Title: Pneumothorax: How to optimize favorable out come

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Key words: Broncho-pleural fistula (BPF), Flail chest, Intercostal tube drainage (ICD), Pleurodesis, primary & Secondary spontaneous pneumothorax (PSP & SSP), Open thoracotomy decortication (OTD) and video-assisted thoracoscopic decortication (VATD).

Abstract:

Introduction: The Pneumothorax (PTX) is the presence or accumulation of air in the pleural space and that leads to variable clinical presentation and to life-threatening hypoxia and even cadiogenic shock. A quick diagnosis and management is the key to success with precise and minimally invasive procedures. However recurrent PTX and partial or unexpanded lung remained a challenge.

Results: A male predominance (87%) with age above 40 years (80%) and secondary spontaneous PTX (SSP) > primary spontaneous PTX (PSP) > traumatic (i.e. 64%, 24% and 12% respectively) were observed among the total 55 cases. TB (36%) followed by COPD (24%) remained the highest underlying cause of SSP in the Indian context. A complete recovery in 69% with partial resolution in 29% and death of one case (2%) was observed. Management with ICD in 82% of case and Pleurodesis was done in 69% cases after full expansion of lung. The 9% of cases were referred to a Cardio thoracic vascular surgeon (CTVS) for open thoracic decortication.

Discussion: A sudden onset of shortness of breath and chest pain were the most common presenting symptom. A quick clinical diagnosis and management, even in absence of CXR, is crucial to prevent mortality, specially in context of cases of accidental chest injury and or tension PTX. A timely recognition of common complications like hemo- or pyo-pneumothorax, BP fistula, persistent air leak, mediastinal emphysema, pleural peel, fibrothorax and the presence of underlying lung diseases with associated comorbidities affect the favorable prognosis and outcomes.

Conclusion: Pneumothorax is one of the frequently encountered emergency of respiration department. A quick recognition of problem with the placement of intercostal drainage (ICD) system with an under water seal is life saving. The pneumothorax needs to be included as a part of CME on respiratory emergencies

Introduction: Pneumothorax (PTX) occurs when air enters the pleural space due to a breach in the integrity of the visceral or parietal pleural membranes. Normally, the negative intra pleural pressures prevent air from entering this space during the respiratory cycle [1]. The PTX is one of the life threatening respiratory emergence and the clinical presentation varies depending on the degree of lung collapse on the affected side, ranging from mild chest discomfort to severe dyspnea [2, 3]. Clinically it can easily be diagnosed however imaging modalities are required to explore the underlying status of lung [4]. The lung air leaks from the injured visceral pleura and continue to collect in the pleural space during each inspiratory phase of respiration and that leads to collapse of ipsilateral lung. Somehow a tension PTX with progressive collection of air may develop due to a check wall mechanism and a further accumulation of air pushes the mediastinum that compress the contralateral lung and the increased intra thoracic pressure leads to life threatening haemodynamic instability [5]. PTX may also be associate with a collection of liquid material e.g. hydro/ pyo/ or haemo pneumothorax. The PTX can be classified as primary or secondary spontaneous pneumothorax (PSP/SSP) and traumatic origin [6, 7]. The incidence of nontraumatic PTX varies around 7-12/ Lakh of population, however the PSP is more frequently observed in tall, thin male while the secondary PTX is more commonly associated with COPD (in near 70%) however pulmonary TB may also considerably contribute in high prevailance country like India. Subcutaneous/surgical emphysema may accompany PTX due to envisage of air in loose subcutaneous tissue and or as a more serious form of mediastinal emphysema. The BTS guide line suggested that a size of PTX should be assessed as a visible air between chest wall and lung edge on a chest radiograph PA view to categorize it into a small PTX with 2 cm rim and larger one with >2 cm [6]. A small PTX may resolve spontaneously [3, 8] , whilst most of the cases may required interventions like aspiration or intercostal tube drainage with under water seal (ICD) till the injured visceral pleura healed [2, 9,10]. A continued air leak may persist and is referred to as bronchopleural fistula (BPF). The amount of air leak may be proportionate to the size of fistula but it becomes difficult to locate and even to close it. A task to identify and

understand the underneath problem the thoracoscopy/ Pleuroscopy, VATS, pleurodesis, decortication of pleura and infection control are some of the options and challenges needed to be precisely used to optimize the out come. Thus this study is undertaken to understand the different aspects of pneumothorax at a rural based medical college.

