prevalence of tracheobronchial anomalies among patients undergoing fibreoptic bronchoscopy: a retrospective analysis from a tertiary care hospital in Wayanad, Kerala, India

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ABSTRACT

Background: Tracheobronchial anomalies are a rare clinical entity and often asymptomatic in nature. Some patients may experience symptoms such as cough, recurrent pneumonia or hemoptysis. Knowledge and understanding of tracheobronchial variations have important implications for diagnosis of symptomatic patients and performing certain procedures, including bronchoscopy and endotracheal intubation. Objective was to study the prevalence of tracheobronchial anomalies detected during routine bronchoscopy in a tertiary care setting.
Methods: Retrospective analysis of hospital data of patients undergoing fibreoptic bronchoscopy for one year in a tertiary care setting.
Results: There were 149 bronchoscopies evaluated. Total of 41 anomalies were detected in 34 (22.8%) subjects. The most common anomaly was bronchial diverticula.
Conclusions: This retrospective study takes stock of various tracheobronchial anomalies among subjects who underwent bronchoscopy in a tertiary care hospital in Wayanad, North Malabar. This study revealed major tracheobronchial anomalies in 22.8% of subjects which is higher when compared to previous studies. This is particularly important due to the fact that Wayanad is a backward hilly district and tribal community constitutes 20% of its population.

Keywords: Bronchial diverticula, Cardiac bronchus, Tracheal bronchus

INTRODUCTION

Several congenital branching anomalies affecting the trachea, main bronchi, and intermediate bronchus have been reported, all of which can be recognized by bronchoscopy or by chest CT. These anomalies are often overlooked. Variations in the pattern of bronchial tree are, for the most part, due to displacement of segmental and sub-segmental bronchi. The main embryonic hypothesis for congenital bronchial anomalies is reduction, migration and selection theories.[1] It is estimated that the incidence of trachea-bronchial anomalies ranges from 1 and 12%.[2-5] Most important tracheobronchial anomalies or variations are tracheal bronchus, accessory bronchus, bronchial diverticula, absent bronchus and supernumerary bronchus. In general these variations are a rare clinical entity owing to the fact that most of these anomalies are asymptomatic in nature and escape detection. But these anomalies can be responsible for pulmonary symptoms such as dyspnea, recurrent pneumonia, and hemoptysis. Tracheobronchial positional anomalies are often associated with other congenital abnormalities but may be isolated. These anomalies may cause inconveniences during procedures

such endotracheal intubation and bronchoscopy. It is essential that these anomalies are recognized prior to lung resection to avoid complications, especially when video-assisted thoracoscopic surgery is performed. This study investigated the prevalence of tracheobronchial anomalies and describes various congenital branching anomalies affecting the trachea, main bronchi, and intermediate bronchus in patients undergoing fibreoptic bronchoscopy for other indications in a tertiary care hospital during a period of one year.

Aim of the study was to study the prevalence of tracheobronchial anomalies detected during routine bronchoscopy in a tertiary care setting in Wayanad District of Kerala.

METHODS

Research methodology

Our study was a retrospective study in which data of all patients who underwent fibreoptic bronchoscopy in the department of Pulmonary Medicine, DM WIMS Medical College Hospital performed for a period of one year between 01-01-2017 to 31-12-2017 were collected and analyzed. Each bronchoscopic procedure was performed by skilled pulmonologist. After prior explained consent for the procedure, bronchoscopy was performed using fibreoptic bronchoscope (Olympus BF1T 150). Clinical details, primary diagnosis, radiologic findings and bronchoscopic findings from images and videos were studied. The total number of cases performed during the study period were 171 of which incomplete reports (n=17) and second and third reports for the same patient (n=5) were excluded from the study. We analyzed major tracheobronchial variations in the remaining 149 cases. The protocol for the research project has been approved by the Institutional Ethics Committee.

Data collected from bronchoscopy were documented in Microsoft excel format. Statistical analysis was performed using SPSS software version 16. Prevalence of tracheobronchial anomalies and percentage of each anomaly were calculated. Statistical significance for age and sex of patients were calculated using Chi-Square Test.

RESULTS

Authors reviewed bronchoscopy reports of 149 patients comprising 109 males and 40 females. Major tracheobronchial variations were observed in 34 patients contributing to a prevalence of 22.8% (Table 1, Figure 1). Multiple anomalies were present in the bronchial tree of 7 patients making a total of 41 anomalies. Out of 109 male patients 26 (23.9%) were found to have tracheobronchial anomalies while among 40 females studied 8 patients (20%) had anomalies. There were 109 patients aged >50 years and 40 patients aged ≤50 years. Among patients with age >50 years 22% had tracheobronchial anomalies. 25% of patients aged ≤50 had tracheobronchial anomalies (Table 2). Statistical significance for age and sex of patients were calculated using Chi- Square Test. It was found that there was no statistical significance between these demographic variables and presence of anomalies.

Table 1: Frequency and prevalence of tracheobronchial anomalies in the study.

