

Al-Nahrain University

Collage of Medicine

Department of Surgery



Management of pneumothorax

A graduation research submitted to the department of surgery at Al-Nahrain University- Collage of Medicine in partial fulfillment of M.B.Ch.B degree.

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

"يُؤَفِّعُ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ حَرَجًا"

صدق الله العلي العظيم

Dedication

I dedicate this humble effort to all my family for there presence and encouragement that drives me foreward

And to my supervisor Dr. Alaa Kassar who stand with me and support me.

ACKNOWLEDGEMENT

I would like to express my thanks and gratitude to my supervisor Dr. Alaa Kassar for his guidance and advices throughout the period this research.

I would like to extend my gratitude and thanks to attending doctors and nurse staff at cardiovascular unit at Al-Imamain Al-Kadhumain medical city for their much appreciated help and cooperation.

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List of abbreviations

abbreviations	meaning
SOB	Shortness of breath
COPD	Chronic obstructive pulmonary disease
PSP	Primary spontaneous pneumothorax
SSP	Secondary spontaneous pneumothorax
ARDS	Acute respiratory distress syndrome
VATS	Video assisted thoracoscopic surgery

Abstract

Background: pneumothorax is an abnormal collection of air in the pleural space between the lung and the chest wall. It is classified as spontaneous (primary or secondary), which occurs without preceding trauma; . Traumatic pneumothorax (non-iatrogenic): The usual cause is direct or indirect trauma to the chest, e.g., road accidents, stab injuries, war injuries. Pneumothorax can be diagnosed by the history and physical examination in slender patients who have had acute onset of chest pain and dyspnea, and confirmed with chest radiograph visualizing the visceral pleural line, however the diagnosis of tension pneumothorax must be made clinically, because there is not enough time for imaging studies.

Treatment options are: observation, needle aspiration, tube thoracostomy, tube therapy with instillation of sclerosing agent, surgery.

Method: Cross sectional study with analytic elements, done by retrospective collection of a convenience sample of 25 patients were included in this study in Al-Imamain Alkadhumain teaching hospital.

Objective: To know the most common cause for pneumothorax. What modality of treatment that is most commonly used in managing patients with pneumothorax, what comorbidity associated with, and the duration of time the patients stay in hospital.

Results: young adults (60%) are significantly the most common age group to have pneumothorax. Male victims (84%) were remarkably more than female (16%). Patients were usually free workers (44%). Most of the patients were presented with SOB (72%). Trauma was the usual cause of pneumothorax (64%). Most of the patients were smokers (60%), with some of them had other lung disease in the form of asthma (8%), COPD (8%), and pneumonia (4%). Large percentage of the patients stay for 3 days (24%). There is a small percentage of recurrence in pneumothorax (8%). The management option for most patients were by the use of chest tube (88%), other option is through observation (4%), and only (8%) need Surgery (thoracotomy).

Conclusion: Trauma was the most common cause for pneumothorax, affecting males more than females who are usually young adults. Most of the patients were smokers with some of

them had other lung disease, the presentation of patient mostly with SOB. Patients most commonly treated by chest tube drainage, with the majority had no recurrence, and the patients usually stay less than 6 days.

Chapter one

Introduction

Anatomy:

The pleural cavity is the potential space between the two pleurae (visceral-parietal) of the lungs. The pleura is a serous membrane which folds back onto itself to form a two-layered membrane structure. The thin space is known as the pleural cavity and contains a small amount of pleural fluid (few milliliters in a normal human). The outer pleura is attached to the chest wall ^[1]. The pleural cavity aids optimal functioning of the lungs during breathing. It transmits movements of the chest wall to the lungs, particularly during heavy breathing. The chest wall transmits pressures to the visceral pleural surface and hence to the lung. ^[2]

Definition:

Pneumothorax is an abnormal collection of air in the pleural space between the lung and the chest wall. ^[5] Symptoms typically include sudden onset of sharp, one-sided chest pain and shortness of breath. ^[5]

Classification of pneumothorax. ^[4]

it classify according to :

1. Etiology
2. Extend
3. Mechanism
4. Duration

Classification by etiology:

1. **Spontaneous pneumothorax** - it is by far the commonest form of pneumothorax in clinical practice and is always secondary to pulmonary or pleural pathology. There is no obvious cause or antecedent trauma. Patients are usually in the 20 - 40 years age group and present with sudden, sharp chest pain and dyspnea. In patients of chronic bronchitis and emphysema who are over 40. There is progressive

destruction of alveolar walls, and thus the high intra pulmonary pressures produced by coughing result in spontaneous pneumothorax.

a. Primary spontaneous pneumothorax: Occurs in apparently healthy persons due to leak of air through a weak area of the pleura it is seen in smokers.

b. Secondary spontaneous pneumothorax: it is seen in cases with any underlying lung conditions, e.g., COPD.

2. **Traumatic pneumothorax** (non-iatrogenic): The usual cause is direct or indirect trauma to the chest, e.g., road accidents, stab injuries, war injuries.

3. **Iatrogenic** or artificial pneumothorax Occurs as a result of any diagnostic or therapeutic procedure.

Classification by extent:

1. **Localized pneumothorax**: When the parietal and visceral pleura have developed adhesions.

2. **Generalized pneumothorax**: When the whole pleural cavity is involved

Classification by Mechanism:

1. **Open pneumothorax**: When there is movement of air in and out of the pleural cavity without any hindrance. This is due to communication between the pleural space and the airways and may lead to development of a Broncho-pleural fistula (BPF).

2. **Closed pneumothorax**: When there is no movement of air, i.e., air is trapped in the pleural space because the hole through which air entered has been obliterated.

