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CLINICAL IMAGE

Traumatic pneumatoceles

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Keywords - trauma, CT, pneumatocele

Case history

A young motorist fell off his bike at 100 km/h. He landed on his right side before sliding to a full stop without hitting anything. This patient was rushed to the emergency department. On the initial physical examination, a dyspnoeic man was seen, with a normal blood pressure and mild sinus tachycardia without a need for fluid resuscitation. A CT scan was ordered because of the apparently multiple injuries. The CT scan showed an iliac crest fracture and fractures of ribs 9 and 10 with a concomitant right-sided pneumothorax. In addition, he had fractures of the spinous process of Th12 and L1 to L4, and the vertebral body of L5, all without neurological deficit. Finally, multiple pneumatoceles and a lung contusion in the inferior lobe of the right lung were present.

A chest tube was inserted which did not alleviate the patient's dyspnoea. After surgical repair of his iliac crest fracture, the patient was detubated on the second post-operative day and made an uneventful recovery. Clinical follow-up was unremarkable, additional chest imaging was not performed.

Discussion

A pneumatocele of traumatic origin may show as round radiolucent areas on a chest X-ray.

In general, pneumatoceles become apparent hours after trauma as multiple, cyst-like cavities, greater than 1 cm in diameter with a thin uniform wall [1,2]. However, most frequently pneumatoceles are not visible on a chest X-ray, in part because of the concomitant lung contusions. The most frequent clinical sign, not present in this patient, is haemoptysis [1]. Traumatic pneumatoceles are rare, most frequently found in young victims of high energetic blunt thoracic trauma. It is believed that pneumatoceles are created by compression-decompression trauma of the chest during (partial) airway closure, thus causing rupture of small airways [1]. Consequently, an air filled cavity may be created with a thin wall, within the lung parenchyma (intraparenchymal). It is possible that pneumatoceles are enlarged by a check-valve mechanism due to bronchiolar obstruction [3]. This mechanism allows air to pass during inspiration, but obstructing air flow during expiration. Pneumatoceles may secondarily be flooded with blood, thus creating an intrapulmonary haematoma.

In contrast, most pneumatoceles are caused by infection [4], for example, from staphylococcus aureus, streptococcus, or tuberculosis. Pneumatoceles following pulmonary infections may be caused by the drainage of necrotic lung parenchyma and/or local hyperinflation secondary to bronchial hyperinflation of the check-valve type [5]. Pneumatoceles in autoimmune diseases like SLE and rheumatoid arthritis may develop secondary to inflammation of the airway causing air to leak into the pulmonary parenchyma [3].

The treatment of traumatic pneumatoceles is conservative [6], focussing on sputum evacuation and thus prevention of secondary infections [1]. In contrast with lung contusions, which heal fast and completely, pneumatoceles heal in weeks to months, often with remaining tissue scarring.

However, specific treatment is required in secondary infected pneumatoceles, progressively growing pneumatoceles, in pneumatoceles rupturing into the pleural space, or if they are bleeding [6]. Prophylactic antibiotic therapy is not used for an uncomplicated pneumatocele, even though secondary infection is the most frequent complication (up-to 30%) [6]. Once a pneumatocele is infected, therapy is similar to that used for lung abscesses [6].

In summary, we have described a young man with traumatic pneumatoceles accompanying a pneumothorax and a lung contusion. As expected, he made a full and uneventful recovery.