Tracheobronchial anomalies	Frequency	Percentage
Present	34	22.8
Absent	115	77.2
Total	149	100

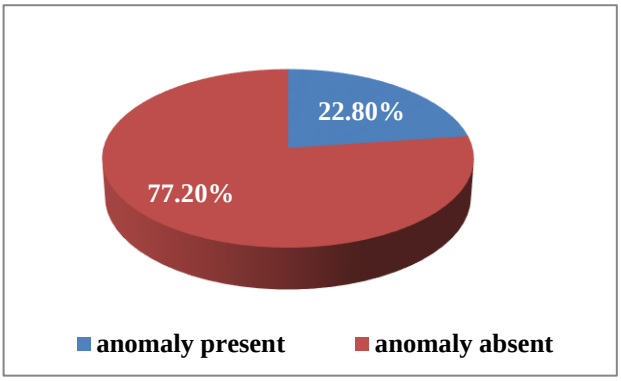

Figure 1: Prevalence of tracheobronchial anomaly in the study population.

Table 2: Chi-square test showing the relationship of age and sex with presence of tracheobronchial anomalies.

Variables		Outcome		P value
		Absent	Present	
Age group	≤50	30(75%)	10(25%)	0.701
	>50	85 (78%)	24(22%)	
Sex	Male	83(76.1%)	26(23.9%)	0.619
	Female	32(80%)	8(20%)	

Most common type of tracheobronchial anomaly observed was bronchial diverticula (Figure 2). 18 cases were found to have the anomaly among which 2 patients had abnormal bronchial divisions also. Size of the diverticula varied and most of them were found to be associated with Chronic Obstructive Pulmonary Disease.

Second most common anomaly seen was branching anomalies where the number of upper and lower lobar bronchus on both sides showed abnormal branching pattern (Figure 3). 16 cases (10.7%) showed branching anomalies. Most of the findings were seen on right side (n=14) compared to left (n=2). Right upper lobe branching anomalies predominated with 5 cases of four divisions for upper lobe and 3 cases of two divisions for upper lobe. In one patient right upper lobe bronchus was found to start proximally from the trachea. Right lower

lobe bronchial anomalies (n=3) mainly included abnormal number of basal segments.

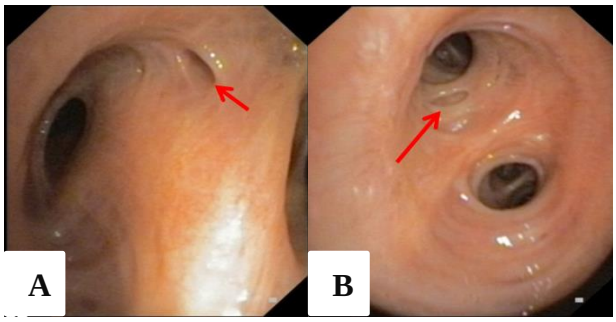

Figure 2: Bronchial diverticula (Red arrows).

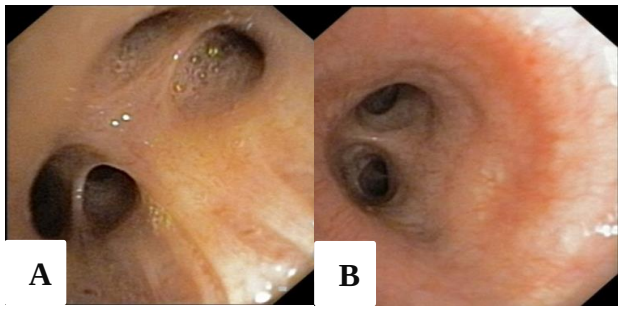

Figure 3: Branching anomalies. A) 4 divisions of Right Upper lobe bronchus, B) Absent superior segment of right lower lobe.

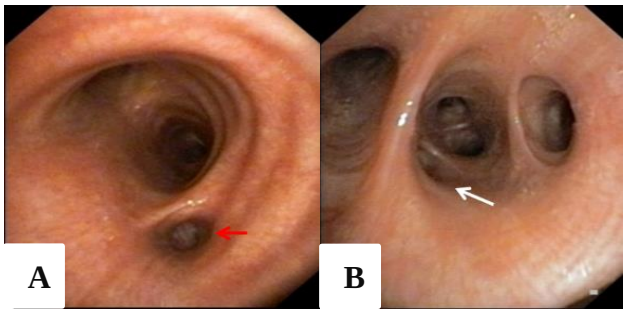

Figure 4: A) Tracheal bronchus (red arrow) B) Cardiac bronchus (white arrow).

Table 3: Summary of tracheobronchial anomalies.

Anomalies	Frequency	Percentage
Diverticula	18	12
Branching anomalies	16	
Right side	14	10.7
Left side	2	
Absent segments	2	1.3
Tracheal bronchus	2	1.3
Tracheobronchomegaly	2	1.3
Cardiac bronchus	1	0.67
Total	41	27.5

Posterior basal segment of right lower lobe was absent in one patient. In 2 patients right middle lobe bronchus divided into 3 segments. On the left side branching anomalies were found in 2 patients. In 2 patients superior segment of right lower lobe bronchus were absent. Tracheal bronchus was found in two patients, in both cases on right side (Figure 4). Both cases of tracheal bronchus were associated with abnormal branching pattern. Tracheobronchomegaly was found in 2 cases. Cardiac bronchus (Figure 4) was found in one patient (Table 3).

