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Clinical, Radiological and Microbial Profile in Bronchiectasis

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Abstract

Introduction: Bronchiectasis can lead to recurrent lower respiratory tract infections resulting worsening of pulmonary functions and respiratory failure. Deterioration in quality of life with increased morbidity and premature mortality is common in bronchiectasis. Increased prevalence of tuberculosis across the country has been exponentially increasing the incidence of bronchiectasis and parallelly increasing the burden of health care cost to the population. The aim of this study was to assess the clinical, radiological and microbial profile of bronchiectasis.

Materials and Methods: This Hospital based observational study was conducted in the Department of Medicine, Assam Medical College and Hospital, Dibrugarh within duration of one year. All admitted patients who presented with signs and symptoms of bronchiectasis fulfilling the inclusion and exclusion criteria were taken up for the study. All the patients above 13 years of age diagnosed as bronchiectasis were included in this study. Patients not willing to give consent and age < 13 years were excluded.

Result: We encountered more females (57.69%) than males (42.31 %).The majority of patients belonged to the age group of 51-60 years (37.18%).The mean age was: 48.18 ± 14.12 years. The most common symptom and sign was cough (100%) and crepitations (75.64%) respectively. The Post tubercular bronchiectasis (52.56%) was the most common etiology followed by COPD (24.36%). Tractional bronchiectasis (61.54 %) was most commonly encountered .Most common pattern of lung involvement was bilateral (30.76%) followed by right lung middle lobe involvement (21.79%).Klebsiella pneumonia (33.33%) was most common microbials which was highly sensitive to amikacin (96.55%) .

Conclusion: Cough was most common symptoms whereas crepitation was the most common sign of bronchiectasis. Post tubercular infection was the most

common etiology. Tractional bronchiectasis was most commonly encountered. Klebsiella was the commonly isolated microbial.

Keywords: Bronchiectasis, Clinical, Radiological, Microbial Profile.

Introduction: Bronchiectasis is defined as an irreversible dilatation and destruction of one or more medium sized bronchi, with a reduction in clearance of respiratory secretions and in the expiratory airflow. This disease can lead to recurrent lower respiratory tract infections, worsening of pulmonary functions, respiratory failure and pulmonary hypertension, resulting in deterioration in quality of life, with increased morbidity and premature mortality[1]. Persistent airway inflammation and mucus hypersecretion may also predispose to mucus plugging and bronchial wall thickening and destruction, resulting in impaired lung function.[2]

The word bronchiectasis is derived from the Greek word, 'bronchion' which means 'windpipe' and 'ektasis' which means 'stretching out'. The condition was clearly described by Laennec in 1819 after a post mortem examination of the lungs of an infant who died following whooping cough[3].

Based on the data obtained from the health-care claims processing systems of more than 30 US health plans spanned over the period of January 1, 1999, to December 31, 2001, prevalence of bronchiectasis ranged from 4.2 per 100,000 persons aged 18–34 years to 271.8 per 100,000 among those aged ≥75 years.[4]

In a Meta analysis, conducted from January 1, 1997, and December 31, 2018 in India, it was seen that the pooled prevalence of bacteriologically positive pulmonary tuberculosis was 295.9 (95% confidence interval: 201.1–390.6) per 100,000 population with the prevalence higher among males than females. It was also seen that it was more in rural areas compared to urban areas. The pooled prevalence of culture positive pulmonary tuberculosis (277.8/100,000 population) was higher than smear positive pulmonary tuberculosis (196.6/100,000 population). The pooled prevalence of bacteriologically positive pulmonary tuberculosis in sensitivity analysis was 186.6/100,000 population.[5]

