IJMPR 2023, 7(4), 101-106

International Journal of Modern Pharmaceutical Research
www.ijmpronline.com

ISSN: 2319-5878
IJMPR
Research Article
SJIF Impact Factor: 5.273

PNEUMOMEDIASTINUM, PNEUMOTHORAX AND SUBCUTANEOUS EMPHYSEMA: STATES MOVING TOWARDS EACH OTHER!

***Hilendarov A., A. Georgiev, L. Chervenkov and N. Sirakov**

Received on: 22/02/2023
Revised on: 12/03/2023
Accepted on: 02/04/2023

***Corresponding Author**
Hilendarov A.

ABSTRACT

Purpose of this presentation is to describe etiology and pathophysiology of pneumomediastinum, pneumothorax and subcutaneous emphysema, and illustrate the imaging features of massive pneumomediastinum, pneumothorax, subcutaneous emphysema and also a case of association with pneumoretroperitoneum and pneumoperitoneum. **Materials and Methods:** For a period of 5 years (2012-2017), 124 traumatic patients have undergone, examined and proved through an emergency department of the University Hospital. They were previously discussed at clinico-radiological meetings to determine adequate diagnostic and follow-up therapeutic behavior. In each of these studies, at least two imaging methods were performed to allow even minimal injuries. Chest X-rays, US examination, CT, and rarely MRI were used. **Results and discussion:** All of these patients have undergone, examined and proved through an Emergency and Diagnostic Imaging departments of the University Hospital. The obtained results were - in 37 patients pneumothorax, 64-pneumomediastinum, 23 subcutaneous emphysema. Spontaneous pneumothorax/SP/, occurs in 24 patients without underlying pulmonary disease. Iatrogenic pneumothorax occurs in 6 of our patients as complication of medical or surgical procedures. Traumatic pneumothorax was found in 5 of all 37 patients with pneumothorax and tension pneumothorax occurred in two patients. In 64 of all patients a pneumomediastinum was presented. Spontaneous pneumomediastinum occurs in 39 of all patients and tension pneumomediastinum are presented in 25 of all patients. In all emergency condition CT is the modality of choice. **Conclusion:**Therefore, it is possible to find amount of gas in mediastinum, pleural cavity and subcutaneous tissues in many different cases; as demonstrated, these conditions could be concurrent or isolated. Radiologist must know these conditions and, most of all, recognize the degree of severity and the onset of complications.

KEYWORDS: Pneumomediastinum, pneumothorax, subcutaneous emphysema, CT, Conventional radiography, Emergency.

INTRODUCTION

I. The purpose of this presentation is to

- Describe etiology and pathophysiology of pneumomediastinum, pneumothorax and subcutaneous emphysema.
- Illustrate the imaging features of massive pneumomediastinum, pneumothorax, subcutaneous emphysema and also a case of association with pneumoretroperitoneum and pneumoperitoneum.

II. Materials and Methods

For a period of 5 years (2012-2017), 124 traumatic patients have undergone, examined and proved through an emergency department of the University Hospital. In each of these studies, at least two imaging methods were performed to allow even minimal traumatic injurie s. All of these patients have undergone, examined and proved through an emergency and Diagnostic Imaging departments of the University Hospital. They were previously discussed at clinico-radiological meetings to determine adequate diagnostic and follow-up therapeutic behavior. In each of these studies, at least two imaging methods were performed to allow even minimal injuries.Chest X-rays, US examination, CT, and rarely MRI were used. The results obtained were - in 37 patients pneumothorax, 64-pneumomediastinum, 23 subcutaneous emphysema.

III.Results and discussion

In 37 of our 124 patients, the diagnosis of pneumothorax was demonstrated by imaging methods.

1. Pneumothorax/pnx/

The clinical expressiondepend on the degree of destruction of integrity of the lung. If it is considerable, it can cause serious injury of the mediastinum and hemodynamic violation.

