" ROLE OF FIBEROPTIC BRONCHOSCOPY IN PATIENTS WITH RESPIRATORY COMPLICATIONS IN MULTISPECIALITY INTENSIVE CARE UNITS"

Dissertation submitted to The Tamil Nadu Dr. M.G.R. Medical University in partial fulfilment of the requirements for the degree of Doctor of Medicine in Tuberculosis and Respiratory Diseases.

Branch – XVII

Institute of Thoracic Medicine,

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BONAFIDE CERTIFICATE

This is to certify that the dissertation "**ROLE OF FIBEROPTIC BRONCHOSCOPY IN PATIENTS WITH RESPIRATORY COMPLICATIONS IN MULTISPECIALITY INTENSIVE CARE UNITS**" is the Bonafide work done by **Dr.S.HARIKRISHNAN** during his **MD (Tuberculosis and Respiratory Diseases)** course in the academic years 2013-2016, at the Institute of Thoracic Medicine and Rajiv Gandhi Government General Hospital – Madras Medical College, Chennai.

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I hereby declare that the dissertation entitled "**ROLE OF FIBEROPTIC BRONCHOSCOPY IN PATIENTS WITH RESPIRATORY COMPLICATIONS IN MULTISPECIALITY INTENSIVE CARE UNITS**" submitted for the degree of Doctor of Medicine in MD degree examination branch XVII **Tuberculosis and Respiratory Diseases** is my original work and the dissertation has not formed the basis for the award of any degree, diploma, associate ship, fellowship or other similar titles. It had not been submitted to any other university or institution for the award of any degree or diploma.

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ABSTRACT

ROLE OF FIBEROPTIC BRONCHOSCOPY IN PATIENTS WITH RESPIRATORY COMPLICATIONS IN MULTISPECIALITY INTENSIVE CARE UNITS

AIM:

1. To determine the contribution of flexible fiberoptic bronchoscopy in intensive care units in terms of therapeutic outcome and diagnostic validity.

2. To determine the safety of flexible bronchoscopy in critically ill patients.

MATERIALS AND METHOD:

Patients with respiratory complications from various speciality intensive care units were enrolled. After clinical and radiological evaluation, if conservative management fails, bronchoscopic intervention was considered. Bronchoscopy was performed according to British Thoracic Society guidelines after informed consent. Swivel-T-Tube adapter was used for the patients in mechanical ventilation. Data such as chest radiograph, arterial blood gas, Bacterial culture of tracheal and BAL secretions between before and after brochcoscopy (6 & 24 hrs) were analysed using standard SPSS software.

RESULTS:

In our study 63 patients were enrolled, mean age was 45±12, in which males 70% (n=44) and females 30 %(n=19). Most of the patients were in mechanical ventilation 85%

(n=54/63). In our study, the indications for bronchoscopy were suspected atelectasis 57.1%(n=36), persistent pulmonary infiltrates 30%(n=19), suspected airway trauma 6.3% (n=4) and difficult intubation 6.3% (n=4). In suspected atelectasis cases(n=36) bronchoscopic findings were mucous plug in 61%(n=22),blood clot in 11%(n=4) and purulent secretions 22%(n=8) and mucoid secretions in 5%(n=2). Post brochoscopic chest radiograph of suspected ateletasis showed partial resolution in 38.8% (n=14) and complete resolution in 47.2%(n=17). Bacterial culture of Bronchoalveolar lavage was at a variance with blind tracheal culture in 23.8%(n=15/59) which modified the antimicrobial therapy. Transient hypoxemia 54% and Transient tachycardia 40% were observed.

CONCLUSION:

Since its introduction by Ikeda, role of flexible bronchoscopy has been expanding and plays a key in diagnostic and therapeutic decision making in the intensive care units. In our study contribution of bronchoscopy played a vital role in therapeutic outcome 73%(n=46) and diagnostic yield in 30.2%(n=19). Patients had good response to bronchoscopy when intervened within 5 days of admission in ICU. No life threatening complications were encountered; hence bronchoscopy is safe in critically ill patients, if basic precautions are taken.

KEYWORDS

Fiberoptic bronchoscopy in intensive care units, Lung atelectasis in ICU, VAP diagnosis, BAL and VAP, Safety of bronchoscopy

INTRODUCTION

In 1897 Gustav Killian used upper gastro intestinal scopy to remove a piece of bone from right main stem bronchus, thus Killian was named as father of bronchoscopy. In 1966, a Japanese private endoscopic company had introduced the first working fiber-optic bronchoscope, which was the basic principle of the instrument made by Shigeto Ikeda in 1964.

Since fiber-optic bronchoscopy introduction in 20th century by Ikeda, has played an important role in pulmonology. Other than diagnostic use, now it is also implemented for therapeutic purposes in different clinical scenarios. Bronchoscope is now used widely not only in stable patients, also in critically ill patients as its versatility and portability allows bronchoscopist to do interventions at bedside. In critically ill patients it is used increasingly because of its diagnostic accuracy and safety[1].

Patients in intensive care units often has multiple organ dysfunctions which makes them high risk for bronchoscopy and this will impose pressure on bronchoscopist. Apart from this, intensive care units will be having less space than bronchoscopy suite because of numerous monitors and instruments. Still FOB is implemented in critically ill patients because of its proven safety in trained hands particularly in critically ill patients in invasive ventilation[1].

It is not easy for one to group the indication for bronchoscopy as diagnostic and therapeutic one and in most of the time it will serve both purposes. In intensive care units its utility as therapeutic procedure is

important. Bronchoscopy is valuable in those cases where sputum and blood were retained inspite of adequate physiotherapy and endotracheal suctioning. Tables 1.1 shows the important indications of fiberoptic bronchoscope in intensive care units.

Between 65% and 79% of FOB performed in ICUs are conducted in patients on mechanical ventilation, and 47% to 75% have therapeutic indications[2]. Olopade and Prakash[3] studied the use of FOB in 198 critically ill patients. In their study, 45% were performed for the removal of retained bronchial secretions, 35% for collecting samples from the lower respiratory tract, 7% for assessing the airway, 2% for hemoptysis, 0.5% for assisting tracheal intubation, and 0.5% for the removal of foreign bodies.

Table:1.1-indications of fiber-optic bronchoscopy in intensive care setup[5,6,7].

DIAGNOSTIC PURPOSES [5,6,7]	THERAPEUTIC PURPOSES[5,6,7]
1. Pneumonia	1. Endotracheal intubation
2. Haemoptysis	2. Atelectasis
3. Thoracic trauma	3. Tracheobronchial obstruction
4. Tracheal stenosis	4. Percutaneous tracheostomy
5. Inhalational airway injury	
6. Upper airway assessment and vocal cord assessment	

INDICATIONS:

PNEUMONIA:

Pneumonia is the most common respiratory illness[2] encountered in the critically ill patients that too with invasive ventilation. It affects about 9%-25% of invasively ventilated patients and in patients with ARDS it accounts 70% of patients. Radiography is the easiest mode to diagnose pneumonia in ventilated patients[4]. It is at most important to diagnose the offending agent as early as possible because the mortality rate of ventilator associated pneumonia is 35%-90%[2]. Hence early appropriate antimicrobials are essential for treatment of ventilator associated pneumonia. Bronchoscopy will yield sufficient amount of sample for identifying the offending agents.

Therefore early bronchoscopy will help one to narrow the antimicrobial coverage. And also if the culture reported as negative, it helps one to avoid unnecessary use of antimicrobials thus preventing the resistant mutants in noscomial organisms, which is another burden in infections in intensive care units. For diagnosis of pneumonia there are two procedures available through bronchoscopy, protected brush specimen and BAL[2,8,9]. In immunocompromised patients, it plays a vital role in getting high yield of specimen and diagnosis of specific pathogens such as pneumocytis jirovecci , tuberculosis and other fungi[2,6] The diagnostic threshold for the bacterial colonies in the BAL is about 10^4 CFU/mL.

Table 1.2 – shows the sensitivity of BAL in diagnosing the organism responsible for ventilator associated pneumonia[10].

SENSITIVITY OF BAL[1,10]	
BACTERIAL	60 – 80 %
MYCOBACTERIA FUNGI VIRAL	70 -80%
PNEUMOCYSTIS JIROVECCI	90-95%

In critical care units the aspiration pneumonia is also important cause for pulmonary infiltrates in lungs as in critically ill patients aspiration is common in them[4].

Limitations:

False positive results are due to upper airway contaminants[1]

False negative results are due to use of lignocaine, which is bacteriostatic. And also if patients are in empirical antimicrobial coverage the diagnostic probability will be low[9].

THORACIC TRAUMA:

About 2.8% of patient with chest trauma have respiratory tract injury which could be fracture of trachea or just lacerations of airway. Bronchoscopy is the safest procedure to investigate such injury[2].

In most of the patients airway lacerations go unnoticed because of other exposed fractures or injuries following trauma. This become evident only when patient is having haemoptysis, chest pain, cough, dyspnea with chest radiograph showing pneumo-mediastinum, pneumothorax, subcutaneous emphysema, atelectasis. Bronchoscopy is indicated in the patients with chest trauma with pneumothorax having continuous air leak with large bubbles as early as possible[4]. In rare cases severe chest trauma will result in complete transection of mainstem bronchi resulting in "fallen lung sign", in such cases bronchoscopy is indicated to confirm the diagnosis[2,11].

TRACHEAL OBSTRUCTIVE PSEUDOMEMBRANE:

Bronchoscopy is the diagnostic modality in patients with prolonged intubation who developed tracheal pseudomembrane[1]. This will be clinically evident when patient become acutely breathlessness after extubation. Bronchoscopy picture will show pale thick membrane which is tightly adherent to tracheal wall. After diagnosis rigid bronchoscopy will be useful in such patient for removal of that membrane. In some cases there may be completely fibrosed tracheal stenosis most commonly seen in subglottic area[2,4,7]. This is due to overt fibrosis due to constant pressure over tracheal wall[1].

AIRWAY INHALATIONAL INJURY:

It is common in patients admitted after inhalation of fumes from plastic or synthetic materials. Some cases were also reported after the inhalation of steam after cooker accidents[12]. The injury could be because of heat itself or due to chemicals in the fumes. Most of the patients will be asymptomatic upto 3

days and suddenly become breathlessness when late reaction sets in. Thus early evaluation of airway is necessary and even minimal findings should be considered significant[4]. If there is involvement of larynx bronchoscopy will be useful in diagnosis and also for bronchoscopy guided intubation[4] is necessary in such patients.

HAEMOPTYSIS:

Fiberoptic bronchoscopy plays a important role in diagnosing the site of bleeding the patients with haemoptysis in intensive care units. In such patient bronchoscopic evaluation in first 12-18 hrs allows one to identify the site of bleeding[1]. If source of bleeding is not visible, subsegmental lavage for fresh blood in recovered fluid may be diagnostic[4].

Table 1.3 – showing stages of inhalation airway injury due to smoke and its nature of presentation during bronchoscopy[13].

BRONCHOSCOPIC PICTURE IN AIRWAY INHALATION INJURY[13]	
Early stage	Slight hyperaemia and edema. Difficult to diagnose in absence of carbon particles.
Hours later	Scaly and necrotic mucosa with focal ulcerations and alternate normal mucosa (leopard skin appearance)
Later stage (severe injury)	Dry and thin mucosa with no edema which is due to deep mucosal involvement or complete epithelial abrasion

THERAPEUTIC USES:

ENDOTRACHEAL INTUBATION:

Flexible bronchoscopy plays a vital role in cases of difficult intubation. It constitutes about 0.07-3.4% of all intubation done in intensive care setups[4]. In airway management in critically ill patients are life saving.

Indications:

- Upper airway evaluation
- In patients whom neck extension is contraindicated8

Usually bronchoscope with diameter 5.7mm is the better choice for assisting difficult intubation. The more flexible bronchoscope like paediatric one is not preferable[2]. Intubation via oral route is advised as this will allows one to use larger diameter endotracheal tube, lesser damage to nasal mucosa, will decrease the incidence of otitis media. Using larger endotracheal tube will help to better drainage of secretions. In intubation with double lumen endotracheal tube bronchoscope guided method is useful as this will allow better access to trachea. In intubation of patients with tracheal stents bronchoscope guided is advised as this avoid the misplacement of the stent from the position[6].

ATELECTASIS:

Lung collapse is the one of the emergency indication of flexible bronchoscopy in intensive care setup. In a study Hasegawa et al[14] reported that about 27% of bronchoscopy done in intensive care was emergency intervention. It is unclear that whether bronchoscopic aspiration plays a edge

over the aggressive chest physiotherapy[4,2,15]. In a study by marini et al prospectively compared the chest physiotherapy with flexible bronchoscopy in mechanically ventilated patients and reported no variance observed between both the technique[16].

Bronchoscopy in specific patients plays a better therapeutic role such as patients with brain injury , spinal cord injury, neuro muscular disorders[4,6,8] . It will have more added benefit when acetyl cystiene is used as mucolytic.

In patient with tenacious secretions with lung collapse bronchoscopy is indicated in emergency as only with chest physiotherapy it is not always possible to drain such secretions[1].

PERCUTANEOUS TRACHEOSTOMY:

Percutaneous dilatational tracheostomy is safe and effective alternative to standard tracheostomy[17,18,19]. Out of available techniques, Ciaglia's percutaneous approach is common approach. Use of fiber-optic bronchoscope allows direct visualisation of the procedure thus minimising the trauma to airway[1].

REVIEW OF LITERATURE

PATHOPHYSIOLOGICAL ASPECTS OF BRONCHOSCOPY IN INTENSIVE CARE UNITS:

RESPIRATORY MECHANICS:

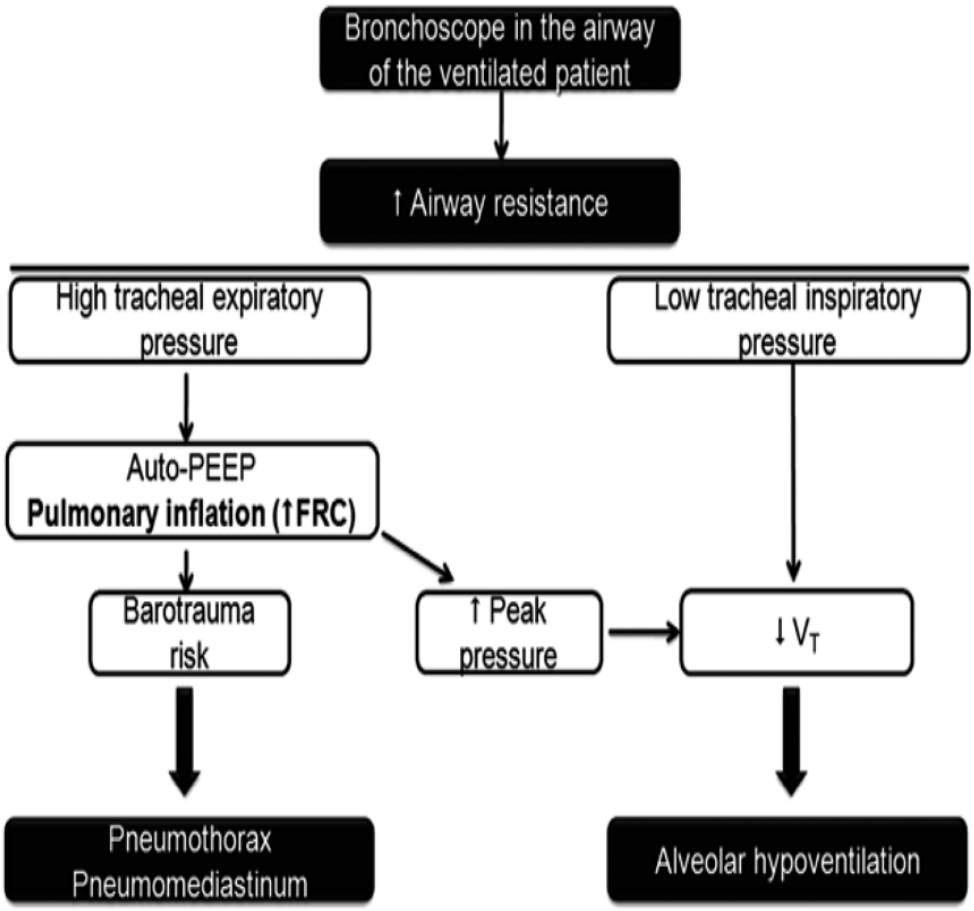
During bronchoscopy, PaO2 will be reduced upto 10-20mmhg while bronchoscope is inside the airways because of increase in airway resistance. A flexible bronchoscope with outer diameter of 5.7mm occupies approximately 10% of the cross-sectional area of trachea[2,18]. Indeed , a 5.7mm flexible bronchoscopy occupies 40% of cross-sectional area of a 9.0mm inner diameter of ETT, 51% of 8.0mm inner diameter ETT and 60% of 7.0mm ETT[20]. PaO2 will be further more decreased because there will be reduction in V_T. V_T will be also affected by swivel adapter. Adding to this, parasympathetic system will mediate reflex bronchospasm during the procedure which will further decrease the airway diameter which is inversely proportional to airway resistance making it increase. Thus adequate local anaesthesia during procedure will obviate this increase in airway resistance.

During BAL there will be proinflammators release because of mucosal reaction, will also play a role in decrease in PaO2 during bronchoscopy, but this will return to normal within 20-30 minutes.

Thus there are some investigators who suggest a minimum difference of 2.0mm between the inner diameter of the ETT and the outer diameter of the flexible bronchoscope,to ensure the maintenance of an adequate V_T[21].

Suction applied during flexible bronchoscopy, although beneficial in patients with atelectasis in whom bronchoscopy is performed to aspirate mucous plugs, can also have a negative impact on respiratory mechanics. Continuous and prolonged suction period may reduce V_T and functional residual capacity significantly, leading to small airway collapse and ventilation perfusion mismatch, inducing hypoxemia[2,20].

FIGURE 2.1 : EFFECTS OF BRONCHOSCOPY PRESNECE IN AIRWAY ON RESPIRATORY MECHANICS:



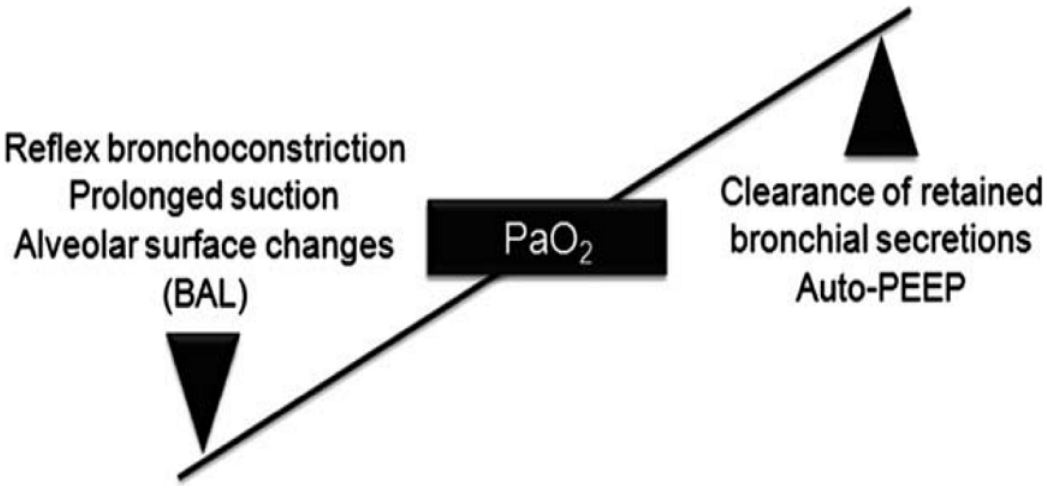
In some patients with lung atelectasis due to intraluminal obstruction due to blood clot, mucus plug, foreign body, there will be increase in PaO2 during procedure itself because of expansion of collapsed segments after removal of such intraluminal obstruction[2]. In addition to this auto PEEP will be produced during bronchoscopy will also contribute to increase in PaO2. In case of PaCO2 , it will increases during procedure because of reduction in V_T and lung inflation. This will be prevent by avoiding suction when there is no secretions.

HEMODYNAMICS:

As there will be a decreased PaO2, increased PaCO2, irritation of airway and anxiety cause adrenergic stimulation which in turn increases the cardiac output and increase mean arterial pressure and pulse rate.

Lindolm et al. showed that during bronchoscopy cardiac output will be increased upto 50% and attained normal within quarter hour[20].

FIGURE 2.2 : CHANGES OF Pao_2 DURING BRONCHOSCOPY[1].



CEREBRAL HAEMODYNAMICS:

Peerless et al.[22] intervened 15 patients with severe head injury who needed bronchoscopy for respiratory complications reported about 114% increase in intra cranial pressure, which return to normal after 20 minutes of procedure. Moreover mean arterial pressure is elevated which will compensate the cerebral perfusion. Increase in intracranial pressure due to elevated PEEP due to cough in normal conscious patient meanwhile in ventilated patients PEEP will be increased due to stimulation of airway by bronchoscope. Thus PEEP will be reduced by adequate anaesthesia and muscle relaxation. And also using larger diameter endotracheal tube will possibly decrease the PEEP thereby intracranial pressure[22].

Hypoxia and hypercapnia also contribute to the increase in intracranial pressure. In conclusion, although there are many factors that can potentially induce intracranial hypertension, the performance of flexible bronchoscopy in patients with severe brain injury is a safe procedure that does not adversely affect the neurological status of the patients with cerebral lesions as long as it is carried out respecting the basic rules[22].

DIAGNOSTIC CONTRIBUTION OF FLEXIBLE BRONCHOSCOPY TO VENTILATOR ASSOCIATED PNEUMONIA :

Patients in intensive care units with mechanical ventilation were at higher risk for ventilator associated pneumonia for about approximate incidence of about 20%. Hence diagnosis of ventilator associated pneumonia at earliest is important to start the patients on appropriate antimicrobials. Earlier studies about the ventilator associated pneumonia have documented that blind endotracheal tracheal aspirate may misclassify the VAP.

