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RADIOLOGICAL SIGNS IN PNEUMOMEDIASTINUM- A STUDY OF 23 CASES

Radiology

Dr Sujata Patnaik Additional Professor, NIMS, Punjaguta: Hyderabad, PIN: 500029: TS- India

Dr Ramasubbaraidu Senior Radiologist, KREST, Tolichowk Hyderabad: PIN: 500081

ABSTRACT

Pneumomediastinum is a rare entity that can present with varied clinical and radiological features. This paper is an analysis of radiological features in 23 consecutive cases. The location, spread and possible cause of the radiological pathology in each case by correlating with the clinical data and results of other investigations. Eleven were aged less than 40 years; youngest was 9 months old and oldest 70 years. Road traffic accidents are the most common cause. Interstitial lung disease, connective tissue disorders, surgical sequelae or cut-throat injuries are other common causes. About 10% were spontaneous. Ring around the artery and double bronchial sign are the most common named signs. Extension of air from pneumomediastinum presenting as surgical emphysema (n=19), pneumothorax (n= 18) and leak into neck (n=14) were other important features.

KEYWORDS:

Pneumomediastinum, Pneumopericardium, Spontaneous pneumomediastinum

INTRODUCTION

Pneumomediastinum, otherwise known as mediastinal emphysema, refers to the presence of extraluminal air in the mediastinal space. It was first described by Bricheteau in 1844 [1]. Pneumomediastinum can further extend into other spaces around and can present with varying clinical and radiological features [2]. This paper is an analysis of radiological features in 23 consecutive cases of Pneumo-mediastinum seen by us.

MATERIAL AND METHODS

We included the cases who had CT scan done as part of investigation. Reports of 23 consecutive cases of pneumo-mediastinum seen by us over last few years. We tried to analyze the location, spread and possible cause of the radiological pathology in each case by correlating with the clinical data and results of other investigations. The radiological features were studied in depth for presence of any named signs suggestive of Pneumomediastinum.

OBSERVATIONS

Of the total 23 cases included there were 18 males. Eleven were aged less than 40 years; youngest was 9 months old and oldest 70 years. Table-1 shows etiology of pneumomediastinum in our 23 patients. Road traffic accidents are the most common cause (Fig- 1) and almost all were males under this category. Interstitial lung disease, connective tissue disorders, surgical sequelae or cut-throat injuries are other common causes (Fig-2). About 10% were spontaneous (Fig-3). Ring around the artery and double bronchial sign are the most common named signs. Extension of air from pneumomediastinum presenting as surgical emphysema (Fig-4) (n=19), pneumothorax (n= 18) and leak into neck (n=14) is a common finding in our cases.

DISCUSSION

Pneumomediastinum, the extraluminal gas in mediastinum is an uncommon entity. The gas in mediastinum can most often originate from alveolar rupture with leakage into interstitium and dissection of air into hilum subsequently into mediastinum. This type of air leak is either from increased alveolar pressure (air way obstruction due to mucus plug, foreign body, mechanical ventilation, blunt trauma, severe cough, emesis or Valsalva) or due to damage to alveolar walls (e.g. Pneumonitis, fibrosis, ARDS or emphysema). PM can also be secondary to injury/perforation of trachea-bronchial tree or esophagus (iatrogenic, traumatic or spontaneous) (Fig-5A, B, C). Inciting events may be identified in up to 70-90% of cases of spontaneous pneumomediastinum [3]. Infections like TB, histoplasmosis, mediastinitis or connective tissue disorders like polymyositis/ connective tissue disorders predispose to PM as in our cases (Fig- 5). Infection is the leading cause of Pneumomediastinum in children and idiopathic in adolescent. Rarely extraluminal gas from neck (facial fractures, tracheal injury), retroperitoneum (Fig-6) (perforated diverticulae or duodenal ulcer) or chest wall (thoracostomy leaks) can spread into mediastinum [5].

Extension of gas from pneumomediastinum into other spaces is not uncommon due to complex anatomical continuity. Mediastinal air may communicate with submandibular space, the retropharyngeal Space and vascular sheaths in neck (Fig-7), pneumoperitoneum, pneumo-retroperitoneum and subcutaneous chest wall emphysema. In a trauma patient it is common to see subcutaneous emphysema along with Pneumomediastinum.