In the annual report of 2022 by the Ministry of Health and Family Welfare, it was seen that among the North Eastern states, Arunachal Pradesh with a population of 16.7 lakhs had 83 of newly diagnosed case of tuberculosis, Assam with a population of 354.8 lakhs had 259 newly diagnosed cases and Manipur with a population of 31.7 lakhs had 134 newly diagnosed cases. In Meghalaya, which has a population of 37.4 lakhs had 142 newly diagnosed cases, Mizoram with a population of 12.8 lakhs had 36 newly diagnosed cases and Nagaland with a population of 20.8 lakhs had 75 newly diagnosed cases. In Tripura, which has a population of 39.9 lakhs had 39 newly diagnosed cases and Sikkim with a population of 6.7 lakhs had 10 newly diagnosed cases of tuberculosis.[6]

The increasing burden of tuberculosis especially in the North Eastern part of our country which is unique geographically with diverse ethnicity, draws special attention due to scanty research especially of bronchiectasis which is considered as one of the most common cause of morbidity and mortality following pulmonary tuberculosis infection.

To bridge this research gap, we intended to carry out this research work to find out the detailed pattern of bronchiectasis in this region by studying the clinical, radiological and microbial profile.

Aims and Objectives

Aim: To study the clinical, radiological and microbial profile of bronchiectasis

Objective: To study the clinical profile and record radiological findings as well as to investigate the pattern of respiratory microbials associated with bronchiectasis by doing culture and sensitivity.

Materials and Methods

This Hospital based observational study was conducted in the Department of Medicine, Assam Medical college and Hospital, Dibrugarh within a duration of one year (1st July 2021 to 30th June 2022).All patients presenting with signs and symptoms of bronchiectasis were admitted in Department of Medicine, Assam Medical College & Hospital, Dibrugarh during the study period and who fulfilled the inclusion and exclusion criteria were taken up for the study. All the patients above 13 years of age diagnosed as bronchiectasis with signs and symptoms and HRCT thorax evidence for bronchiectasis were included in this study. Patients not willing to give consent and age < 13 years were excluded from the study.

Sample size: Considering 95% confidence interval with 10% of absolute precision and based on previous study [7] on bronchiectasis patients, the sample size is calculated to be 78 for the present study. Sample size was calculated using the formula:

$n=4pq/d^2$

Where, n = sample size, p = prevalence (from previous studies),

q = 100-p, d = allowable error (5-20% of p).

Operational case definition

A) Patient of bronchiectasis was taken who had the following: 8

a**) Clinical symptoms of bronchiectasis:** Cough with/without expectoration, Excessive sputum volume, Hemoptysis, Shortness of breath, Chest pain, and recurrent chest infections.

b) **Clinical signs** of bronchiectasis on general examination and the respiratory system: Crepitations, Wheeze, Clubbing

B) Findings on HRCT thorax[9]

a) **Specific findings of bronchial dilatation:** Increased bronchoarterial ratio-Internal bronchial diameter >adjacent pulmonary artery, Signet ring sign (vertical bronchi) and lack of bronchial tapering.

b) **Contour abnormalities:** Cylindrical bronchiectasis-Tram tracks, Varicose bronchiectasis- string of pearls, Cystic bronchiectasis- cluster of grapes, Visibility of airways in peripheral 1 cm of lung.

c) **Common nonspecific findings:** Bronchial wall thickening, Fluid or mucus filled bronchi.

d) **Ancillary findings:** Volume loss, Mosaic perfusion, Air trapping, Tree in bud, Bronchial artery enlargement.

Method of data collection:

After obtaining institutional ethics committee approval and written informed consent from the patients who fulfills the inclusion and exclusion criteria, the demographic and clinical data were collected for each patient.

Methodology: A detailed history of the patients was taken including present illness, prior history of tuberculosis, childhood exanthematous fevers, hospitalization for pneumonia/ respiratory infections and co-morbidities. Meticulous general and systemic examinations were performed. Routine investigations along with pulmonary function test, HRCT thorax, sputum culture and sensitivity were done. Etiology specific tests were done only in those patients where it was indicated based on high index of suspicion. (Peripheral blood eosinophil, serum IgE, serum IgA, serum IgM, sweats chloride, CFTR genetic mutation analysis, ciliary examination, bronchoscopy).

