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TRAUMATIC PULMONARY PNEUMATOCELES (PSEUDOCYST)

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ABSTRACT

Introduction: Traumatic pulmonary parenchymal cavitory lesions (TPPCs) are pulmonary pseudo cysts raiding secondary to lung contusion.

Method: To provide an overview of the etiology, presentation, diagnosis and treatment of TPPCs, and to discuss this in the context of a cohort of 12 retrospectively reviewed patients with TPPCs presenting to Sahlgrenska University Hospital, Gothenburg, Sweden, from January 2014 to December 2016. Between January 2014 and December 2016, a total of twelve trauma patients presented to Sahlgrenska University Hospital with TPPC following blunt trauma.

Results: TPPCs are of limited clinical consequence. Inexperienced clinicians may treat these inappropriately. A Computed Tomography (CT) scan is the investigation of choice. Treatment is symptomatic. Intervention is indicated only in case of complications.

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INTRODUCTION

Pneumatoceles are thin-walled air-filled cysts of the lung that are most often seen in children with bacterial pneumonia but also develops after blunt thoracic trauma, positive-pressure ventilation, and caustic aspiration (Kaplan et al., 1996). A subtype of pneumatocele are Traumatic Pulmonary Pneumatoceles (TPPCs). These are uncommon cavitory lesion which develop in an area of pulmonary contusion following blunt thoracic trauma and develop from one or more spaces within the lung that remain air-filled or are filled partly or completely with blood. It is hypothesized, that these lesions are a consequence of the glottis being closed or the bronchus being obstructed at the time of the trauma, resulting in the compressed air causing pressure cavities (Tsitouridis et al., 2007). The rapid compression and decompression of the chest damages alveoli and interstitial lung tissue, while retraction forces create small cavities filled with air and/or fluid (Yazkan et al., 2009;

Melloni et al., 2003; Tsitouridis et al., 2007). A primary TPPC is a direct result of trauma itself 8. If there is no connection between the area of contused lung and the respiratory tract, the lesion will become a pulmonary hematoma (Yazkan et al., 2009; Stathopoulos et al., 2002; Athanassiadi et al., 2003). These pulmonary hematomas may subsequently develop into secondary TPPCs. Mechanical ventilation may play a role in the development of pulmonary pseudocysts, but the significance is unclear (Yazkan et al., 2009; Melloni et al., 2003). In general, these lesions occur after traffic collision or fall from a height, and usually develop in areas of pulmonary contusion ipsilateral to site of injury (Costa et al., 2013). Bilateral presentation of TPPCs exist but are rare, as are TPPCs arising due to penetrating injury 4-6 TPPC are categorized as pseudocysts as they are differentiated from true pulmonary cysts by the presence of a thin wall of interstitial conjunctive tissue in association with macrophages and fibrous tissue, without epithelial lining or bronchial wall elements (Fagkrezos et al., 2012). These lesions are generally treated conservatively; unnecessary examination and treatment might be offered by clinicians without knowledge of this condition. A TPPC may appear as a round radiolucent area on a chest X-ray.

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Table 1. Our 12 patients after blunt trauma with CT verified TPPC from Jan 2014 to December 2016

Patient	Type of Trauma	Age	Sex	Pneumothorax In cm	Chest Tube	Location of TPPC	Haemothorax
1	MVA	45	F	3 cm	no	LIL	1 cm
2	MC	32	M	no	no	LIL	Minimal
3	Fall	51	F	no	no	RSL	Minimal
4	MVA	42	M	5 cm	yes	RIL	2 cm
5	Assault	22	M	1 cm	no	LIL	Minimal
6	Fall	48	M	2 cm	no	LIL	Minimal
7	Fall	19	F	no	no	RSL	Minimal
8	MVA	28	M	5 cm	yes	LIL	Minimal
9	MC	26	M	7 cm	yes	LIL	1 cm
10	MC	39	M	6 cm	yes	LIL	Minimal
11	Assault	32	M	2 cm	no	LIL	2 cm
12	MC	30	M	8 cm	yes	RSL	1 cm
Total							
12	MC=4 MVA=3 Fall=3 Assault=2	Range: 19-51 years Mean: 34.5 years	M=9 F=3	PTX= 2-8 cm	Chest Tub=5	L=8 R=4	Max=2 Cm

LIL=Left Inferior Lobe, RSL=Right Superior Lobe, MVA= Motor Vehicle Accident, MC=Motorcycle Accident, PTX=Pneumothorax
TPPC= Traumatic Pulmonary Pneumatocele