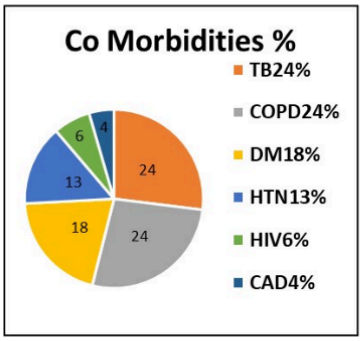
Result: The patient profile, clinical data with interpretation, and possible inference is summarized in a tabulation form.

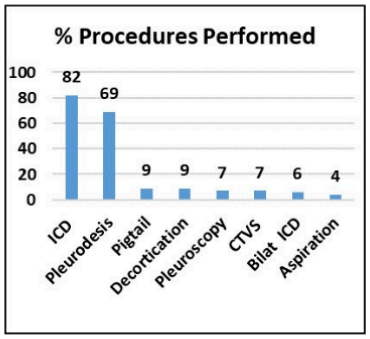
SN	Profile	DATA	Interpretation/ Inference
1	M : F	87: 13	Male predominance of 6-7 Time
2	**AGE distribution** < 40 Yr 40- 60 > 60	**No. / percent** 11 (20%) 31 (56%) 13 (24%)	Maximum cases in 40-60 Yrs (elder age) are more vulnerable for COPD, TB, CA, and are in productive age with stress, strain and addictive habits (>64%)
3	Rural : Urban	71% : 29 %	Not Specific
4	**Addiction** Smoker Alcoholic Tobacco Chewing	**No. / percent** 35 (64%) 21 (38%) 19 (35%)	Smoking in 64% is a known cause for the COPD & Ca lung however the low immunity in alcoholic may make them vulnerable to Tuberculosis.
5	**Symptom** Breathlessness Chest pain Cough Fever Expectoration Vomiting Swelling	**No. /Percent** 50 (91%) 44 (80%) 14 (26%) 08 (15%) 13 (24%) 04 (07%) 02 (04%)	Sudden onset SOB is most usual presentation and observed in 91% of cases and these cases use to be considered for differential diagnosis of PTX. Chest pain to be excluded with cardiac, neuromuscular or GIT etiology. Other symptoms could be due to sudden shock, Hypoxia, and circulatory failure.

6	**Co morbidities** TB COPD DM HTN HIV CAD	**No. / Percent** 20 (36 %) 13 (24%) 10 (18%) 7 (13%) 3 (06%) 2 (04%)	In Indian context Pulmonary Tuberculosis is the most common cause of PTX, however COPD with rupture of pleural bleb specially those with smoking abuse remained the commonest cause of PTX. Associated co-morbidities could further worsen the general condition of individuals.
7	**General Examination** Pallor JVP raised Pedal edema Tachypnea Clubbing Icterus	**No. / Percent** 08 (15%) 08 (15%) 07 (13%) 06 (11%) 06 (11%) 04 (07%)	Raised JVP and Pedal edema are serious effect of PTX with high intra thoracic pressure, Rt sided cardiac failure and low cardiac output, with low BP and SpO_2. The clubbing is a sign of long standing hypoxia e.g. ILD or suppurative lung disease like underlying lung abscess, bronchiectasis or empyema thoracic etc.
8	**SpO2 and or ABG** Normal Type 1 RF Type 2 RF	**No. / Percent** 03 (05%) 39 (71%) 13 (24%)	ABG were performed at admission. Hypoxia and tachypnea with CO_2 washout in 71% Type 2 Respiratory Failure (RF) in 24% due to low alveolar ventilation/ fatigue or exhausted patient.
9	**Site of PTx** RIGHT LEFT Bilateral	**No. / Percent** 34 (62%) 18 (33%) 03 (05%)	Right lung is bigger than left and therefore nearly double the cases of right sided PTX reported means more loss; however the degree of collapse lung is more valuable, while bilateral PTX is more serious condition.
10	**Type of PTX** PSP SSP Traumatic PTX Iatrogenic PTX	**No. / Percent** 13 (24%) 35 (64%) 04 (07%) 03 (05%)	The PSP is usually easiest to manage but the SSP is a complication of underlying diseases hence dual management has to be done, while the extent of trauma is indefinite. The pleurodesis should also be plan to prevent recurrence.