Investigations:

Pulmonary Function Test*:* Spirometry was performed using technique that meet published standards with spirometer, Spirolab II, MIR. It was done before and 10-15 minutes after inhalational administration of total dose of 400 mcg salbutamol. Activities that the patients should avoid prior to spirometry: Smoking within at least 1 hour of testing, Consuming alcohol within 4 hour of testing, Performing vigorous exercise within 30 minutes of testing, Eating a large meal within 2 hour of testing, Wearing clothes that substantially restricts full chest and abdominal expansion

Patient positioning: Test was performed in sitting positioning

Procedure: Instruction to the patient on how the breathing maneuver is carried out, nostrils of the patients were closed with a nose clip, mouth piece to be held with teeth and seal lips tightly around it, patients were asked to blow out the air as rapidly, forcefully and completely as possible (approximately 6 seconds).After complete exhalation patients were asked to take rapid maximum inhalation, test were repeated for minimum 3 times and best values for interpretation were taken.

When both acceptability and repeatability were met, the tests were considered concluded. If these criteria were not met, procedure was continued until both of the criteria are met with analysis of additional acceptable spirograms, or a total of eight tests have been performed (optional), or the patient/subject cannot or should not continue.

Table 1: Criteria for acceptability and repeatability of spirograms:

Acceptability criteria	Repeatability criteria
They are free from arte facts such as cough during the first second of exhalation, glottis closure that influences the measurement, early termination or cut-off, effort that is not maximal throughout, leak or obstructed mouthpiece. They have good starts. Extrapolated volume, 5% of FVC or 0.15 L, whichever is greater They show satisfactory exhalation - Duration of ≥6 s (3 s for children) or a plateau in the volume–time curve	After three acceptable spirograms have been obtained, the following tests to be applied The two largest values of FVC must be within 0.150 L of each other The two largest values of FEV1 must be within 0.150 L of each other

HRCT thorax

HRCT thorax was done at Department of Radiology using the PHILIPS BRILLANCE Ict 256 CT SCAN,(model no-4598 016 10641). Scans were performed in suspended inspiration. Lung window setting used with window width of 1000 to 1600 HU and window level of -600 to -700HU. HRCT was performed obtaining 1mm section at 10mm intervals and kVp of 120 and mA of 120. Coronal and sagittal reformatting was done to a slice thickness of 0.23 mm. Each HRCT was analyzed for specific features relevant to the evaluation of bronchiectasis.

Sputum Culture and Sensitivity

Standard operating procedure was followed during the whole procedure. Sputum was collected in wide mouthed sterile containers. Patients were asked to have deep breath before coughing to have proper sputum. Early morning sample was preferred. Sputum samples were transported directly after collection to the laboratory and were processed immediately. Sputum samples were examined by direct microscopy after Gram staining,

Zeihl Neelson staining and KOH mounting. Sputum specimen containing >25 neutrophils and <10 squamous epithelial cells per low power field were considered adequate for culture.

Bacterial culture was done on blood agar, Mac Conkey agar and chocolate agar while fungal culture was done on Sabourand dextrose agar media. The significant bacterial and fungal isolates recovered on culture were identified to the species level using standard bacterial and mycological procedures in the Microbiology Department of Assam Medical College and Hospital. The bacterial and fungal growths were considered significant after repeated culture yielded same growth.

Antibiotic susceptibility was seen by using the conventional method and disc diffusion method by challenging bacterial isolates with antibiotic disks that are placed on the surface of an agar plate that has been seeded with a lawn of bacteria. When disks containing a known concentration of antimicrobial agent are placed on the surface of a freshly inoculated plate, the agent immediately begins to diffuse and establish a concentration gradient around the disc the highest concentration is closest to the disc.

Statistical analysis

The data collected was tabulated in Microsoft Excel Worksheet 2010 and results on continuous measurements were presented as mean ± standard deviation. Discrete data are expressed as numbers and percentage (%).

