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International Journal of Pharmaceutical Research & Allied Sciences, 2022, 11(1):35-39
https://doi.org/10.51847/597Cjlr708

Review Article

ISSN : 2277-3657
CODEN(USA) : IJPRPM

Review on Pneumothorax Diagnostic and Management Approach in Emergency Department

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ABSTRACT

Pneumothorax is an emergency that must be addressed immediately. It is divided into secondary pneumothorax and primary pneumothorax. A secondary pneumothorax occurs because of the presence of an existing lung illness but primary pneumothorax occurs without any evidence that the patient is suffering from any significant lung disease and it also occurs without any apparent cause. The spontaneous type occurs without an apparent cause in healthy people. The Medline, Pubmed, Embase, NCBI, and Cochrane databases were searched for studies of patients who developed Pneumothorax symptoms. Pneumothorax's recent diagnosis and treatment were the topics that determined the articles were selected with regards to the inclusion criteria. Other articles were the exclusion criteria, and the mentioned topics were not amongst their primary endpoint. The incidence, etiology, and management options were analyzed. The critical thoracic disorder that is characterized by a strange gathering of air in the pleural space that results in the dysfunction of a lung is known as Pneumothorax. As there have not been enough studies performed, treatment options tend to vary but are all mostly based on BTS and ACCP guidelines.

Key words: *Pneumothorax, Medical thoracoscopy, Spontaneous, Pulmonary bullae causing pneumothorax*

INTRODUCTION

A critical thoracic disorder that is characterized by the gathering of air in the pleural space that leads to lung collapse is known as Pneumothorax [1]. Pneumothorax could be a result of some medical procedures, damage caused by lung disease, or penetrating chest injuries [2]. Spontaneous pneumothorax, (SP), occurs without trauma [2].

Pneumothorax is classified as spontaneous and nonspontaneous. There is no evidence of any obvious precipitating factor when it is spontaneous. Lung disease is considered secondary pneumothorax if it has been detected [3]. The

analysis and assessment of spontaneous pneumothorax on an extensive base has not been the topic of many studies; the first one has published in the USA 40 years ago as part of the Rochester Project [4].

Both spontaneous and iatrogenic pneumothorax are common occurrences in pulmonary medicine. Spontaneous pneumothorax occurs without an obvious cause, in healthy individuals, while an underlying pulmonary disease causes the second type. Signs of pneumothorax include chest pain and dyspnea that interfere with normal breathing. This interference is because of the preservation of gas following the presence of gas bubbles in the pleural cavity or bullae ruptures in the pleural space. Primary pneumothorax will develop in sound patients with no history of lung disease when the bullae rupture. Patients who have secondary spontaneous pneumothorax are usually diagnosed with a wide variety of parenchymal lung diseases, such as pulmonary emphysema. It is a result of the rupture of impaired pulmonary tissue which happens when the pleural space is invaded by air through damaged, compromised, or distended alveoli [4].

MATERIALS AND METHODS

For selecting the articles, PubMed database was applied. ((“Pneumothorax "[Mesh]) AND (“diagnosis and treatment”[Mesh]) OR (“Pneumothorax diagnosis and treatment Mesh])) were some keys used in the mesh.

Pneumothorax's recent diagnosis and treatment were the topics that determined the articles selected based with regards to the inclusion criteria.

Other articles were the exclusion criteria, and the topics mentioned were not amongst their primary endpoint.

The most clinically relevant publications that were chosen out of 1,202 articles indexed in the last 20 years were around 90 in total, and evaluation was carried out for the full texts. After a complete examination, 31 of the 90 were added. Using reference lists from well-known and linked studies, additional publications and research were built. To help doctors assess cirrhosis simply and practically, expert consensus commentary and recommendations are included where necessary.

RESULTS AND DISCUSSION

An analysis of all hospitalizations for adult spontaneous pneumothorax provided some data on the management and epidemiology of spontaneous pneumothorax at a population level in 2015 [5]. It was noted that the annual incidence of hospitalizations was high (22.7/100 000), its occurrence was not seasonal, it occurs predominantly in men at a younger age and earlier peak of incidence (sex ratio: 1:3.3), about a quarter of patients had had previous surgical procedures, and about 28% already had multiple hospitalizations for pneumothorax. Gender was also proven to have an age-dependent impact on the outcomes and characteristics of the disease, which in turn suggests that pneumothorax is a largely different disease in men and women [6].