Some studies which compared the bronchoscopy with quantitative culture of BAL or protected specimens documented that FOB may superior diagnostic yield. However the sensitivity and specificity still remain uncertain which warrants the use of invasive technique.

The Canadian critical care trial group compared the BAL with quantitative culture and endotracheal aspirate with non quantitative culture and founded that they are associated with similar clinical outcomes and antimicrobials use. They have used primary end point as 28 day mortality rate in which they found no significant difference between two groups[23].

Amir K Vejadan and Mahilheh khosravi showed in a clinical trial study titled “BAL for pneumonia prevention in tracheostomy patients” concluded that FOB is warranted in patients in intensive care units on tracheostomy and in patients with increased tracheo bronchial secretion not only for the diagnosis of pneumonia and also it decreases the mortality and morbidity and also cost

effective for the intensive care management. In this study they enrolled 67 head injury patients and divided them into two groups as interventional group and conventional group for airway secretion clearing. Patient on interventional group showed decreased ICU stay(n=35 , p <0.0001) and also needed decreased nursing time(P<0.0001)[24] .

Table 2.1 shows comparison of conventional and bronchoscopic methods[24].

PARAMETERS	BROCHOSCOPIC METHOD (n=35)	CONVENTIONAL METHOD (n=32)	p VALUE
ICU stay in days	12 ± 2	18 ± 2	<0.0001
Nursing time in min.	8 ± 2	54 ± 5	<0.0001
Nosocomial pneumonia	5(14%)	11(34%)	0.03
Tracheostomy site infection	1(3%)	10(31%)	0.001
Mortality related to respiratory problems	3(8.6%)	8(25%)	0.003

L Papazian et al[25] compared the bronchoscopic and blind sampling technique for diagnosis of ventilator associated pneumonia in which he compared BAL and PSB with BBS. The histology of VAP was proved in 18 patients. He concluded that sensitivity of BBS was higher than PSB and also it

achieved statistical significance under operator characteristic curve $p<0.05$. Hence BBS is more sensitive and non invasive for the diagnosis of ventilator associated pneumonia.

Andrew F Shorr[26] et al. studied the role of invasive techniques in intensive care unit. In which they enrolled four RCT with 628 patients. They found out Staphylococcus aureus and Pseudomonas aeruginosa as main offending agent for VAP. Overall invasive technique such as bronchoscopy did not alter the mortality or morbidity[26]. However these studies confirms the antimicrobial regimen modification done after fibre optic bronchoscopy in about 50% of patients.

In a prospective analysis, Hans-Jurgen Woske et al compared the three bronchoscopic methods for microbiological specimen sampling.

Table 2.2 shows comparison of bronchoscopic sampling methods

Comparison of brochoscopic methods by Hans-jurgen woske et al.[27]		
METHOD	**THRESHOLD(CFU/ml)**	**POSITIVE CULTURES n=60 VAPS**
BAL	10^4	56 (90%)
TBS	10^5	56(90%)
PSB	10^6	50(83%)

The sampling methods compared were,

1. BAL
2. Protected brush sampling
3. Bronchoscopic Tracheobronchial secretions.

They enrolled 279 patients and observed incidence was 23 VAPs per 1000 ventilator days. The most common bacteria isolated was Staphylococcus aureus which was 38%. In this they concluded that all three methods produced comparable results with 90% detection rate. TBS is the cheap and easy bronchoscopic technique that should be further investigated[27].

In a study by chirstopher A Guidry et al[28] enrolled 360 patients from surgical intensive care units. They concluded that patients under gone diagnostic bronchoscopy had shorter length of stay in intensive care units and had shorter duration of antimicrobials[28].

TABLE 2.3 ISOLATION OF ORGANISM IN ICU [27]

Bacteriology of VAP

Species	Number of cases; $n = 77$
Gram-positive:	
Staphylococcus aureus (among them 1 methicillin-resistant)	29 (37.7%)
Streptococcus pneumoniae	4 (5.2%)
Other streptococci	5 (6.5%)
Gram-negative:	
Haemophilus influenzae	8 (10.4%)
Pseudomonas aeruginosa	8 (10.4%)
Klebsiella sp.	7 (9.1%)
Escherichia coli	6 (7.8%)
Enterobacter sp.	3 (3.9%)
Proteus sp.	3 (3.9%)
Acinetobacter sp.	1 (1.3%)
Morganella morganii	1 (1.3%)
Citrobacter freundii	1 (1.3%)
Branhamella catarrhalis	1 (1.3%)

ATELECTASIS:

In a report by A.Estella et al[29] from 208 bronchoscopies , the most frequent therapeutic indication was suspected atelectasis and microbiological diagnosis. In which the most common therapeutic indication was resolution of atelectasis.

In another study by J.S.Turner et al[30] from 147 bronchoscopies reported that 37 scopies where done for therapeutic purposes in which lobar collapse were 28. After bronchoscopy he observed full re-expansion in 20 patients, partial in 5 patients and no change in 3 patients.

Haenel et al[31] studied "the efficacy of intrabronchial air insufflations in patients with acute lobar collapse" in 17 patients. After removal of mucous plug through bronchoscopy they had done selective intrabronchial air insufflation using AMBU bag and 3 way stopcock. They observed about 14 patients had re-expansion after bronchoscopy and 10 achieving full re-expansion and 4 had partial re-expansion[31].

In a study titled "Re expansion of refractory lung collapse using FOB with a balloon cuff" done by Harada et al[32], 15 patients were enrolled in which about 14 out of 15 were had re expansion after flexible bronchoscopic intervention[32].

CONSERVATIVE MANAGEMENT FOR ATELECTASIS:

- Positioning and postural drainage of retained secretions
- Sterile suction of endotracheal tube or tracheostomy tube
- Percussion and vibrations

INDICATION FOR CHEST PHYSIOTHERAPY:

Clinical features suggestive of retained secretions refractory to suctioning

Radiological features suggestive of acute atelectasis

Decreased PaO_2 due to retained secretions

Prophylactic for – neurological diseases affecting innervations of respiratory muscles and moderate to severe brain trauma.

POSITIONING:

Positioning plays a vital role in chest physiotherapy as it related with ventilation perfusion ratio. Changes in ventilation and perfusion relationship with postural changes were well documented. In ARDS patients there was a improvement in hypoxemia after positioning. Positioning with good lung down is the one of the commonest position to improve arterial blood oxygen as the result of better ventilation and perfusion in good lung. Prone position is usually advised for the patients with atelectasis of lower lobe – superior and posterior segments.

POSTURAL DRAINAGE:

This helps in drainage of increased secretions from the periphery of the lung to segmental and main airway with the help of gravity. There was about 11 positions to drain 14 segments of the lung. Postural drainage mainly helps in clearance of secretions and mucous thus increases the functional residual capacity. Postural drainage upto 15 to 60 minutes a day is necessary but it depends mainly on individual patient condition.

Johnson et al reported no difference between postural drainage and chest percussion along with deep breathing exercises in patient with acute lobar collapse.

Adverse effect such as transient decrease in PaO_2 were reported in patient with respiratory complications who underwent postural drainage.

PERCUSSION AND VIBRATION:

Percussion is the most commonly recommended technique for clearing the secretions in the airway. The proposed mechanism is vibrating waves will cause increased mucocilliary clearance and release of chemical mediators due to physical stimulation which in turn also increases the mucocilliary clearance. This is mostly used in patients in mechanical ventilation.

Vibration is the most vigorous part of chest physiotherapy. The rib cage is shaken during expiration phase of respiration. This is called as rib shaking or rib springing. This is not advised in patients with chest trauma.

LITERATURE ABOUT SAFETY OF BRONCHOSCOPY IN INTENSIVE CARE UNITS.

D Dang et al[33] prospectively evaluated the safety of fibre optic bronchoscopy and its sedation in a tertiary care level. They had enrolled 558 patients within 12 months period in which 216 transbronchial biopsy were done. They found out that only 2.2% major complication occurred in first 4 hours of scopy and no complications were associated with sedation. Those

complications also did not need any major medical intervention, all were self limiting.

C M Lucena et al[34] carried out a prospective study in 297 patients to describe the diagnostic performance and safety in critically ill patients and concluded that fibre optic bronchoscopy is safe and fast which also helps in the clinical management.

Joel R. peerless et al[22] studied the cerebral haemodynamics in patients with severe head injury. They enrolled 15 patients with head injury who needs bronchoscopic intervention for nosocomial pneumonia or treatment of lobar collapse. During bronchoscopy patients had average increase in intracranial pressure of 13.5mmHg and demonstrated no deterioration in Glasgow coma scale. They concluded that even the intracranial and mean arterial pressure rises, the cerebral perfusion pressure was maintained. Also the intracranial and mean arterial pressure returns to normal after procedure[22].

In a prospective study conducted by N Snow and A E Lucas[35] in surgical ICU assessed the efficacy and safety of the procedure. 51 patients were enrolled in which 60% of scopy done for lung atelectasis and 3% for persistent pulmonary infiltrates and 12% patients for airway trauma. They concluded that significant improvement demonstrated in patients with lung collapse in chest radiograph taken after 24 hrs. About 38% of patients improved radiologically immediately after the procedure

FOB is a relatively safe procedure if done with basic safety precautions even in critically ill patients . Major complication arise in 0.008% to 0.15% and minor about 6.5%[2,4].

Olopade and prakash[3] in their review study with 804 fiberoptic bronchoscopy in intensive care units did not observed any bronchoscopy related deaths.

Jin F et al[36] observed in a large retrospective study which include both diagnostic and therapeutic indication broncoscopy of sample size about 23,682 had 0.013% of mortality rate and 0.637% of severe complications.

As per British thoracic society guidelines which considered life threatening complication following the fibre optic bronchoscopy were listed below,

i. Respiratory depression
ii. Pneumonia
iii. Pneumothorax
iv. Massive haemorrhage
v. Airway obstruction
vi. Arrhythmias
vii. Pulmonary edema

AIMS AND OBJECTIVES:

- To determine the contribution of flexible fiberoptic bronchoscopy in intensive care units in terms of therapeutic outcome and diagnostic validity.
- To determine the safety of flexible bronchoscopy in critically ill patients.

MATERIALS AND METHODS

MATERIALS:

Call overs from the intensive care units of various specialities were attended and patients were initially evaluated clinically and radiologically. If respiratory complications were diagnosed in the patients, they were started on conservative management. If the conservative management failed to improve the patient's oxygenation or refractory to empirical antibiotics, bronchoscopic intervention was planned. Thus we enrolled consecutive 63 patients called for expert opinion from various speciality intensive care units with respiratory complications refractory to conservative management during the study period.

INCLUSION CRITERIA:

a. Patients in multispeciality intensive care units with respiratory complications in whom the conservative management failed to improve the pulmonary status.
b. Patients with severe hypoxemia inspite of adequate ventilator support whose clinical and radiological condition warrants emergency bronchoscopic intervention were enrolled.
c. Preferred age of the patient was 18-65 years
d. Patient in intensive care units with difficulty in endotracheal intubation with conventional laryngoscope.
e. Patients with chest trauma with suspected airway injury

EXCLUSION CRITERIA:

a. Patients with whose relatives not willing to give the consent
b. Patient with recent myocardial infarction
c. Patients with increased intracranial tension

STUDY PLACE:

Various multi speciality intensive care units in Rajiv Gandhi Government General Hospital, Chennai. The speciality ICUs were segregated as follows,

Medical and toxicology intensive care units

Surgical intensive care units

Neurology / trauma care intensive care units

Post-anaesthetic intensive care unit

Other speciality which includes nephrology ICU , vascular surgery ICU, radiation oncology ICU.

STUDY DESIGN: Prospective and observational study.

STUDY PERIOD: JANUARY 2015 – OCTOBER 2015

METHODOLOGY:

Patients with respiratory complications, who were critically ill in multi speciality intensive care units seen in call overs, were examined clinically and radiologically. If conservative management is not given by referring unit, conservative management were advised initially. On further follow up if patient's pulmonary condition not improved or get worsened they were enrolled in our study. In patients who had adequate conservative management by referring unit and refractory to conservative management were also enrolled during initial evaluation itself. Patients were intervened for following indications.

❖ INDICATION FOR BRONCHOSCOPY IN OUR STUDY:

- Suspected lung atelectasis
- Suspected persistent pulmonary infiltrates
- Retained airway secretions
- Suspected airway injury
- Difficult intubation.

Calls were received from various speciality ICUs for the favour of management of persistent hypoxia secondary due to lung collapse, retained airway secretions. For patients with persistent pulmonary infiltrates were called for diagnosis of offending organism. After initial assessment, conservative managements such as chest physiotherapy in cases of suspected collapse or frequent airway suctioning in cases of increased secretions and empirical antimicrobial in cases of pulmonary infiltrates were advised. Patients were

followed up every 12 hrs. If there is adequate expansion of the lung with improvement in arterial blood gas analysis, conservative management was continued. But in cases were conservative management failed to improve the pulmonary status, need of bronchoscopy were taken into account for further management. Some cases were referred after failure of conservative management, in such patients need of bronchoscopy were taken into account during initial evaluation itself. After analysing the general conditions and contraindications for the bronchoscopy by expert pulmonologists flexible bronchoscopy was done in 63 patients for the favour of expansion of lung collapse, diagnosis of ventilator associated pneumonia, diagnosis of airway trauma and assisting difficult intubation. Informed and written consent were obtained from the close relatives of the patients.

PATIENT SELECTION:

Patients with suspected lung collapse

Patients with persistent pulmonary infiltrates

Patients with suspected airway trauma

Patient with difficulty in endotracheal intubation.

INITIAL EVALUATION:

Patients with respiratory complications were evaluated initially by clinical and radiological examinations. Most of the patients were in mechanical ventilation with FiO_2 100%. Patients past respiratory illness such as bronchial asthma, recurrent / recent respiratory illness with /without admissions, prior

history of tuberculosis and other relevant history were obtained. If present, related clinical data were obtained.

If clinical examination suggestive of pulmonary pathology such as lung collapse or pneumonia, radiological investigation was planned. In most of the cases the chest radiograph was already done by treating physician or doctor itself. Chest radiograph was the initial radiological evaluation. If this correlates with clinical findings, conservative management was planned. In cases of suspected lung collapse chest physiotherapy such as positioning , postural drainage, percussion, and airway suctioning were advised and it was done by trained chest physiotherapist. Initial arterial blood gas analysis was done and recorded.

Patients were followed up after 12 hours for improvement in oxygenation. This is done by pulse-oximetry and arterial blood gas analysis. The ventilator settings were adjusted in order to maintain arterial blood oxygen saturation. When there was no deterioration on further follow up ventilator settings were adjusted for weaning. If patient's condition improves with chest physiotherapy, weaning from ventilator was planned.

At any point of time during the follow up if the patient's respiratory condition worsened or not responded to the conservative management, the possibility of intervention with treating doctor and experienced pulmonologist from our department was discussed. If there was no contraindication and patient's relatives consented for intervention, bronchoscopy was done.

PROCEDURE:

Bronchoscopy was done according to British Thoracic Society (BTS) guidelines. In patients with invasive ventilation bronchoscopy is performed through endotracheal or tracheostomy tube.

Olympus conventional fiberoptic bronchoscope was used.

In sedated patients no anaesthesia was used. In conscious patients spray as you go technique was used.

Swivel – T – Tube adapter was used in patient connected to mechanical ventilator as this will allow to perform bronchoscopy without disconnecting the ventilator. This adapter has three arms, one connected to endotracheal tube and one for introduction of bronchoscope and one side port for connecting it to the ventilator for maintance of PEEP during the procedure.

Figure- 4.1 shows swivel t tube adapter.

The size of the endotracheal tube was 8 mm in all patients as this will allow to maintain the minute volume and avoid barotraumas to the critically ill patients. The endotracheal tubes must be 2mm greater than the outer diameter of the bronchoscope.

The ventilator settings were individualised in order to maintain the tidal volume and to control the pressure in airway during the procedure.

Continuous monitoring of vitals such as saturation, pulse rate, blood pressure and three lead ECG were done.

During and post bronchoscopy, the FiO_2 was set in 1.0.

Bronchoscopy was adequately lubricated.

Bronchoscopy was inserted into endotracheal or tracheostomy tube through swivel-T-tube adapter. In spontaneously breathing patients inserted through nasal cavity.

First endotracheal tube’s position was confirmed.

Then right and left bronchial tree were inspected. If there were increased secretions, they were removed by suctioning. Only short suction intervals were used.

In cases of thick purulent tenacious secretions or with mucous plug, normal saline was instilled and then mucous plug was removed. Sterile secretions from suspected pulmonary segments were collected in sterile mucous extractor for culture and sensitivity.

After removal of mucous plug and thick purulent secretions for culture and sensitivity bronchoscope was removed.

Chest physiotherapy was withheld upto 24 hours to study the outcome of bronchoscopy per se. Chest radiograph, arterial blood gas analysis and ventilator settings were recorded after 6 hour and after 24 hours and analysed , to study the contribution of bronchoscopy in patients with respiratory complications refractory to conservative management.

Table 4.1 shows ventilator setting during bronchoscopy

VENTILATOR SETTING	EFFECT OF ADJUSTMENTS
Increase in FiO_2 to 1.0	Prevents the significant desaturation
Increase in respiratory rate	To compensate shallow breathing due to sedation
Decrease the PEEP	To compensate for increase in intraluminal pressure due to bronchoscope.

In patients with severe breathlessness after road traffic accident due to severe chest trauma, chest radiograph were taken, if this showed features suggestive of airway injury such as pneumo mediastinum and continuous air leak after intercostals drainage for pneumothorax, patients were evaluated for the fitness for flexible bronchoscopy and then bronchoscopy was done to inspect the airway for any lacerations. If any injuries were made out, patient was referred to cardiothoracic surgeon for surgical management.

Patients with severe breathlessness immediately after prolonged endotracheal or tracheostomy tube removal were intervened with bronchoscopy to make out the cause. If any granulomatous lesion or stenosis was diagnosed patient was reffered to cardio thoracic surgeon for surgical management.

In our study we intervened 4 patients with suspected airway trauma. 2 patients with polytrauma and 2 after prolonged invasive ventilation. In which one patient was diagnosed as right main bronchus laceration and in one carinal laceration was made out and in another two patients with post extubation stridor, subglottic and tracheal stenosis at middle third of trachea were diagnosed.

In patients had difficult endotracheal intubation from intensive care setup, emergency fiberoptic bronchoscopy guided endotracheal tubation was assisted.

Endotracheal tube size 8mm was used. Endotracheal tube was lubricated and passed over the flexible bronchoscope. Flexible bronchoscope was used as a guide to intubate the patient. Flexible bronchoscope was introduced through mouth with bite block to prevent injury to bronchoscopy. Upper airway was inspected and then scope was passed through the vocal cord and inspection was done , if any purulent secretions were there aspirated with short suctions in a sterile extractor. After that endotracheal tube was guided over the bronchoscopy and the cuff was inflated after the visual confirmation of position with bronchoscopy. Bronchoscopy was removed and endo tracheal tube was connected to mechanical ventilator.

In our study 4 patients were intervened to assist difficult intubation. 2 patient were morbid obesity with mallampatti classification IV. And 1 patient with cervical spine injury planned for emergency surgery and 1 patient in post operative ward after self extubation , reinsertion became difficult because of tissue edema.

DEFINITIONS:

The impact of flexible bronchoscopy in intensive care units is described in terms of its utility.

For diagnostic purposes, bronchoscopy was defined as ‘contributory’ if endoscopic or microbiological findings determined a change in clinical decisions. A positive BAL culture that determined a change in antimicrobial therapy was defined as useful in cases of persistent pulmonary infiltrates.

If bronchoscopy was carried out for therapeutic purposes, it was defined as “contributory” if the acute problem that demanded bronchoscopy in the place was resolved by this means. In cases of lung atelectasis, re-expansion after bronchoscopy is taken as therapeutically contributory.

In cases of airway exploration for assisting endotracheal intubation, successful bronchoscopic guided intubation is defined as “contributory”.

OBSERVATIONS AND RESULTS

STATISTICAL ANALYSIS:

Categorical data were described using frequencies and percentages, while quantitative data was described using mean ± SD or median (IQR) depending on the type of data. Cross-tabulations were done for important variables. Association was determined using chi-square test or McNemar test. Statistical significance was determined at 5%.

OBSERVATION:

63 patients with respiratory complications refractory to conservative managements were intervened and their data were analysed for contribution of flexible fiber-optic bronchoscopy in intensive care unit.

AGE:

Mean age observed were 45± 12 (mean ± SD).

In patient with trauma mean age was 43.5 (n = 21) , in which 12 patients had bronchoscopy for lung atelectasis. Only two patients above 45 were did not responded to bronchoscopic intervention within 24 hours.