3. **Valvular (tension) pneumothorax**: When air is able to enter during inspiration, but is unable to exit during expiration. This type of pneumothorax becomes a medical emergency because the air pressure keeps on increasing gradually, and the lung debates more and more, leading to pressure effects on the mediastinum and great veins. As an effect, the mediastinum is displaced and the great veins become kinked, leading to decreased venous return to the heart. This leads to increasing

cardiac and respiratory embarrassment, at this stage it is usually termed a 'tension pneumothorax' because of the rising pressure which builds up in the pleural cavity

Classification by Duration:

1. Acute
2. Chronic

Table 1.1: Causes of secondary spontaneous pneumothorax according to frequency^[3]

Causes of secondary spontaneous pneumothorax according to frequency
<u>Airway disease</u>
Chronic obstructive pulmonary- disease
Cystic fibrosis
status asthmaticus
<u>Infectious lung disease</u>
Pneumocystis carinii pneumonia
Necrotizing pneumonia
<u>Interstitial lung disease</u>
Sarcoidosis
Idiopathic pulmonary fibrosis
Pulmonary Langerhans cell histiocytosis
lymphangioliomatosis
Tuberous sclerosis
<u>Connective tissue disease</u>
Ankylosing spondylitis- Polymyositis, Dermatomyositis, Scleroderma
Marfan syndrome. Ehler-danlos syndrome
<u>Cancer</u>
Sarcoma
Lung cancer
<u>miscellaneous</u>
Catamenial pneumothorax
Pneumothorax ex vacuo
Aerosolized pentamidine isethionate (NebuPent. Pentacarinat. Pentam) therapy

A primary pneumothorax is one that occurs without an apparent cause and in the absence of significant lung disease.^{[6][7]}

A primary spontaneous pneumothorax (PSP) tends to occur in a young adult without underlying lung problems, and usually causes limited symptoms.^{[8][9]}

Secondary spontaneous pneumothoraces (SSPs), by definition, occur in individuals with significant underlying lung disease. Hypoxemia (decreased blood-oxygen levels) is usually present and may be observed as cyanosis (blue discoloration of the lips and skin). Hypercapnia (accumulation of carbon dioxide in the blood) is sometimes encountered; this may cause confusion and – if very severe – may result in comas. The sudden onset of breathlessness in someone with chronic obstructive pulmonary disease (COPD), cystic fibrosis, or other serious lung diseases should therefore prompt investigations to identify the possibility of a pneumothorax.^{[8][10]}

Traumatic pneumothorax most commonly occurs when the chest wall is pierced, such as when a stab wound or gunshot wound allows air to enter the pleural space. Traumatic pneumothoraces have been found to occur in up to half of all cases of chest trauma, with only rib fractures being more common in this group. The pneumothorax can be occult in half of these cases, but may enlarge – particularly if mechanical ventilation is required.^[9] They are also encountered in patients already receiving mechanical ventilation for some other reason.^[9]

Tension pneumothorax:

Although multiple definitions exist, a tension pneumothorax is generally considered to be present when a pneumothorax (primary spontaneous, secondary spontaneous, or traumatic) leads to significant impairment of respiration and/or blood circulation.^[11]

Clinical feature of Tension pneumothorax:

1. increased heart rate(tachycardia)and tachypnea in the initial stages
2. low oxygen levels and blood pressure,
3. displacement of the trachea
4. Rarely, there may be cyanosis (bluish discoloration of the skin due to low oxygen levels),and altered level of consciousness

5. hyperresonant percussion note on examination of the affected side with reduced expansion and decreased movement
6. displacement of the apex beat (heart impulse)
7. This is a medical emergency and may require immediate treatment without further investigations

Evaluation

A. history

1. spontaneous pneumothorax :pleuritic chest pain and localized to the side of pneumothorax ,and dyspnea are the major symptom ,onset is generally sudden it is mild in primary spontaneous pneumothorax that happened at rest and delay seeking medical attention ,but in secondary pneumothorax it is severe due to impaired lung function.

2.traumatic pneumothorax :the same presentation but associated with various form of injury ,in iatrogenic pneumothorax they may not occur for 24 hr or more after diagnostic or therapeutic procedure as in deteriorating of symptom in patient on ventilator.

B. physical examination

may be normal vital sign ,or tachycardia is the most common sign of spontaneous pneumothorax

hypotension and tachycardia can present in tension pneumothorax or secondary spontaneous pneumothorax .

hyperresonant percussion note on examination of the affected side with reduced expansion and decreased movement and displacement of the apex beat (heart impulse)in tension pneumothorax.

C. investigation

1.arterial blood gas show low oxygen levels and hypocarbia.

2.ECG change include left axis deviation ,non specific ST- and T-wave change ,ST depression and T inversion.

3. plain chest radiograph, ideally with the X-ray beams being projected from the back (posteroanterior, or "PA"), and during maximal inspiration (holding one's breath), is the most appropriate first investigation.

4. Computed tomography (CT, or "CAT scan") is not necessary for the diagnosis of pneumothorax, but it can be useful in particular situations. In some lung diseases, especially emphysema, it is possible for abnormal lung areas such as bullae to have the same appearance as a pneumothorax on chest X-ray, and it may not be safe to apply any treatment before the distinction is made and before the exact location and size of the pneumothorax is determined.^[13] In trauma, where it may not be possible to perform an upright film, chest radiography may miss up to a third of pneumothoraces, while CT remains very sensitive.^[12]

A further use of CT is in the identification of underlying lung lesions. In presumed primary pneumothorax, it may help to identify blebs or cystic lesions (in anticipation of treatment, see below), and in secondary pneumothorax it can help to identify most of the causes listed above^[12]

Treatment

The treatment of pneumothorax depends on a number of factors, and may vary from discharge with early follow-up to immediate needle decompression or insertion of a chest tube. Treatment is determined by the severity of symptoms and indicators of acute illness, the presence of underlying lung disease, the estimated size of the pneumothorax on X-ray, and – in some instances – on the personal preference of the person involved.^[10]

In traumatic pneumothorax, chest tubes are usually inserted. If mechanical ventilation is required, the risk of tension pneumothorax is greatly increased and the insertion of a chest tube is mandatory.^{[9][13]}

Any open chest wound should be covered with an airtight seal, as it carries a high risk of leading to tension pneumothorax. Ideally, a dressing called the "Asherman seal" should be utilized, as it appears to be more effective than a standard "three-sided" dressing. The Asherman seal is a specially designed device that adheres to the chest wall and, through a valve-like mechanism, allows air to escape but not to enter the chest.^[14]

Tension pneumothorax is usually treated with urgent needle decompression. This may be required before transport to the hospital, and can be performed by an emergency medical technician or other trained professional.^{[11][14]} The needle or cannula is left in place until a chest tube can be inserted.^{[11][14]} If tension

pneumothorax leads to cardiac arrest, needle decompression is performed as part of resuscitation as it may restore cardiac output.^[14]