We differentiate several types of pneumothorax. In 28 patients the pneumothorax was spontaneous.

a/ Spontaneous pneumothorax/SP/, occurs in 24 of our patients, without primary pulmonary damage. Often these patients are asymptomatic Fig. 1. SP in our patients, is typically presented in tall, young people and it is related to increased shear forces in the apex of the lung.[1] The exact location of air leakage is almost impossible or difficult to find.[2]

Fig. 1: CT image. Left pneumothorax, pneumomediastinum and subcutaneous emphysema.

Normaly, the pleural space has a negative pressure. If the pleural space is filled with a tear gas collection, the lungs collapses until the pressure equilibrium is compensated.. Many sources provide evidence that genetic factors are of particular significance (Marfan syndrome, homocystinuria, and Birt-Hogg-Dube syndrome).[3]

b/ Iatrogenic pneumothorax occurs in 6 of our patients.

Iatrogenic pneumothorax results as a difficulties encountered in diagnostic and therapeutic procedures. The reaisons in our patients were - transthoracic needle aspiration, pleural biopsy, central venous catheter insertion and thoracentesis.[4,5]

Fig. 2: CT guided biopsy of a lesion of right lung, with a little pneumothorax in the site of needle insertion.

Fig. 3: This patient underwent a transbronchial biopsy in the inferior left lobe, with a subsequent left pneumothorax.

c/ Traumatic pneumothorax was found in 5 of all 37 patients with pneumothorax. The main causes for the occurrence of traumatic pneumothorax include:

•Complex traumatic injury (with and without communication with the external environment)

•Trauma with discontinuity of the ribs.

• Risky actions (deep-water swimming, flying)

Complications include haemopneumothorax, bronchoplephal fistula and inflammation. Figure 4

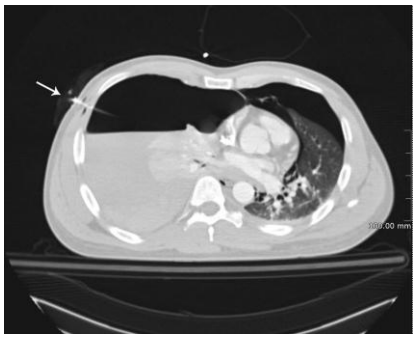

Fig. 4: Trauma with rib fractures. In the right side it is associated with a quantity of liquid with horizontal air-fluid level: hematic hydropneumothorax. A drainage tube was placed in the right pleural space

d/ Tension pneumothorax occurred in two of all patients.

Pressure pneumothorax occurs when the damage affects the pleura or the bronchial branches. Because the pressure is increasing, a pulmonary collapse occurs and leads to hypoxia. Hypoxia occurs as a result of the contraction of the lung from the affected side, and the compressed lung on the opposite side is hampered for sufficient gas exchange [6] Fig. 5

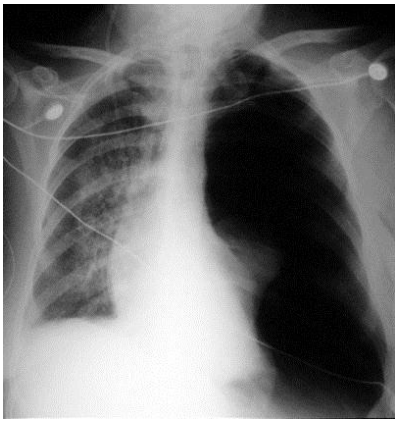

Fig. 5: Left tension pneumothorax shifting of mediastinum to the opposite side.

Radiological signs of pneumothorax.
In chest radiograph a pneumothorax is demonstrate by
-visible visceral pleural edge seen as a very thin, sharp white line Fig. 6

Fig. 6: Spontaneous right pneumothorax.

-the peripheral space is radiolucent compared to adjacent lung
-the lung may completely collapse

Radiograph is performed in lateral decubitus with the suspected side up. In CT scan we use lung window to search for pneumothorax.

2. Pneumomediastinum
In 64 of all patients a pneumomediastinum was presented. This result from physical trauma in 39 patients and in 25 patients with other situations that lead to air escaping from the lungs, airways or bowel into the chest cavity.