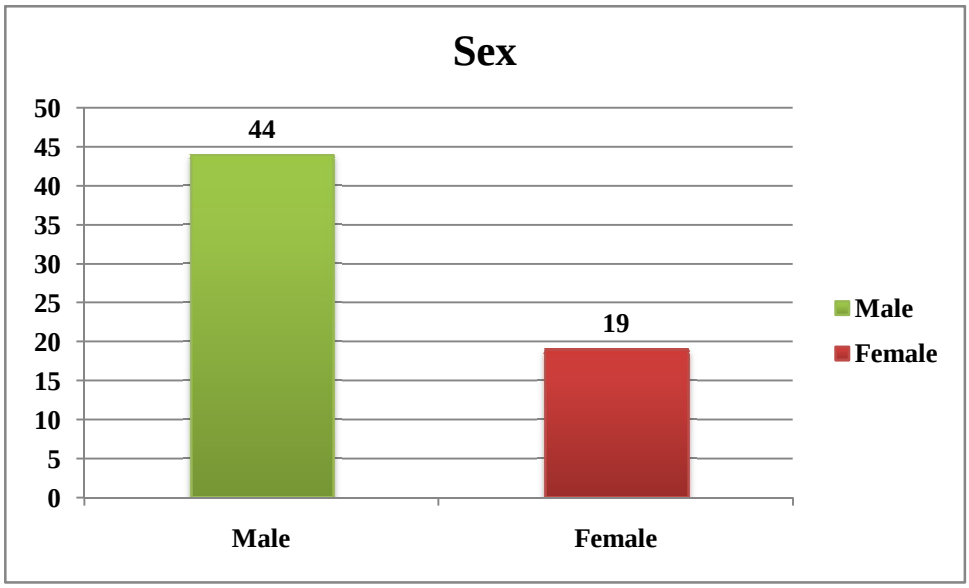
SEX:

In total of 63 patients enrolled, 44 were male 69.8% and 19 were females 30.2%.

Table-5.1 shows sex distribution among patients enrolled.

Sex	n	%
Male	44	69.8
Female	19	30.2

Figure-5.1 shows sex distribution among study population.



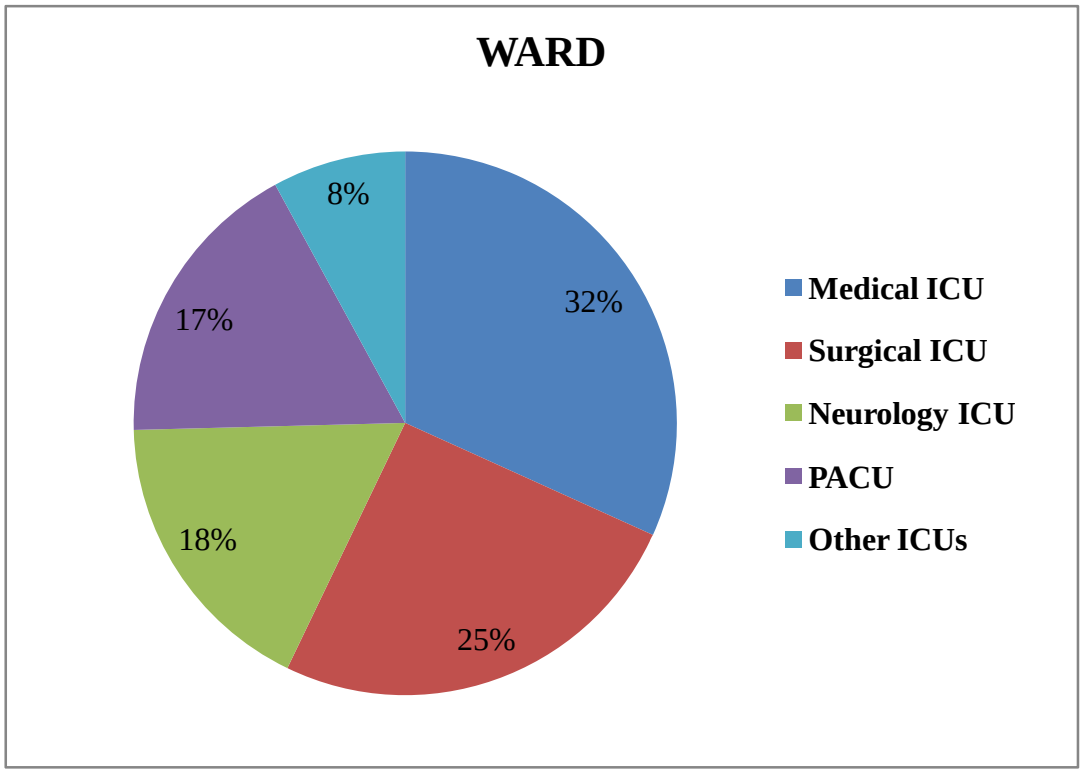
WARD:

Patients from various intensive care units were enrolled. In which 31.7% from medical ICU and 25.4% from surgical ICU, 17.5% of patients from neurology, 17.5% from post anaesthetic ICU and 7.9% were from other specialities such as nephrology ICU, vascular surgery ICU, radiation oncology ICU.

Table-5.2 shows distribution of patients from various specialities

WARD	n	%
Medical ICU	20	31.7
Surgical ICU	16	25.4
Neurology ICU	11	17.5
Post Anaesthesia care unit	11	17.5
other ICUs	5	7.9

Figure 5.2 shows distribution of patients from various specialities



INITIAL CHEST X RAY FINDINGS:

In chest radiograph taken during initial evaluation, lung atelectasis was made out in 36 patients in which one patient was diagnosed as total lung collapse whose primary diagnosis was road traffic accident – poly trauma with head injury. 29 patients out of 36 were lobar collapse and 6 were multilobar collapse. two patients with polytrauma showed pneumomediastinum in initial chest radiograph taken immediately for bronchoscopy to rule out airway injury.

25 patient's chest radiograph showed airspace opacities in which 19 patients had bilateral lesion and 6 had unilateral lesion.

Figure 5.3 shows initial chest radiograph findings.

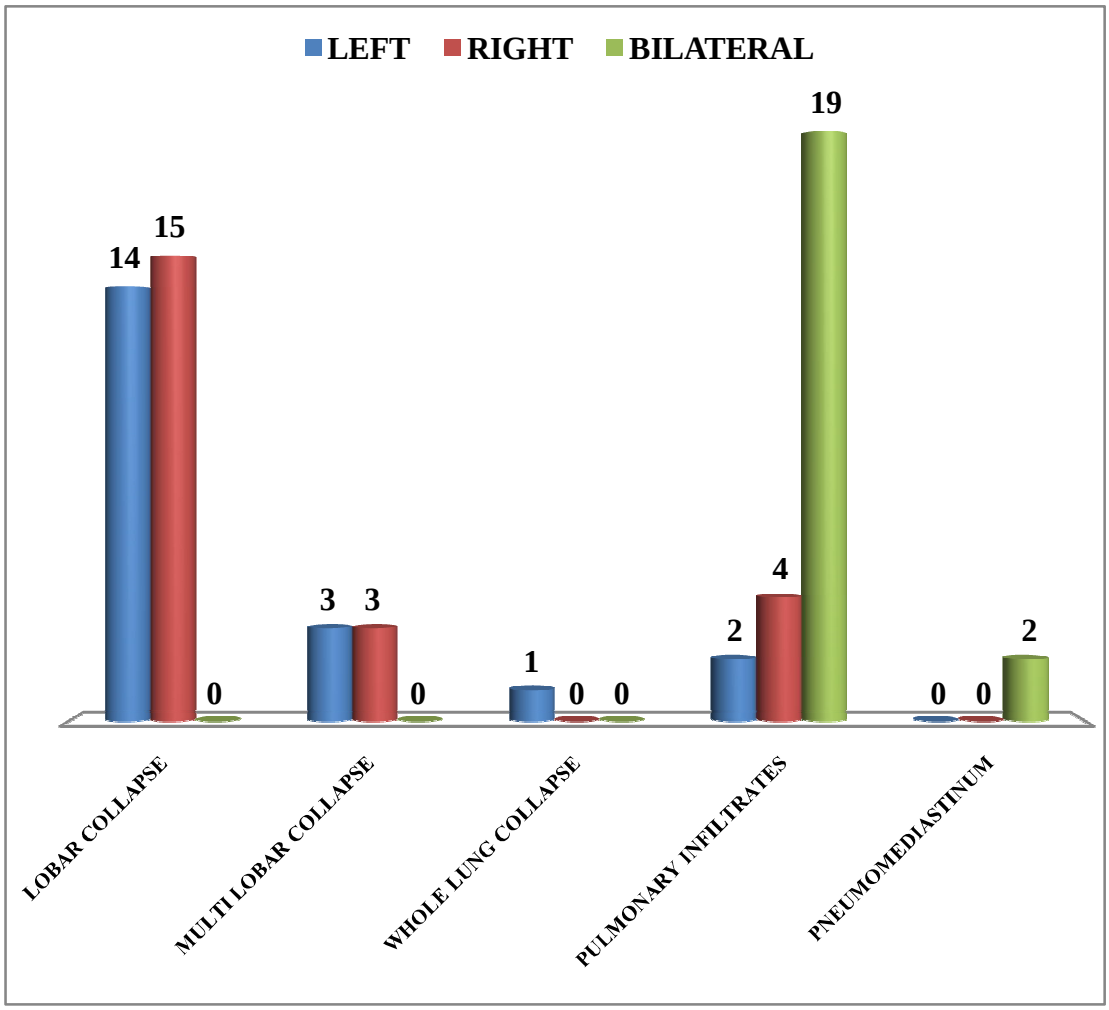


Table-5.3 shows initial chest radiograph findings

Initial Chest Radiograph Findings	n	%
Lobar Collapse	29	46
Multi-Lobar Collapse	6	9.5
Whole Lung Collapse	1	1.5
Pulmonary Infiltrates	25	39.6
Pneumomediastinum	2	3.1

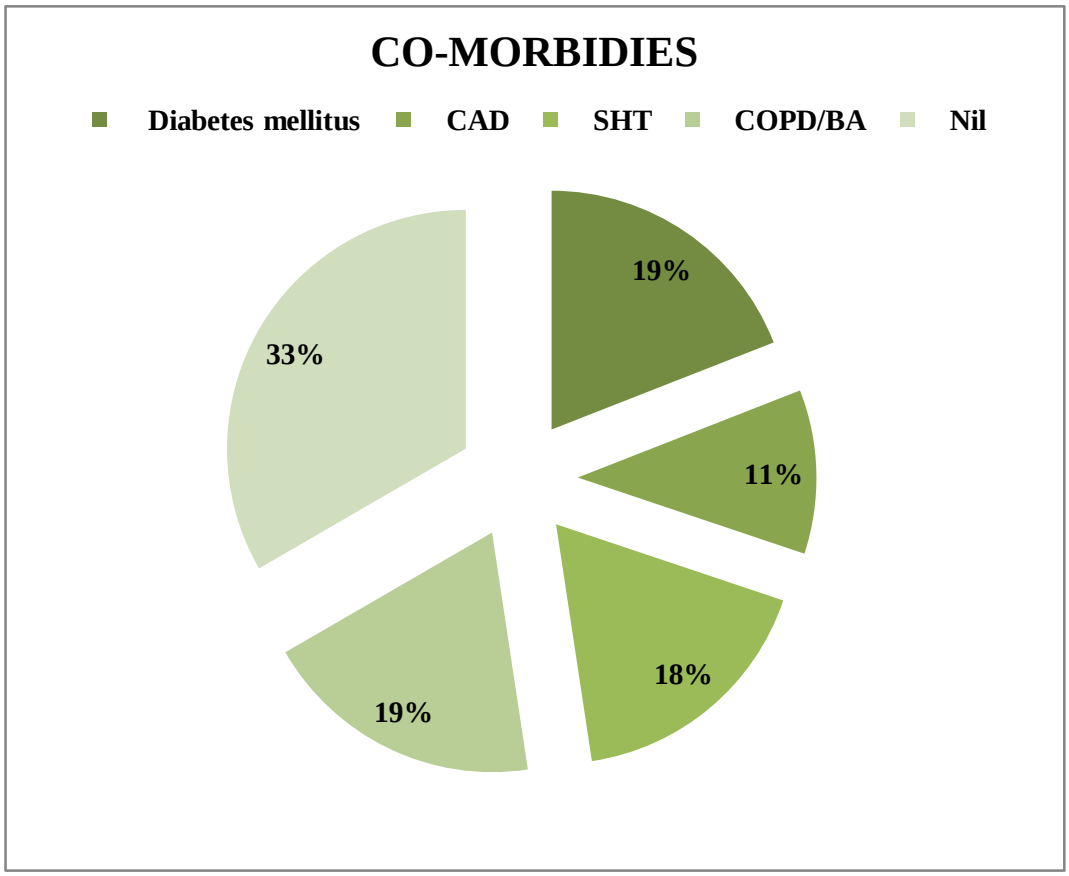
COMORBIDITIES:

Out of 63 patients intervened 33.3% patients had no co-morbid illness and 19% of patients had diabetes mellitus and another 19% had obstructive airway diseases. Systemic hypertension observed in 17.5 % of patients and old coronary artery diseases in 7 patients in which one patient had transient arrhythmia during bronchoscopy which subsided on its own without any intervention.

Table-5.4 shows co morbidities among study population

Co-morbidities	n	%
Diabetes mellitus	12	19.0
Obstructive airway diseases	12	19.0
Systemic hypertension	11	17.5
Coronary artery diseases	7	11.1
Nil	21	33.3

Figure-5.4 shows co morbidities among study populations.



MODE OF VENTILATION:

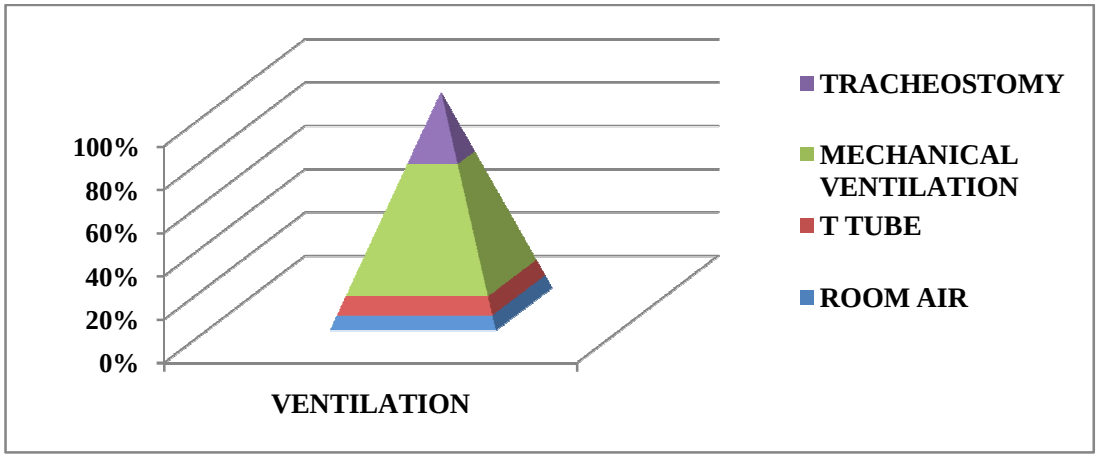
55.5% of patient were in mechanical ventilator with endo-tracheal tube and 30.1% of patients were in mechanical ventilator with tracheostomy tube. Therefore 85.6% patients intervened were under invasive ventilation needed bronchoscopy.

14.3% (n=9) patients were in room air in which 4 patients were intervened for assisting difficult intubation and 2 intervened for suspected airway trauma and 3 for suspected lung collapse. Hence only three patients with lung collapse were not under mechanical ventilation.

Table-5.5 shows mode of ventilation in study population.

Ventilation	N	%
Room air and T tube	9	14.3
Mechanical ventilation by endotracheal tube	35	55.5
Mechanical ventilation by Tracheostomy tube	19	30.1

Figure-5.5 shows mode of ventilation among study population

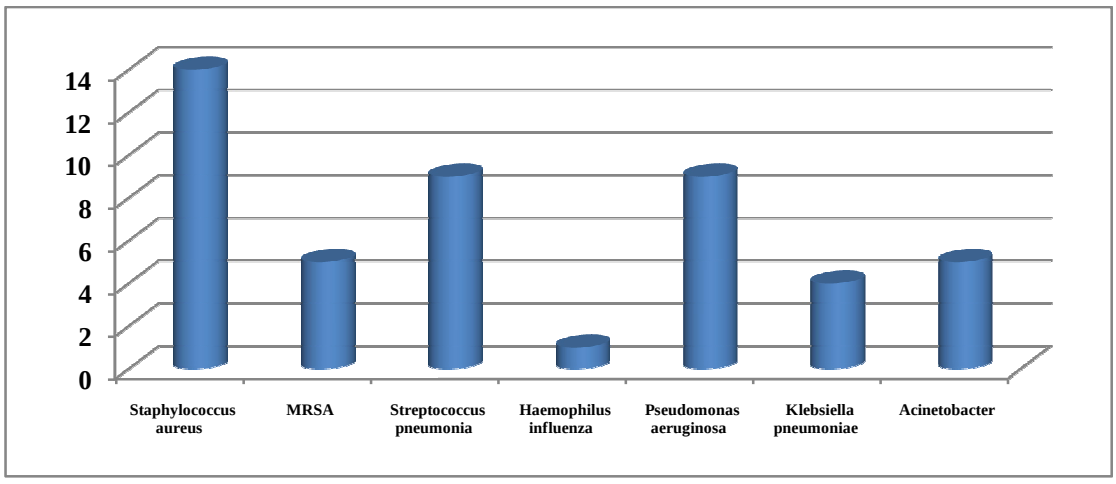


CULTURE AND SENSITIVITY PATTERN IN BRONCHO ALVEOLAR LAVAGE:

In BAL culture mixed infections were isolated in 11.1% of patients. Staphylococcus isolation was increased to 30.1% from 24% in blind tracheal aspirate culture. In 30% of staphylococcus isolation 8% (n=5) were MRSA. Followed by staphylococcus, Streptococcus and Pseudomonas were isolated. About 30% of patients was at variance with blind tracheal aspirate culture prior to bronchoscopy.

Table-5.7 shows culture pattern of BAL.

BAL culture	n	%
Staphylococcus aureus	14	22.2
MRSA	5	7.9
Streptococcus pneumonia	9	14.3
Haemophilus influenza	1	1.6
Pseudomonas aeruginosa	9	14.3
Klebsiella pneumoniae	4	6.3
Acinetobacter	5	7.9
Negative	5	7.9
Not done	4	6.3
Mixed infection	7	11.1



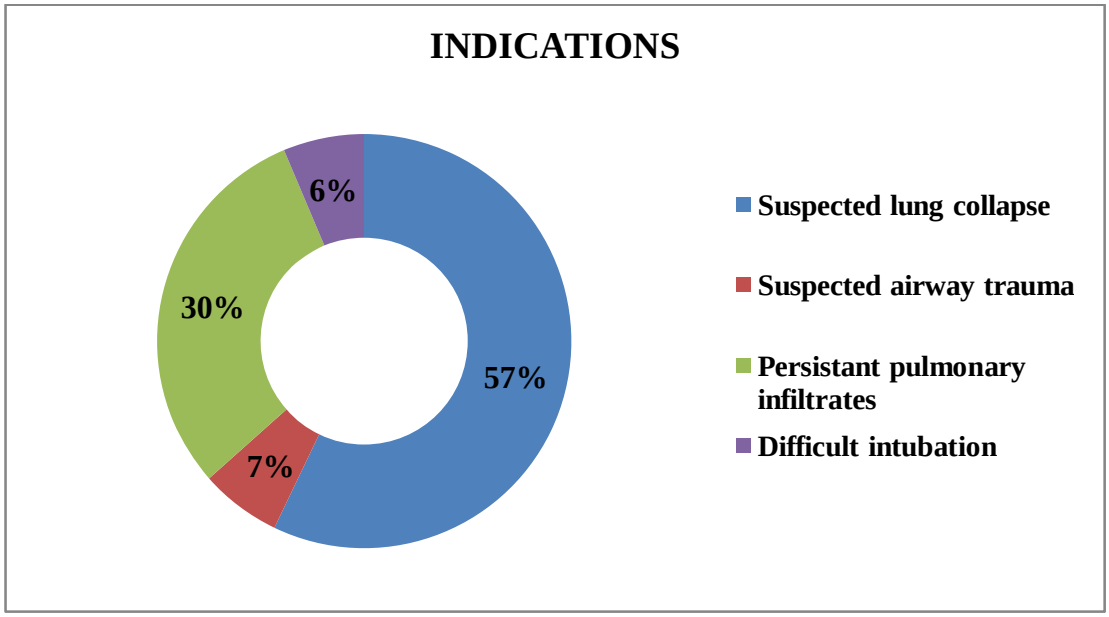
INDICATION:

The most common indication for which we were called for was suspected lung collapse 57.1%. followed by persistent pulmonary infiltrates 30.1% , suspected airway trauma 6.3% and difficult intubation 6.3%.

Table-5.8 shows indication for bronchoscopy done.

Indication for FOB	n	%
Suspected lung collapse	36	57.1
Suspected airway trauma	4	6.3
Persistent pulmonary infiltrates	19	30.1
Difficult intubation	4	6.3

Figure-5.7 shows indication for bronchoscopy done.



COMPLICATIONS:

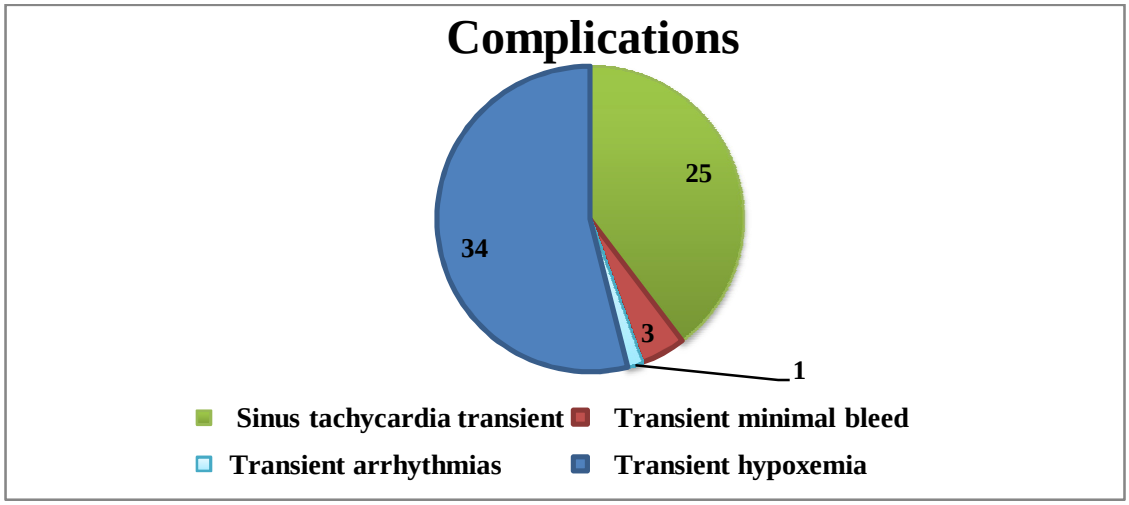
The most common complication observed was transient hypoxemia during and after procedure. But the oxygen saturation started to improve after 20-30 minutes of procedure. As the procedure is done with swivel T tube adapter which helps to give positive pressure ventilation even during procedure , no procedure was deferred for transient desaturation.