Conservative:

Small spontaneous pneumothoraces do not always require treatment, as they are unlikely to proceed to respiratory failure or tension pneumothorax, and generally resolve spontaneously. This approach is most appropriate if the estimated size of the pneumothorax is small (defined as <15% of the volume of the hemithorax) should take 12 days to complete reabsorption, there is no breathlessness, and there is no underlying lung disease.^{[12][15]}

Secondary pneumothoraces are only treated conservatively if the size is very small (1 cm or less air rim) and there are limited symptoms. Admission to the hospital is usually recommended. Oxygen given at a high flow rate may accelerate resorption as much as fourfold.^{[10][14]}

Aspiration

In a large PSP (>50%), or in a PSP associated with breathlessness, some guidelines recommend that reducing the size by aspiration is equally effective as the insertion of a chest tube. This involves the administration of local anesthetic and inserting a needle connected to a three-way tap; up to 2.5 liters of air (in adults) are removed. If there has been significant reduction in the size of the pneumothorax on subsequent X-ray, the remainder of the treatment can be conservative. This approach has been shown to be effective in over 50% of cases.^{[8][10][12]} Compared to tube drainage, first-line aspiration in PSP reduces the number of people requiring hospital admission, without increasing the risk of complications.^[13]

Aspiration may also be considered in secondary pneumothorax of moderate size (air rim 1–2 cm) without breathlessness, with the difference that ongoing observation in hospital is required even after a successful procedure.^[10] American professional guidelines state that all large pneumothoraces – even those due to PSP – should be treated with a chest tube.^[15] Moderately sized iatrogenic traumatic pneumothoraces (due to medical procedures) may initially be treated with aspiration.^[9]

Chest tube:

A chest tube (or intercostal drain) is the most definitive initial treatment of a pneumothorax. These are typically inserted in an area under the axilla (armpit) called the "safe triangle", where damage to internal organs can be avoided; this is delineated by a horizontal line at the level of the nipple and two muscles of the chest wall (latissimus dorsi and pectoralis major). Local anesthetic is applied. Two types of tubes may be used. In spontaneous pneumothorax, small-bore (smaller than 14 F, 4.7 mm diameter) tubes may be inserted by the Seldinger technique, and larger tubes do not have an advantage.^{[10][17]} In traumatic pneumothorax, larger tubes (28 F, 9.3 mm) are used.^[13]

They are connected to a one-way valve system that allows air to escape, but not to re-enter, the chest. This may include a bottle with water that functions like a water seal, or a Heimlich valve.

In case of recurrent pneumothorax:

1. Tube thoracostomy with instelation of sclerosing agent :

Approximately 50% of patient with an initial PSP have arecurrence on the above measure ,effort has been done to diminish the recurrence rate by injecting various agent in the pleural space to create intinse inflammatory reaction to obliterate the space .

Talc slurry and tetracycline derivative are widely used

The recurrence rate after its application was 10%

The drawback in talc is 4% associated with ARDS from instelation intrapleuraly ,with 2% mortality

Tetracycline derivative has less risk of ARDS but more painful experience for many patient

2.Pleurodesis and surgery:

Pleurodesis is a procedure that permanently eliminates the pleural space and attaches the lung to the chest wall. No long-term study (20 years or more) has been performed on its consequences. Good results in the short term are achieved with a thoracotomy (surgical opening of the chest) with identification of any source of air leakage and stapling of blebs followed by pleurectomy (stripping of the pleural lining) of the outer pleural layer and pleural abrasion (scraping of the pleura) of the inner layer. During the healing process, the lung adheres to the chest wall, effectively obliterating the pleural space. Recurrence rates are approximately 1%.^{[8][10]} Post-thoracotomy pain is relatively common.

3.Video-assisted thoracoscopic surgery (VATS) wedge resection

A less invasive approach is thoracoscopy, usually in the form of a procedure called video-assisted thoracoscopic surgery (VATS). The results from VATS-based pleural abrasion are slightly worse than those achieved using thoracotomy in the short term, but produce smaller scars in the skin.^{[8][10]} Compared to open thoracotomy, VATS offers a shorter in-hospital stays, less need for postoperative pain control, and a reduced risk of lung problems after surgery.^[10]

Chapter two

Method

Study design

Cross sectional study with analytic elements.

Place and timing of data collection:

the study was conducted at Al-imamain alkadhumain medical city, data collection period were from 10th of November 2018 to 16th of February 2019.

Target population and sampling technique:

Target population were patients who had cases of pneumothorax admitted to Al-imamain alkadhumain medical city during the period of data collection.

A convenience sample of 25 patient were included in this study.

Data collection:

The data was collected retrospectively by taking patients registry from the recorded data in the notebook at the cardiovascular ward in Al-imamain alkadhumain medical city.

The data was collected according to the following topics:

Patient's age, Patient's gender, Patient's occupation, Cause of pneumothorax , Comorbidities, Side affected , Duration of admission , Recurrence , Modality of treatment .

Statistical analysis:

The analysis of data was carried out using Microsoft Office Access 2010 Database. The data was presented in tables and charts of frequency and percentage.

Aim:

To know the most common cause for pneumothorax. What modality of treatment that is most commonly used in managing patients with pneumothorax, what comorbidity associated with, and the duration of time the patients stay in hospital.

Chapter Three

Result:

It seems that young adults (60%) are significantly the most common age group to have pneumothorax, followed by adults (36%), children were the least common (4%).

Male victims (84%) were remarkably more than female(16%).

Patient were usually free workers (44%), the rest was distributed with other occupation listed in the table3.

Most of the patients was presented with SOB (72%) ,the others with chest pain(24%), and cough (4%).

Trauma was the usual cause of pneumothorax (64%), followed by spontaneous pneumothorax (36%).

Most of the patients were smoker (60%),with some of them had other lung disease in the form of asthma (8%), COPD (8%), and pneumonia (4%).

Large percentage of the patient stay for 3 days (24%), were the others for 2,4,5 at (20%) for each, and the least stay for 1,6,7,10 days (4%) for each.

There is small percentage of recurrence in pneumothorax (8%).

The management option for most patients were by the use of chest tube (88%), other option is through observation (4%), and only (8%) need Surgery(thoracotomy).