Important for diagnosis is communication with certain anatomical structures such as the submandibular space, the retropharyngeal space and the vascular envelopes in the cervical region[8], as well as directly with retroperitoneum. One of the reason for ,pneumomediastinum was oesophageal perforation Fig. 7

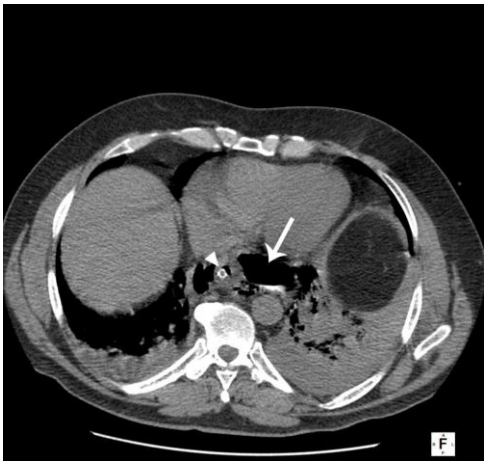

Fig. 7: CT scan shows spontaneous rupture of distal oesophageal wall. Arrow indicates a fluid collection in the posterior mediastinum with an air-fluid level and presence of iodinate radiopaque contrast medium after oral administration.

a/ Spontaneous pneumomediastinum occurs in 39 of all patients. It is more common in patients, between the 2nd and the 4th decade, particularly in males. Risk factors include frequent cough illnesses and regular drug use.

The course of the illness is usually asymptomatic. Symptoms often include - indefinite chest pain, difficulty in breathing, loss of voice and temperature. Investigation reveals a throbbing sound that is heard over the pre-cardium in a mediastinal emphysema caused by a heart rush on air-filled tissues.[9]

Complications
As it has become clear, the expansion of the mediastinal pleura from gas into the mediastinum leads to rupture and PT. It is clear that the presence of gas in the mediastinum can lead to a pneumopericardium as well as a pneumoperitoneum.

b/ Tension pneumomediastinum are presented in 25 of all patients. It is due to an increase in high pressure from the accumulation of free air that compresses the heart and reduces the venous peak and press the bronchial tree. This emergency situation requires prompt treatment in order to reverse cardiovascular and respiratory impairment.

Clinical presentation
We and many authors believe that pneumomediastinum cases are more common than initially thought, as many patients do not seek medical attention. The reason is that it may not be identified on chest radiograph, and the symptoms associated with it are attributable to musculoskeletal pain or other causes. Pneumomediastinum often occurs in young patients because the mediastinal tissues are rare, but in the elderly are compact, which complicates air migration.

In these cases, the main symptom is severe chest pain retrosternal and spreading to the neck or back. Symptoms such as difficulty breathing, voice change and gas under the skin are also included, specifically affecting the face, neck, and chest. The clinical examination includes tachycardia, tachypnea or fright, imitating cardiac tamponade.[10]

Radiological signs of pneumomediastinum
On plain chest radiography: Fig. 8

Fig. 8: Pneumomediastinum with pneumoperitoneum. Arrow indicates air surronding trachea and bronchus that allows their wall to be seen. The other arrow shows a radiolucent line under the diaphragm.

On CT scan pneumomediastinum findings are
- weak shadows or gas bubbles that underline the mediastinal structures, raise the mediastinal pleura and extend to the chest wall
- the gas collection outlines the inner surface of the mediastinal pleura, creating a visible line from the pleura to the main pulmonary artery and the aortic arc; this pleural line is from both the parietal pleura and the visceral pleura of the lung. Fig. 9

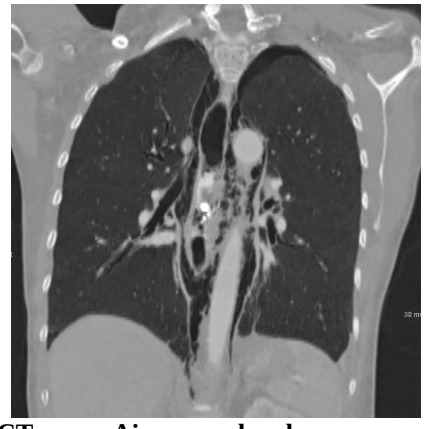

Fig. 9: CT scan. Air around pulmonary vessels and bronchi on the right side and surrounding the entire descending aorta and posterior mediastinal structures.