One patient had arrhythmia which returned to sinus rhythm 20 minutes after the procedure. No major life threatening complications were encountered.

Table 5.9 shows complication observed among study population

Complication	n	%
Sinus tachycardia transient	25	39.7
Transient minimal bleed	3	4.8
Transient arrhythmias	1	1.6
Transient hypoxemia	34	54.0

Figure-5.8 shows complication observed among study population



INITIAL CHEST RADIOGRAPHY FINDINGS IN VARIOUS INTENSIVE CARE UNITS:

This table correlates the initial chest radiograph findings in patients from various ICUs. Most common radiographic finding in patients from medical ICU was lung atelectasis, in which lobar collapse were 50%, multi-lobar collapse were 15%, whole lung collapse were 5%. About 30% of patients were referred for the favour of management of persistent pulmonary infiltrates from medical ICU.

Table 5.10 shows chest radiograph findings distributed among various speciality ICU.

WARD	Initial Chest radiograph findings					Total
	Lobar collapse	Multi lobar collapse	Whole lung collapse	Pulmonary infiltrations	Pneumo Mediastinum	
Medical ICU	10 50%	3 15%	1 5%	6 30%	0 0%	20 100%
Surgical ICU	8 20%	2 12.5%	0 0%	4 25%	2 12.5%	16 100%
Neurological ICU	5 45.5%	1 9.1%	0 0%	5 45.5%	0 0%	11 100%
Post anaesthesia care unit	3 27.3%	0 0%	0 0%	8 72.7%	0 0%	11 100%
other ICUs	3 60%	0 0%	0 0%	2 40%	0 0%	5 100%
Total	29 46%	6 9.5%	1 1.6%	35 39.7	2 3.2%	63 100%

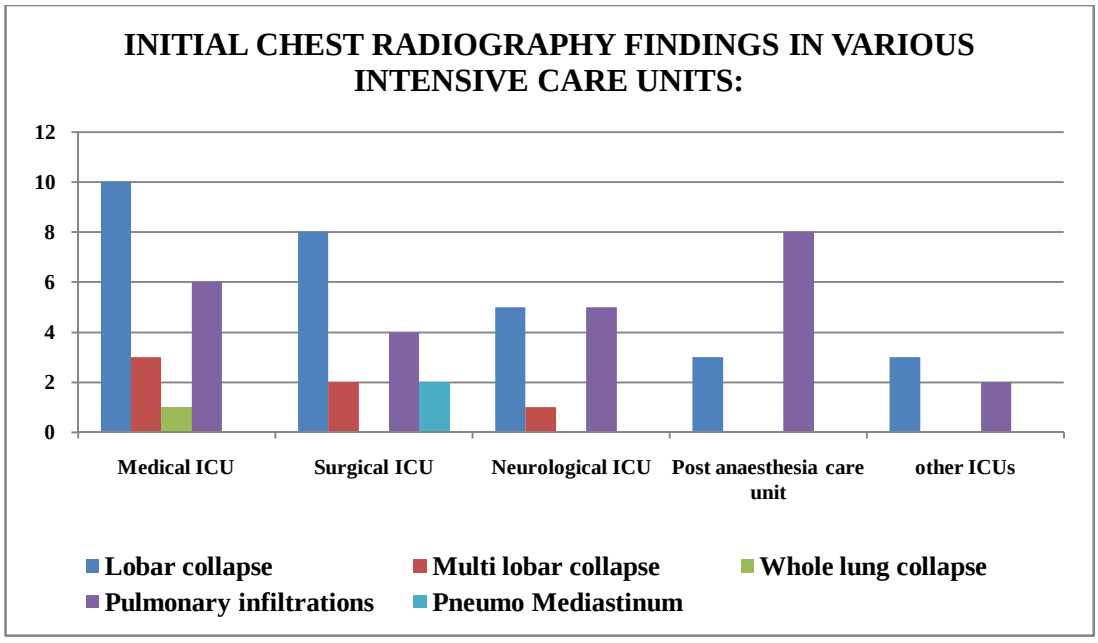
In surgical ICU most common radiographic finding was lobar collapse 50% followed by pulmonary infiltrations 25%, multi lobar 12.5%. Another 12.5% (n=2) were pneumo-mediastinum in patients with polytrauma.

Out of 11 patients referred from neurology intensive care unit, 54.5% (n=6) showed lung atelectasis and 45.5% (n=5)were showed pulmonary infiltrations.

11 patients were referred from post anaesthetic care unit, 72.7% chest radiograph showed pulmonary infiltrations and 27.3% (n=3) of chest radiograph showed lung atelectasis

From other speciality intensive care unit, 60% of chest radiograph showed lobar collapse and another 40% showed pulmonary infiltrations.

Figure 5.9 shows chest radiograph findings distributed among various speciality ICU.



TYPE OF RESPIRATORY FAILURE IN INITIAL ABG FROM VARIOUS INTENSIVE CARE UNITS:

Hypercapnic respiratory failure was common among patients from medical ICU. They were about 55% and 40% of patients showed hypoxic respiratory failure initially. One ABG was normal at the time of initial evaluation itself.

Patients from surgical ICU were predominantly Type I Respiratory Failure 87.5% and 6.2% were hypercapnic and another 6.2 % were normal.

Table 5.15 shows types of respiratory failure distribution among various intensive care units.

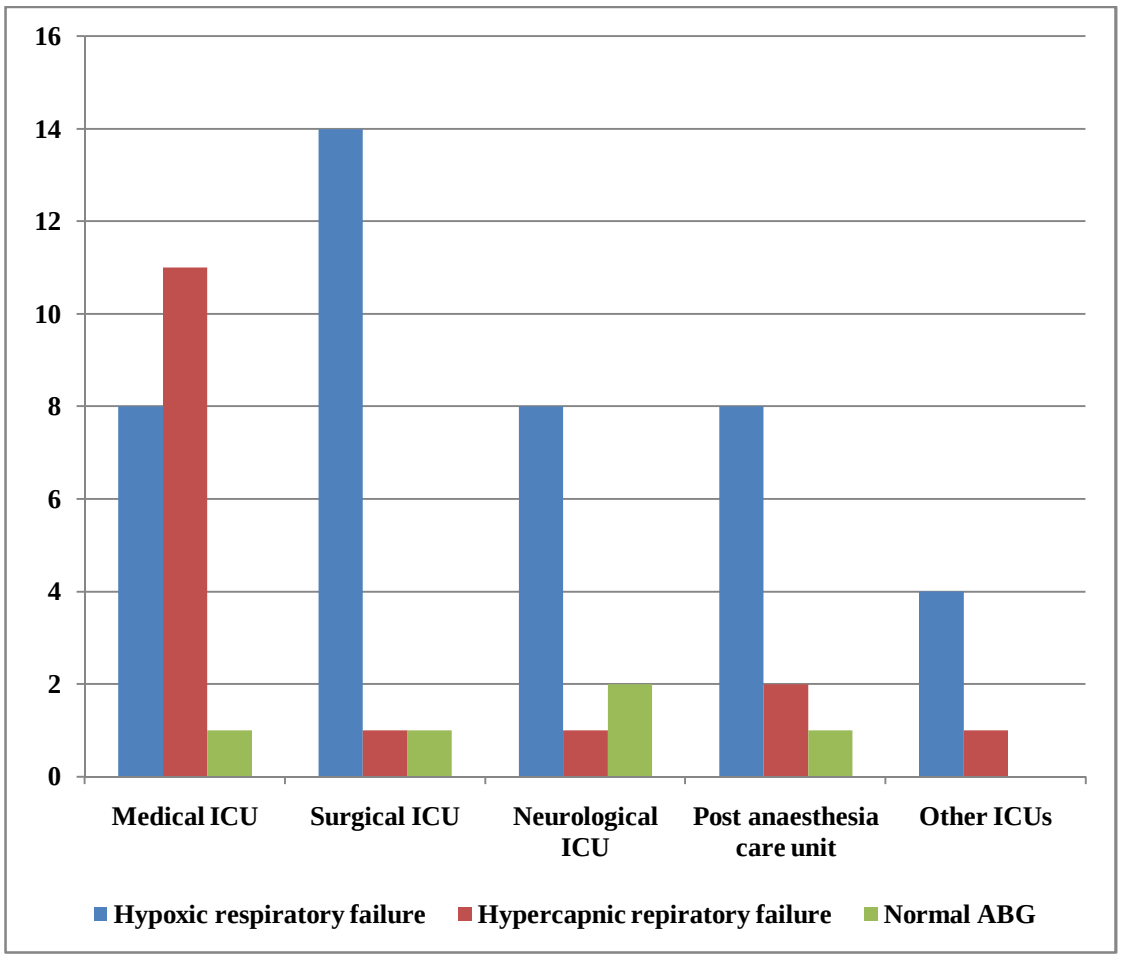
WARD	Initial ABG			Total
	Hypoxic respiratory failure	Hypercapnic repiratory failure	Normal ABG	
Medical ICU	8 40%	11 55%	1 5%	20 100%
Surgical ICU	14 87.5%	1 6.2%	1 6.2%	16 100%
Neurological ICU	8 72.7%	1 9.1%	2 18.2%	11 100%
Post anaesthesia care unit	8 72.7%	2 18.2%	1 9.1%	11 100%
Other ICUs	4 80%	1 20%	0 0%	5 100%
Total	42 66.7%	16 25.4%	5 7.9%	63 100%
Chi square test , p-value= 0.039				

72.7% were respiratory failure of type I from post anaesthetic care unit and 18.2% type II respiratory failure. 9.1% showed normal ABG.

In neurology ICU 72.7% of patients presented with hypoxic respiratory failure and 9.1% were hypercapnic and 18.2% were normal at the time of initial evaluation.

Patients from other specialities showed hypoxic respiratory failure at 80% and 20% of them were in hypercapnic respiratory failure.

Figure 5.14 shows types of respiratory failure distribution among various intensive care units.



CHANGES IN POST BRONCHOSCOPY CHEST RADIOGRAPH AFTER 6 HOURS IN PATIENTS WITH LUNG ATELECTASIS:

Out of 63 patients, 36 patients had for lung atelectasis in which 29 were lobar collapse, 6 were multilobar collapse , 1 was total lung collapse. When comparing pre bronchoscopy chest radiograph with post bronchoscopy radiograph at 6^{th} hour the following observations were made

Out of 29 lobar collapse patients, 37.9% showed partial re-expansion, 37.9% shows complete re-expansion and 24.1% showed no expansion

Table-5.11 shows changes in post bronchoscopy chest radiograph after 6 hours in patients with lung atelectasis

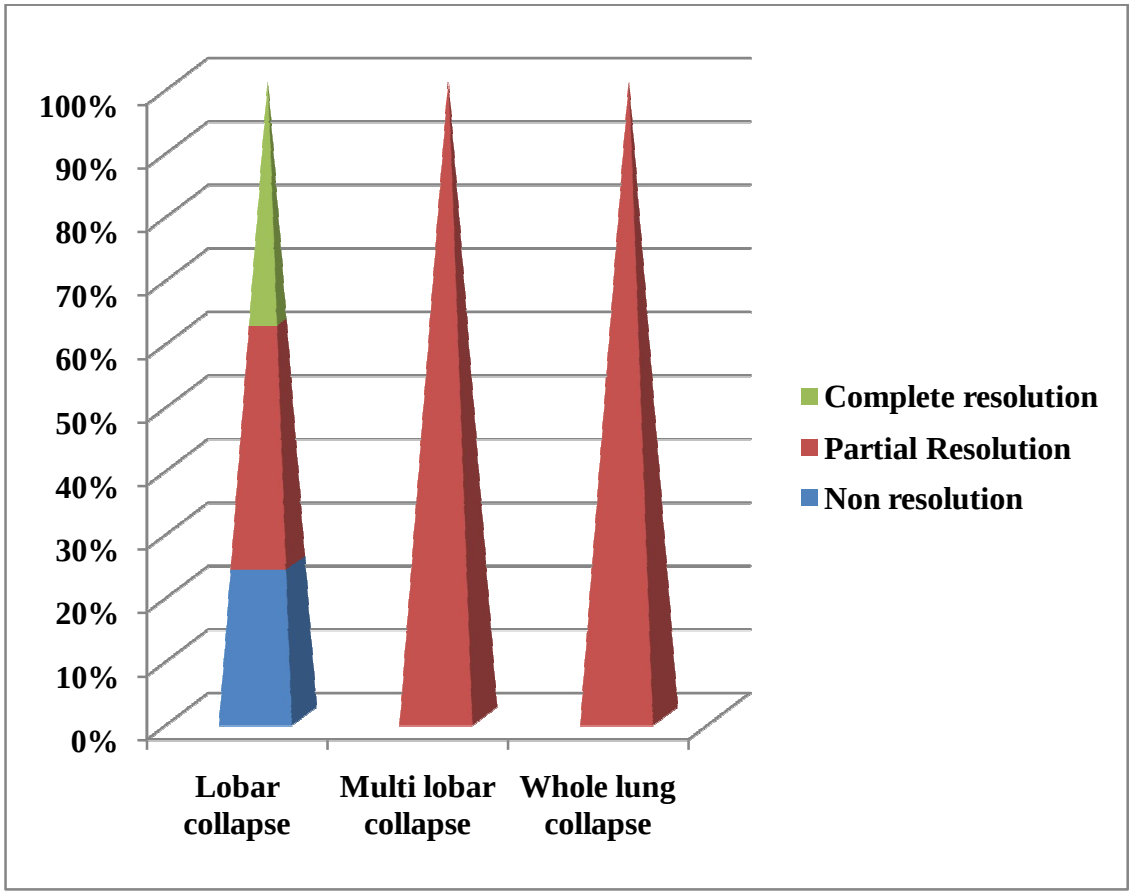
Initial chest radiograph	Chest radiograph after 6 hours			Total
	Non resolution	Partial re-expansion	Complete re-expansion	
Lobar collapse	7 24.1%	11 37.9%	11 37.9%	29 100%
Multi-lobar collapse	0 0%	6 100%	0 0%	6 100%
Whole lung collapse	0 0%	1 100%	0 0%	1 100%
Total	7 19.4%	18 50%	11 30.5%	36 100%

In case of multilobar collapse all patients responded to bronchoscopy at 6th hour itself but no one showed complete re-expansion.

A patient with total lung collapse responded with partial re-expansion at the end of 6th hour.

For 8 patients who intervened for suspected airway injury and for assisting difficult intubation repeat chest radiograph were not taken as the contribution of bronchoscopy in those patient decided at the time of procedure itself.

Figure-5.10 shows changes in post bronchoscopy chest radiograph after 6 hours in patients with lung atelectasis.



CHANGES IN POST BRONCHOSCOPY CHEST RADIOGRAPH AFTER 24 HOURS IN PATIENTS WITH LUNG ATELECTASIS:

To know the progress of radiological improvement in intervened patients, chest radiograph was repeated after 24 hour. The observations were compared with pre and post bronchoscopy chest radiograph are as follows.

In 29 patients whose chest radiograph showed lobar collapse, 51.7% had complete re-expansion, 31% had partial re-expansion. About 17.2% had no expansion even after 24 hr.

Table-5.12 shows changes in post bronchoscopy chest radiograph after 24 hours in patients with lung atelectasis

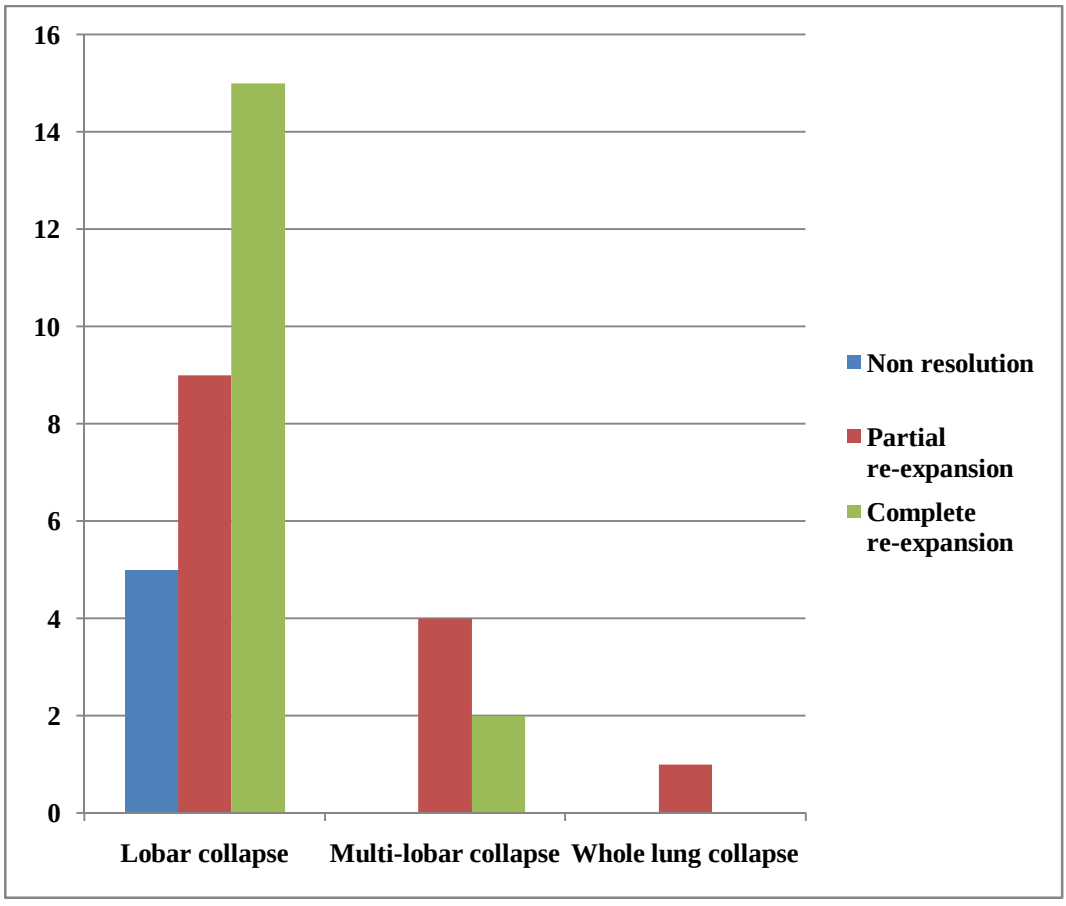
Initial chest radiograph	Chest radiograph after 24 hours			Total
	Non resolution	Partial re-expansion	Complete re-expansion	
Lobar collapse	5 17.2%	9 31%	15 51.7%	29 100%
Multi-lobar collapse	0 0%	4 66.7%	2 33.3%	6 100%
Whole lung collapse	0 0%	1 100%	0 0%	1 100%
Total	5 13.8%	14 38.8%	17 47.2%	36 100%

In multilobar collapse, all patients were responded at 6th hour itself by partial re-expansion. After 24 hours it is observed that only 2 patients were further improved to complete re-expansion.

A patient with total lung collapse showed some further improvement in chest radiograph when compared to chest radiograph at 6th hour. But complete re-expansion was not obtained.

Out of 25 patients with persistent airspace opacities, 36% (n=9) patients showed minimal resolution of opacity radiologically.

FIGURE 5.11 shows changes in post bronchoscopy chest radiograph in patients with lung atelectasis.



IMPROVEMENT IN ARTERIAL BLOOD GAS AFTER 6 HOURS OF BRONCHOSCOPY:

Out of 63 patients, 55 patients were in respiratory failure in which 39 patients were in hypoxic respiratory failure and 16 pateints were hypercapnic respiratory failure. After bronchoscopy, improvement in arterial blood gas after 6 hour of bronchoscopy was studied. The observation were as follows,

Among patients with hypoxic respiratory failure(n=39),66.6% showed improvement in arterial saturation. 7.6% patients improved to normal arterial blood gas. About 25.6% did not showed any improvement in oxygen saturation.