A continuum of fascial spaces was described by Maunder to explain the pathophysiology. Visceral space in neck invests trachea, esophagus in neck and extends posterolaterally into carotid sheath. It descends inferiorly and extends posterior to hilar vessel and airway to bronchovascular sheath. Continuing inferiorly the visceral space invests soft tissue and extends down to extra peritoneal area beneath the fascia transversalis [5]. Deep cervical emphysema and PM by penetrating oral trauma is very rare. Air probably pass from parapharyngeal space to visceral plane and from retropharyngeal space to mediastinum as one of our case who had cut in laryngopharynx, retroparapharyngeal air and pneumomediastinum (Fig 2). Cyrlak et al described two other routes of communication with the retroperitoneum via a tissue plane extending through sternocostal attachment of diaphragm as well as periaortic and peri-oesophageal fat plane [6] (Fig-6). Koop K and his colleagues postulated that the border between the mediastinum, pleural, and abdominal cavity are not always air tight. Subcutaneous emphysema as symptoms of severe underlying cause like pneumothorax, tracheal, oesophageal rupture [7].

Spontaneous Pneumomediastinum is relatively rare occurs about 1 in 7000-12000 hospital admission and may be associated with combination of pneumothorax, epidural pneumatosis, pneumo-pericardium, subcutaneous emphysema (Fig-8) [8,9]. Spontaneous pneumomediastinum in otherwise healthy subjects without any obvious causative factors like operation, perforation, presence of infection, trauma. But according to certain authors 70-90% of cases there may be trigger factors. Spontaneous pneumomediastinum is more often seen in young adults and generally has a benign course. Rate of complications of PM such pneumothorax and pneumo-pericardium are rare. Pseudo-tamponade is unknown. There is also low recurrence rate. Hence treatment for small spontaneous PM is conservative [10].

RADIOLOGICAL SIGNS

Mediastinal emphysema appears as thin line of lucency outlining the cardiac silhouette as well as thin streak of air within mediastinum (Fig-2A). Unlike air in a pneumothorax or pneumopericardium the air remains fixed in Pneumomediastinum and does not rise to the highest

point. Radiographic signs depend on depiction of normal anatomical structures that are outlined by air as it leaves mediastinum. Gas just above the left side of the heart has been observed as most common location for pneumomediastinum (Fig 2A,4A). A visible pleural line, lucent streak outlying anterior ascending aorta, arch its branches and trachea, the sternal insertion of diaphragm, thymus and brachiocephalic veins [4]. Subcutaneous emphysema is the most common sign seen as in our series.

The named signs suggesting pneumo mediastinum include [11-15]

1. Ring round the artery sign- air outlining aorta/pulmonary artery and its branches (Fig 1-5)
2. Thymic sail sign- air outlining thymus appearing as sail
3. Spinnaker sail sign- air elevating thymus
4 Tubular artery sign- air outlining the aortic branches (Fig 1-5)
5. Continuous diaphragm sign -air outlining central portion of diaphragm due to air trapped posterior to pericardium (Fig 9)
6. Double bronchial wall sign- both the walls of bronchus visible (Fig 10)
7. Naclerios v sign/ extra pleura sign- air outlining the descending thoracic aorta and extending laterally between parietal pleura and medial aspect of left hemi-diaphragm
8. Haystack sign (the heart appears like a haystack in Monet's paintings): air crossing the superior mediastinum
9. Air may also be seen in the pulmonary ligament

Blunt trauma is the most common mechanism in patient with pneumomediastinum as in our series. The 2 cases of spontaneous PM had trigger factors like tuberculosis of lung and pneumonia. Prevalence of PM in patients with dermatomyositis and polymyositis is only 8.3% [16]. We encountered 4 cases of ILD and connective tissue disease including a case of scleroderma. PM in HIV patient is 0.4-3.3% with PJP infection [16]. HIV disease can cause oesophageal mucosal dysfunction and reduced ability of mucosal cells to repair and thus advanced opportunistic infection may lessen the mechanical strength of esophagus and makes it prone to perforation. The only case of oesophageal perforation in our study was HIV positive (Fig 5).