Secondary pneumothorax has specific characteristics. This may be explained by the disease’s epidemiological characteristics such as age and greater male predominance, but it might also be explained by its outcomes (more/longer hospitalizations) and/or its management (more frequent surgery) [7]. This may present some explanation as to the gender-related contrasts since secondary pneumothorax is more visible in the male gender. Nevertheless, other components are also likely contributors: atmospheric pressure and meteorological events (such as thunderstorms) have been known to be affiliated with clusters of pneumothorax, regardless of gender, as well as loud music. This raises the question of a possible seasonality of the disease [8], but a study performed in the UK did not find evidence of seasonal distribution [9].

Primary spontaneous Pneumothorax (or PSP), occurs more often in men than women (the chance for men is roughly three to six times higher than for women). The occurrence of PSP in the male gender ranges from 7.4 to 37 per 100,000 population yearly. The incidence in women ranges from 1.2 to 15.4 per 100,000 population yearly [3]. There are geographic differences to this disease, with a higher prevalence in the UK than in the USA. The reasons behind the geographic differences are unknown. A retrospective study of Japanese students suggested that the prevalence of asymptomatic PSP may be as high as 0.042 percent, and lower in women than in men [6].

Risk factors

Primary Spontaneous Pneumothorax typically occurs at rest. The hazards for PSP comprise smoking, male gender, having a tall body shape, and being underweight. For SSP, potential causes include several latent respiratory disorders such as cystic fibrosis, COPD with emphysema, lung cancer, tuberculosis, human immunodeficiency virus-associated pneumocystis carinii pneumonia, and interstitial pneumonitis. PSP typically develops in patients between 10 and 30 years old, but SSP tends to develop in elderly patients (between the ages of 60 and 64 years).

In this case, an underlying condition is already more likely, which explains the correlation [10]. Patients suffering from SSP already have their lung function compromised, which turns SSP into a potentially life-threatening situation that requires imminent intervention.

Underlying lung disease can be a cause or a risk factor for pneumothorax. It can also develop as a side-effect of mechanical ventilation. Major risk factors include [10]:

- *Smoking:* Even if the patient does not have emphysema, the risk increases with time.
- *Genetics*: Some particular forms of pneumothorax have been known to be present in family genes.
- *Previous pneumothorax:* The risk of recidivism is high for anyone who has already experienced a pneumothorax.

Symptoms and signs

Symptoms most commonly begin with (usually mild) dyspnea or pleuritic, ipsilateral chest pain. In small pneumothoraces, a physical examination can be normal. Tactile fremitus and breath sounds are typically absent or decreased in larger pneumothoraces, and percussion is highly resonant. As rare as tension pneumothorax is in PSP, tachypnea and tachycardia, cyanosis (blueish skin), and rapidly evolving hypotension should raise a doubt [11].

Diagnosis can be confirmed in the majority of cases with an upright posteroanterior chest radiograph. This permits the practitioner to estimate the size of the pneumothorax with correct precision. Also, the contralateral movement of the mediastinum and trachea is not a symptom of tension pneumothorax and should not control treatment methods because, in spontaneous pneumothorax, it is a normal phenomenon. Some pleural fluid is present in a minority of patients. The majority of PSP patients, including children, have blebs or bullae usually at the apices of their lungs. The growth of these bullae, blebs, and other places of pleural permeability (such as lesions) can be a result of abnormal connective tissue, distal airway inflammation, ectomorphic physiognomy with more obstructive intrapleural pressures, apical ischemia at the apices, hereditary predisposition, anatomical abnormalities of the bronchial tree, low body mass index and caloric restriction [12]. Other symptoms include bluish skin (cyanosis) caused by a lack of oxygen, stabbing chest pain that worsens when trying to breathe in, dry, hacking cough, shortness of breath, fatigue, tachypnea, and tachycardia [12].

Diagnosis

A computed tomography (CT) scan or a chest X-ray is necessary for diagnosing a pneumothorax. Only monitoring is required for small spontaneous pneumothoraces, as they typically resolve without treatment [13]. A small pneumothorax, as described by the American College of Chest Physicians (ACCP) guidelines, is a marginal depth of less than 3 cm. However, the British Thoracic Society (BTS) expressed a small pneumothorax as a reduction in apical length of lower than 2 and greater than 2 and is considered a large pneumothorax [14].