Table-5.13 shows improvement of arterial oxygen saturation after 6 hours of bronchoscopy

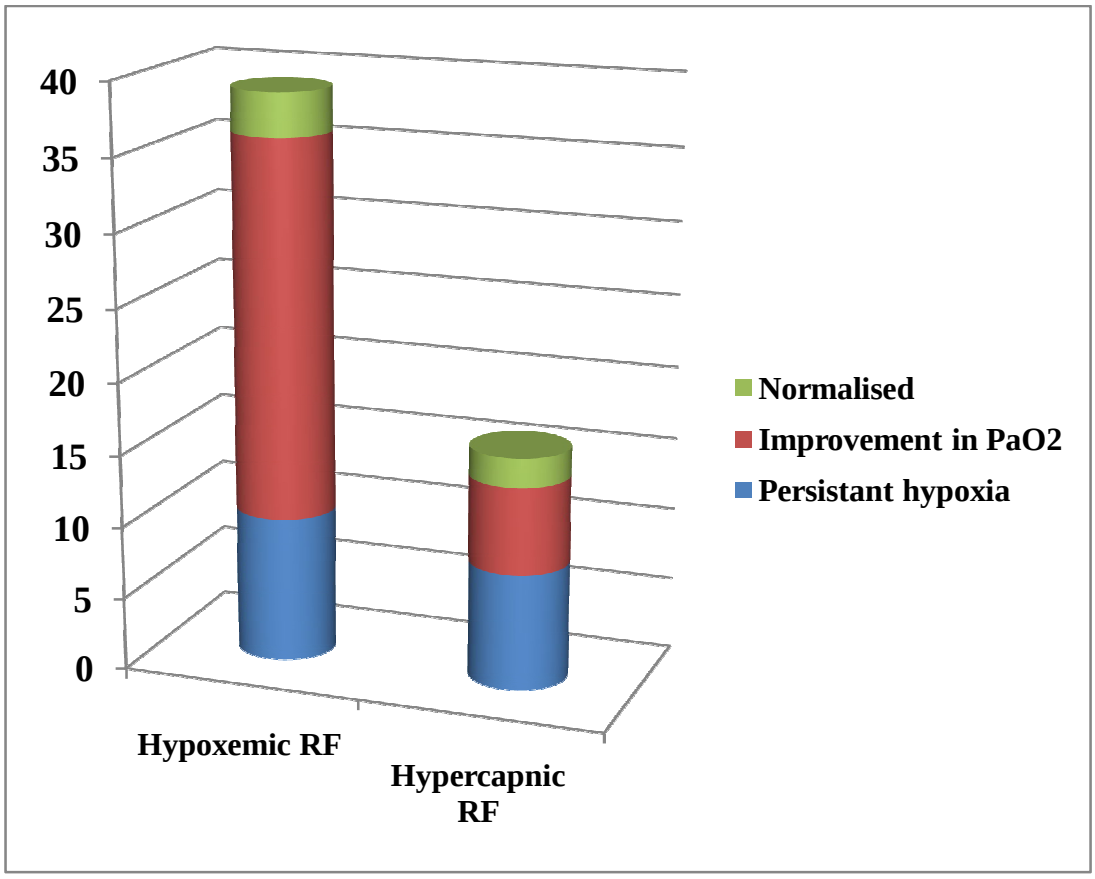
Type of respiratory failure in initial ABG	ABG after 6 hours				Total
	Persistent hypoxia	Persistent hypercapnia	Normalised	Improvement in PaO_2	
Hypoxic respiratory failure	10 25.6%	0 0%	3 7.6%	26 66.6%	39 100%
Hypercapnic respiratory failure	0 0%	8 50%	2 12.5%	6 37.5%	16 100%
Total	10 18.1%	8 14.5%	5 9.0%	32 58.1%	55 100%

Among patients with hypercapnic respiratory failure (n=16), 37.5% showed improvement in arterial saturation and 12.5% patients improved to normal blood gas. 50% showed no improvement in arterial blood gas.

For 8 patients intervened for suspected airway trauma and assisting difficult intubation, repeat ABG was not done as they were intervened for diagnostic purposes.

This crosstabulation is statiscally significant by chi square test with p valve <0.001.

Figure 5.12 shows improvement of arterial oxygen saturation after 6 hours of Bronchoscopy



IMPROVEMENT IN ARTERIAL BLOOD GAS AFTER 24 HOURS OF BRONCHOSCOPY:

After 24 hours, 33.3%(n=13) of hypoxic respiratory failure patients improved to normal. 51.2%(n=20) showed improved oxygen arterial saturation. 15.3%(n=6) showed persistent hypoxia.

In initial hypercapnic patients (n=16), four patients improved to normal arterial blood gas. 62.5%(n=10) showed improvement in arterial blood gas. Two patients showed no improvement persistent hypercapnia.

Table-5.14 shows improvement of arterial oxygen saturation after 24 hours of bronchoscopy

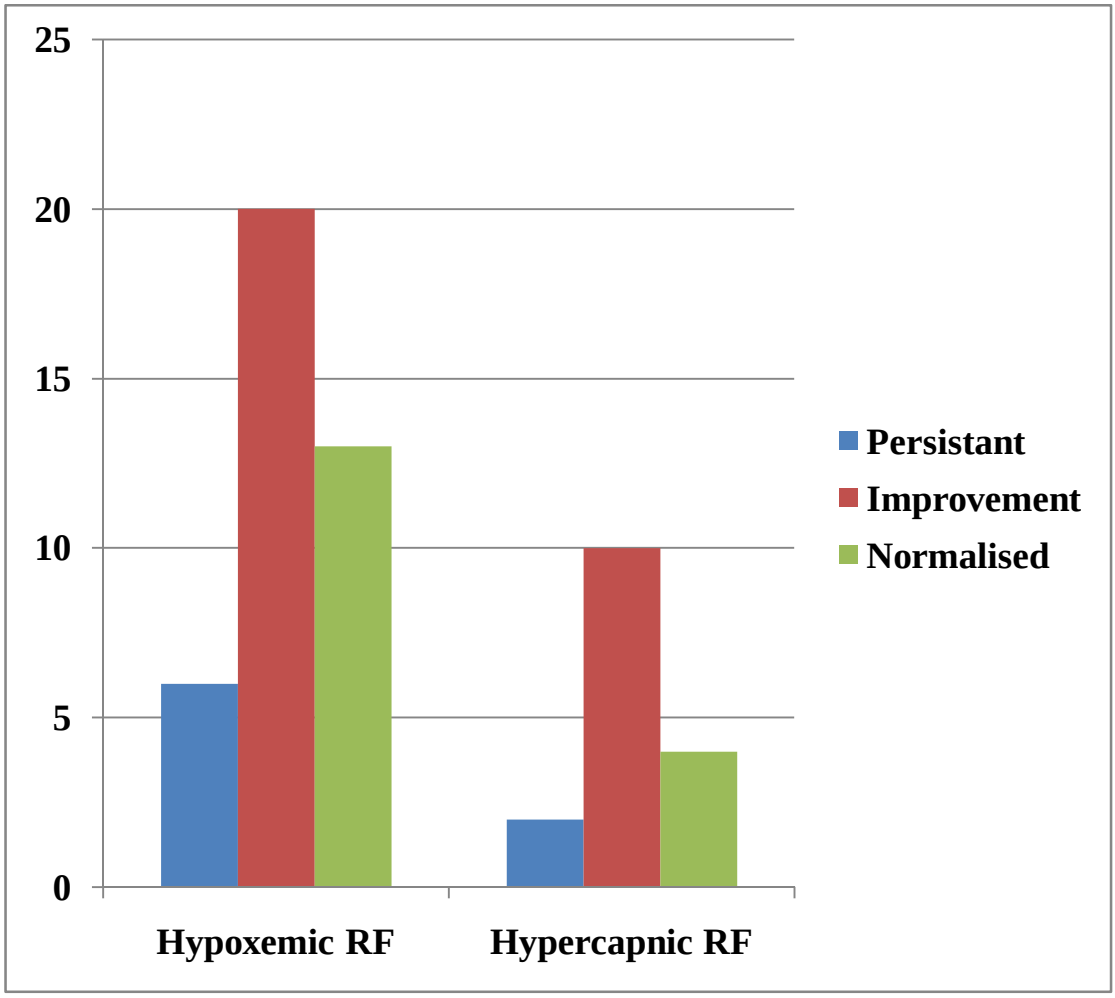
Type of respiratory failure in initial ABG	ABG after 24 hours				Total
	Persistent hypoxia	Persistent hypercapnia	Normalised	Improvement in PaO_2	
Hypoxic respiratory failure	6 15.3%	0 0%	13 33.3%	20 51.2%	39 100%
Hypercapnic respiratory failure	0 0%	2 12.5%	4 25%	10 62.5%	16 100%
Total	6 10.9%	2 3.6%	17 30.9%	30 54.5%	55 100%

Thus 14.5% patients showed persistent values of arterial blood gas after 24 hrs of bronchoscopy.

When compared with ABG after 6 hours , 12 more patients were improved to normal ABG in which 10 patients were from hypoxic respiratory failure and 2 patients were from hypercapnic respiratory failure. Thus patients with hypoxic respiratory failure had marginally better improvement than hypercapnic failure.

This cross tabulation is statistically significant by chi square , p value = 0.008.

Figure-5.13 shows improvement of arterial oxygen saturation after 6 hours of bronchoscopy



COMPARISON BETWEEN THE INDICATION FOR BRONCHOSCOPY AND BRONCHOSCOPIC FINDINGS:

The indication for bronchoscopic intervention was classified into four main diagnosis- suspected lung atelectasis, persistent pulmonary infiltrates, suspected airway trauma, assisting the difficult intubation. Data of bronchoscopic findings was studied according to each indication as follows,

Table-5.16 shows bronchoscopic findings distributed among indications for bronchoscopy.

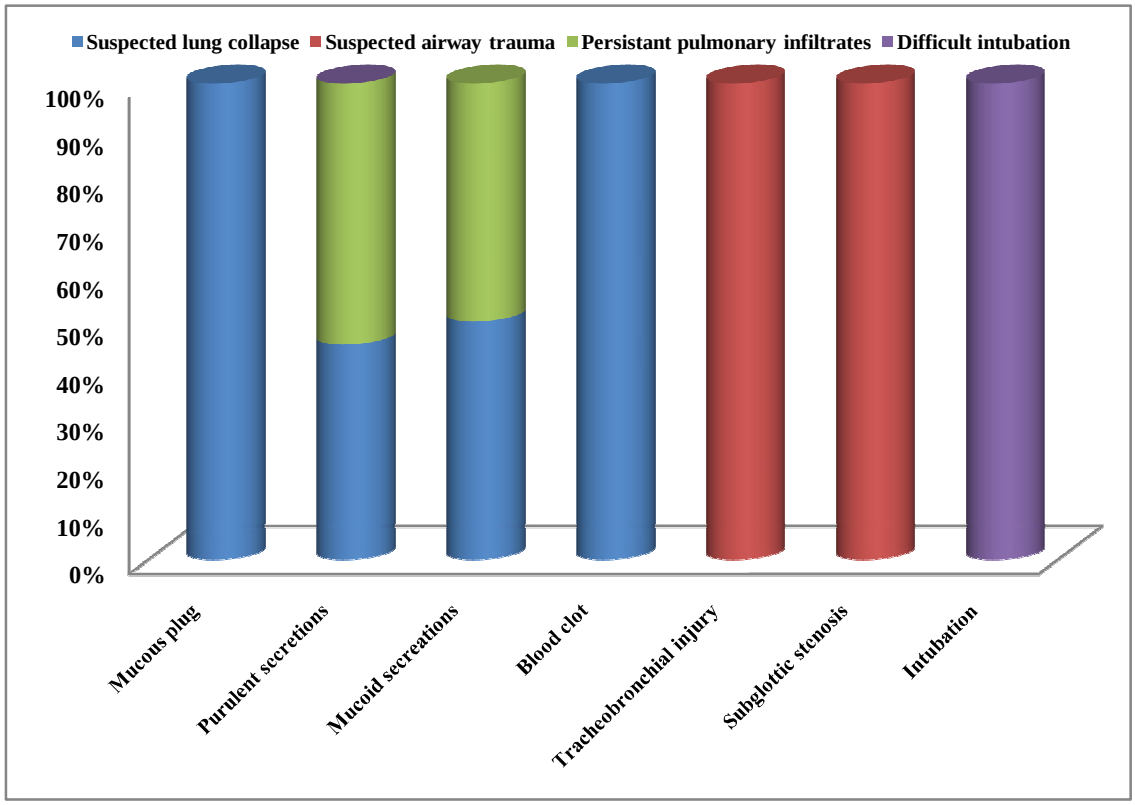
Bronchoscopic Findings	Indication for bronchoscopy				Total
	Suspected lung collapse	Suspected airway trauma	Persistent pulmonary infiltrate	Difficult Intubation	
Mucous plugs	16 44.4%	0 0.0%	0 0.0%	0 0.0%	16 25.4%
Purulent secretions	14 38.9%	0 0.0%	17 89.4%	0 0.0%	31 49.2%
Mucoid secretions	2 5.6%	0 0.0%	2 10.5%	0 0.0%	4 6.3%
Blood clot	4 11.1%	0 0.0%	0 0.0%	0 0.0%	4 6.3%
Tracheao bronchial injury	0 0.0%	2 50.0%	0 0.0%	0 0.0%	2 3.2%
Subglottic stenosis	0 0.0%	2 50.0%	0 0.0%	0 0.0%	2 3.2%
Intubation successful	0 0.0%	0 0.0%	0 0.0%	3 75.0%	3 4.8%
Intubation failure	0 0.0%	0 0.0%	0 0.0%	1 25.0%	1 1.6%
Total	36 100.0%	4 100.0%	19 100.0%	4 100.0%	63 100.0%

In total of 36 suspected lung atelectasis patient, 44.4% had mucous plugings, 38.9% had purulent secretions. These two forms major cause for lung atelectasis. In four patients with chest trauma with suspected lung contusion had blood clots, which forms 11.1% total lung atelectsis patients in our study. Only 2 patients with mucoid secretions had lung atelectasis.

In suspected airway trauma cases (n=4) , 50%(n=2) patients had subglottic stenosis and two patients had airway trauma one at the level of carina and one at the level of right main bronchus.

In 19 patients who intervened for persistent pulmonary infiltrates, 89.5%(n=17) had purulent secretions and 10.5%(n=2) patients had mucoid secretions. This crosstublation analysed with chi square test is statistically significant with p value <0.001.

Figure-5.15 Shows bronchoscopic findings distributed among indications for bronchoscopy



BRONCHOSCOPIC FINDINGS AND IMPROVEMENT IN ARTERIAL BLOOD GAS ANALYSIS AFTER 24 HOURS:

After intervention patients were followed up for clinical and radiological improvement. Thus improvement in oxygen saturation after bronchoscopy was studied after 6^{th} and 24^{th} hour. The bronchoscopic findings and improvement in oxygen saturation after 24 hrs were compared and analysed by chi square test and its p value was = 0.001 which is statistically significant. The observations were as follows.

Table-5.17 shows bronchoscopic findings and improvement in arterial blood gas analysis after 24 hours

Bronchoscopic Findings	ABG after 24 hours					Total
	Persistent hypoxia	Persistent hypercapnia	Normalised	Improvement in PaO_2	Not done	
Mucous plug	1 6.2%	1 6.2%	4 25%	10 62.5%	0 0%	16 100%
Purulent secretions	4 12.9%	1 3.2%	10 32.3%	16 51.6%	0 0%	31 100%
Mucoid secretions	0 0%	0 0%	2 50%	2 50%	0 0%	4 100%
Blood clot	1 25%	0 0%	1 25%	2 50%	0 0%	4 100%
Trachea-bronchial injury	0 0%	0 0%	0 0%	0 0%	2 100%	2 100%
Sub-glottic stenosis	0 0%	0 0%	0 0%	0 0%	2 100%	2 100%
Assisting Intubation	0 0%	0 0%	0 0%	0 0%	4 100%	4 100%
Total	6 9.5%	2 3.2%	17 27%	30 47.6%	8 12.7%	63 100%
Chi square test , p-value =0.001						

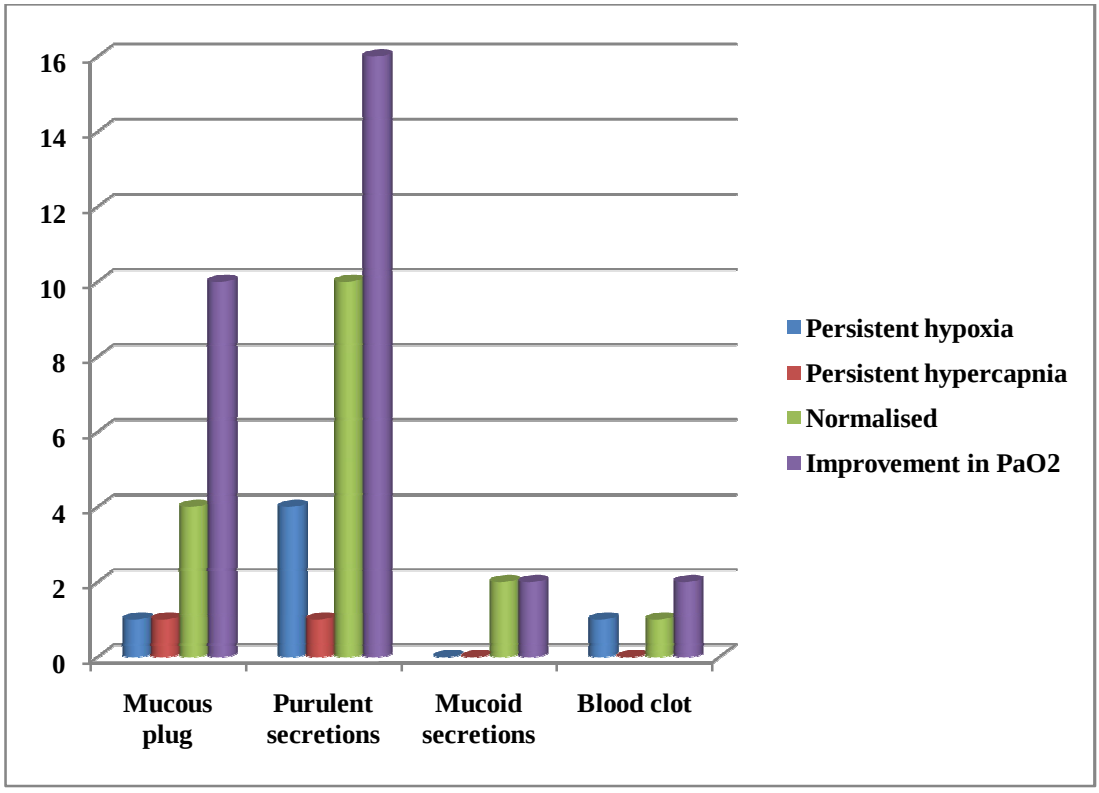
Out of 31 patients who had purulent secretions, 16.1%(n=5) remained persistent hypoxic or hypercapnic state. 32.3% improved to normal oxygen saturation by 24 hours and 51.6% of patients had improvement in oxygen saturation when compared with previous arterial blood gas.

In patients with mucous plugging, 25% improved to normal oxygen saturation and 62.5% showed improvement in arterial blood gas compared to previous one. Only two patients(12.5%) did not showed any improvement.

In patients who had blood clots during bronchoscopy 50% showed improvement 25% improved to normal and 25% remained in hypoxic state.

Analysed using chi-square test p value =0.001.

Figure-5.16 shows improvement in ABG according to different bronchoscopic findings



EMPIRICAL ANTIMICROBIALS AND POST BRONCHOSCOPIC CHANGE IN ANTIMICROBIALS:

In our study we studied the influence of empirical antimicrobial on post bronchoscopic change in antimicrobials due to change in culture and sensitivity results.

Number of days of empirical antimicrobials were taken into account and patients were segregated into less than 5 days and greater than 5 days. Almost all patients started on empirical antimicrobials by the referring unit.

Table-5.18 shows effect empirical antimicrobial comparison with change in antimicrobial regimen after bronchoscopy.

No. of days of antimicrobials pre bronchoscopy	**Change in antimicrobials**			**Total**
	Yes	**No**	**NA**	
<=5 days	14 40%	17 48.6%	4 11.4%	35 100%
>5 days	1 3.6%	27 96.5%	0 0%	28 100%
Total	15 23.8%	44 69.8%	4 6.3%	63 100%

The results observed as follows;

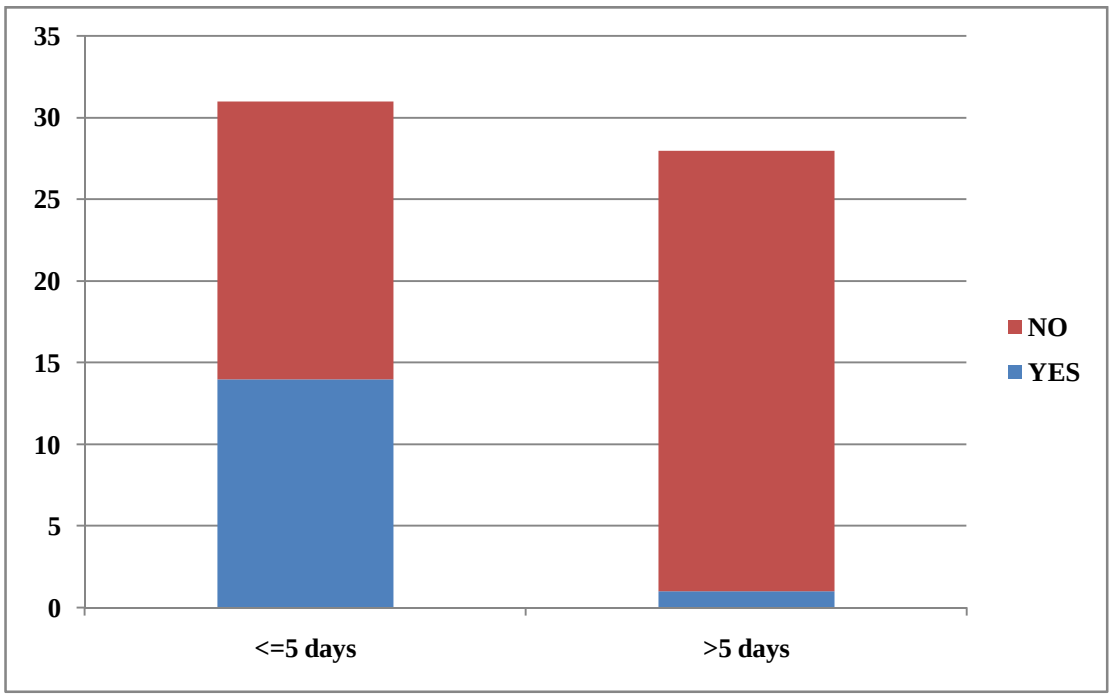
Out of 64 patients, 4 patients were not started on antimicrobials and these patients were included in less than 5 days.