Table3.1:age of patient with pneumothorax

Patient age	frequency	persent
child (3-10 years)	1	4
Adolescence (11-17 y)	0	0
Young adult (18-40 y)	15	60
Adult (41-65 y)	9	36
total	25	100

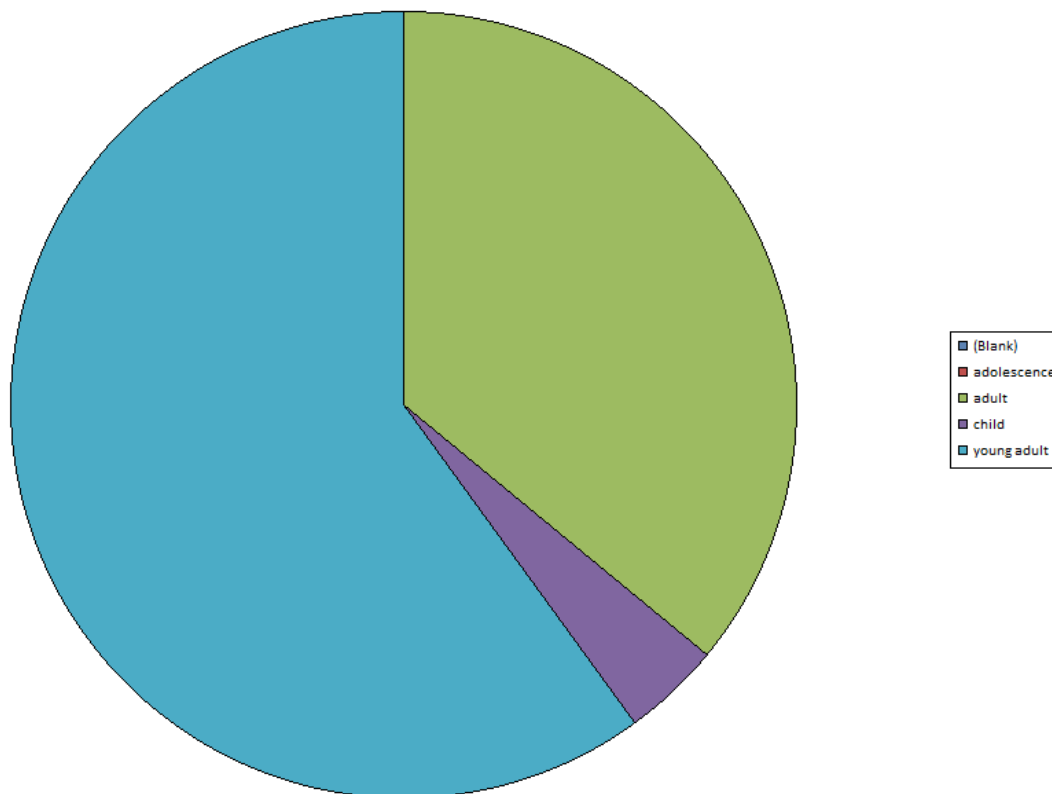


Figure3.1: age of patient with pneumothorax

Table3.2:gender of patient

Gender	Frequency	Percent
Male	21	84
Female	4	16
Total	25	100

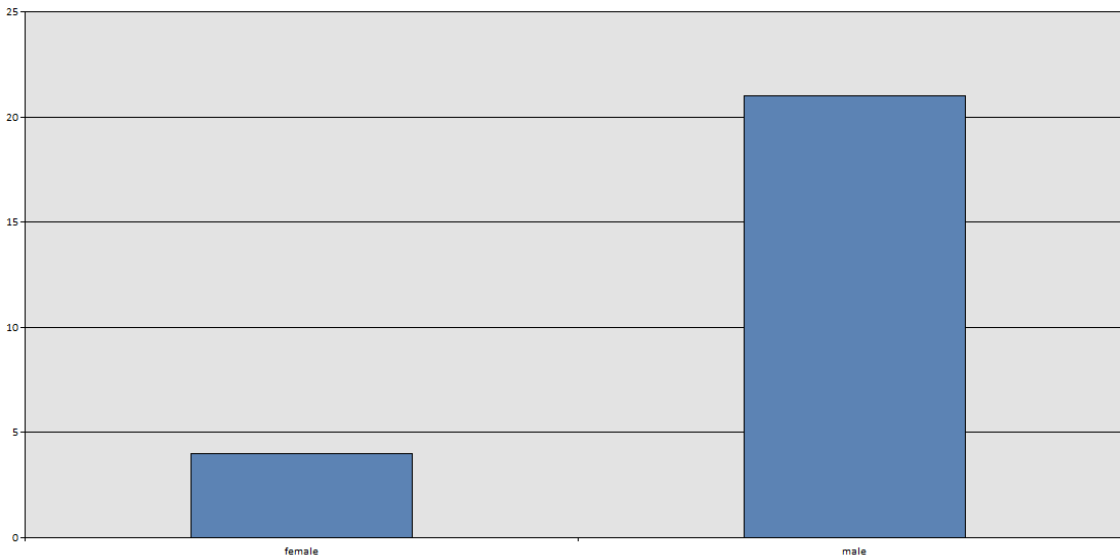


Figure2: gender of patients

Table3.3: occupation of patient

Occupation	Frequency	Percent
Un employee	1	4
employee	2	8
Free worker	11	44
House wife	4	16
Police man	2	8
Soldier	2	8
Student	3	12
Total	25	100