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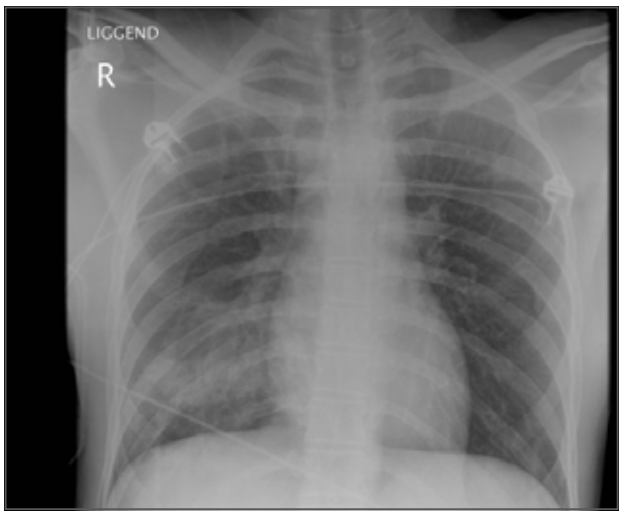
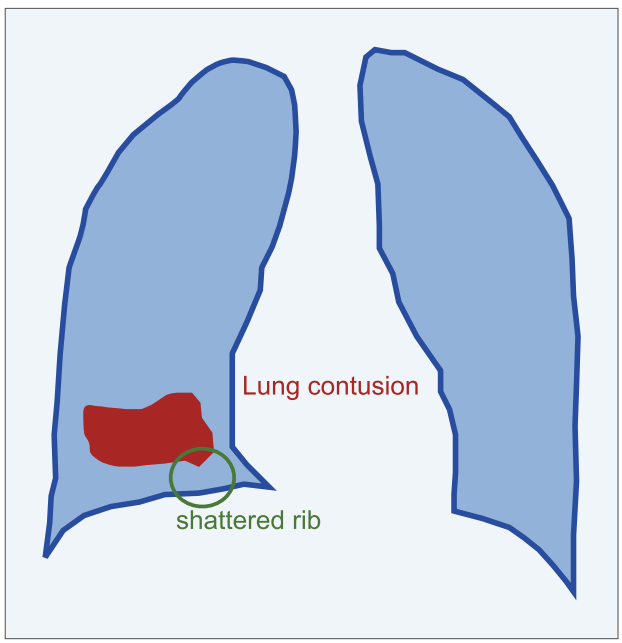
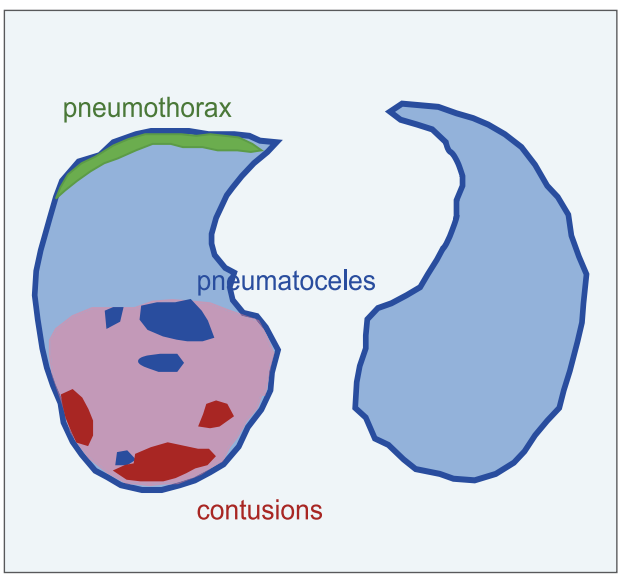
Figure 1. Chest X-ray. Right: Rib 10 shattered, lungcontusion, no obvious pneumothorax. Left: no obvious abnormalities.





Figuur 2. CT-Thorax. lung contusion, pneumatoceles and pneumothorax.



References:

1. Schimpl G, Schneider U. Traumatic pneumatoceles in an infant: case report and review of the literature. Eur J Pediatr Surg 1996; 6: 104-106.

2. Armstrong P. Basic patterns in lung disease. In: Armstrong P, Wilson AG, Dee P, Hansell DM (eds). Imaging of diseases of th chest. 3rd ed. Spain: Mosby; 2000, p 115.

3. Quigley MJ, Fraser RS. Pulmonary pneumatocele: pathology and pathogenesis. AJR 1988; 150: 1275-1277.

4. Wan-Hsiu L, Sheng-Hsiang L, Tsu-Tuan W. Pneumatocele formation in adult pulmonary tuberculosis during antituberculous chemotherapy: a case report. Cases Journal 2009; 2: 8570.