Results

In this study total 78 patients were studied. The results and observations of the study are illustrated in the following tables and figures:

Fig. 1 shows that the females (57.69%) were more common than males (42.31 %) with male: female ratio 1:1.36.

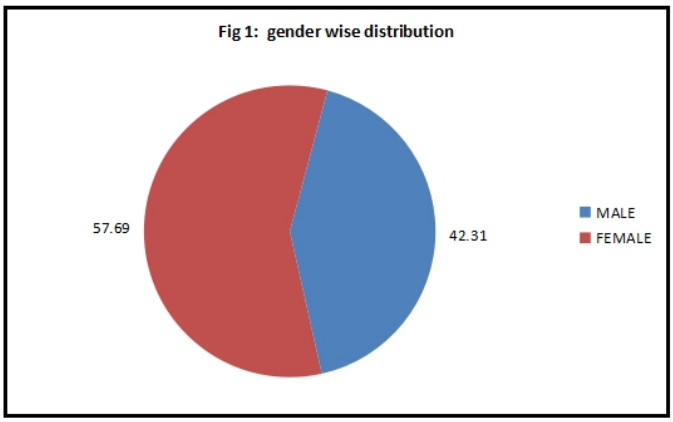


Fig.1: gender wise distribution of study subjects

Figure 2 shows that the majority of patients belonged to the age group of 51-60 years (37.18%) followed by age group of 41-50 years(21.80%) , 21-30 years (15.38% , 31-40 years (14.10%), 61-70 years(5.13%) and >70 years(6.41%). The mean age was: 48.18 ± 14.12 years.

Fig. 2: age wise distribution of the study subjects

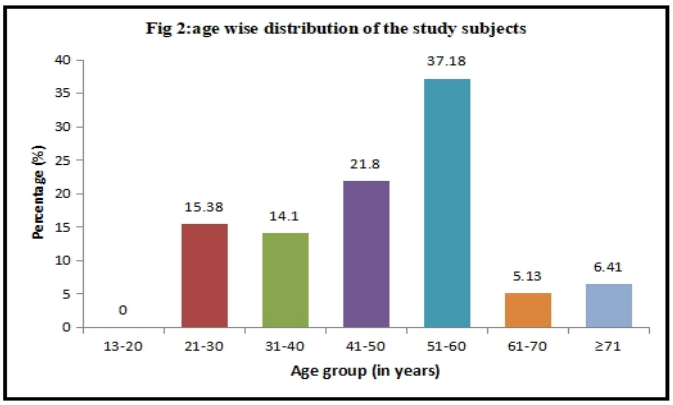


Table 1: symptoms of bronchiectasis in study subjects

Symptoms	Numbers(n=78)	Percentage (%)
Fever	34	43.59
Cough	78	100
Expectorant:		
A) Purulent	28	35.90
B) Mucopurulent	30	38.46
C) Mucoid	20	25.64
Haemoptysis	16	20.51
Chest pain	12	15.38

Weight loss	24	30.77
Fatigue	27	34.62
Respiratory distress	55	70.51

The above table 1 shows the most common symptom was cough (100%) with mucopurulent sputum in 38.46%(n=30) followed by purulent sputum 35.90% (n=28),and mucoid expectoration 25.64%(n=20). 70.51%(n=55) of the study subjects had respiratory difficulty, 43.59%(n=34) had fever, 34.62%(n=27) had fatigue, 30.77%(n=24) had weight loss, 20.51%(n=16) hemoptysis and 15.38%(n=12) had chest pain.Fig 3: shows that the most common sign was found to be crepitations (75.64%) followed by pallor (24.36 %), clubbing (23.08 %) and wheeze (17.95%).