In total of 35 patients with less than 5 days of antimicrobials, 40% had change in culture and sensitivity report hence changed to sensitive antimicrobial according to bronchoalveolar culture and sensitivity. In 48.6% the same antimicrobial was continued as bronchoalveolar reports were not in variance with culture and sensitive reports of blind tracheal aspirate.

28 patients had greater than 5 days of antimicrobials, in which only 3.6% had different BAL culture and sensitivity. 96.4% of patients had no change in antimicrobials.

This cross tabulation was analysed using chi-square test, p value is <0.001.

Figure-5.17 shows empirical antimicrobials comparison with change in antimicrobial regimen after bronchoscopy



NUMBER OF DAYS SINCE ADMISSION IN ICU AND ITS RADIOGRPAHIC OUTCOME: AFTER 6 HOURS

Data regarding time since admission at the time of bronchoscopy was collected and is analysed with the chest radiographic findings at 6^{th} and 24^{th} hours to evaluate whether early bronchoscope intervention changes the therapeutic outcome or not. The observation were analysed in cross tabulation between these two by chi square test. The results and observations were as follows.

Table-5.19 shows no.of days since admission in icu and its radiogrpahic outcome: after 6 hours

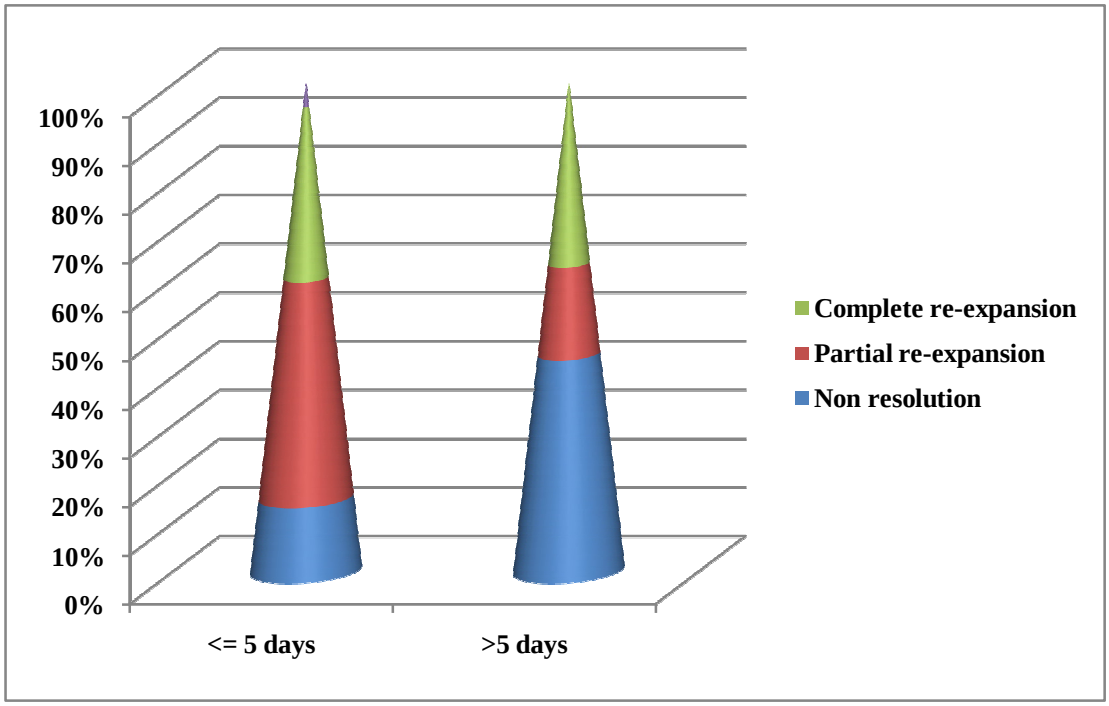
No. of days of admission	Chest radiograph after 6 hours				Total
	Non resolution	Partial re-expansion	Complete re-expansion	Not done	
<= 5 days	4 21.1%	10 52.6%	5 26.3%	0 0%	19 100%
>5 days	16 44.4%	14 38.8%	6 16.7%	0 0%	36 100%
As emergency	0 0%	0 0%	0 0%	8 100%	8 100%
Total	20 31.7%	24 38%	11 17.5%	8 12.7%	63 100%
Chi square test , p-value=0.058					

Number of patients intervened at less than 5 days were 19. Out of which 52.6% showed partial re-expansion and 26.3% showed complete re-expansion and 21.1% showed no expansion on radiograph taken at post bronchoscopy 6th hours

Out of 36 patients intervened at greater than 5 days since admission in intensive care units, 38.8% showed partial expansion , 16.7% showed complete expansion and 44.4% showed no expansion on radiograph taken at 6th hour of post bronchoscopy.

For 8 patients bronchoscopy was done immediately on admission. This table is analysed using chi square test and found statistically significant p value <0.001.

Figure-5.18 shows No.of days since admission in ICU and its radiographic outcome: after 6 hours



NUMBER OF DAYS SINCE ADMISSION IN ICU AND ITS RADIOGRPAHIC OUTCOME: AFTER 24 HOURS

After 24 hours, in patients intervened before 5 days of admission, 36.8% showed complete resolution and 47.4% showed partial re-expansion.

15.8% of showed no improvement radiologically after 24 hour of bronchoscopy among 19 patients intervened before 5 days of admission.

In patients who intervened after 5 days of admission, 27.8% showed complete re-expansion , 25% showed only minimal improvement and 13.9% showed partial re-expansion.

Table-5.20 shows number of days since admission in ICU and its radiographic outcome: after 24 hours.

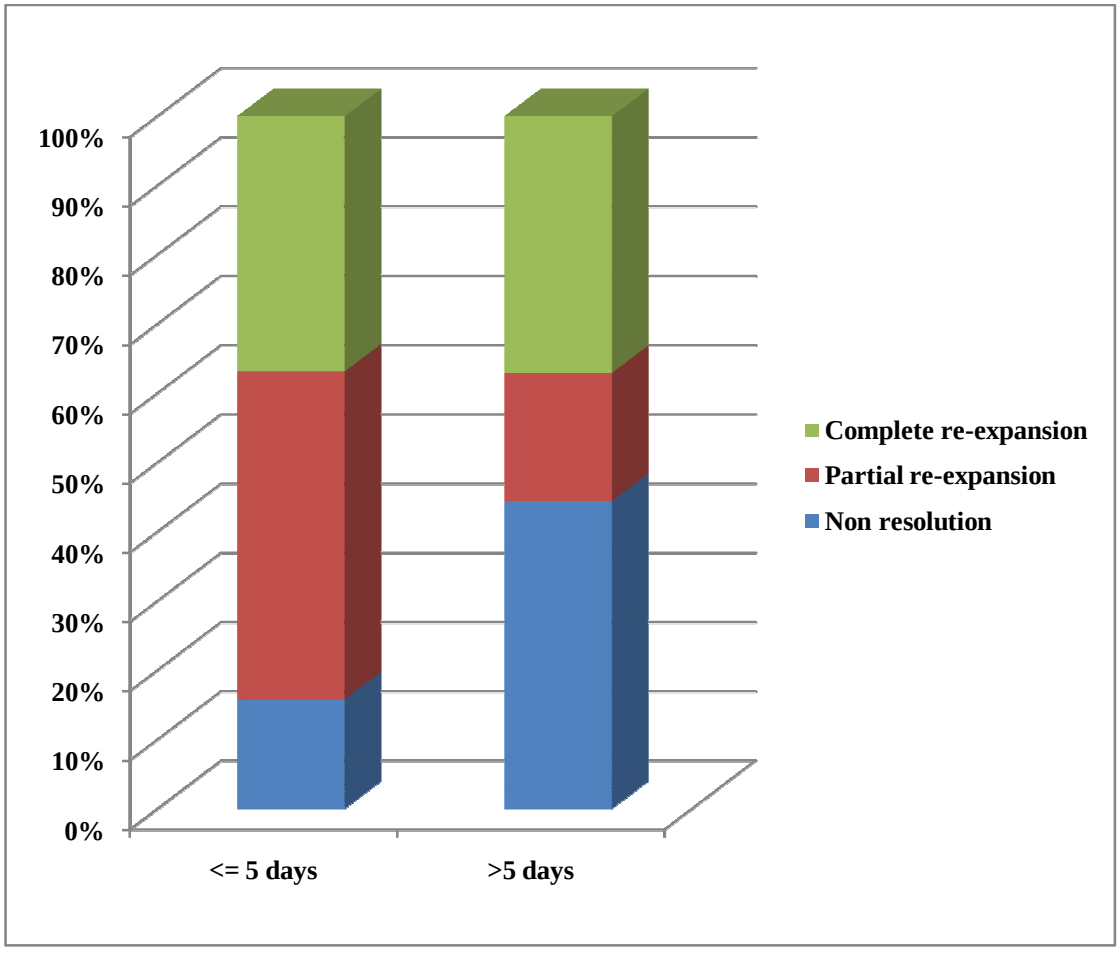
No.of days of admission	Chest radiograph after 24 hours				Total
	Non resolution	Partial re-expansion	Complete re-expansion	Not applicable	
<= 5 days	3 15.8%	9 47.4%	7 36.8%	0 0%	19 100%
>5 days	12 33.3%	14 38.8%	10 27.8%	0 0%	36 100%
As emergency	0 0%	0 0%	0 0%	8 100%	8 100%
Total	15 23.8%	23 34.8%	17 27.0%	8 12.7%	63 100%
Chi square test , p-value <0.001					

About 33.3% patients were not improved after 24 hours chest radiograph among 36 patients who intervened after 5 days of admission in intensive care units.

Thus patients who intervened before 5 days of admission in intensive care unit showed better therapeutic outcome when compared with the patients who was intervened after 5 days of admission in intensive care units.

This comparison was done by chi square test which is statistically significant with p value <0.001.

Figure-5.19 shows number of days since admission in icu and its radiographic outcome: after 24 hours



BRONCHOSCOPIC FINDINGS AND ITS DIAGNOSTIC VAILIDITY:

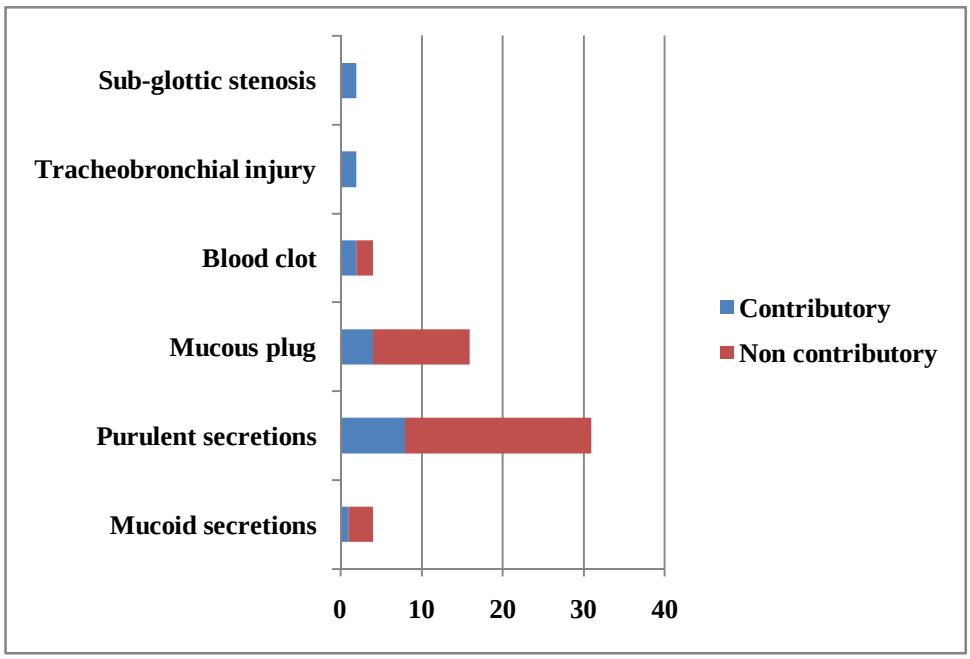
The bronchoscopic findings and the bronchoscopic contribution to diagnostic validity were compared and analysed using chi square test.

In patients with mucoid secretions 25% had diagnostic contribution and 75% didn't had diagnostic contribution. Out of 31 patients with purulent secretions 25.8% had diagnostic contribution. In 16 patients with mucous plugging 25% contributed to diagnosis.

Table-5.22 shows correlation between bronchoscopic findings and its diagnostic validity.

Bronchoscopic findings	Diagnostic contribution		Total
	Contributory	Not contributory	
Mucoid secretions	1 25%	3 75%	4 100%
Purulent secretions	8 25.8%	23 74.2%	31 100%
Mucous plug	4 25%	12 75%	16 100%
Blood clot	2 50%	2 50%	4 100%
Trachea-bronchial injury	2 100%	0 0%	2 100%
Sub-glottic stenosis	2 100%	0 0%	2 100%
Assisting Intubation	0 0%	0 0%	4* 100%
Total	19 30.2%	40 63.5%	59/63
* patients with difficult endotracheal intubation were intervened only for therapeutic purpose.			

Figure-5.21 shows correlation between bronchoscopic findings and its diagnostic validity



CORRELATION BETWEEN FOB FINDINGS AND ITS THERAPEUTIC CONTRIBUTION:

Bronchoscopic findings were analysed individually whether it was contributed to therapeutic outcome or not. The common bronchoscopic findings were segregated and compared with therapeutic contribution results.

In patients with mucoid secretions 100% of patients were improved in pulmonary status either clinically or radiologically. Out of 31 patients with purulent secretions 71% had improved.

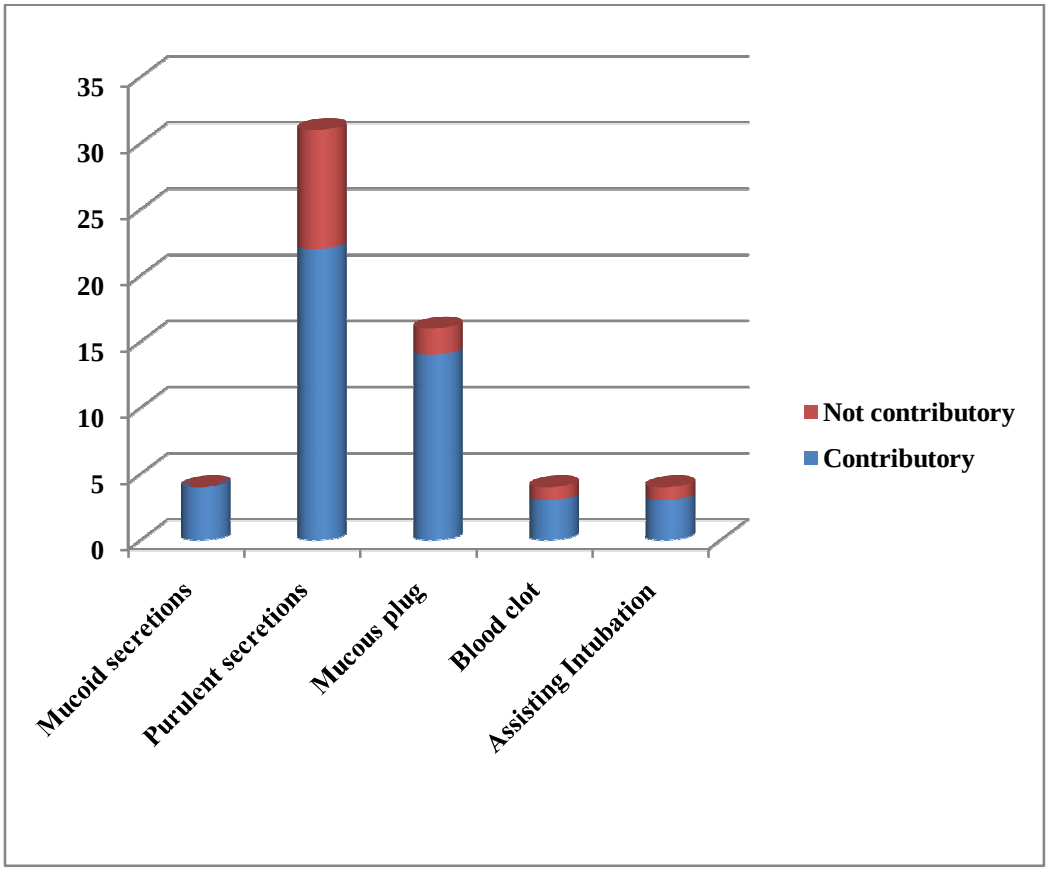
Table-5.24 shows correlation between FOB findings and therapeutic contribution

Bronchoscopic findings	Therapeutic contribution		TOTAL
	Contributory	Not contributory	
Mucoid secretions	4 100%	0 0%	4 100%
Purulent secretions	22 71%	9 29%	31 100%
Mucous plug	14 87.5%	2 12.5%	16 100%
Blood clot	3 75%	1 25%	4 100%
Trachea-bronchial injury	0 0%	0 0%	2* 100%
Sub-glottic stenosis	0 0%	0 0%	2* 100%
Assisting Intubation	3 75%	1 25%	4 100%
Total	46 73.0%	13 20.6%	63 100%
*4 patients with suspected airway trauma were intervened only for diagnostic purpose.			

The pulmonary status was improved in 87.5% of patients in whom the bronchoscopic finding was mucous plugging (n=16). In patients with blood clot bronchoscopy improved the pulmonary status in 75% of patients.

In patients intervened for airway trauma and difficult intubation, all 8 patients were improved in pulmonary status.

Figure 5.23 shows correlation between FOB findings and its therapeutic contribution



INDICATION FOR FOB AND THERAPEUTIC CONTRIBUTION:

The indications for bronchoscopy done in intensive care units were categorised into four. All these indication were analysed separately with the therapeutic outcome of the patients and the observations were as follows.

In 36 patients with suspected lung atelectasis, 86.1% had good therapeutic outcome. In patients with persistent pulmonary infiltrates 63.1% of patient were therapeutically benefitted.

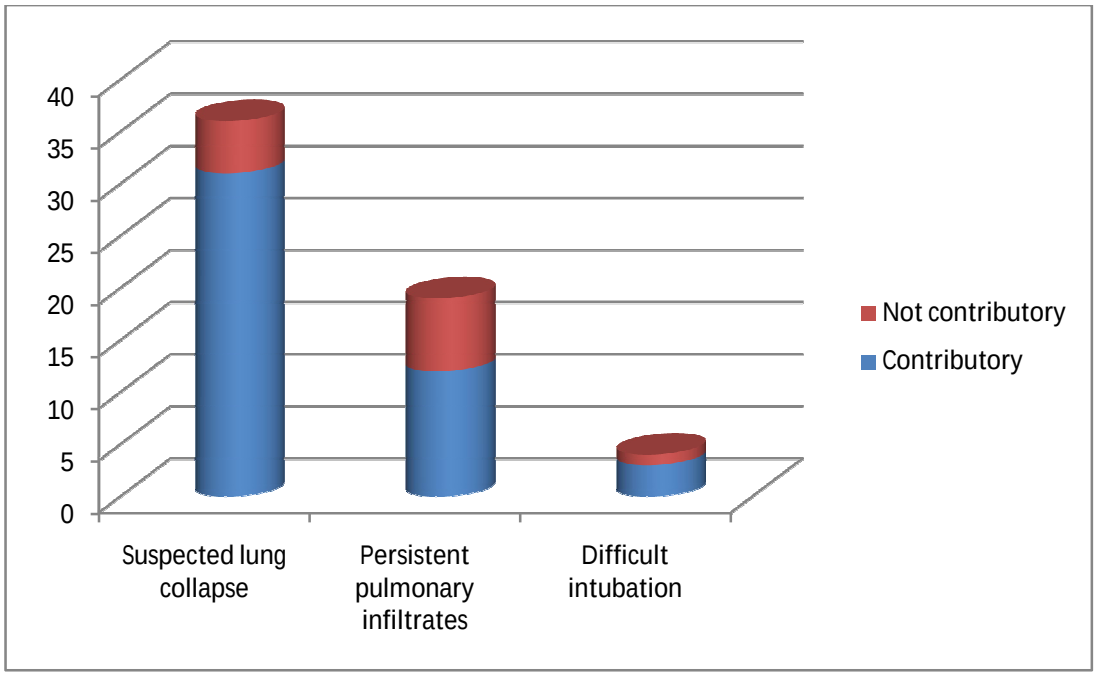
Table-5.25 shows correlation between indication for bronchoscopy and therapeutic contribution

Indications for bronchoscopy	Therapeutic contribution			Total
	Contributory	Not contributory	Not applicable	
Suspected lung collapse	31 86.1%	5 13.8%	0 0%	36 100%
Suspected airway trauma	0 0%	0 0%	4 100%	4 100%
Persistent pulmonary infiltrates	12 63.1%	7 36.8%	0 0%	19 100%
Difficult intubation	3 75%	1 25%	0 0%	4 100%
Total	46 73%	13 20.6%	4 6.3%	63 100%

In patients with suspected airway trauma all patients were diagnosed with airway injury and referred to concern surgeon for surgical management. In patients intervened for assisting difficult intubation, 75% of patients were successfully intubated and in one patient assisting with bronchoscopy also failed and tracheostomy tube was inserted by surgeons.

Overall 73% of patients had better therapeutic outcome in the study either by reexpansion of collapsed lung or by improvement in arterial blood gas.

Figure-5.24 shows correlation between indication for bronchoscopy and its therapeutic contribution



CORRELATION BETWEEN INDICATIONS FOR BRONCHOSCOPY AND DIAGNOSTIC CONTRIBUTION:

In total of 36 patients with lung atelectasis, 30.5% of patients had culture and sensitivity of BAL in variance with blind tracheal aspirate. Thus helpful in diagnosis of ventilator associated pneumonia and change in treatment with appropriate antimicrobials.