5. Puri MM, Srivastave A, Jain AK, Behera D. Pneumatocele formation in adult escherichia coli pneumonia. Ann of Thoracic Med 2011; 6: 101-102.

6. Melloni G, Cremona G, Ciriaco P, Pansera M, Carretta A, Negri G, Zannini P. Diagnosis and treatment of traumatic pulmonary pseudocysts. J Trauma 2003; 54: 737-743.

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CLINICAL IMAGE

Pulmonary Cavities after High Energy Trauma

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Abstract - In this report, we describe a 21-year-old patient with pulmonary pseudocysts after a car accident. In our patient we found multiple, big Traumatic Pulmonary Pseudocysts (TPPC) on the CT scan. A chest radiograph did not show any radiologic sign matching TPPC. The size of the pseudocysts decreased during the admission period. In this case, mechanical ventilation had no influence on the size of the pseudocysts. With watchful waiting complete pulmonary recovery was attained.

Keywords - **Blunt chest trauma, Traumatic pulmonary pseudocysts, CT scan**

Case report

A 21-year-old male was admitted to hospital after a high energetic trauma. He had driven his car at high speed into a tree. On site, the patient was awake and he was haemodynamic and respiratory stable.

In the emergency department, his airway was clear and he had a Glasgow Coma Scale of 15. Oxygenation was adequate and breath sounds were normal. He had no haemoptysis and did not complain of chest pain. The patient's heart rate and blood pressure were normal. Examination of the abdomen did not reveal any abnormalities except for some tenderness in this area and in the pelvis. The patient had two open fractures of the femur on the right side and a swollen ankle. Because of increasing restlessness, he was intubated and sedated. His past medical history revealed no specific illness or substance abuse. Chest radiography on admission, before intubation, showed mediastinal and subcutaneous emphysema in the upper quadrants and consolidation of the right lower lobe.(Figure 1)

Computed Tomography (CT) of the thorax showed bilateral, basal consolidations in the lower lobes with cavitations, surrounded by lung parenchyma with patchy consolidations and a pneumothorax on the left. There were also similar cavities around the minor fissure. The largest cavity was found in the right lung and was 37 x 26 mm, no fluid levels were seen. Paraseptal emphysema on the anteromedial side of the right lower lobe and a left ventral pneumothorax was also seen (Figure 2). Because of oxygen desaturation combined with diminished breathing sounds on the left side, a chest tube was inserted on that side while the patient was still on the CT table.

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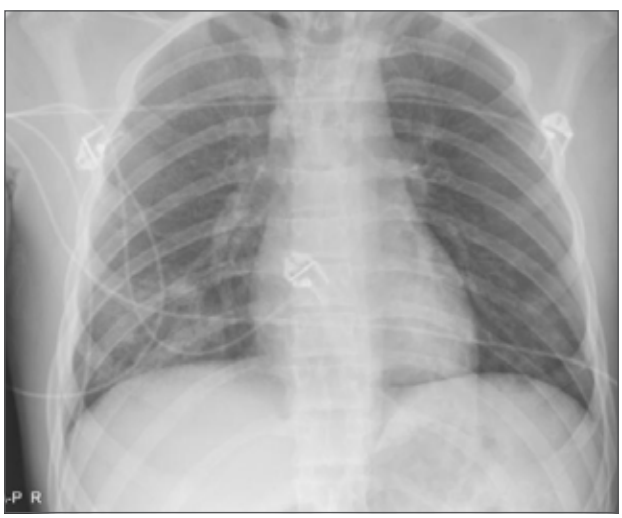
Complete examination of the patient revealed fractures of both femurs, and on the right side fractures of medial collum, os ilium, patella, forefoot, calcaneus, ankle and countenance. Furthermore, bilateral pulmonary contusion, ruptured spleen and devascularization of the right kidney were found. Due to decreased breath sounds on both sides and decreasing saturation after admission to the ICU, a chest tube on the right side was inserted. However, a pneumothorax on the right side was not confirmed by chest X-ray. External fixation of most fractures was performed. The pneumothoraxes required additional drains during the following days. Adequate gas exchange could be achieved with pressure supported volume controlled ventilation with low tidal volumes. The patient received antibiotics because of his open fractures. The damage to the abdominal parenchymatous organs was treated conservatively.