Fig. 3: Signs of bronchiectasis in study subjects

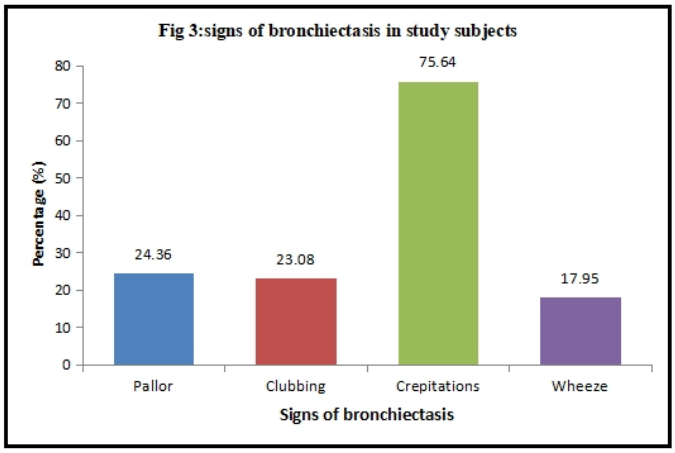


Table 2: etiology of bronchiectasis in study subjects

Etiology	Number (n=78)	Percentage (%)
Connective tissue disorder	4	5.13
Immunocompromised	4	5.13
Idiopathic	10	12.82
COPD	19	24.36
Post tubercular	41	52.56

The above table 2 shows that the Post tubercular bronchiectasis (52.56%) was seen as the most common etiology followed by COPD (24.36%), idiopathic (12.82%), immunocompromised (5.13%) and connective tissue disorder (5.13%).

Fig 4 shows that the most common PFT pattern was found to be obstructive type (41.02%) followed by restrictive (24.36%), normal pattern (24.36%) and mixed pattern (10.26%).

Fig. 4: PFT pattern of bronchiectasis in study patients

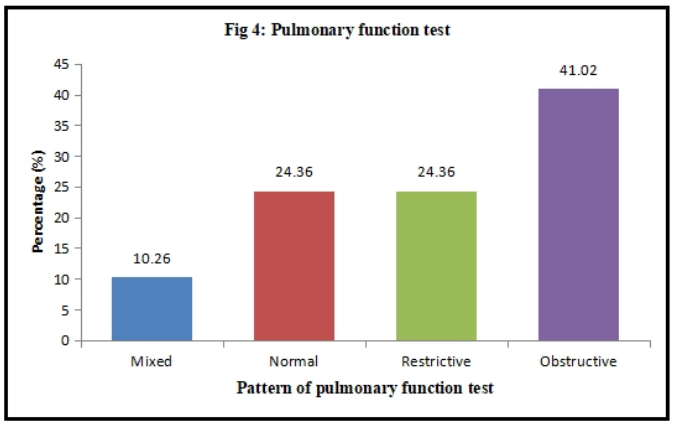


Table 3: Type of bronchiectasis of study patients

Type of bronchiectasis	Numbers (n=78)	Percentage (%)
Varicose	0	0
Cylindrical	14	17.95
Cystic	16	20.51
Tractional	48	61.54

The above table 3 shows that tractional bronchiectasis (61.54 %) was the most common type followed by cystic bronchiectasis (20.51%) and cylindrical bronchiectasis (17.95%). None of the subjects showed varicose type of bronchiectasis.

Table 4: Pattern of lung involvement in study patients

Pattern of lung involvement	Numbers (n=78)	Percentage (%)
Right lung lower lobe	10	12.82

Right lung upper lobe	11	14.1
Left lung upper lobe	12	15.38
Left lung lower lobe	16	20.51
Right lung middle lobe	17	21.79
Bilateral	24	30.76

The above table 4 shows the most common pattern of lung involvement was seen to be bilateral involvement in 30.76%(n=24) followed by right lung middle lobe involvement in 21.79(n=17), left lung lower lobe involvement in 20.51%(n=16), left lung upper lobe involvement in 15.38%(n=12), right lung upper lobe involvement in 14.1%(n=11) and right lung lower lobe involvement in 12.82%(n=10).