The two important radiological differentials are pneumothorax and pneumopericardium. Pneumothorax is seen as an apical lucency in upright position and deep sulcus sign may be seen. Air column changes position with change of posture. Multiple thin streaky lucency outline the mediastinal structures. Pneumopericardium presents as a band of lucency surrounding heart (Fig 11). It outlines the ascending aorta and pulmonary artery but does not extend to arch or along trachea or bronchi or into neck. Moreover, in pneumo-pericardium changes position with change of posture. Other entities that can be confused are subcutaneous emphysema, pneumoperitoneum and Machs bands. On CT scan small pneumomediastinum may have to be differentiated from subcarinal air cyst, para-tracheal air cyst and tracheal diverticulum (Fig 12) [18].

Conclusions

Pneumomediastinum is a fascinating radiological entity that can present with varied radiological signs and features. At times it may pose difficulty in distinguishing from pneumothorax and pneumopericardium on chest radiographs.

Table 1: Table showing etiology of Pneumomediastinum in our 23 patients

Etiology	Male	Females	No. of cases	Remarks
RTA	11	1	12	more common in male
ILD/CONNECTIVE TISSUE DISEASE	0	4	4	in females most common cause
SPONTANEOUS	2	0	2	TB, PNEUMONIA
SURGERY AND CUT THROAT	3	0	3	ALL MALE
INFECTION	1	0	1	
OESOPHAGEAL RUPTURE	1	0	1	

Table 2: Details of extension of pneumomediastinum to other spaces

SN	PM	PNEUMO PERICARDIUM	PNEUMO THORAX	SUBCUTANEOUS EMPHYSEMA	EXTn. NECK	EXTn. ABDOMEN
1	+		+	+		
2	+		+	+	+	
3	+		+	+	+	
4	+		+	+	+	
5	+			+	+	
6	+			+		
7	+		+	+		
8	+		+	+		
9	+		+	+	+	
10	+	+	+	+	+	
11	+		+	+		
12	+		+			
13	+		+	+	+	
14	+			+	+	
15	+		+	+	+	+
16	+		+			
17	+		+	+		
18	+	+	+	+	+	
19	+					
20	+	+	+	+	+	
21	+				+	
22	+		+	+	+	
23	+		+	+	+	
TOTAL	23	3	18	19	14	1

IMAGES

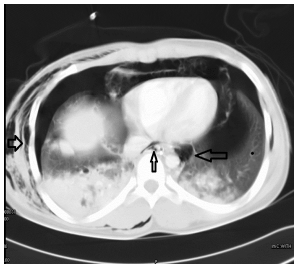


Fig 1- 25 M: Post- traumatic pneumothorax with pneumomediastinum. Subcutaneous emphysema and air outlining the descending aorta is also seen (indicated by arrow)

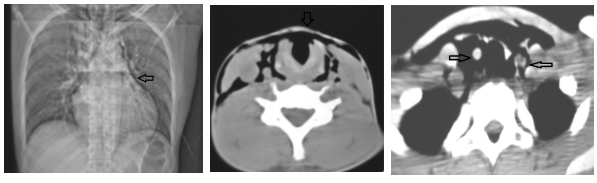


Fig 2A: Air outlining the left heart border	**Fig 2B:** Cut throat injury is shown by arrow	**Fig 2C:** Extension of air into mediastinum outlining the arch vessels

Fig-2: Young male: suicidal cut throat injury showing pneumomediastinum and retropharyngeal air

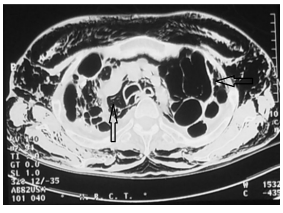


Fig-3: 70 M: CT scan chest showing cavities and bullous lesion, spontaneous pneumothorax and subcutaneous emphysema. Air is outlining the trachea, esophagus and bullae and cavities are indicated by arrow

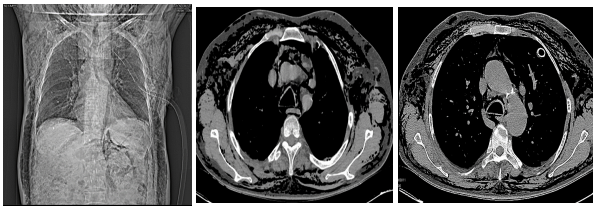


Fig 4: 60 M: Extensive surgical emphysema (A) Ring round the arteries/ tubular vessel sign, double tracheal lumen(B) and air along anterior junctional line(c)