In patients with persistent pulmonary infiltrates only 21% of patients showed different culture and sensitivity of BAL when compare with blind tracheal aspirate

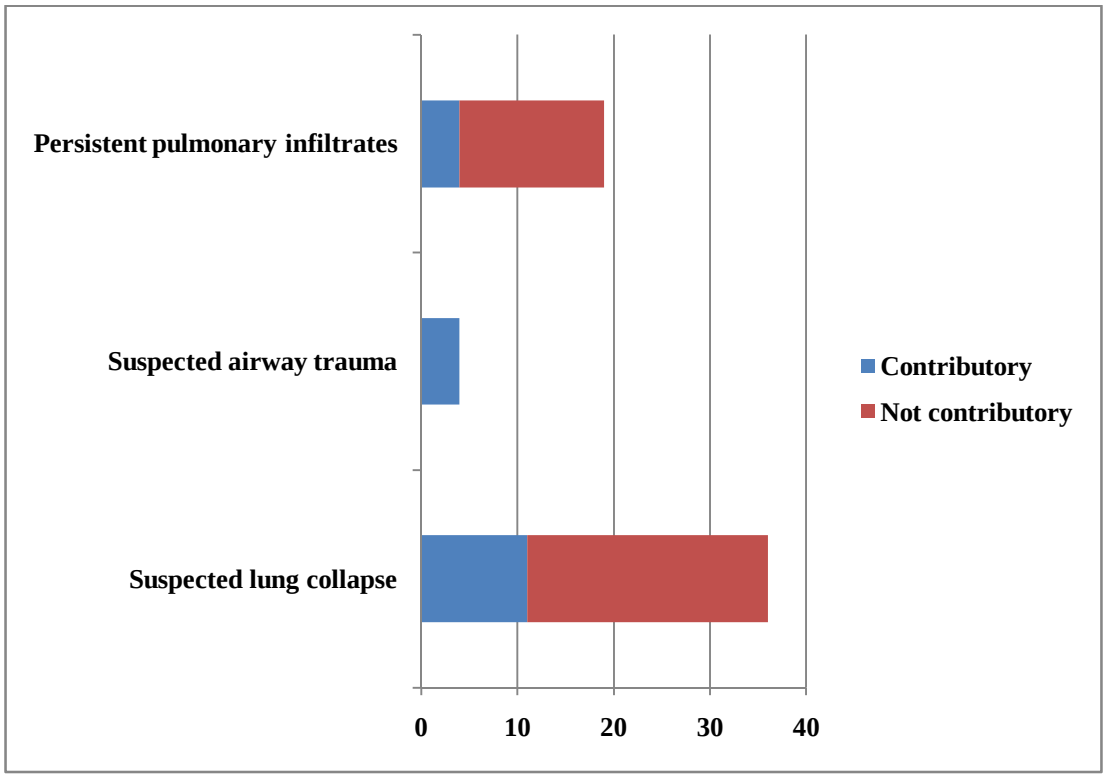
Table 5.26 shows correlation between indication for bronchoscopy and diagnostic contribution

Indications for bronchoscopy	Diagnostic contribution			Total
	Contributory	Not contributory	Not applicable	
Suspected lung collapse	11 30.5%	25 69.4%	0 0%	36 100%
Suspected airway trauma	4 100%	0 0%	0 0%	4 100%
Persistent pulmonary infiltrates	4 21.1%	15 78.9%	0 0%	19 100%
Difficult intubation	0 0%	0 0%	4 100%	4 100%
Total	19 30.1%	40 63.4%	4 6.3%	63 100%
Chi square test , p-value < 0.001				

In patients with suspected airway trauma, all patients were diagnosed with injury. Two patients with pneumomediastinum had airway laceration and two patients with dyspnea immediately after extubation is diagnosed with subglottic stenosis

Overall out of 63 patients intervened, in 30.1% bronchoscopy had diagnostic validity.

Figure- 5.25 shows correlation between indication for bronchoscopy and diagnostic contribution



DISCUSSION

The present study describes the utility of bronchoscope in intensive care setup both for diagnostic and therapeutic purposes, has shown to be effective and inter-indicated in the resolution of atelectasis and diagnosis of pneumonia. Hence we consider having bronchoscope and staff trained in their use is strongly recommended in the approach to respiratory complications in critically ill patients.

THERAPEUTIC OUTCOME:

Although treatment for atelectasis and diagnosis of VAP are the most common indications for bronchoscopy in ICU, there are others such as diagnosis of airway injury and inhalational injury and assisting difficult endotracheal intubation[4,37,38]. In our study also the most common indication for bronchoscopy was lung atelectasis in which lobar collapse was common. Apart from this we intervened four cases of airway trauma and four cases for assisting difficult intubation.

Reports of overall utility of bronchoscopy in intensive care units from previous studies ranges from 38% to 71%[29,30,39,40]. Overall utility of bronchoscopy in this study is 85% which is higher than that reported in earlier series. Out of 36 patients of suspected atelectasis, 86.1% showed clinical and radiological improvement. In 36 cases of lung atelectasis, 80.5% patients showed partial and complete re-expansion after 6 hours following flexible bronchoscopy. After 24 hours further two more patients showed improvement

in chest radiograph, hence improvement observed in 86.1% of cases. Out of 36 patients with lung atelectasis 47.2% showed complete re-expansion.

71% of purulent secretions had good therapeutic outcome, 87.5% of mucoid secretions and 75% blood clot had good therapeutic outcome. In patients with purulent secretions, 29% had not responded therapeutically which is higher of all patients who not responded therapeutically (n=13).

DIAGNOSTIC VALIDITY:

In diagnosis of ventilator associated pneumonia, BAL and protected brush sampling are the two techniques that imply some proficiency to obtain the highest sensitivity and specificity. Evidence supporting superiority of these techniques over other invasive techniques is currently lacking. Hans – jurgen woske et al[27] compared the three bronchoscopic methods for microbiological specimen sampling and concluded that tracheobronchial secretion aspiration is cheap and easy technique providing comparable reports with BAL and protected brush specimen.

In patients with less than 5 days of empirical antimicrobials, BAL shows culture and sensitivity reports variance with blind tracheal aspirate in about 40%, hence result in change in antimicrobial regimen. Thus bronchoscopy yield will be better if BAL is done before starting antimicrobials. Only 3.6% had antimicrobial regimen changed in patients had taken greater than 5 days of antimicrobials.

ORGANISM PROFILE:

In this study patient with respiratory complications had Staphylococcus aureus as their common organism. It comprised about 30% in which 7.9% was MRSA. Followed by Streptococcus and Pseudomonas at 15.9% each. Other organisms isolated were Haemophilus, Klebsiella, Acinetobacter. In previous studies by Hans- jurgen woske[27] regarding organism profile also recorded Staphylococcus aureus as the commonest organism in patients with respiratory complications in ICU. Kollef and ward et al[41] and Heyland et al[42] had documented that Staphylococcus aureus as predominant organism in ICU followed by Pseudomonas.

In our study patients with less than 5 days of antimicrobials showed change in antimicrobials regime after BAL culture reports. Out of 35 patients 40% had change in antimicrobials. Only 3.6% of patients had change in antimicrobials treatment among 28 patients who had taken greater than 5 days of antimicrobials.

CLINICAL PROFILE OF STUDY POPULATION:

In a prospective study titled bronchoscopy in critically ill surgical patients by N Snow et al.[35] was reported that in their study 46 out of 51 patients were in mechanical ventilation. About 85.6% were in mechanical ventilator in this study. Thus patients in mechanical ventilation either by endotracheal tube or by tracheostomy were at high risk of developing pulmonary complications in our study.

The mean age of patients who were refractory to conservative management to pulmonary complications in intensive care unit was 45±12. Males were having higher respiratory complications than females in intensive care units. Both responded equally to bronchoscopic intervention.

33.3% of patients had no co morbid illness, as most of the study populations were polytrauma and post operative patients. Apart from this diabetes mellitus and obstructive airway disease were found in 19% each. Followed by systemic hypertension and coronary heart disease.

SAFETY PROFILE:

No life threatening complications were encountered. Minor complications such as sinus tachycardia, hypoxemia was returned to normal limits by itself without any interventions. One patient had transient arrhythmia which returned to sinus rhythm within 20 minutes after the procedure. Literature regarding the safety profile also proves the same, prospective study by D Dang et al[33] found out 2.2% of major complications occurred in first 4 hours and no complications associated with sedation. C M Lucena et al[34] also concluded flexible bronchoscopy is safe in critically ill patients which also helps in clinical management.

CONCLUSION:

1. Lung atelectasis was the most common indication for the bronchoscopic intervention done in our study. It forms about 57% of our total study population. About 85% of patients showed improvement in chest radiograph after bronchoscopy . Hence bronchoscopy may be considered in treatment protocol for patients with lung atelectasis in intensive care units.
2. Staphylococcus aureus (30%) is the most common organism isolated in our study in which 8% were Methicillin Resistant Staphylococcus aureus. Hence it is preferable to include staphylococcus in empirical antimicrobial coverage.
3. 80.5% patients with lung atelectasis showed improvement after 6 hours and further, only 5.6% improved in next 24 hours. Hence after bronchoscopy, chest radiograph can be taken after 6 hours to know the effect of bronchoscopy during the follow up.
4. In patients with less than 5 days of antimicrobials, BAL shows culture reports variance with blind tracheal aspirate in about 40%, hence result in change in antimicrobial regimen. Thus bronchoscopy yield will be better if BAL is done before starting antimicrobials. Only 3.6% had antimicrobial regimen changed in patients had taken greater than 5 days of antimicrobials.
5. Most of the patients who needed bronchoscopy were in the mechanical ventilator. This is about 85.1% of study population. Hence patients in

mechanical ventilator should be given adequate precautions to prevent respiratory complications.

6. There was about 23% of difference observed in better therapeutic outcome if intervened early days of admission in intensive care units.
7. Patients with chest trauma whose chest radiograph suggestive of airway injury, emergency bronchoscopy for the diagnosis of airway injury is lifesaving. Because diagnosis of airway injury will help surgeons to plan surgery as early as possible. In our study two patients with pneumomediastinum were diagnosed with airway injury and referred for surgical management.
8. Bronchoscopy should be done as emergency procedure in patients who had post extubation stridor, to diagnose tracheal or subglottic stenosis. This will also helpful for surgeons to plan for the surgery.
9. In cases of difficult intubation, flexible bronchoscopy assistance is life saving because it will cut down the time duration as this allows direct visualisation and confirmation of position of endotracheal tube.
10. In our study no major complications were encountered in any of our patients. Hence flexible bronchoscopy is safe in critically ill patients if basic precautions were taken.

LIMITATIONS:

In our study most of the patients were started on empirical antimicrobials by referring unit for treating primary or respiratory illness even before the opinion. Hence the organism profile and the diagnostic validity for ventilator associated pneumonia may be low in our study.

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ANNEXURES

ABBREVIATIONS:

ABG – Arterial Blood Gas

FOB – Fiberoptic Bronchoscopy

BAL – Bronchoalveolar Lavage

ETT- Endotracheal Tube

PEEP – Positive End Expiratory Pressure

ICU – Intensive Care Unit

ARDS – Acute Respiratory Distress Syndrome

MRSA – Methicillin Resistant Stapylococcus aureus

PaO_2 – Partial Pressure Of Oxygen in arterial blood

$PaCO_2$ – Partial Pressure Of Carbon Di Oxide in arterial blood

VAP – Ventilator Associated Pneumonia

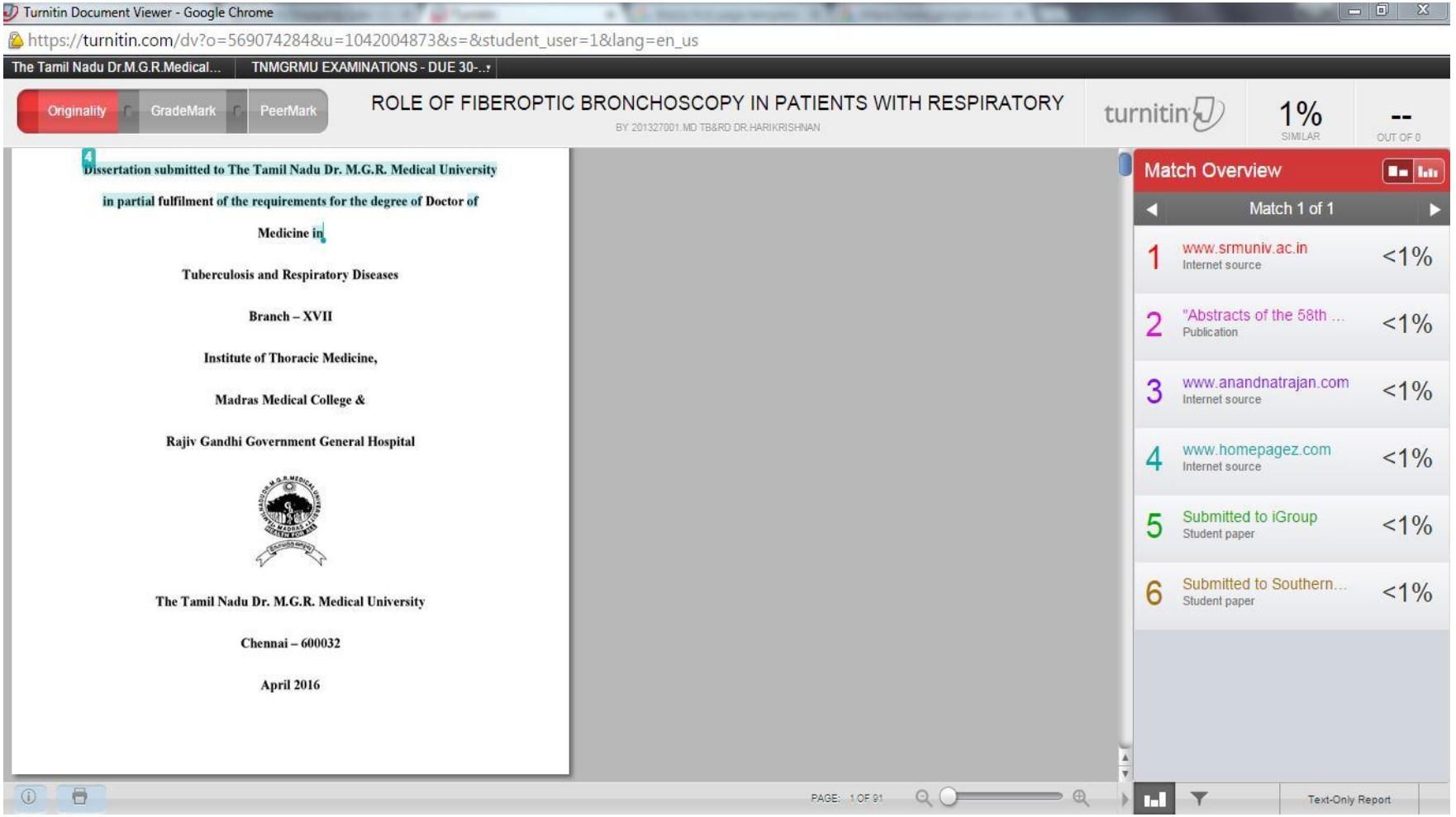
RCT – Randomised Controlled Trial

PSB – Protected Sample Brushing

BBS – Blind Bronchial Aspirate

FiO_2 - Fraction of inspired oxygen

TURNITIN-PLAGIARISM SCREEN SHOT



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" ROLE OF FIBEROPTIC BRONCHOSCOPY IN PATIENTS WITH
RESPIRATORY COMPLICATIONS IN MULTISPECIALITY
INTENSIVE CARE UNITS "

Dissertation submitted to The Tamil Nadu Dr. M.G.R. Medical University
in partial fulfillment of the requirements for the degree of Doctor of
Medicine in
Tuberculosis and Respiratory Diseases
Branch - XVII
Institute of Thoracic Medicine,
Madras Medical College &
Rajiv Gandhi Government General Hospital

The Tamil Nadu Dr. M.G.R. Medical University
Chennai - 600032
April 2016

ETHICAL COMMITTEE APPROVAL ORDER

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI-3

EC Reg No.ECR/270/Inst./TN/2013
Telephone No. 044 25305301
Fax : 044 25363970

CERTIFICATE OF APPROVAL

To
Dr.S.Harikrishnan
Postgraduate in M.D.(TB & RD)
Madras Medical College
Chennai – 600 003.

Dear Dr. S.Harikrishnan,

The Institutional Ethics Committee has considered your request and approved your study titled **"Role of Broncoscopy in Patients with Respiratory Complications in Multi Speciality Intensive Care Units" No.32012015.**

The following members of Ethics Committee were present in the meeting held on 20.01.2015 conducted at Madras Medical College, Chennai-3.

1. Dr.C.Rajendran, M.D.,	: Chairperson
2. Dr.R.Vimala, M.D., Dean, MMC, Ch-3	: Deputy Chairperson
3. Prof.B.Kalaiselvi, M.D., Vice-Principal, MMC, Ch-3	: Member Secretary
4. Prof.R.Nandini, M.D., Inst.of Pharmacology, MMC	: Member
5. Prof.P.Ragumani, M.S., Professor, Inst.of Surgery, MMC	: Member
6. Prof.Md.Ali, M.D., D.M., Prof. & HOD of Medl.G.E., MMC	: Member
7. Prof.K.Ramadevi, Director , Inst.of Biochemistry, MMC	: Member
8. Prof.Saraswathy, M.D., Director, Pathology, MMC, Ch-3	: Member
9. Prof.S.G.Sivachidambaram, M.D., Director i/c, Inst.of Internal Medicine, MMC	: Member
10. Thiru S.Rameshkumar, Administrative Officer	: Lay Person
11. Thiru S.Govindasamy, B.A., B.L.,	: Lawyer
12. Tmt.Arnold Saulina, M.A., MSW.,	: Social Scientist

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

22/1/15

Member Secretary, Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

PATIENT INFORMATION SHEET

TITLE OF THE STUDY: Role of fiberoptic bronchoscopy in patients with respiratory complications in multispeciality intensive care units

We are conducting a study on among patients admitted in Rajiv Gandhi Government General Hospital, Chennai.

The purpose of this study is to determine the contribution of flexible fiberoptic bronchoscopy in intensive care units in terms of therapeutic outcome and diagnostic validity. To determine the safety of flexible bronchoscopy in critically ill patients.

Patients with respiratory complications in ICU who are refractory to conservative management will be taken up for bronchoscopic intervention.

The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.

The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of Investigator Signature of Participant

Date :

PATIENT CONSENT FORM

Study Detail	:	Role of fiberoptic bronchoscopy in patients with respiratory complications in multispeciality intensive care units
Study Centre	:	Rajiv Gandhi Government General Hospital, Chennai.
Patient's Name	:	
Patient's Age	:	
IP number	:	

Patient may check (√) these boxes

a) I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ☐

b) I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ☐

c) I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. ☐

d) I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or well-being or any unexpected or unusual symptoms. ☐

e) I hereby consent to participate in this study. ☐

f) I hereby give permission to undergo detailed clinical examination, Radiographs, blood investigations and surgical procedure as required. ☐

Signature of Investigator

Signature of Participant

Date &time :

Place :

Name and address

ஒப்புதல் படிவம்

பெயர் வயது

பாலினம்

முகவரி

ராஜீவ் காந்தி அரசு பொதுமருத்துவமனையில் நெஞ்சக மருத்துவ பிரிவில் பட்ட மேற்படிப்பு மாணவர் செ.ஹரிகிருஷ்ணன் "ராஜீவ் காந்தி அரசு மருத்துவமனையில் பல்நோக்கு தீவிர சிகிச்சை பிரிவில் நுரையீரல் சிக்கல்கள் உள்ள நோயாளிகளுக்கு மூச்சு குழாய் உள்நோக்கியின் பயன்களை கண்டறிதல்" என்ற ஆய்வின் செயல் முறை மற்றும் அனைத்து விவரங்களையும் கேட்டுக் கொண்டு எனது சந்தேகங்களை தெளிவுப்படுத்திக் கொண்டேன் என்பதை தெரிவித்துக் கொள்கிறேன்.

நான் இந்த ஆய்வில் முழு சம்மதத்துடன், சுய சிந்தனையுடனும் கலந்து கொள்ள சம்மதிக்கிறேன்.

இந்த ஆய்வில் என்னுடைய அனைத்து விபரங்கள் பாதுகாக்கப்படுவதுடன் இதன் முடிவுகள் ஆய்விதழில் வெளியிடப்படுவதில் ஆட்சேபனை இல்லை என்பதை தெரிவித்துக் கொள்கிறேன். எந்த நேரத்திலும் அந்த ஆய்விலிருந்து நான் விலகிக் கொள்ள எனக்கு உரிமை உண்டு என்பதையும் அறிவேன்.

கையொப்பம் / ரேகை

இடம் :

நாள் :

ளி

EVALUATION FORM

Name:

Age:

Sex:

Ip number:

ICU ward :

Clinical examination:

Ventilator settings:

Radiological findings:

Chest xray :

CT-CHEST:

<u>Indication for fibre-optic bronchoscopy:</u>

Route : NASAL / ENDOTRACHEAL TUBE / TRACHEOSTOMY

Anaesthesia :

Name of bronchoscopist:

Procedure:

Findings: Vocal cords

Trachea

Carina

Right bronchial tree

Left bronchial tree

Intervention done :

Bronchoalveolar lavage

Endobronchial brushings

Endobronchial biopsy

Investigations:

Bronchoalveolar lavage for bacterial culture and sensitivity.

Bronchoalveolar lavage for acid fast bacilli.

Bronchoalveolar lavage for fungal stain and culture.

Bronchoalveolar lavage for cytology.

Bronchoalveolar lavage for cell count.

Endobronchial brushing for cytology.

