



REVIEW ARTICLE

SPONTANEOUS PNEUMOTHORAX THE ROLE OF CT CHEST

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ABSTRACT

Background: Pneumothorax is air in pleural cavity. Spontaneous Pneumothorax may be primary or secondary. The aim of the study is to present the role of Chest Computer Tomography to Spontaneous Pneumothorax. **Methods:** In a 30 year period a retrospective study took place. During the years 1993 to 2024 (30 years) 1189 patients (978 male and 211female), treated for spontaneous (primary or secondary) pneumothorax in the department of Thoracic Surgery of the General Hospital of Nicaea-Piraeus. **Results:** In a 30 year period 1189 patients, 978 (82,253%) male and 211 (17,746%) female, age 17 – 87 years old mean age 38 years old. Only 155 patients of 1189 (12,699 %) received conservative treatment (oxygen administration, analgesic monitoring), while 1038 (87,300 %) were treated with chest drain insertion. Operation underwent 278(23,380%) out of 1189 patients. The average patients age was 38 years old (max 87, min 17) while the average hospitalisation stay was 7.1 days (max 21, min 1).The elderly patients for spontaneous secondary pneumothorax had a longer stay in the hospital compared to younger population of the study. All patients underwent Chest CT preoperative and postoperative as follow up patients. **Conclusion:** Chest CT considered gold standard. Considered also very helpful for diagnosis preoperative (diagnosis of PNx, Bullae disease-study of parenchyma) and postoperative too (follow up).

INTRODUCTION

Pneumothorax is air in pleural cavity. Spontaneous Pneumothorax may be primary or secondary. The aim of the study is to present the role of Chest Computer Tomography on Spontaneous Pneumothorax.

METHODS

In a 30 year period a retrospective study took place. During the years 1993 to 2024 (30 years) 1189 patients (978 male and 211 female), treated for spontaneous pneumothorax in the department of Thoracic Surgery of the General Hospital of Nicaea-Piraeus.

RESULTS

In a 30 year period 1189 patients, 978 (82,253%) male and 211 (17,746%) female, age 17 – 87 years old mean age 38 years old. Only 155 patients of 1189 (12,699 %) received conservative treatment (oxygen administration, analgesic monitoring), while 1038 (87,300 %) were treated with chest drain insertion. Operation underwent 278(23,380%) out of 1189 patients.

The first five years of the study the operation rate was 10% but the operation rate the last five years of the study was 70%. The pneumothorax was located on the right in 72z patients (60,807%), on the left in 440 (37,005%), and on both sides in 16 (1,345 %). The average patients age was 38 years old (max 87, min 17), while the average hospitalisation stay was 7.1 days (max 21, min 1). Elderly patients had a longer stay in the hospital. There is an important positive ratio between the patient's age and the duration of hospitalisation ($r = 0.209$, $n = 1107$, $p < 0.001$). Three elderly male patients, 84, 85 and 87-year old, man who could not be treated surgically due to old age and other comorbidities received a blood patch successfully. Chest radiography as a routine and initial exploration underwent all patients. Chest radiography was very useful for the post thoracic drain insertion and follow up patients. Almost all patients underwent Chest Computer Tomography preoperative and postoperative as a follow up patients.

DISCUSSION

Pneumothorax is air leak in pleural cavity. Spontaneous Pneumothorax may be primary and secondary.^{1,2} Hippocrates 5th BC suspected air in pleural cavity.¹ Galen he supported that was a lesion between two pleurae (parietal and visceral).¹