11	ABG (on admission) Normal Type 1 RF Type 2 RF	**No. / Percent** 03 (05%) 39 (71%) 13 (24%)	Interpretation of ABG at the time of admission showed hypoxemia with low or normal PCO2 e.g. type-1 Respiratory failure (RF) due to tachypnea in 71% and more serious type-2 RF in 24% cases.
12	**Procedure** Aspiration Pigtail catheter Drain ICD Bilateral ICD Thoracoscopy CTVS (Post Op) Pleurodesis Decortication	**No. / Percent** 02 (04%) 05 (09%) 45 (82%) 03 (06%) 04 (07%) 04 (07%) 38 (69%) 05 (09%)	Three cases (5%) were managed conservatively and noninvasively with high flow intermittent oxygen. Rest of the cases managed considering the general condition, routine investigation, clinical, radiologic and underlying disease and a least invasive intervention was preferred.
13	**Complication** Surgical &mediastinal emphysema Secondary Infection Non expansion Persistent air leak Fibrothorax	**No. / Percent** 05 (09%)	Infection due to underlying disease or from the connectivity to atmospheric air, lung re-expansion edema, BP fistula, Surgical and 0r mediastinal emphysema, Persistent air leak, unexpanded lung, fibrothorax, trapped lung, pleural peel formation etc are some of the examples apart from a life-threatening Tension PTX and respiratory failure
14	**Out comes of PTX** Complete Resolution Partial Resolution Died	**No. / Percent** 38 (69%) 16 (29%) 01 (02%)	The role of incentive spirometry, physiotherapy, Yogic exercise like Pranayama should be given due consideration. Surgical intervention includes e.g. Pleurectomy, OTD, VATD etc

15	**Classification**	**No. / Percent**	1. A total of 13 (24%) cases of PSP
	1. **PSP**	13 (24%)	
	2. **SSP**	35 (64%)	2, A total of 35 (64%) cases of SSP: PTB & COPD
	2.1 PTB	13 (24%)	were most frequent
	2,2 COPD	13 (24%)	
	2.3 Pneumonia	03 (05%)	3. Acquired PTX 07 cases (12%)
	2.4 Bronchiectasis	03 (05%)	1 case of Flail chest
	2,5 Ca lung	03 (05%)	3 Rib fracture/ Haemothorax/ Lung contusion
	3. **Traumatic PTX**	07 (12%)	3 Central line, shoulder block, Pyothorax





Discussion: The present study observed that the Pneumothorex (PTX) was more prevailed above the 40 year of age with male predominance and that could be due to underlying ailments like TB in 24%, COPD 24%, and addictive habits of smoking found in >64% with stress and strain of a productive life. A similar data were also reported by other authors [2,9,10]. The PSP (24%) remained less common than secondary spontaneous PTX (64%) and the traumatic origin of 12% were observed in our study which were matching as 26%, 64%, and 10% respectively with Josh P et al [2]. The present study revealed that the breathlessness remained the most common symptom (90.9%) followed by chest pain (80.0%) whilst rest of the symptoms were nonspecific may relevant to other underlying and co existing ailments/ co-morbidities. A sudden increase of pre existing SOB, tearing chest pain and typical pleuritic pain that may referred to shoulder or arm are other usual presentations. A stab wound or chest injury with underlying fractured rib, contusion and inflammation with internal bleeding are not uncommon in road traffic accident. We came across 4 cases of chest trauma and each one was managed differently; one had a single site only with one rib fractured with