Dependent location of gas and visible webs of connective tissue outside pleural line help distinguish extrapleural gas from pneumothorax. Fig. 10 and Fig. 11.

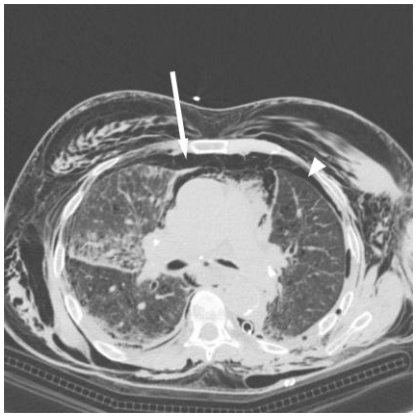

Fig. 10: CT scan. Patient with inferior left lobectomy for lung cancer with pneumomediastinum and massive subcutaneous emphysema. CT scan shows left pneumothorax (arrowhead).

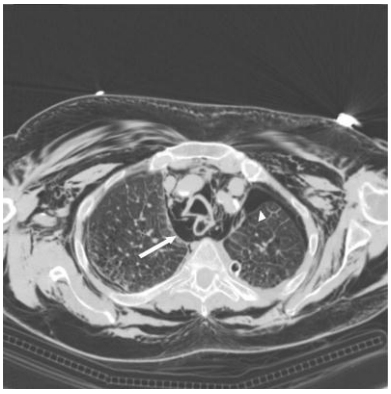

Fig. 11: CT scan. Same patient of figure 11 observed in a more cranial CT slice.

Pneumomediastinum (arrow)on the right and pnx (arrowhead) on the left.

In the emergency condition of a tension pneumomediastinum**, CT is the modality of choice Fig.12**

Fig. 12: CT scan. Massive subcutaneous emphysema with a amount of air around mediastinal structures determining flattening of the anterior cardiac contour (arrowheads) and compression of the right atrium.

It is also appropriate to distinguish the pneumomediastinum from the pneumopericardium. The reason is that pneumomediathinum is much more bulky. Pneumomediastinum is presented as a multitude of weak and shady shadows, with gas collections rarely circumventing the heart, and are not limited to the heart.

Expression of pneumopericard

- It is presented as just a strip of gas that defines the left ventricle and the right atrium - this strip may be broad, curved and outlined by the pericardium, - it usually does not reach the upper mediastinum or the neck area.

4. Subcutaneous emphysema

In 35 patients the prouved diagnosis is subcutaneous emphysema refers to air in the subcutaneous tissues of the body wall or limbs, because air often dissects into the deeper soft tissues and musculature along fascial planes.Fig.13

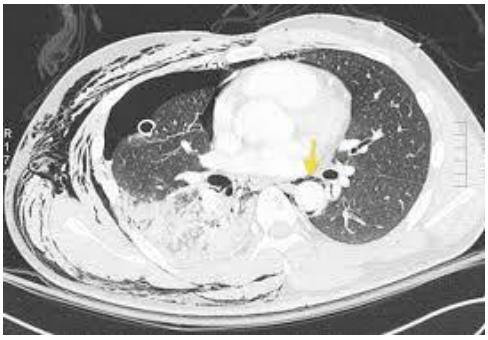

Fig. 13: CT scan. Massive subcutaneous emphysema of upper thorax after lung surgery; also pneumothorax and pneumomediastinum is associated.

Fig. 14: X-ray. After lung surgery, subcutaneous emphysema from the thorax to the abdomen wall.