Fig 5 shows the most common organism isolated on sputum culture was found to be Klebsiella pneumonia (33.33%) followed by Pseudomonas aeruginosa (17.95%), Acinetobacter baumanii1 (5.38%), Staphylococcus (12.83%), Escherichia coli (5.13%) and Haemophilus influenza (1.28%). 14.10% (n=11) of study subjects showed no significant growth of organisms. There was no fungal growth isolated in the sputum.

Fig. 5: Organisms encountered on sputum culture of study patients

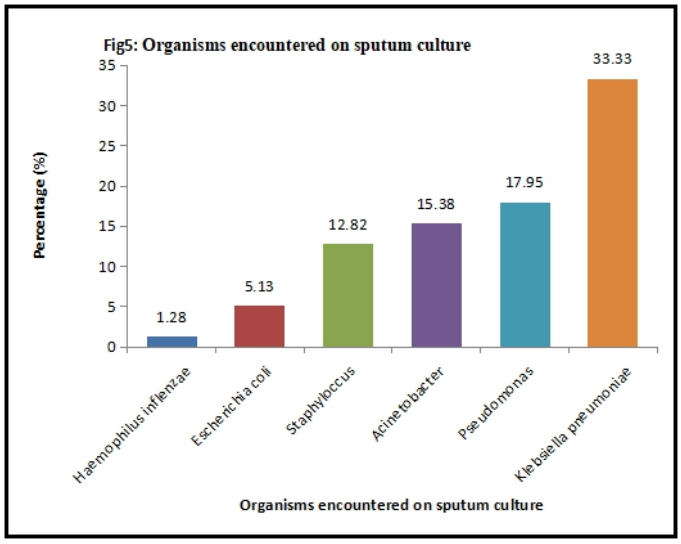
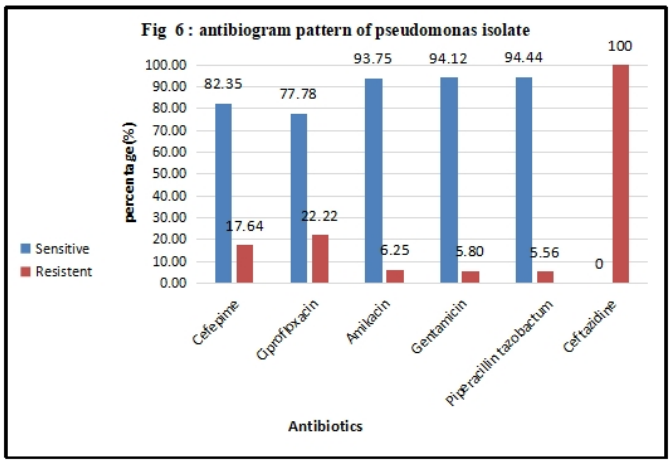


Table 5: Antibiogram pattern for Klebsiella isolated in the study subjects

Antibiotic spectrum	Sensitive (%)	Resistant (%)
Amikacin	96.55	3.45
Amoxyclav	77.78	22.22
Ceftazidime	16.39	84.61
Cotrimoxazole	68.00	32.00
Ciprofloxacin	87.5	12.5
Cefotaxime	56.00	44.00
Doxycycline	75.00	25.00

The above table 5 shows antibiogram pattern for Klebsiella isolated in the bronchiectasis subjects. The most sensitive antibiotic was the amikacin (96.55%) followed by ciprofloxacin(87.50%), amoxyclav(77.78%), doxycycline (75.00%), cotrimoxazole(68.00%), cefotaxime (56.00%) and ceftazidine (16.39%). The most resistant antibiotic was ceftazidine (84.61%) followed by cefotaxime (44.00%), cotrimoxazole (32%), doxycycline (25.00%), amoxyclav(22.22%), ciprofloxacin(12.5%) and amikacin (3.45%).Fig 6 shows the most sensitive antibiotic for pseudomonas was the Pipercillin tazobactum (94.44%) followed by gentamicin (94.12%), amikacin (93.75%), cefepime (82.35%) and ciprofloxacin (77.78%). The most resistant antibiotic was ceftazidime (100%) followed by ciprofloxacin (22.22%), cefepime (17.64%), amikacin (6.25%), gentamicin (5.88%) and Pipercillin tazobactum (5.56%).