a minimal < 2cm pneumothorax which was managed conservatively. Another two cases had haemo-pneumothorax with multiple rib fracture and one of them also had lung contusion; and both were managed with ICD, while the fourth one had a flail chest was managed with ICD and fixation of the hemithorax was done by the orthopedic surgeon. Carl A Beyer et al stated that a PTX of more than 35mm and or haemothorax of >300 ml should be managed with insertion of ICD in combination with warm saline irrigation of pleural space to clear retained blood and an intrapleural instilation of thrombolytics [11].

Bilateral PTx: Our study reported 3 cases but not a buffalo chest, is common proceeding a post thoracic surgery, lung cryo biopsy and post esophagotomy [7]. These cases in the present study were successfully managed with ICD. All the cases of pneumothorax may not require the ICD with under water seal, however we preferred and used 24-26 gauge fr ICD in 32 (58%) cases while a less invasive procedures like needle aspiration of air [8] with three way adopter attached to a 50cc syringe was used in 4% and a pig tail catheter was also used in 9% of cases with added advantage of repeated saline irrigation and intra pleural thrombolytic therapy with successful resolution of PTX. The cases having a bigger air leak, or e.g. pyo or haemothorax may require 32-34 fr a bigger bore catheter to minimize the plugging [7].

The tension PTX; is a medical emergency that should be diagnosed quickly with a characteristic history of severe sudden onset of progressive dyspnea. A clinical examination could revealed fullness of chest, decreased movement, hyperresonant chest, and absent breath sound on the affected side and tracheal shift to opposite side with poor GC or vitals. In such a life-threatening situation a plastic venflon can be placed in the 2nd intercostal space at mid clavicular line even without waiting for chest x-ray this may save the life. There were two such cases during the study period.

A persistent air leak in cases of PTX is due to non healing of alveolar-pleural or the bronchopleural fistula (BOF) and usually remained for a longer period with infection or new growth and continued drain formation/ collection. There could be various presentation of partial or incomplete expansion of lung e.g. empyema (Infection), BP Fistula (persistence air leak) and fibrothorax (with trapped lung) with or without BPF. The surgical repair is gold standard but it is not always feasible to close and even to precisely locate the site of leak. Karen C et al [12] mentioned variable out comes with using fibrin sealants and endoscopically placed “one-way” valves and metal coils etc and pleurodesis, Our study showed partial lung expansion in 29 % and full lung expansion was achieved in only 69 % of cases with one unfortunate mortality 2%. cases. There had referred 5 (9%) cases to Thoracovascular surgeon to consider decortication. However a comparative data from Joshi P et. al., Hassan et al. and Gupta et. al. [2, 9, 10] had reported a better success rate of > 90%. There were 5 cases of recurrent PTX and among them 2 developed on the contralateral hemithorax (due underlying COPD) and all were successfully managed with ICD followed by pleurodesis. The chemical

pleurodesis with doxycycline is included in our protocol as a routine for all the cases of PTX after achieving full lung expansion to prevent recurrence. Prabhat B et al mentioned an encouraging result of open thoracotomy and decortication (OTD) specially in cases of chronic empyema with fibrothorax (13) and with the similar procedure 5 (9%) cases were managed by the Thoracic cardiovascular surgeon. Pan H et. al. meta had analysed six studies to compare **video-assisted thoracoscopic decortication** (VATD) with OTP and concluded that the VATD is better as it is less invasive, shorter hospital stay and reduced ICD and air leak duration [(14)]. Although medical thoracoscopy is becoming popular among respiratory intensivist to perform various task yet it require availability and skill development. The loculation/ septations in the pleural space were removed with a favorable result in 4 (7%) cases with semi rigid Video thoracoscope.

Conclusion: The under graduates should be well aware of the management of Pneumothorax as a most common respiratory emergency. The management of underlying disease, unexpanded or trapped lung are the challenges that require timely and meticulous selection of diagnostic and therapeutic modalities which is a key to success.