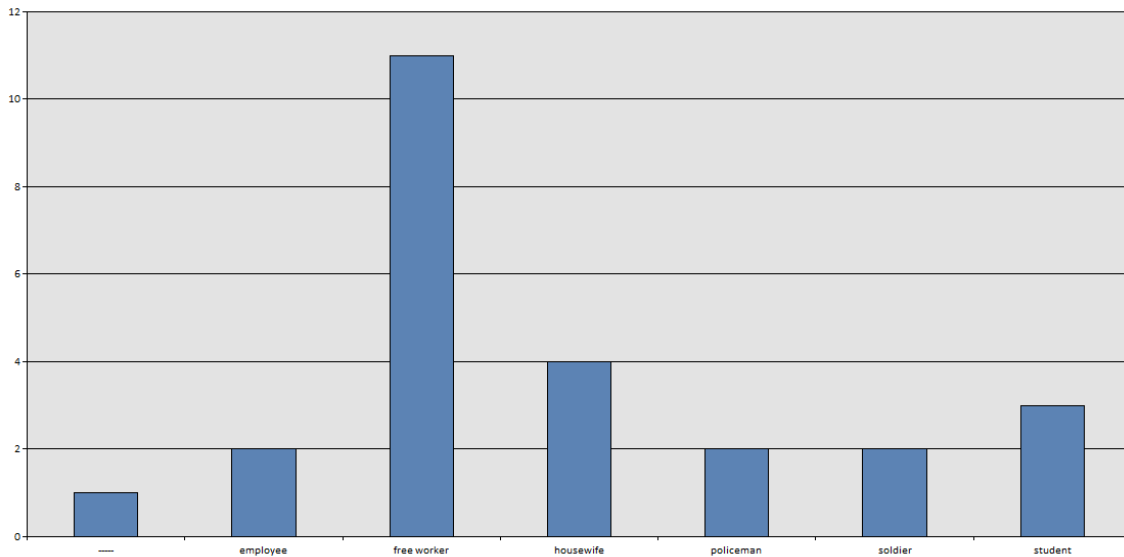


Figure3: occupation of patient

Table3.4:presentation of patients

Presentation	Frequency	Percentage
SOB	18	72
Chest pain	6	24
Cough	1	4
Total	25	100

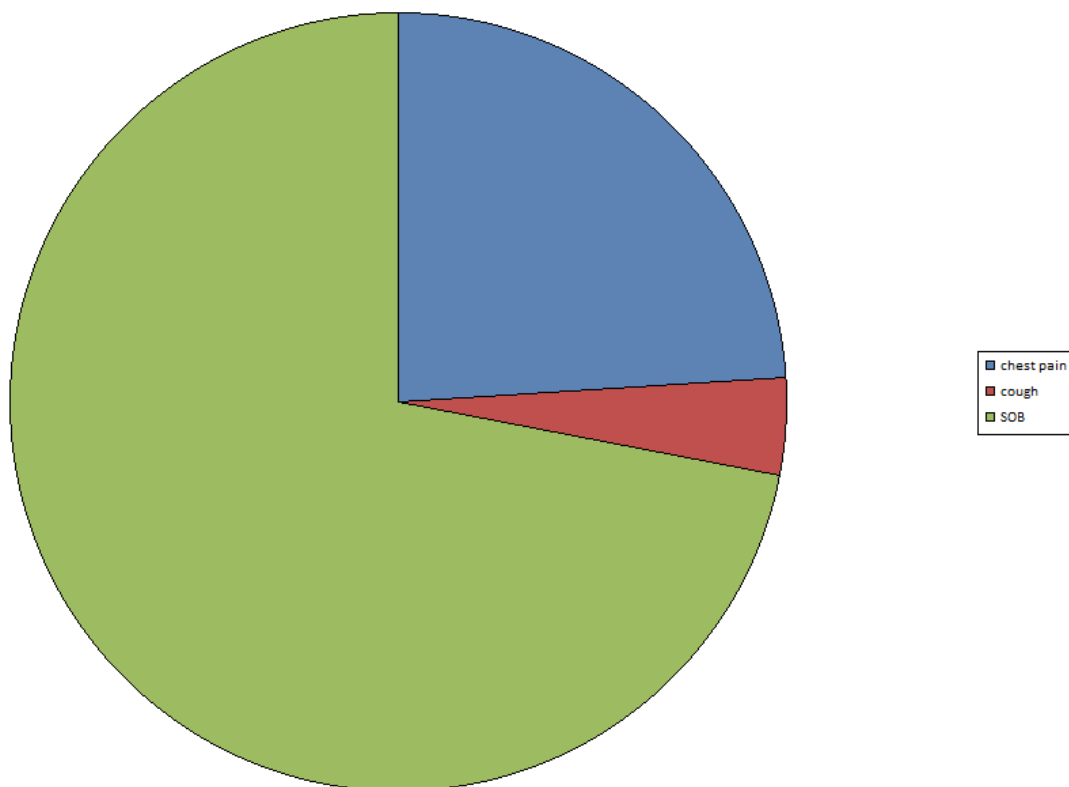


Figure3.4: presentation of patients

Table3.5:duration of admission in patient with pneumothorax

Duration of admission	Frequency	Percent
1	1	4
2	5	20
3	6	24
4	5	20
5	5	20
6	1	4
7	1	4
10	1	4
Total	25	100