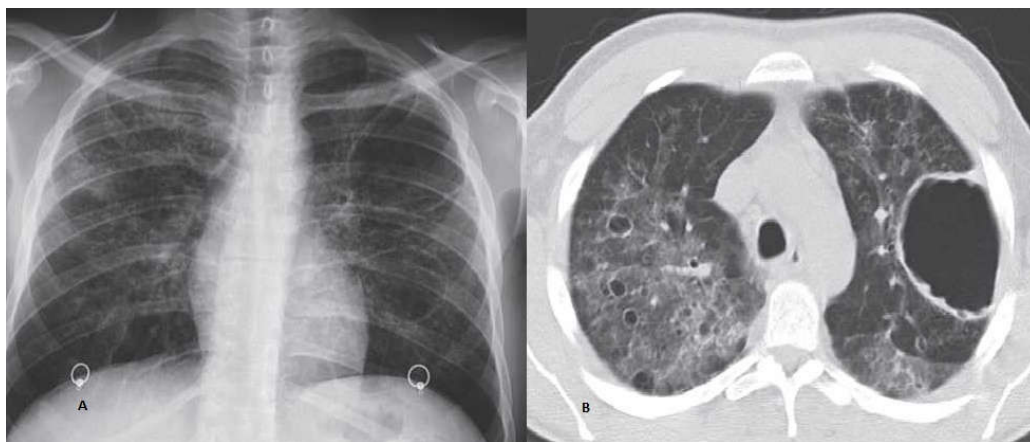


Fig-1A. Frontal radiograph shows a thin-walled cavity (pneumatocele) in the left lung. B. CT shows bilateral pneumatoceles and associated ground glass opacities. The combination is suspicious for *Pneumocystis carinii* pneumonia.(Radiology key)

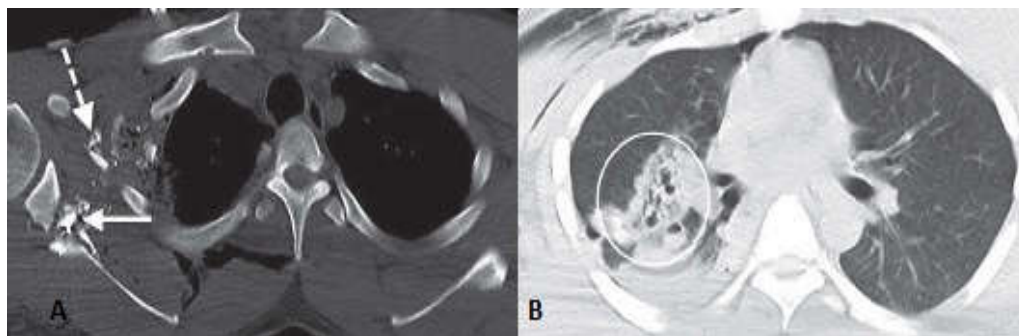


Fig. 2. Penetrating injury. A: CT scan of a 29-year-old man who sustained a gunshot wound to the right shoulder and chest shows metallic fragments adjacent to a comminuted fracture of the right scapula (solid arrow) and comminuted right rib fractures (dashed arrow); B: CT scan with lung windowing shows multiple consolidations in the right upper lobe (circle), indicating pulmonary lacerations. There is also subcutaneous emphysema.(Radiology key)

In general, these become apparent hours after trauma as multiple, cyst-like cavities, greater than 1 cm in diameter with a thin uniform wall (Fig 1) (Yazkan *et al.*, 2009; Stathopoulos *et al.*, 2002).

Incidence of TPPCs

The incidence of TPPC is about 1-3% after chest injury in adults (Yazkan *et al.*, 2009; Melloni *et al.*, 2003; Tsitouridis *et al.*, 2007). In 50% of cases the pseudocysts can be seen on a plain chest x-ray, while CT is the best diagnostic test for TPPC 3-7. From this follows that with the increasing use of CT scans

in trauma screening the reported incidence might very well increase in future. The incidence is higher among children and young adolescents; 85% of patients with TPPC are younger than 30 years. This is possibly due to the skeletal structures of the thoracic cavity being more compliant in younger people and thus allow for a greater transfer of kinetic energy to the lung parenchyma compared to adults (Melloni *et al.*, 2003; Tsitouridis *et al.*, 2007). TPPC scan be asymptomatic, but if there are symptoms present they can be variable and non-specific. Often, they are hard to distinguish from symptoms of the trauma itself; haemoptysis, dyspnoea, hypoxemia, chest pain, coughing and sometimes hyperthermia. Physical