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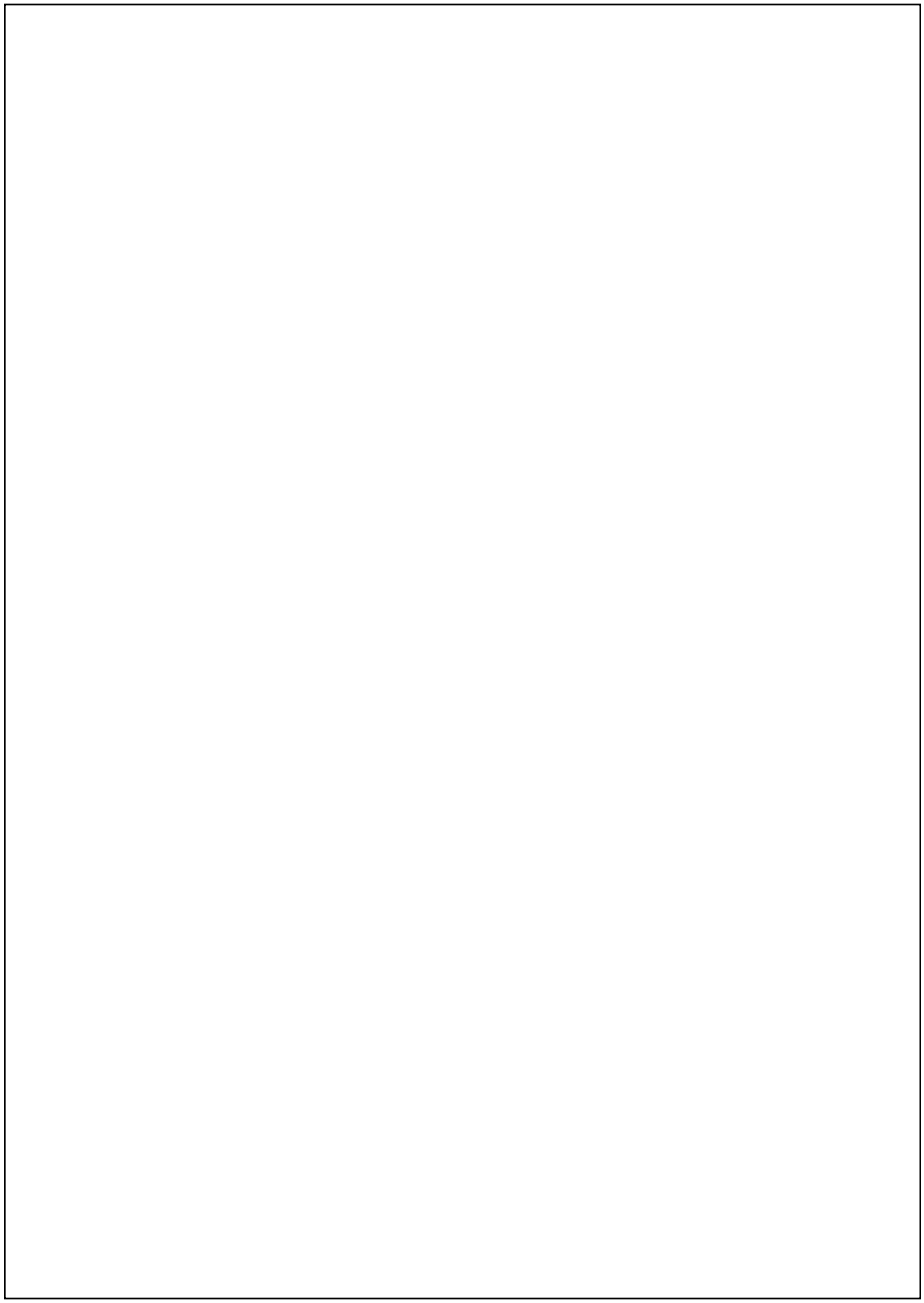

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