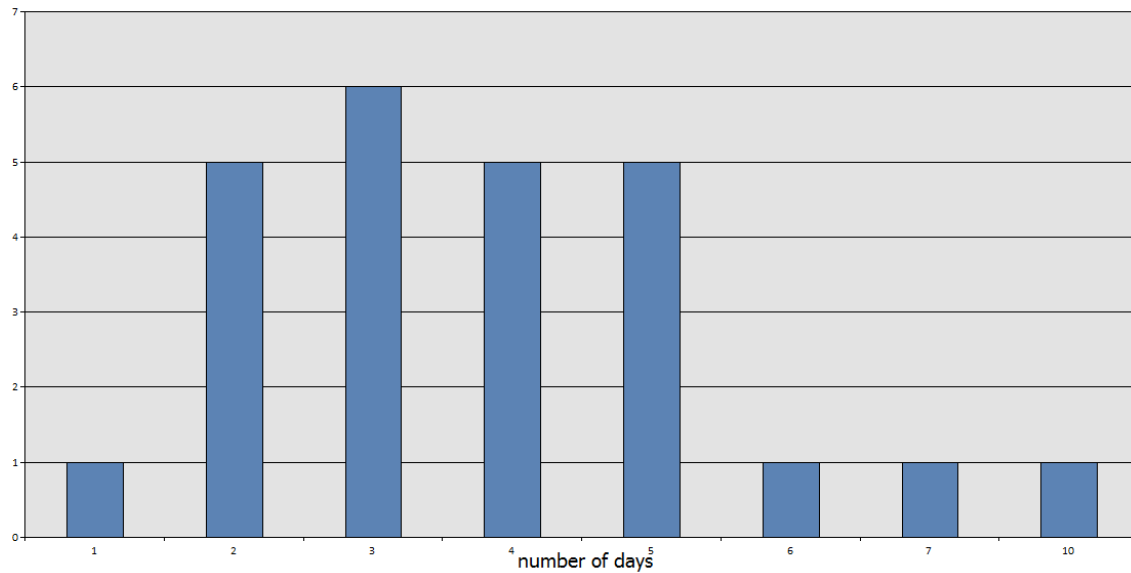


Figure3.5:duration of admission in patient with pneumothorax

Table3.6:side of lung affected

Side affected	Frequency	Percent
Right side	14	56
Left side	11	44
Total	25	100

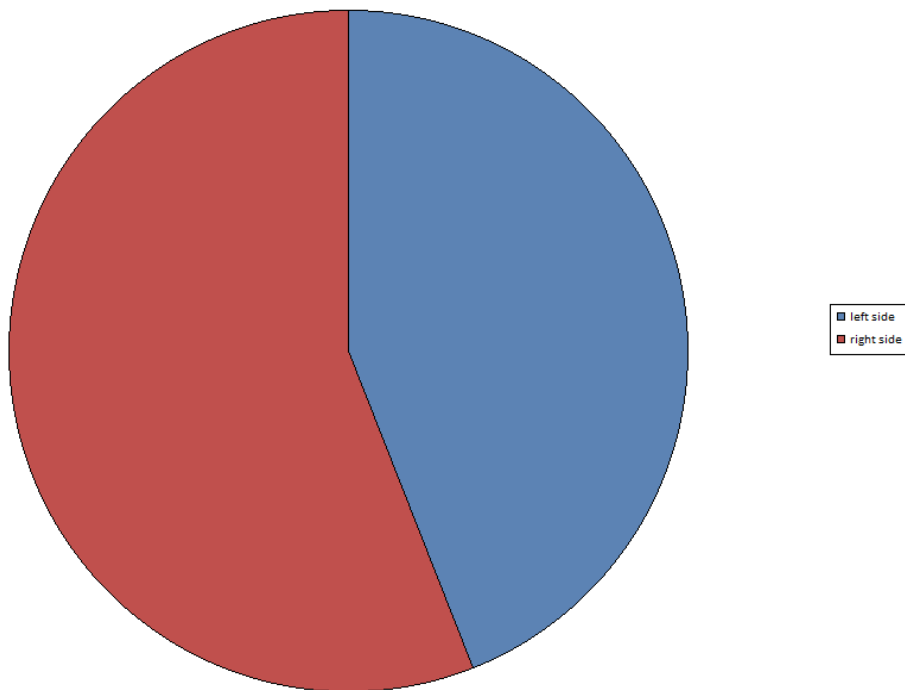


Figure3.6:side of lung affected

Table3.7:smoking history

Smoking history	Frequency	Percent
Smoker	15	60
Non smoker	10	40
Total	25	100

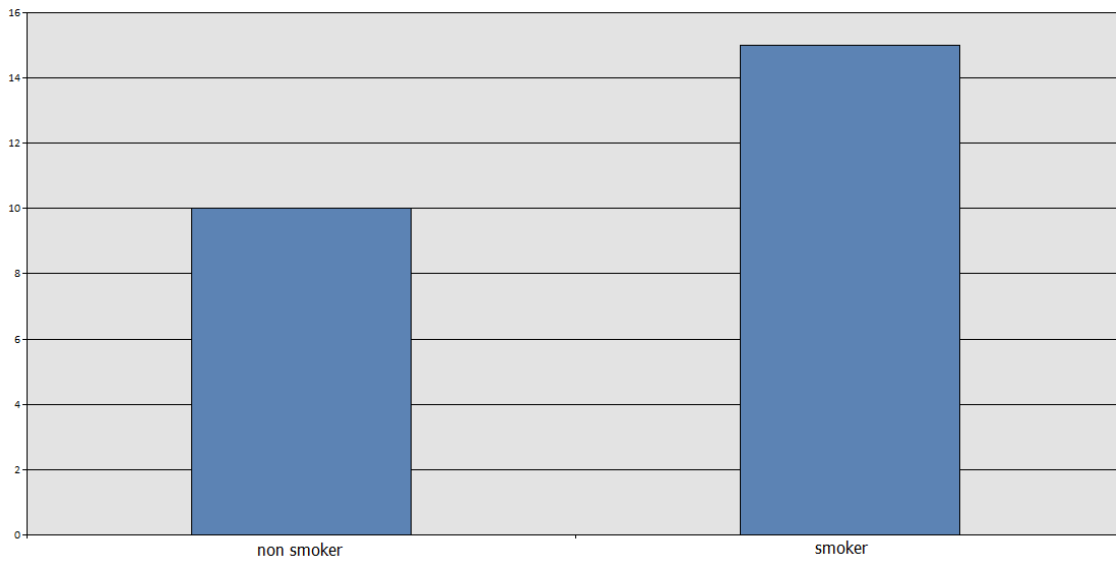


Figure3.7:smoking history

Table3.8: trauma in patient with pneumothorax

History of trauma	Frequency	Percent
Lung trauma	16	64
Safe lung	9	36
Total	25	100