Treatment

Depending on some factors, treatment for pneumothorax may vary by severity: in some cases, the patient will need instant needle decompression/installment of a chest tube, while in other cases, discharging the patient and planning a follow-up may be sufficient. The treatment will also be subject to change according to the physician in charge of handling the treatment. Indeed, a minimally invasive medical thoracoscopy with one port is usually performed by pulmonary experts, while thoracic surgeons will typically need two ports and a surgery suite.

If a patient presents with traumatic pneumothorax, thoracic surgeons will be inserting chest tubes and handling treatment as there is a possibility that other organs might be affected. Also, if mechanical ventilation is required, the risk of tension pneumothorax is greatly increased, and the insertion of a chest tube, in this case, is compulsory. Tension pneumothorax may also develop as a result of an open chest wound, which is why it is paramount to cover it with an airtight seal [15].

It is essential to perform an urgent needle decompression to treat tension pneumothorax. This might turn out to be necessary at the site of the accident and before transport if the EMT observes the "silent lung" phenomenon [15]. The cannula or needle in this case is left in position before the chest tube is inserted. If tension pneumothorax leads to cardiac arrest, needle decompression is performed as part of resuscitation and may restore cardiac output.

A procedure whereby an irritant is installed inside the pleural space to make an inflammation that pins the two pleura together, preventing fluid accumulation in the pleural space is known as Pleurodesis. It is performed to prevent reaccumulation of fluid in cases of severe recurrent pleural effusions and is considered the final way out. Surgical thoracotomy is the most effective method that is considered together with the identification of any source

of air leakage and stapling of blebs. The next procedure is the pleurectomy of the outer pleural layer and pleural abrasion of the inner layer is the final step [15]. There are three different treatment strategies Alongside the observation and giving the victim chest tube placement or oxygen/aspiration. The guidelines for both BTS and ACCP determined pneumothorax severity and the importance of aspiration differently but they both discussed the detailed treatment guidelines for pneumothorax.

Observation

Observation is to be kept in all SSP and PSP cases. On account of the low mortality rate of PSP, Stable PSP patients can be observed while the gas is being absorbed from the pleural cavity. The observation of clinically stable patients who have been diagnosed with a small volume pneumothorax has been recommended by both ACCP and the BTS. Admission for observation is best for patients residing too far from a hospital as mentioned by ACCP guidelines, but clinically balanced patients should be watched for three to six hours. The patients can be discharged if a repeated chest radiograph shows that there was no progression of the pneumothorax showing that the lesion responsible for the porosity/leakage has closed [16].

Oxygen therapy

A method that can be used to absorb the gas in the pleural cavity is known as diffusion. Diffusion can be facilitated or made faster by changing the composition of the gas in the intra-pleural cavity. Carbon dioxide (CO_2) is taken in 23 times more quickly than oxygen, and oxygen is taken in 62 times more quickly than nitrogen. When the patient inhales 100% oxygen, nitrogen will disappear from the pleural cavity, leaving only oxygen left. The oxygen is accumulated more quickly into the veins from the pleural cavity. The absorption rate of intra-pleural cavity gas is roughly 1.25% daily in ambient air [17]. The complete accumulation of a pneumothorax (occupying 25% of the cavity) will be finished after twenty days. However, when the patient is supplemented with oxygen, the absorption rate sees an acceleration rate multiplied by 3 or 4. This result is particularly useful when a sizeable amount of gas pervades the pleural cavity [18, 19].

Simple aspiration

A small catheter is used for aspiration of a pneumothorax. It is put inside the pleural cavity and left installed in the pleural cavity during observation or it can be removed immediately after removing the air from the pleural cavity. The mean success rate of aspiration is between 53% and 58% in patients with spontaneous pneumothorax. In patients with PSP specifically, the mean success rate is 75%, and it is much greater than the mean success rate for SSP which is 37% [20].

CONCLUSION

Pneumothorax is divided into2; spontaneous and nonspontaneous (no apparent precipitating factor present). There is a scarcity of large, randomized, prospective clinical trials relating to patients with pneumothorax. However, we know that it occurs more often in the male gender than the female gender [6]. The hazards of PSP include smoking, male gender, having a tall body shape, and being underweight. For SSP, several underlying respiratory disorders have been described as potential causes. As there have not been enough studies performed, treatment options tend to vary but are all mostly based on BTS and ACCP guidelines [10].

ACKNOWLEDGMENTS : None

CONFLICT OF INTEREST : None

FINANCIAL SUPPORT : None

ETHICS STATEMENT : None

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