Figure 1. A-P Chest X-ray on admission before intubation



A repeated CT-thorax on day 4 showed that the pneumothorax on the left side had increased and new atelectasis of the left lower lobe was present. The cavities in the lower lobes had decreased in size (Figure 3). The cavitary lesions in the lung parenchyma were interpreted as TPPCs.

Discussion

Blunt trauma of the chest often leads to a pulmonary contusion or intrapulmonary haemorrhage. Development of pulmonary pseudocysts after blunt trauma is a rare complication, especially bilateral presentation of pseudocysts [1-3]. TPPCs are cavitary lesions, with a wall formed by interlobular interstitial connective tissue, without epithelial lining, that develop in the pulmonary parenchyma following chest trauma [2-4]. The incidence of TPPC is about 1-3% after a chest injury in adults [1,3,4]. With the increased use of CT scans in trauma screening, the 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 [1,3,4]. The hypothesis is that the chest is more compliant in younger people and thus there is a greater transfer of kinetic energy to the lung parenchyma, compared with adults [3,4]. The rapid compression and decompression of the chest damages alveoli and interstitial lung tissue, retraction forces create small cavities filled with air and/or fluid [1,3,4]. If there is no connection between the lesion and the respiratory tract, the lesion will become a pulmonary hematoma [1,2,5]. Resolving pulmonary hematomas may develop into secondary pulmonary pseudocysts [5]. A primary pulmonary pseudocyst is a direct result of trauma itself [5]. In this case, however, no signs of intra-pulmonary hematomas were seen at any point and therefore the probable cause was direct laceration.

Another hypothesis for this condition is that when the glottis is closed or the bronchus is obstructed at the time of the trauma, the compressed air causes pressure cavities [4].

The role of mechanical ventilation in the development of pulmonary pseudocysts is unclear [1,3]. TPPC can be asymptomatic, but if there are symptoms they are variable and non-specific and include haemoptysis, dyspnoea, hypoxaemia, chest pain, coughing and sometimes hyperthermia [1-4]. However, these symptoms can also be attributed to the trauma itself [3]. Physical examination usually reveals little or no abnormalities; sometimes rales can be heard [2].

In the majority of cases the pseudocysts occur within 12 to 24 hours after trauma and can be oval or spherical, unilateral or bilateral and single or multiple [1,2,4]. The diameter of the pseudocysts varies from 1 to 14 cm and can quickly change in shape and size [2-5]. The lower lobes are those most commonly involved, the apices seem not to be affected by TPPC [3,4]. The location of pseudocysts can be central or subpleural, on the side of trauma impact, but they can also be located on the other side, due to the contre-coup effect [3]. In 50% cases the pseudocysts can be seen on chest radiography [2-4]. CT is the best diagnostic test for TPPC [1,2,4].

The diagnosis of TPPC is made by exclusion. Differential diagnoses for TPPC include rupture of the oesophagus, lung abscess, tuberculous cavity, mycosis, Wegener granulomatosis, bronchial carcinoma and bronchogenic cyst and substance abuse by inhalation [3-5]. Improvement of symptoms and the CT scan, without treatment, can confirm the diagnosis.

Figure 2. CT scan on day of trauma. In the right lower lobe multiple intraparenchymal cavities of variable sizes are present, one of which contains an air-fluid level. Surrounding ground glass opacity is noted. Ground opacities are also present in the left lower lobe. In both lower lobes, similar subpleural cavities in a paravertebral position can be seen. A pneumothorax is also noted on the left side.