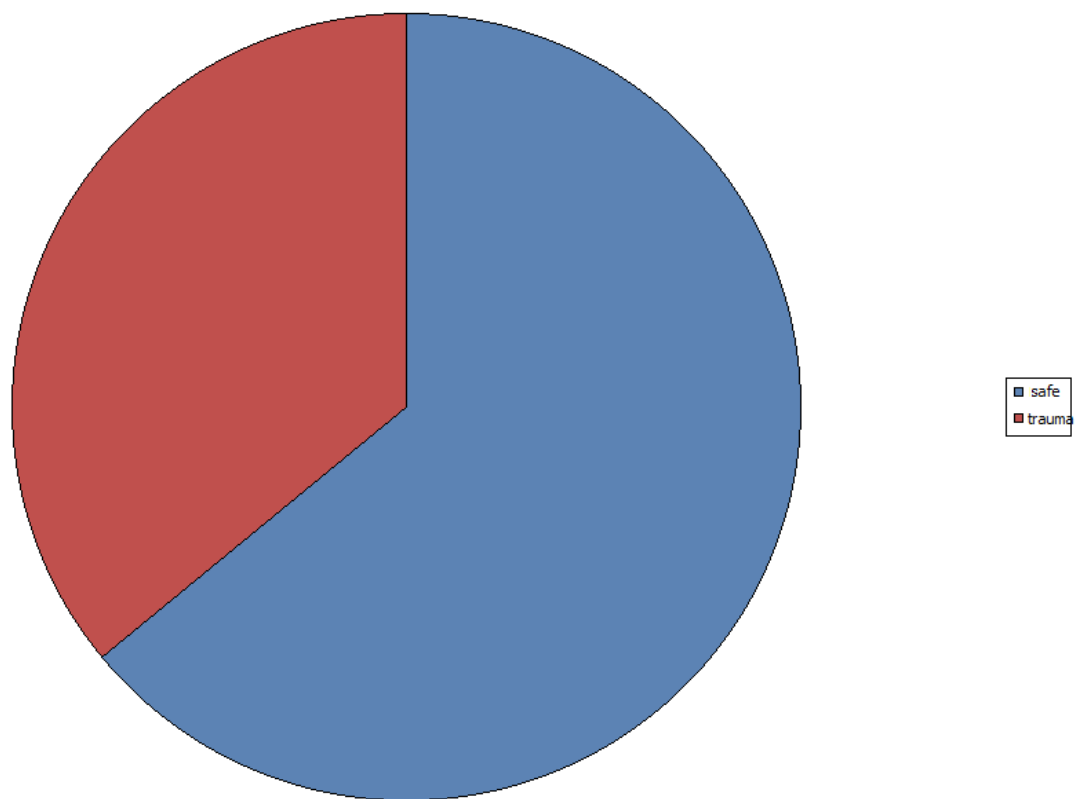


Figure3.8: trauma in patient with pneumothorax

Table3.9: secondary lung disease in patient with pneumothorax

Secondary lung disease	Frequency	Percent
Normal lung	20	80
Asthma	2	8
COPD	2	8
Pneumonia	1	4
Total	25	100

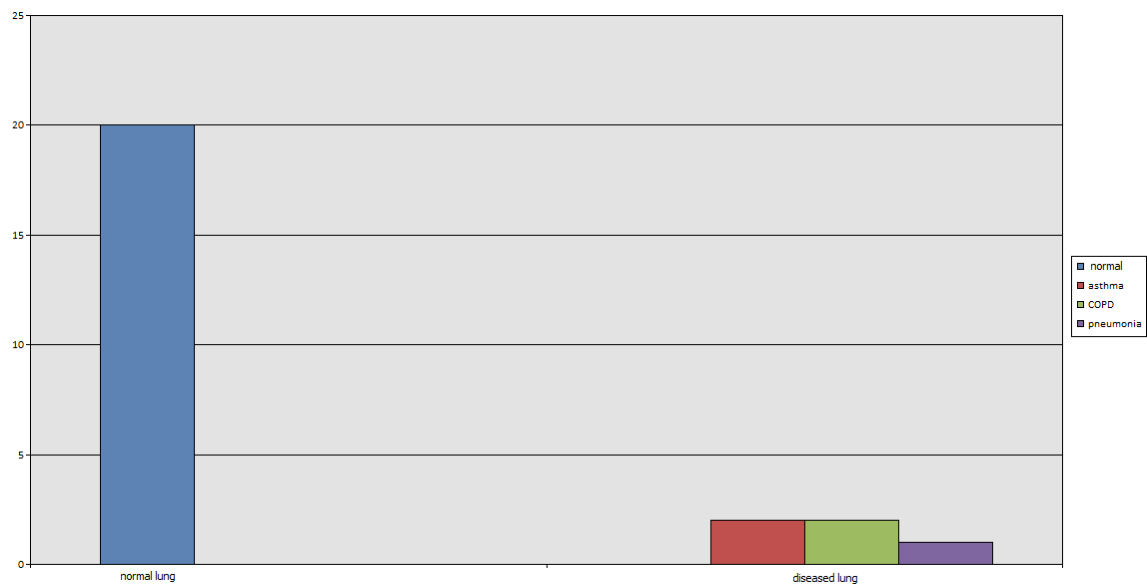


Figure3.9: secondary lung disease in patient with pneumothorax

Table3.10: management of pneumothorax

Management	Frequency	Percent
Observation	1	4
Chest tube	22	88
Surgery(thoracotomy)	2	8
Total	25	100

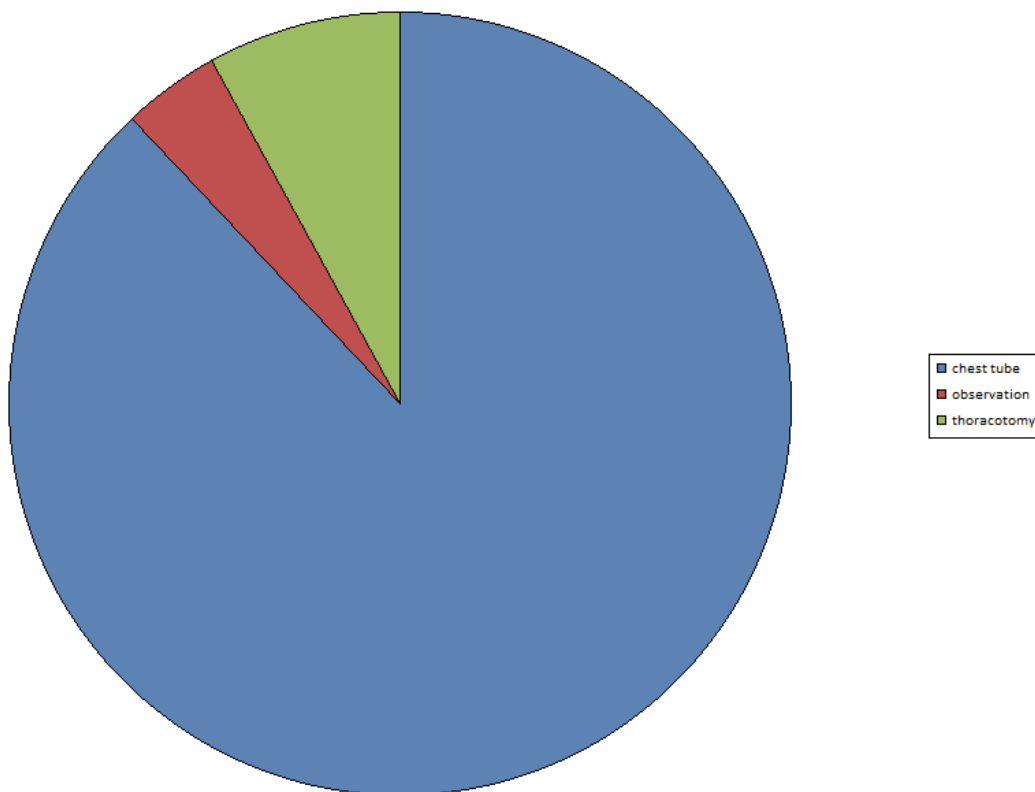


Figure3.10: management of pneumothorax

Table3.11: recurrent pneumothorax

Recurrence	Frequency	Percent
Not recurrent	23	92
2 nd attack	1	4
3 rd attack	1	4
Total	25	100