DISCUSSION

Tracheobronchial development begins early in fetal life. The trachea and bronchi develop as a diverticulum of the ventral wall of the foregut at 24-26 days gestation.[1,6] Bronchial buds undergo stages of dichotomous and lateral branching that give rise to the conducting airways.[7] The pathogenesis of congenital branching anomalies remains unknown, but these anomalies probably occur early in fetal life. Evans hypothesized that defects involving supernumerary bronchi may occur at about 29-30 days gestation, whereas displaced bronchi are more likely to occur after 32 days.[6]

Numerous tracheobronchial branching anomalies have been described. It is estimated that prevalence of tracheobronchial anomalies range from 1-12%.[2-5] In this study we retrospectively analyzed the bronchoscopy reports of 149 patients comprising 109 males and 40 females. Major tracheobronchial variations were observed in 34 patients contributing to a total of 41 anomalies. Tracheobronchial anomalies detected constitute 27.5% among 22.8% of subjects in this study. This is higher than the prevalence reported in various studies. This may be explained by the facts that population in this district constitute many closed communities among tribals.

Most congenital tracheobronchial anomalies are asymptomatic and are discovered incidentally. Commonest tracheobronchial anomaly observed in this study was bronchial diverticula. These are blind-ended bronchi and can be congenital or acquired. Acquired bronchial diverticula can be observed in chronic obstructive pulmonary disease.[8] Bronchial diverticula are seen in 18 subjects and 2 patients in this group had abnormal bronchial divisions also. Size of the diverticula varied and most of them were found to be associated with Chronic Obstructive Pulmonary Disease.

Abnormal branching patterns and absent bronchial segments were the second common anomaly noted in this study. Previous literature shows that bronchial anomalies affecting the upper lobe are seven times more frequent on the right side.[9] In the study by Ghaye et al, displaced right upper lobe bronchus was the most common type (57%).[1] Left sided bronchial branching anomaly was seen mainly in left upper lobe bronchus. Similarly Ghaye et al, also

concluded that, left sided branching anomalies occurred five times less frequently than right upper lobe bronchus anomalies.[1] Affected patients are usually asymptomatic. Findings of our study were in concordance with the above observations. 16 cases (%) showed branching anomalies. Most of the findings were seen on right side (n=14) compared to left (n=2). Right upper lobe branching anomalies predominated with 5 cases of four divisions for upper lobe. In one patient right upper lobe was found to start proximally from the trachea. Right lower lobe bronchial anomalies (n=3) mainly included abnormal number of basal segments. Posterior basal segment of right lower lobe was absent in one patient. In 2 patients right middle lobe bronchus divided into 3 segments. On the left side anomalies were found in 2 cases which were in left lower lobe bronchus. Segmental bronchial agenesis predominates in the right upper lobe. 3 patients in this study had bilobed right upper lobe while in 2 patients superior segment of right lower lobe bronchus were absent.

Authors observed tracheal bronchus in two patients (1.3%) on the right side contributing to 5.9% of all anomalies. Both the cases presented with clinical features of right upper lobe pneumonia. Tracheal bronchus was also associated with abnormal branching pattern of bronchi. The term tracheal bronchus encompasses a variety of bronchial anomalies originating from the trachea or main bronchus and directed to the upper lobe territory.[10,11] A prevalence of 0.1%-2% for right tracheal bronchus and 0.3%-1% for left tracheal bronchus has been reported.[8] A bronchus abnormally originating directly from the trachea is exposed to additional risks during tracheal intubation, such as lobar or segmental atelectasis due to luminal occlusion by the tube or respiratory failure due to inadvertent intubation of the tracheal bronchus.[9,12] Clinically, tracheal bronchus may be associated with recurrent pneumonia, stridor, or respiratory distress in children.[13]

Accessory cardiac bronchus (ACB) is a supernumerary bronchus that originates from the medial wall of the main bronchus or intermediate bronchus and is directed caudally toward the heart.[14] ACB is seen in 0.07%-0.5% of the general population.[15] Ghaye et al, have found 14 ACBs in 17,500 consecutive patients (frequency, 0.08%).[1] In this study, we observed accessory cardiac bronchus on the right side in one patient (0.67%) and the frequency is in concordance with previous studies.

This is a hospital based study and hence did not reflect the prevalence in the community; this is the limitation of the study.

CONCLUSION

Tracheobronchial anomalies affecting the trachea, main bronchi, and intermediate bronchus are often overlooked. But these anomalies may present with symptoms of lower respiratory infection. These anomalies, which probably occur early in fetal life, can be either supernumerary or displaced. Authors found that there is increased prevalence of tracheobronchial anomalies in this study compared to previous studies. Most common anomalies observed were bronchial diverticula and abnormal bronchial branching. Awareness of the bronchial anatomic principles and use of a lobe-based classification scheme will facilitate recognition of tracheobronchial anomalies.

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