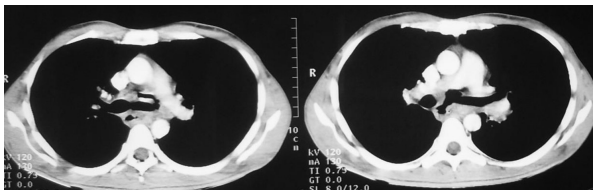


Fig 5: A: 32M: HIV positive having oesophageal rupture and pneumomediastinum

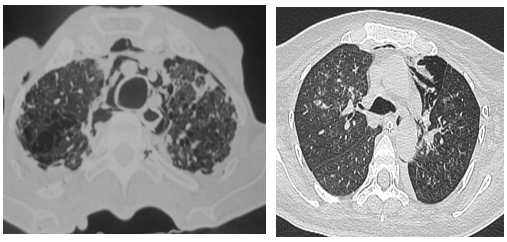


Fig 5 B: 67 M: interstitial lung disease with spontaneous pneumomediastinum. Ring round the arteries sign is positive.	**Fig 5 C:** 35 F: A case of PSS which had pneumomediastinum

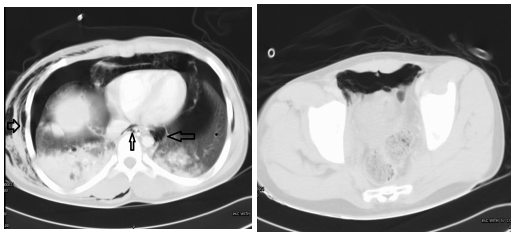


Fig-6: 25M: Pneumomediastinum with pneumopericardium (a) extension into abdominal spaces (b)



Fig 7: 55 M: Post-CABG: air lining the muscle fibers in pectoralis muscle(a) and extension of mediastinal air along the vascular sheath of neck (b) represented by arrow

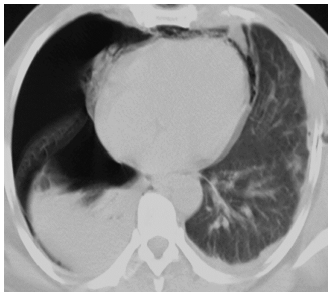


Fig 8: 55M: Pneumothorax and spontaneous pneumomediastinum

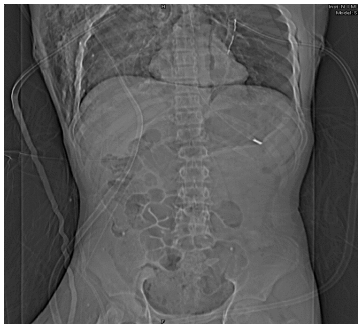


Fig-9: 25M: RTA pneumomediastinum with continuous diaphragm sign

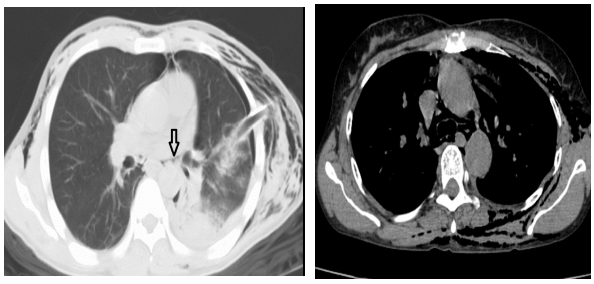


Fig 10: A: 38m: accident with fracture of ribs, scapula and clavicle showing air along the bronchus (arrow).	**Fig 10 B:** 9-year boy had RTA, image reveals positive double bronchial wall sign

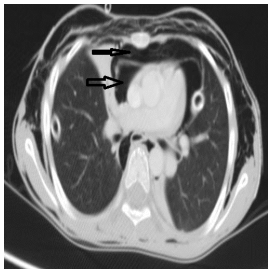


Fig 11: 9-year male child operated for TM joint had pm (small arrow) and pneumo pericardium (large arrow)

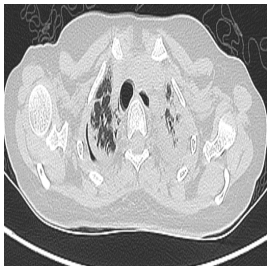


Fig 12: A case of ankylosing spondylitis having minimal air in mediastinum in 26-year male

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