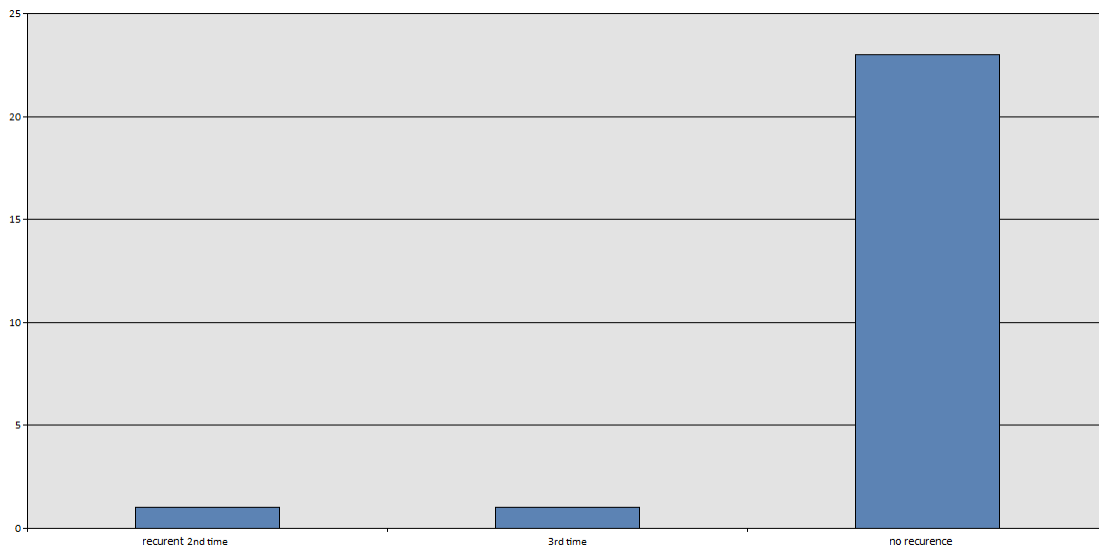


Figure3.11: recurrent pneumothorax

Chapter four

Discussion:

The results show that the most common cause of pneumothorax is trauma, which explains why males are affected more than females since they're more vulnerable to injury, a study was carried out in England between the years of 1991 to 1995 also found that the incidence of pneumothorax in males more than females^[18].

The study shows that young adults followed by adults are more affected, since they usually have occupation putting them in risk to get injured, workers are usually affected followed by house wife and students, while some patients didn't have jobs who are either an employee or in children age groups.

Traumatic pneumothorax was the most common cause which is similar to a study conducted in UK in 2015^[19], while primary spontaneous pneumothorax was more common than secondary spontaneous pneumothorax, asthma and COPD was the main cause of the later.

Smoking was the most common comorbidity, with most of the traumatic victims was resulted from RTA or tramatic blast injury.

Thoracostomy was the most common modality of treatment, since it is most common mean of treatment for traumatic pneumothorax, a single patient was treated by observation, because he had a little amount of air inside his pleural cavity as it was shown on his chest x-ray. Surgical treatment was done for two primary spontaneous pneumothorax case.

In a study done in east Tennessee state university, USA over 130 patients between (1973-1984), they found that chest tube was most common modality of treatment followed by observation alone, depending on the age of the patients, knowing that the use of observation alone can be dangerous and is associated with a higher recurrence rate^[20].

Another study in USA was done in 2011, found that most patients with occult pneumothorax can be carefully monitored without tube thoracotomy in 94% of the

patients the observation method was success; however occult pneumothorax progress and respiratory distress are independently associated with observation failure^[21].

While study in France done in 2007 found that Chest tube drainage (CTD) can be replaced by a less traumatic approach (needle aspiration and, in case of failure, small tube connected to a one-way valve), so &at less than 50% of patients with pneumothorax need to be hospitalized. However, pneumothoraxes associated with underlying lung diseases usually require CTD since needle aspiration is less successful in these cases^[22].

A study in USA, Division of Trauma, Department of Surgery, University of Arizona, carried out on trauma patients with pneumothorax, between 2008 and 2009, found Gat Pigtail catheters are smaller and less invasive, they are safe and can be performed at the bedside. It has a comparable efficacy to Chest Tube in patients with pneumothorax^[23]. Another study was done on trauma patients between 2010 and 2012 suggested that, for patients with a simple, uncomplicated traumatic pneumothorax, use of a 14-Fr pigtail catheter is associated with reduced pain at the site of insertion, with no other clinically important differences noted compared with chest tubes^[24].

In this study most of the patients stayed less than 6 days in the hospital, however, some patients with primary spontaneous pneumothorax had recurrent admissions to hospital, which usually ended up with surgical treatment.

Chapter Five

Conclusion:

Trauma was the most common cause for pneumothorax, affecting males more than females who are usually young adults.

Most of the patient was smoker with some of them had other lung disease, the presentation of patient mostly with SOB.

Patients most commonly treated by chest tube drainage, with the majority had no recurrence, and the patients usually stay less than 6 days.

Recommendations:

More extensive research should be done over a longer period of time, more than one year for calculating the prevalence over wider sample of people.

Data is preferred to be collected prospectively for more accurate results.

Since trauma is the most common cause of pneumothorax, it is important to provide more advanced means of safety and educational support to decrease the incidence of pneumothorax.

It is recommended to use pigtail catheters more often in pleural drainage since they're associated with less pain and complications.

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