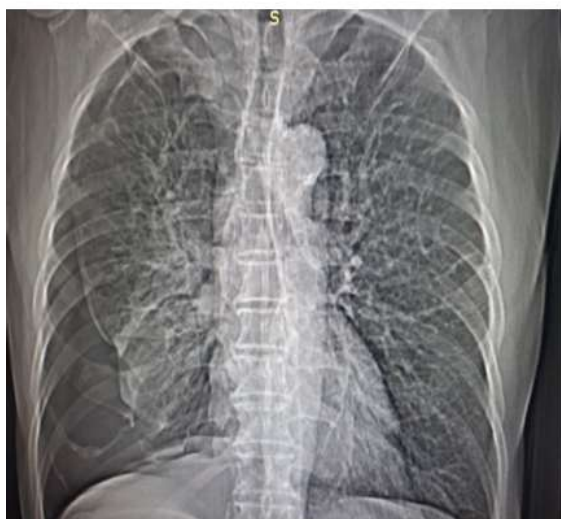


Image 1. Chest radiography large right pnx



Image 2. Chest ct right pnx and bullae disease



Image 3. Chest ct right hydropneumothorax



Image 4. Large bullae excision

Table 1. Clasification of spontaneous pneumothorax

PRIMARY
Rupture of subpleural bullae.
SECONDARY
Emphysema
Chronic Obstructive Pulmonary Disease (COPD)
Cystic Fibrosis
Spontaneous rupture of oesophagus
Marfan's syndrome
Eosinophilic granuloma
Asthma
Lung Cancer
Lemfangioliomyomatosis
Menstruation
Metastatic Cancer especially Sarcoma
Pneumonia and Pulmonary Abscess
Pneumocystis Carinii (AIDS)
NEONATAL

Table 3. Pneumothorax treatment options

General
1. Oxygen supplementation (nasal canula or venturi mask with high flow) – nitrogen washing theory
2. Analgesics
3. Observation for 24h (small ptx < 20%, clinical stable patients)
Conservative treatment
▪Air elimination techniques
1. Needle aspiration
2. Catheter drainage
▪Pleurocath (12-14f)
▪Large bore chest tubes (>20f)
3. Pezzer drainage
(consider application of negative pressure suction, usual range 5-20cm h2o, in cases of incomplete lung expansion)
▪Persistent air leak (>5days)
Non-surgical
(especially on elderly patients with severe comorbidities, non-fit to surgery)
▪Chemical pleurodesis via large bore chest tube (talc, blood patch , bleocin)
▪Out patient care with heimlich valve
Surgical treatment
Bullectomy
+/- apical pleurectomy +/- chemical pleurodesis +/- pleura mechanical abrasion
Open thoracotomy vats rats
Special considerations for optimal treatment decision
Time of onset (duration increased, the more difficult the re expansion will be)
Age
Secondary pneumothorax (ie. Copd, bronchiectasis, interstitial lung disease)
Special types (tension, bilateral)

Versallius in 16th century knew about positive and negative pressure in thoracic cavity.¹ With the appearance of stethoscope by Laennec and the x-Ray from Roentgen, the diagnosis was proceed.¹ The term "Pneumothorax" was established in 1803 and the Lancet journal published the first x-Ray of pneumothorax in 1901¹Primary spontaneous pneumothorax occurs mostly in young people. It rarely occurs before puberty. Most common in male than female.¹ It is also related with smoking.^{1,2}Chest CT considered very useful because offers a quite significant study of the parenchyma. Existence of small pneumothorax that may miss the Chest Radiography.Excellent study of the parenchyma, blebs bullae, lung diseases. It is also very useful to plan the operation. Considered a useful weapon for the thoracic surgeon.^{3,4}Patients are usually tall, thin with narrow shoulders. They also report, tightness, cough. Tachycardia, sweating, low blood pressure and paleness may be also present. Flatulence during percussion and reduction of respiratory whisper are typical of major pneumothorax.^{1,2}The clinical examination varies to the severity of Pneumothorax. In case of tension Pneumothorax the mentioned findings and the displacement of the mediastinum to the healthy hemithorax are typical. The Tension pneumothorax diagnosis must be clinical. The early clinical diagnosis and on time chest insertion in tension pneumothorax can save patients life.^{1,2} In case of a minor pneumothorax clinical findings may be misleading and the Chest radiography considered necessary.^{1,2,3,4} To mention that computer tomography of the chest considered gold standard for diagnosis because can show small pneumothoraxes that may be missed in common radiography. Also can show the blebs existence and bullae too.^{1,3,4}Provided lung windows are examined, a pneumothorax is very easily identified on CT, and should pose essentially no diagnostic difficulty. When bullous disease is present, a loculated pneumothorax may appear similar.^{1,3,4}