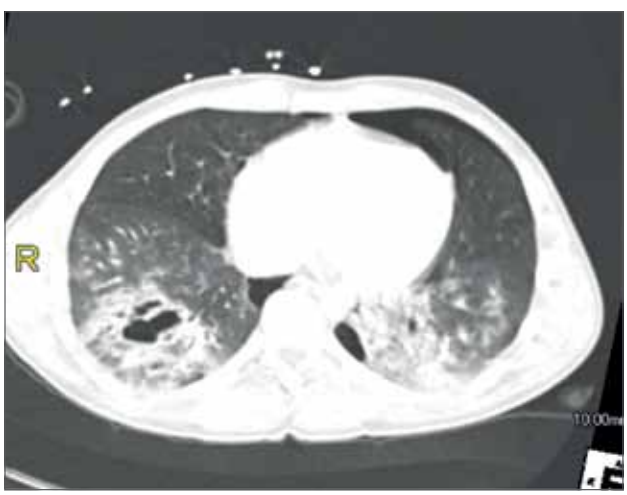
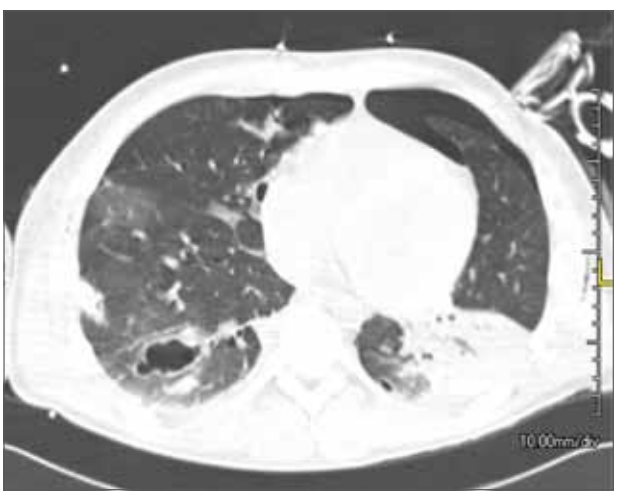


Figure 3. A follow-up CT on day 4 shows resolution of the ground glass opacities surrounding the cavities in the right lower lobe. There is atelectasis of the left lower lobe glass



Consolidation usually disappears within 7 to 10 days after the trauma [3]. The cysts will increase in size during the first 2 weeks and will slowly disappear within 2 to 3 months [1,2]. Given the spontaneous remission, only symptomatic therapy is indicated. Complications of TPPC are rare [2,3]. Rupturing of a pseudocyst can induce a secondary pneumothorax [1,3]. Pseudocysts can get infected [1-3]. After spontaneous remission, no residual radiographic abnormalities are usually present [2]. Indeed, our patient had a complete and uneventful pulmonary recovery.

Conclusion

TPPCs are cavitary lesions, with a wall formed by interlobular interstitial connective tissue, without epithelial lining, that develop in the pulmonary parenchyma after 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 requires no special treatment and will resolve spontaneously.

References

1. Yazkan R, Ozpolat B, Sahinalp S. Diagnosis and management of post-traumatic pulmonary pseudocyst. Respir Care 2009;54:538-41.
2. Stathopoulos G, Chrysikopoulou E, Kalogeromitros A, Papakonstantinou K, Poulakis N, Polyzogopoulos D, et al. Bilateral traumatic pulmonary pseudocysts: case report and literature review. J Trauma 2002;53:993-6.
3. Melloni G, Cremona G, Ciriaco P, Pansera M, Carretta A, Negri G, et al. Diagnosis and treatment of traumatic pulmonary pseudocysts. J Trauma 2003;54:737-43.
4. Tsitouridis I, Tsinoglou K, Tsandiridis C, Papastergiou C, Bintoudi A. Traumatic pulmonary pseudocysts: CT findings. J Thorac Imaging 2007;22:247-51.
5. Athanassiadi K, Gerazounis M, Kalantzi N, Kazakidis P, Fakou A, Kourousis D. Primary traumatic pulmonary pseudocysts: a rare entity. Eur J Cardiothorac Surg 2003;23:43-5.