FOLLOW UP :

After 6 hours

Chest radiograph

ABG

After 24 hours

Chest radiograph

ABG

PARAMETER	VARIABLES	CODE
AGE	MALE	1
	FEMALE	2
WARD	MEDICAL ICU	1
	SURGICAL ICU	2
	NEUROLOGY ICU	3
	PACU	4
	SPECIALITY ICU	5
CLINICAL EXAMINATION		
	BILATERAL WHEEZE	1
	BILATERAL CREPS	2
	RIGHT ABSENT SOUNDS	3
	LEFT ABSENT SOUNDS	4
	UNILATERAL WHEEZE	5
	UNILATERAL CREPS	6
CXR		
	LEFT LOBAR COLLAPSE UZ	1
	LEFT LOBAR COLLAPSE LZ	2
	RIGHT LOBAR COLLAPSE UZ	3
	RIGHT LOBAR COLLAPSE MZ	4
	RIGHT LOBAR COLLAPSE LZ	5
	LEFT MULTILOBAR COLLAPSED	6
	RIGHT MULTILOBAR COLLAPSED	7
	LEFT WHOLE LUNG COLLAPSE	8
	RIGHT WHOLE LUNG COLLAPSE	9
	UNILATERAL PULM. INFILTRATE	10
	BILATERAL PULM.INFILTRATES	11
	PNEUMOMEDIASTINUM	12
CONSERVATIVE MANAGEMENT		
	CHEST PHYSIOTHERAPY	1
	EMPIRICAL ANTIBIOTICS	2
	NOT GIVEN	3
	NOT APPLICABLE	4
ABG		
	HYPOXIC RESP FAILURE	1
	HYPERCAPNIC RESP FAILURE	2
	NORMAL	3
VENTILATION		
	ROOM AIR	1
	MECHANICAL VENTILATION	2
	NIV	3
	TRACHEOSTOMY	4
	T TUBE	5
CO-MORBIDS		

	DIABETES MELLITUS	1
	CAD	2
	INCREASED ICH	3
	SHT	4
	PTB	5
	COPD/BA	6
	NIL	7
TBS – C/S		
	MS STAP AUREAS	1
	MRSA	2
	STREP PNEUMONIA	3
	HAEMOPHILUS	4
	PSEUDOMONAS	5
	KLEBSIELLA	6
	ACITENOBACTER	7
	NEG	8
	NOT DONE	9
FOB FINDING		
	MUCOID SECREATIONS	1
	PURULENT SECREATIONS	2
	MUCOUS PLUG	3
	BLOOD CLOT	4
	TRACHEO BRONCHIAL INJURY	5
	PURULENT SEC + MUCOUS PLUG	6
	SUBGLOTTIC STENOSIS	7
	INTUBATION SUCESSFUL	8
	INTUBATION FAILURE	9
INDICATION		
	SUSPECTED LUNG COLLAPSE	1
	SUSPECTED AIRWAY TRAUMA	2
	DIAGNOSTIC BAL	3
	THERAPAEUTIC BAL	4
	DIFFICULT INTUBATION	5
COMPLICATION		
	SINUS TACHYCARDIA TRANSIENT	1
	TRANSIENT MINIMAL BLEED	2
	MASSIVE BLEEDING	3
	LIFE THREATENING ARRYTHMIAS	4
	IATROGENIC AIRWAY INJURY	5
	TRANSIENT HYPOXMIA	6
	NIL	7
CXR 6/24 HRS		
	NON RESOLUTION	1
	PARTIAL EXPASION	2

	COMPLETE EXPANSION	3
	MINIMAL RESOLUTION	4
	COMPLETE RESOLUTION	5
	NOT DONE	6
ABG 6/24 HRS		
	PERSISTENT HYPOXIA	1
	HYPERCAPNIA	2
	NORMAL	3
	IMPROVEMENT IN PaO2	4
	NOT DONE	5
BAL C/S		
	MS STAP AUREAS	1
	MRSA	2
	STREP PNEUMONIA	3
	HAEMOPHILUS	4
	PSEUDOMONAS	5
	KLEBSIELLA	6
	ACITENOBACTER	7
	NEG	8
	NOT DONE	9
	MIXED INFECTION	10
	FUNGAL	11
CHANGE IN ANTIBIOTICS		
	YES	1
	NO	2
NO OF DAYS SINCE ADMISSION		
	LESS THAN 5 DAYS	1
	GREATER THAN 5 DAYS	2
NO DAYS OF EMPIRICAL ANTIBIOTICS		
	LESS THAN 5 DAYS	1
	GREATER THAN 5 DAYS	2
PaO2/FiO2		
	>50	1
	>100	2
	NO CHANGE	3
	NOT APPLICABLE	4
THERAPEUTIC ADVANTAGE		
	CONTRIBUTORY	1
	NOT CONTRIBUTORY	2
DIAGNOSTIC CONTRIBUTION		
	CONTRIBUTORY	1
	NOT CONTRIBUTORY	2

MASTERCHART

NAME	AGE	SEX	DIAGNOSIS	WARD	CLINICAL EXAMINATION	OLD XRAYS	CXR	NO OF DAYS OF ADMISSION	NO OF DAYS OF ANTIBIOTICS	ABG	VENTILATION	CO-MORBIDS	TBS BLIND ASP C/S	INDICATION FOR FOB	FOB FINDINGS	COMPLICATIONS	CXR-6HRS	ABG-6HRS	PaO2/FiO2	CXR-24HRS	ABG-24HRS	PaO2/FiO2	BAL C/S	CHANGE IN ANTIBIOTICS	THERAPEUTIC CONTRIBUTION	DIAGNOSTIC CONTRIBUTION
natarajan	38	M	GBS	1	3	4	6	1	1	1	4	1	8	1	3	1	2	4	1	3	3	1	1	1	1	1
dayalu	55	F	BA/DM/CAP	1	4	4	2	2	3	1	2	1	1	1	3	6	2	4	2	2	4	1	1	2	1	2
sengani	48	M	STROKE	3	4	4	2	2	4	1	2	4	7	1	3	6	2	1	3	2	4	3	7	2	1	2
selvan	25	M	POLYTRAUMA	2	4	4	2	2	3	1	4	7	8	1	6	6	1	1	3	2	4	1	8	2	1	2
rose	31	F	METABOLIC ENCHEPH	1	3	4	4	3	1	1	2	4	3	1	2	1	3	4	1	3	3	1	10	1	1	1
syed thajudeen	47	M	ARF	1	4	4	1	3	2	2	2	6	1	1	3	6	2	2	3	2	4	3	2	1	1	1
perumal	32	M	DVT/STROKE	3	4	4	2	3	3	1	5	4	3	1	3	6	3	4	1	3	4	1	3	2	1	2
sekar	36	M	CKD	5	3	4	4	3	3	1	2	7	6	1	3	6	1	1	3	1	1	3	6	2	2	2

navaneetham	**58**	**F**	**ARF**	**1**	**3**	**4**	**3**	**2**	**2**	**2**	**2**	**6**	**8**	**1**	**2**	**6**	**3**	**4**	**1**	**3**	**4**	**1**	**8**	**2**	**1**	**2**
vairamani	**61**	**M**	**POLYTRAUMA**	**2**	**4**	**4**	**2**	**3**	**4**	**1**	**4**	**2**	**4**	**1**	**6**	**1**	**2**	**4**	**2**	**3**	**4**	**1**	**4**	**2**	**1**	**2**
aadhi	**45**	**M**	**CNS TUMOR**	**3**	**1**	**2**	**7**	**2**	**2**	**1**	**4**	**4**	**1**	**1**	**3**	**6**	**2**	**4**	**1**	**2**	**3**	**1**	**1**	**2**	**1**	**2**
baanu	**34**	**F**	**SNAKE BITE**	**1**	**3**	**4**	**4**	**3**	**3**	**1**	**1**	**2**	**7**	**1**	**2**	**1**	**3**	**4**	**1**	**3**	**3**	**1**	**7**	**2**	**1**	**2**
saarangan	**54**	**M**	**ARF**	**1**	**4**	**4**	**1**	**3**	**4**	**2**	**3**	**6**	**5**	**1**	**2**	**6**	**3**	**4**	**1**	**3**	**4**	**1**	**5**	**2**	**1**	**2**
subaiyah	**50**	**M**	**ARF**	**1**	**3**	**4**	**7**	**3**	**1**	**1**	**2**	**4**	**3**	**1**	**3**	**6**	**2**	**4**	**1**	**2**	**4**	**1**	**10**	**1**	**1**	**1**
saroja	**45**	**F**	**HEAD INJURY**	**3**	**4**	**4**	**1**	**2**	**2**	**1**	**2**	**7**	**7**	**1**	**6**	**1**	**1**	**1**	**3**	**1**	**4**	**3**	**7**	**2**	**2**	**2**
chellappan	**47**	**M**	**POLYTRAUMA**	**2**	**4**	**3**	**2**	**1**	**4**	**2**	**5**	**1**	**6**	**1**	**4**	**2**	**3**	**4**	**1**	**3**	**3**	**1**	**6**	**2**	**1**	**2**
thulasi	**36**	**F**	**POLYTRAUMA**	**3**	**3**	**4**	**3**	**2**	**3**	**1**	**4**	**7**	**5**	**1**	**3**	**6**	**2**	**4**	**2**	**3**	**3**	**1**	**5**	**2**	**1**	**2**
nallakannu	**50**	**M**	**LARYNX TUMOR**	**4**	**3**	**2**	**4**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**3**	**1**	**1**	**1**	**3**	**1**	**4**	**3**	**1**	**2**	**2**	**2**
krishnaiah	**58**	**M**	**STROKE**	**3**	**3**	**4**	**3**	**2**	**2**	**1**	**1**	**4**	**8**	**1**	**1**	**6**	**3**	**4**	**1**	**3**	**4**	**1**	**1**	**1**	**1**	**1**
soundar	**37**	**M**	**POLYTRAUMA**	**2**	**4**	**4**	**6**	**3**	**3**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**4**	**1**	**3**	**3**	**1**	**2**	**2**	**1**	**2**
poorani	**27**	**F**	**OPC POISIONING**	**1**	**3**	**4**	**5**	**3**	**2**	**2**	**2**	**7**	**8**	**1**	**6**	**6**	**1**	**2**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**1**

vediyan	**68**	**M**	**ARF**	**1**	**3**	**4**	**4**	**2**	**3**	**2**	**2**	**6**	**5**	**1**	**3**	**6**	**2**	**2**	**3**	**2**	**4**	**3**	**5**	**2**	**1**	**2**
balan	**48**	**M**	**POLYTRAUMA**	**2**	**4**	**3**	**2**	**1**	**3**	**1**	**2**	**2**	**1**	**1**	**4**	**1**	**1**	**1**	**3**	**1**	**1**	**3**	**1**	**2**	**2**	**2**
senthilburugan	**35**	**M**	**PANCREATIC CA**	**4**	**4**	**2**	**1**	**2**	**1**	**1**	**4**	**1**	**1**	**1**	**3**	**6**	**3**	**4**	**1**	**3**	**4**	**1**	**2**	**1**	**1**	**1**
yogeswaran	**23**	**M**	**ARF**	**1**	**4**	**4**	**2**	**3**	**4**	**2**	**3**	**6**	**3**	**1**	**1**	**6**	**2**	**2**	**3**	**2**	**4**	**3**	**3**	**2**	**1**	**2**
sathiyamoorthy	**58**	**M**	**ARF**	**1**	**3**	**4**	**7**	**2**	**2**	**2**	**2**	**6**	**5**	**1**	**3**	**1**	**2**	**4**	**2**	**2**	**3**	**1**	**5**	**2**	**1**	**2**
nalakannu	**59**	**M**	**POLYTRAUMA**	**2**	**3**	**4**	**5**	**3**	**4**	**1**	**4**	**1**	**1**	**1**	**6**	**6**	**1**	**1**	**3**	**1**	**4**	**3**	**1**	**2**	**2**	**2**
pandi	**50**	**M**	**POLYTRAUMA**	**2**	**3**	**3**	**5**	**1**	**3**	**1**	**2**	**4**	**8**	**1**	**4**	**2**	**3**	**4**	**1**	**3**	**4**	**1**	**5**	**1**	**1**	**1**
janaki	**43**	**F**	**COLONIC CA**	**4**	**3**	**4**	**5**	**3**	**2**	**2**	**5**	**7**	**1**	**1**	**2**	**6**	**2**	**4**	**1**	**3**	**3**	**1**	**10**	**1**	**1**	**1**
elumalai	**61**	**M**	**ARF**	**1**	**3**	**4**	**9**	**3**	**4**	**2**	**3**	**6**	**3**	**1**	**3**	**1**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**1**	**2**
maruthu	**51**	**M**	**POLYTRAUMA**	**2**	**4**	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**4**	**2**	**2**	**4**	**1**	**2**	**4**	**1**	**10**	**1**	**1**	**1**
chellamal	**60**	**F**	**CKD**	**5**	**3**	**2**	**5**	**3**	**2**	**1**	**5**	**7**	**6**	**1**	**6**	**6**	**3**	**4**	**2**	**3**	**3**	**1**	**6**	**2**	**1**	**2**
gangaram	**54**	**M**	**POLYTRAUMA**	**2**	**4**	**4**	**1**	**2**	**4**	**1**	**2**	**4**	**3**	**1**	**3**	**1**	**2**	**4**	**2**	**2**	**4**	**1**	**3**	**2**	**1**	**2**
ramalingam	**41**	**M**	**post op**	**5**	**3**	**2**	**5**	**4**	**3**	**1**	**2**	**7**	**2**	**1**	**3**	**6**	**3**	**4**	**1**	**3**	**4**	**1**	**2**	**2**	**1**	**2**

muthuraman	**58**	**M**	**POLYTRAUMA**	**2**	**4**	**4**	**6**	**2**	**4**	**1**	**5**	**4**	**3**	**1**	**2**	**6**	**2**	**4**	**1**	**2**	**3**	**1**	**3**	**2**	**1**	**2**
sasireka	**36**	**F**	**ARF**	**1**	**3**	**4**	**4**	**3**	**2**	**2**	**1**	**6**	**5**	**1**	**2**	**1**	**2**	**2**	**3**	**3**	**4**	**3**	**10**	**1**	**1**	**1**
ANBUMANI	**34**	**M**	**RTA**	**2**	**2**	**4**	**11**	**2**	**2**	**1**	**2**	**7**	**1**	**3**	**2**	**6**	**1**	**1**	**3**	**1**	**1**	**3**	**1**	**2**	**2**	**2**
SHANMUGAM	**46**	**M**	**POST GASTR**	**4**	**2**	**2**	**11**	**3**	**3**	**1**	**2**	**2**	**5**	**4**	**2**	**1**	**4**	**4**	**1**	**4**	**4**	**2**	**5**	**2**	**1**	**2**
SHANDIYA	**23**	**F**	**CKD**	**5**	**2**	**4**	**11**	**3**	**4**	**2**	**2**	**6**	**5**	**3**	**2**	**1**	**1**	**4**	**1**	**1**	**4**	**1**	**10**	**2**	**2**	**1**
ANUMANTHAN	**57**	**M**	**POST OP**	**1**	**6**	**2**	**10**	**3**	**3**	**1**	**2**	**7**	**1**	**3**	**2**	**6**	**4**	**4**	**2**	**4**	**4**	**2**	**1**	**2**	**1**	**2**
SUNDARAM	**53**	**M**	**RTA**	**3**	**6**	**4**	**10**	**3**	**2**	**1**	**2**	**1**	**8**	**4**	**2**	**1**	**4**	**4**	**1**	**4**	**4**	**1**	**5**	**1**	**1**	**1**
VELIYAMMAL	**41**	**F**	**POST OP**	**2**	**2**	**2**	**11**	**4**	**1**	**1**	**2**	**7**	**5**	**4**	**2**	**6**	**1**	**1**	**3**	**1**	**1**	**3**	**5**	**2**	**2**	**2**
IMMANUEL	**46**	**M**	**RTA**	**3**	**2**	**4**	**11**	**3**	**2**	**1**	**4**	**2**	**1**	**3**	**2**	**4**	**1**	**4**	**4**	**1**	**4**	**1**	**1**	**2**	**1**	**2**
MAKKAN	**52**	**M**	**POST OP**	**1**	**2**	**2**	**11**	**4**	**3**	**1**	**5**	**4**	**3**	**3**	**1**	**1**	**4**	**4**	**1**	**4**	**3**	**1**	**3**	**2**	**1**	**2**
SETTU	**46**	**M**	**RTA**	**2**	**6**	**4**	**10**	**4**	**1**	**1**	**2**	**1**	**5**	**3**	**2**	**1**	**4**	**3**	**1**	**4**	**3**	**1**	**5**	**2**	**1**	**2**
VAIRAMANI	**36**	**F**	**RTA**	**3**	**2**	**4**	**11**	**3**	**2**	**2**	**5**	**6**	**8**	**3**	**2**	**1**	**1**	**3**	**1**	**4**	**3**	**1**	**1**	**1**	**1**	**1**
MUTHURAM	**30**	**M**	**POST OP**	**1**	**2**	**2**	**11**	**3**	**4**	**1**	**2**	**7**	**1**	**4**	**6**	**6**	**4**	**4**	**1**	**4**	**4**	**1**	**1**	**2**	**1**	**2**

SAMUNDEESWARI	**38**	**F**	**PANCREATITIS POST NECROSECTOMY**	**4**	**2**	**2**	**11**	**4**	**2**	**1**	**4**	**1**	**3**	**3**	**2**	**1**	**1**	**4**	**1**	**1**	**4**	**1**	**3**	**2**	**2**	**2**
NATHAN	**27**	**M**	**RTA**	**3**	**6**	**4**	**10**	**4**	**4**	**3**	**2**	**7**	**7**	**4**	**2**	**6**	**1**	**4**	**1**	**1**	**4**	**1**	**7**	**2**	**2**	**2**
SELVI	**47**	**F**	**POST OP**	**4**	**2**	**2**	**11**	**4**	**1**	**1**	**4**	**4**	**2**	**4**	**2**	**1**	**1**	**4**	**1**	**1**	**3**	**1**	**2**	**2**	**1**	**2**
ARUMUGAM	**58**	**M**	**POST OP**	**2**	**6**	**2**	**10**	**4**	**1**	**1**	**2**	**1**	**1**	**3**	**2**	**1**	**1**	**3**	**1**	**4**	**3**	**1**	**1**	**2**	**1**	**2**
SENTHIL MURUGAN	**28**	**M**	**POST OP**	**4**	**2**	**2**	**11**	**4**	**4**	**1**	**2**	**7**	**7**	**3**	**1**	**6**	**1**	**3**	**1**	**1**	**3**	**1**	**7**	**2**	**1**	**2**
FARIZ AHMED	**67**	**M**	**POST OP**	**4**	**6**	**2**	**10**	**4**	**1**	**1**	**2**	**1**	**8**	**4**	**2**	**1**	**1**	**1**	**3**	**1**	**4**	**1**	**3**	**1**	**2**	**1**
NAKKAR	**41**	**M**	**POST OP**	**5**	**2**	**4**	**11**	**3**	**1**	**1**	**4**	**7**	**6**	**3**	**2**	**1**	**1**	**1**	**3**	**4**	**1**	**3**	**6**	**2**	**1**	**2**
SOMAN	**48**	**M**	**RTA**	**3**	**2**	**4**	**11**	**4**	**1**	**3**	**2**	**7**	**3**	**3**	**2**	**6**	**1**	**1**	**3**	**1**	**1**	**3**	**3**	**2**	**2**	**2**
arivalagan	**25**	**M**	**POLY TRAUMA/PNEUMOMEDIASTINUM**	**2**	**2**	**4**	**12**	**5**	**2**	**3**	**1**	**7**	**8**	**2**	**5**	**1**	**6**	**5**	**4**	**6**	**5**	**4**	**8**	**2**	**1**	**1**
madhanagopal	**34**	**M**	**POLYTRAUMA**	**2**	**2**	**4**	**12**	**5**	**2**	**1**	**2**	**7**	**5**	**2**	**1**	**6**	**6**	**5**	**4**	**6**	**5**	**4**	**10**	**1**	**1**	**1**
surya	**26**	**F**	**KEROSENE POISONING**	**1**	**1**	**4**	**11**	**5**	**1**	**3**	**4**	**7**	**8**	**2**	**7**	**6**	**6**	**5**	**4**	**6**	**5**	**4**	**8**	**2**	**1**	**1**
latha	**54**	**F**	**POST THYROIDECTOMY**	**4**	**1**	**2**	**11**	**5**	**1**	**3**	**1**	**7**	**8**	**2**	**7**	**1**	**6**	**5**	**4**	**6**	**5**	**4**	**8**	**2**	**1**	**1**
MARIMUTHU	**54**	**M**	**gastric carcinoma**	**4**	**2**	**4**	**11**	**5**	**1**	**1**	**1**	**1**	**9**	**5**	**8**	**6**	**6**	**4**	**4**	**6**	**5**	**4**	**9**	**3**	**1**	**3**

vadivel	**63**	**M**	**bariatric surgery**	**4**	**2**	**1**	**11**	**5**	**1**	**1**	**1**	**7**	**9**	**5**	**9**	**6**	**6**	**4**	**4**	**6**	**5**	**4**	**9**	**3**	**2**	**3**
vijaya	**49**	**F**	**COPD**	**1**	**1**	**1**	**11**	**5**	**1**	**2**	**1**	**6**	**9**	**5**	**8**	**6**	**6**	**3**	**4**	**6**	**5**	**4**	**9**	**3**	**1**	**3**
suvalai	**53**	**F**	**COPD**	**1**	**1**	**3**	**11**	**5**	**1**	**2**	**1**	**6**	**9**	**5**	**8**	**6**	**6**	**4**	**4**	**6**	**5**	**4**	**9**	**3**	**1**	**3**