Secondary spontaneous pneumothorax occurs mostly in older in age patients. Is related also with smoking.^{1,2,3,4} Emphysema, COPD, Cystic Fibrosis, Spontaneous rupture of oesophagus, Marfan's syndrome, Eosinophilic granuloma, Asthma, Lung Cancer, Menstruation, Lemfangioleiomyomatosis, Metastatic Cancer especially Sarcoma, Pneumonia and Pulmonary Abscess, Pneumocystis Carinii (AIDS) also related with spontaneous secondary pneumothorax^{1,2}, (see table 1). Chest CT offers a quite significant study of the parenchyma^{1,2,3,4} Chronic Obstructive Pulmonary Disease (COPD), Lung Cancer, Chest infection and Pulmonary abscess most frequent seen in patients related with secondary spontaneous pneumothorax.^{1,2,3,4} Bronchoscopy may be very useful and helpful.A quite significant study of the parenchyma offers Computer Tomography of the Chest.^{1,2,3,4} Also these patients required prolonged hospital stay with increased morbidity. Secondary spontaneous pneumothorax occurs due to underlying chest diseases. Most commonly they are observed in patients with chronicobstructive pulmonary disease (COPD), which accounts for approximately 70% of cases.^{1,3,5} A large primary pneumothorax can be tolerated for a few days to collapse, but a small secondary spontaneous pneumothorax on COPD and elderly patients above 70es may kill. Chest drain and oxygen considered first step. Operation bullectomy pleurodesis, lung volume reduction (thoracotomy, VATS, RATS) is indicated but not for all patients (comorbidities). Elderly patients with secondary spontaneous pneumothorax and COPD aged over seventies considered within high risk of morbidity and mortality.^{1,2,5} Older patients underwent oxygen therapy, chest drain insertion chemical pleurodesis, also pleurodesis with blood, plasma satisfactorily. Three elderly male patients, 84, 85 and 87-year old, man who could not be treated surgically due to old age and cardiorespiratory insufficiency and other comorbidities, received pleurodesis with blood (40ml of autologous blood of the patient for 3 days), blood patch successfully.¹Autologous blood pleurodesis reported as an effective but underused method by De Andrade *et al*.⁶Autologous blood pleurodesis for treatment of prolonged air leak in secondary spontaneous pneumothorax considered helpful byAghajanzadeh,⁷ Chambers *et al*,⁸ reported that blood pleurodesis is effective for determining the cessation of persistent air leak. De Andrade *et al*,⁶Aghajanzadeh *et al*,⁷Chambers *et al*,⁸Pathak *et al*,⁹also supported the use of Autologous blood patch for prolonged air leak in spontaneous

pneumothoraxes in the adolescent population. Chest computer tomography as follow up patients can show the pleurodesis.In COPD group of patients bronchoscopy and Bronchoscopic interventions may improve patients life.Bronchoscopy and Bronchoscopic techniques like, Endobronchial one-way valves, Lung volume reduction coils (LVRC), Airway bypass, Glue and biologics also Vapor therapy for lung volume reduction are Bronchoscopic interventions to treat severe COPD, have made great progress over the last decade offering benefit to patients with few treatment options available.¹⁰ These various techniques have unique approaches that have uncovered some of the critical obstacles to success such as collateral ventilation and incomplete occlusion of the target lobe.¹² As these techniques advance, we may continue to see that in the wide spectrum of severe COPD patients, refinement of selection criteria for the respective techniques may have a significant impact on the results for the patient.¹²To mention that a 41 year old female post menstruation developed pneumothorax and within 32 hours operated for spontaneous secondary haemopneumothorax. Underwent bullectomy, stop of the bleeding point (adhesion), partial decortication of the apical pleura and pleurodesis. No diaphragmatic fenestrations found on CT Scan and during the operation. She had a good postoperative recovery and discharged home the forth postoperative day. Ct chest was very helpful for diagnosis and plan operation. Tobias *et al*¹¹ presented a case report with Catamenial Pneumothorax (intrathoracic endometriosis). A 37 year old woman with recurrent episodes of spontaneous right-sided pneumothorax and chest pain that occurred close to her menstrual periods diagnosed with spontaneous secondary pneumothorax underwent operation for spontaneous haemopneumothorax. She underwent bullectomy pleurodesis and a couple of sutures to diaphragmatic holes - fenestrations successfully. Were found 4 distinct fenestrations (the largest of which was 3 mm in diameter) that were freely communicating with the peritoneal cavity. These fenestrations were closed individually by suture ligation.The use of Chest CT considered very helpful in similar cases.¹¹

CONCLUSION

Chest CT considered gold standard. Considered also very helpful for diagnosis preoperative (diagnosis of PNX, - study of parenchymaBullae disease, COPD, tumors...) and postoperative too (follow up).

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