In the trauma situation, the gas often doesn't need treatment, but its importance lies in the fact that its presence indicates possible serious injuries that could require urgent management. Air collections are distributed in the course of fascicles and can reach the head, neck, limbs, abdomen and scrotum.[10] Fig. 15

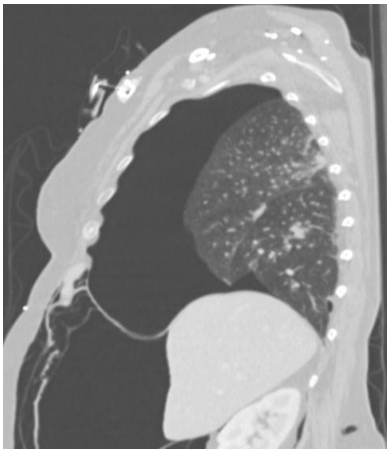

Fig. 15: Huge volume of air in peritoneum and retroperitoneum slipped down from mediastinum: the diaphragm has a concave shape pushed down from pleural pressure.

Radiological signs of subcutaneous emphysema:

-One ordinary chest X-ray shows faint shadows in the soft tissues that can trace the muscle fibers.

- If they engage the front to the chest wall, the subcutaneous emphysema outlines the sternum muscle, leading to the sign of the ginkgo leaf. Fig. 16.

On chest CT subcutaneous emphysema is readly visible, with pockets of air seen as extremely dark low attenuation areas in the subcutaneous space.[10]

Fig. 16: Patient with subcutaneous emphysema and pneumomediastinum after positioning of chest tube for right pneumothorax.

IV. CONCLUSION

Therefore, it is possible to find amount of gas in mediastinum, pleural cavity and subcutaneous tissues in many different cases; as demonstrated, these conditions could be concurrent or isolated. Radiologist must know these conditions and, most of all, recognize the degree of severity and the onset of complications.

REFERENCES

1. Sahn SA, Heffner JE. Spontaneous pneumothorax. N Engl J Med, 2000 Mar 23; 342(12): 868-74. PMID 10727592.
2. Noppen M, Dekeukeleire T, Hanon S, Stratakos G, Amjadi K, Madsen P. Fluoresceinenhanced

autofluorescence thoracoscopy in patients with primary spontaneous pneumothorax and normal subjects. Am J Respir Crit Care Med, 2006 Jul 1; 174(1): 26-30. PMID 16627865

3. Gunji Y, Akiyoshi T, Sato T, Kurihara M, Tominaga S, Takahashi K. Mutations of the Birt Hogg Dube gene in patients with multiple lung cysts and recurrent pneumothorax. J Med Genet, 2007 Sep; 44(9): 588-93. PMID 17496196
4. Plewa MC, Ledrick D, Sferra JJ. Delayed tension pneumothorax complicating central venous catheterization and positive pressure ventilation. Am J Emerg Med, 1995 Sep; 13(5): 532-5. PMID 7662057.
5. De Lassence A, Timsit JF, Tafflet M, et al. Pneumothorax in the intensive care unit: incidence, risk factors, and outcome. Anesthesiology, 2006 Jan. 104(1): 5-13. PMID 16394682.
6. Hashmi S, Rogers SO. Tension pneumothorax with pneumopericardium. J Trauma, 2003 Jun; 54(6): 1254. PMID 12813356.
7. Korom S, Canyurt H, Missbach A, et al. Catamenial pneumothorax revisited: clinical approach and systematic review of the literature. J Thorac Cardiovasc Surg, 2004 Oct; 128(4): 502-8. PMID 15457149
8. Zylak CM, Standen JR, Barnes GR, Zylak CJ. Pneumomediastinum revisited. Radiographics, 2000; 20: 1043-1057. PMID 10903694.
9. Principles of pulmonary medicine, Steven E. Weinberger, Barbara A. Cockrill, Jess Mandel, 2008.
10. Galvan Fernandez, I. Jimenez Cuenca, I. Sanchez Lite, Pneumomediastinum: complication of an aspirated foreign body, October 2015, EuroRad case report.