Fig. 6: Antibiogram pattern of pseudomonas isolated in the bronchiectasis subjects.



Discussion:

Gender distribution of the study population

Out of 78 patients, we encountered 33 males (42.31%), and 45 female (57.69%) with male to female ratio 1:1.36 According to Nicotra MB et al [10], 69% were female and 30.89% were male. Methe P et al[7] encountered 58% females and 42% male.Saleh AD et al,[11] have found that 63% were women and 37% were male. Quint J et al[12] found 58.5% women and 41.5% male in their study.

Age distribution of the study population

We encountered about 59% of the study subjects with bronchiectasis in the age group of 40 to 60 years with mean age 49 years.

Methe P et al[7] observed most of the patients in the age group 51-60 years (38%) followed by in 61-70 years age group (20%). Saleh AD et al[11] found majority of the patients in the median age of 61 (46-71) years. According to Kelly MG et al,[13] the mean age of the patients were 57±2 years with increase of patients in 5th and 6th decade. Hariprasad K et al[14] encountered majority of the patients within 41- 66 years of age and the median age was 56 years.Our study concluded similar results with the above mentioned studies.

Distribution of symptoms of the study population:

The most common symptom was cough (100%) with mucopurulent sputum in 38.46% (n=30) followed by purulent sputum 35.90% (n=28), and mucoid expectoration 25.64%(n=20). 70.51%(n=55) of the study subjects had respiratory difficulty, 43.59%(n=34) had fever, 34.62%(n=27) had fatigue, 30.77%(n=24) had weight loss, 20.51%(n=16) hemoptysis and 15.38%(n=12) had chest pain.

According to Mehmet Ali Habesoglu et al [1] the most frequent complaints were cough (83.6%) and sputum (83.6%).Methe P et al[60] observed that 100% patients had cough and sputum production followed by dypnoea (76%) and haemoptysis (24%). Most of the study population had mucopurulent sputum production. According to Imam JS et al,[15] the most frequent symptoms were cough (73%), productive sputum production (53%), dyspnea (64%) and fatigue (50%) in the United States Bronchiectasis Registry. Airway secretions were described as abundant and frequent, mucopurulent may be difficult to expectorate. This resulted in wheezing, chest congestion and hemoptysis.Stockley RA et al[16] found that cough (>90%) was the commonest symptom in bronchiectasis.

Distribution of signs on examination of the study population

We observed that crepitations was the common sign (75.64%) followed by pallor (24.36%), clubbing (23.08%) and wheeze (17.95%).

According to Nicotra MB et al [10]crackles was seen in 70% and wheezing in 34% of study population. Methe P et al[7]found that crepitations were most common sign (72%) followed by clubbing (26%) and rhonchi (18%).

Distribution of etiology of the study population

In our study, we observed past history of TB in 52.56% which was followed by COPD (24.36%), idiopathic

(12.82%), connective tissue disorder (5.13%) and immunocompromised (5.13%). Post tubercular is seen most commonly as the etiology as India is endemic for tuberculosis.

According to Methe P et al[7], post infectious bronchiectasis was seen commonly in 50% of study population. Olveira C et al,[17] encountered the causes of bronchiectasis as post-infectious(30%), cystic fibrosis(12.5%), immunodeficiencies (9.4%), COPD (7.8%), asthma (5.4%), ciliary dyskinesia (2.9%) and systemic diseases (1.4%). Dimakou K et al[18] found that Post-infectious bronchiectasis was the most common (25.2%)cause followed by patients with history of past tuberculosis (22.3%). Shoemark et al[19] identified underlying cause in 74% patients whereas rest were idiopathic bronchiectasis. The common etiologies were: post-infection, primary ciliary dyskinesia, ABPA, and immune deficiency. These patients had symmetrical predominant lower lobe disease with onset of chronic chest and sinus symptoms in middle age.