examination usually reveals few or no abnormalities; sometimes crepitation can be heard (Stathopoulos *et al.*, 2002). In most of cases the pseudo cysts occur within 12 to 24 hours after trauma and can be oval or spherical, unilateral or bilateral and single or multiple (Yazkan *et al.*, 2009; Stathopoulos *et al.*, 2002; Tsitouridis *et al.*, 2007). The diameter of the pseudocysts varies from 1 to 14 cm but can change quickly in shape and size (Stathopoulos *et al.*, 2002; Melloni *et al.*, 2003; Tsitouridis *et al.*, 2007; Athanassiadi *et al.*, 2003). The lower lobes are classically the most commonly affected; the lung apices are less commonly affected (Melloni *et al.*, 2003; Tsitouridis *et al.*, 2007). The location of pseudocysts can be central or sub pleural, ipsilateral to the injury, or contra lateral due to the contra-coup effect (Melloni *et al.*, 2003). Between January 2014 and December 2016, a total of twelve trauma patients presented to Sahlgrenska University Hospital with TPPC following blunt trauma (Table 1). In Table 1, the characteristics of 12 patients are fully described. A majority (75%) of TPPCs arose in male patients. A total of 58% were due to vehicular incidents. In keeping with published literature, TPPCs tended to affect the lower lobes (75%). The majority arose in young people and were always (100%) associated with the formation of a haemothorax and, almost always (75%), associated with a concomitant pneumothorax. This suggests that TPPCs may tend to arise in thoracic trauma violent enough to result in hemo- or pneumothorax.

Diagnoses and differential diagnoses

TPPC is a diagnosis of exclusion. Differential diagnoses include rupture of the oesophagus, lung abscess, tuberculous cavity, mycosis, Wegener granulomatosis, bronchial carcinoma and bronchogenic cyst and substance abuse by inhalation (Melloni *et al.*, 2003; Tsitouridis *et al.*, 2007; Athanassiadi *et al.*, 2003). A CT scan is the investigation of choice. Improvement of symptoms without treatment can confirm the diagnosis. Consolidation usually disappears within 7 to 10 days after the trauma. The cysts will increase in size during the first 2 weeks and will slowly disappear within 2 to 3 months (Yazkan *et al.*, 2009; Stathopoulos *et al.*, 2002). Given the spontaneous remission, only symptomatic therapy is indicated. Complications of TPPC are rare (Stathopoulos *et al.*, 2002; Melloni *et al.*, 2003). But include infection and pneumothorax secondary to cyst rupture (Yazkan *et al.*, 2009; Stathopoulos *et al.*, 2002; Melloni *et al.*, 2003). After spontaneous remission, no residual radiographic abnormalities are usually present (Stathopoulos *et al.*, 2002). However, surgical treatment is indicated for complex pneumatoceles, infected lesions refractory to antibiotics and drainage, uncontrolled haemorrhage, or clinical deterioration. Due to the low number of patients in this study, statistical analysis was not required. In our study we had 9 men and 3 women, chest X ray demonstrated 9 pneumothorax which was between (Costa *et al.*, 2013; Fagkrezos *et al.*, 2012; Yazkan *et al.*, 2009; Stathopoulos *et al.*, 2002; Melloni *et al.*, 2003; Tsitouridis *et al.*, 2007; Athanassiadi *et al.*, 2003) centimeter. Five of nine patients got chest tube. the location of TPPC were 8 on left side and 3 were on right side of lung. All 12 patients were discharged between 24 and 72 hours.

Conclusion

TPPCs are cavitory lesions, with a wall formed by interlobular interstitial connective tissue, without epithelial lining, that develop in the pulmonary parenchyma after blunt chest trauma with an incidence of 1-3%, possibly by damage to alveoli by the rapid compression and decompression of the chest during trauma. With the increase in use of CT scans in trauma screening, the incidence of this condition might very well increase in future. TPPC require no special treatment and will resolve spontaneously. However, surgical treatment is indicated for complex pneumatoceles, infected lesions refractory to antibiotics and drainage, uncontrolled haemorrhage, or clinical deterioration. To investigate the phenomenon of TPPCs more accurately in the lungs, We need a wider study, with more patients and a review of pulmonary function at different times after the trauma.

Disclosure: The authors declare no conflicts of interest.

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