Distribution of pulmonary function test of study population

We observed the most common PFT pattern as obstructive type (41.02%) followed by a restrictive (24.36%), normal (24,36%) and mixed (10.26%).

Chalmers JD et al[20] found that 49.5% had airflow obstruction, followed by restrictive (18.8%) and normal spirometry (31.7%) based on FEV_1/FVC ratio. Methe P et al[7] observed common pattern of pulmonary function test as obstructive pattern .According to Lee JH et al[21] out of 49 patients, 34 patients showed abnormal lung function: obstructive type in 16 cases and mixed obstructive-restrictive type in 18 cases.

Distribution of HRCT thorax findings of study population

In our study, tractional bronchiectasis (61.54%) was the most common type of bronchiectasis followed by cystic bronchiectasis (20.51%) and cylindrical bronchiectasis (17.95%).We observed that most common lung involvement in bilateral (30.76%) lung followed by right lung middle lobe(21.79), left lung lower lobe (20.51%), left lung upper lobe (15.38%),right lung upper lobe (14.1%() and right lung lower lobe (12.82%).

According to Methe P et al[7],most common bronchiectasis was cystic bronchiectasis(50%) followed by of tractional (26%)and cylindrical bronchiectasis (24%). Dimoukou K et al,[18] encountered most common lung involvement bilaterally(63.7%) with worst affected in lower lobes. In patients with a history of tuberculosis, bronchiectasis was seen in the upper lobes.King PT et al[22]showed that most patients (80%) had 2 or more lobes with evidence of bronchiectasis and the most common pattern was a bilateral lower lobe involvement. The most commonly involved lobe was the right lower lobe (69%). Li z et al[23] encountered cylindrical bronchiectasis in 37.7% patients, varicose in 40.8% patients, cystic in 21.4% patients.Multilober involvement was most common (77.2%). The most commonly involved lobes were left lower lobe (76.5%).

Distribution of sputum culture of the study population

We encountered Klebsiella pneumonia in 33.33% followed by of Pseudomonas aeruginosa (17.95%), Acinetobacter baumanii (15.38%), Staphylococcus (12.83%), Escherichia coli (5.13%) and Haemophilus influenza (1.28%) in the study subjects.

According to Methe P et al[7], most commonly isolated organism was Pseudomonas aeruginosa(34%) followed Klebsiella pneumonia(20%), 8% of Staphylococcus

aureus and Streptococcus, Acinetobacter (10%) and Aspergillus(8%).King P et al[24] observed thatthe most common isolates was *H. influenzae* followed by *P. aeruginosa* . It is also associated with more hospitalizations and worse quality of life. Pasteur MC et al[25] in their study encountered Haemophilus as the most common organism (35%)followed by Pseudomonas (31%).They also observed Moraxella in 20%, Staphylococcus in 14%, Streptococcus in 13% and Aspergillus in 2% of study subjects. Our study concluded that Klebsiella is the most common organism isolated in the study subjects as compared to other studies.

Limitations of the study

Our study was done in a single centre with small sample size. Hence, findings cannot be generalized to the population as a whole. Also, severity of the condition of the patients could not be assessed as we did not follow up the patients.

Conclusion

Our study has shown that most common clinical presentation of bronchiectasis was cough whereas crepitation was the most common sign. Post tubercular bronchiectasis was common with obstructive type pulmonary function test. Tractional bronchiectasis was most commonly encountered. Klebsiella was the commonly isolated organism in the sputum which showed sensitivity mostly towards amikacin. However, multicentered, large cohort study with long term follow up is needed to explore the details of bronchiectasis to plummet overall morbidity and mortality as well as burden of the health care cost.

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