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Review

Traumatic pulmonary pseudocyst: An underreported entity

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ABSTRACT

Background: Traumatic pulmonary pseudocysts (TPP) are underreported cavitary lesions of the pulmonary parenchyma that can develop following blunt chest trauma. Although the occurrence of traumatic pulmonary pseudocyst is rare, this condition should be considered in the differential diagnosis of any cavitary lesion. Awareness of this injury and its clinical significance is important for successful management in order to avoid medical errors in the course of treatment.
Methods: A literature search was conducted through Medline using the key phrases "traumatic pulmonary pseudocyst" and "traumatic pneumatocele." Relevant articles, especially those with focus on diagnosis and management of traumatic pneumatocele in adults, were selected. Due to the scarcity of literature and lack of Level I evidence on this subject, studies published in any year were considered.
Results: A search of "traumatic pulmonary pseudocyst" and "traumatic pneumatocele" yielded 114 studies. Most of these were excluded based on inclusion and exclusion criteria. Thirty-five articles were reviewed. The majority of these were individual case studies; only eight articles were considered large case studies (greater than eight patients).
Conclusion: Traumatic pulmonary pseudocysts are lesions that occur secondary to blunt chest trauma. Diagnosis is based on a history of trauma and appearance of a cystic lesion on CT. Accurate diagnosis of traumatic pulmonary pseudocyst is imperative to achieve successful outcomes. Failure to do so may lead to unnecessary procedures and complications.

Contents

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Introduction

Traumatic pulmonary pseudocysts (TPP) are rare cavitary lesions associated with blunt thoracic injury first described by Fallon in 1940 [1]. Since the original description, these lesions have been assigned various names in the literature, including traumatic pulmonary pseudocyst, traumatic pneumatocele, and traumatic lung cyst [2]. Many authors agree that the term traumatic pulmonary pseudocyst, proposed by Santos and Mahendra, is most accurate [3]. The walls of TPPs are formed by interlobar interstitial connective tissue and lack bronchial elements. True cysts, on the other hand, are enclosed by epithelial tissue [3].

The etiology of TPP is usually associated with blunt thoracic trauma. Motor vehicle accidents and falls have been reported as the most common mechanisms of injury, but little is known about the prevalence of pseudocyst according to mechanism of injury [4]. Few reports to date have described TPP in association with penetrating trauma. One report described the formation of a pseudocyst following guidewire manipulation. A second report described a pseudocyst that resulted from intraparenchymal chest tube insertion. All other case reports described the development of pseudocysts following stab wounds [5]. Barotrauma can also result in pseudocyst formation. Complications of mechanical ventilation, although primarily described in infants, can produce single or multiple air-filled cystic lesions consistent with TPP [6].

Methods

A literature search was conducted through Medline, using the key phrases “traumatic pulmonary pseudocyst” and “traumatic pneumatocele.” The selection criteria included studies with a surgical focus and those that discussed the diagnosis and treatment of TPP in adults. Recent publications were preferred, but due to the underreported nature of this lesion, studies published in any year were considered. Studies that discussed TPP in children were largely excluded in order to avoid confusion with post-infectious pneumatoceles.

Results

A search of “traumatic pulmonary pseudocyst” and “traumatic pneumatocele” yielded 114 articles in total after removing duplicates. Application of the previously stated inclusion and exclusion criteria narrowed the selection to 35 articles, which were reviewed. All studies were classified according to the levels of evidence. There was a notable lack of Level I evidence; all chosen studies provide Level III evidence. The majority of these were individual case studies; only eight articles were large case studies with greater than 8 patients.

Discussion

Pathophysiology

Traumatic pulmonary pseudocysts are most often seen in children and young adults. In 1965, Sorsdahl and Powell reported that 85% of patients with TPP were under the age of 30 [7]. TPP develops after transmission of compressive forces to the lung parenchyma secondary to blunt chest trauma [8]. A significant degree of chest wall compliance, as seen in younger individuals, is required for TPP formation [9]. By the fourth decade of life, however, the costal cartilages and posterior costovertebral ligaments lose their flexibility. In older adults, the result is rib and sternal fractures rather than pseudocyst formation [10]. TPP also has a male predominance. Fagkrezos et al [11] suggested that because males are more often involved in motor vehicle accidents and falls, they are more likely to be affected.

The literature describes several mechanisms for the development of TPP following blunt trauma. Most authors agree that pseudocysts are produced by shearing forces causing pulmonary laceration accompanied by the escape of air or fluid into the tissue [12]. The exact mechanism is unknown, but several theories have been proposed. Williams and Bonte [13] suggest that concussive waves produced by blunt trauma create shearing forces that tear the lung parenchyma. Alternatively, Fagan and Swischuk [14] speculate that TPP develops following sudden, severe compression of a segment of the peripheral bronchial tree, which obstructs the bronchus and transmits an explosive pressure distally. This creates a “bursting lesion.” These theories led to the proposal of a two-step inclusive mechanism, which is now widely accepted [15]. First, compressive traumatic forces increase intrapulmonary pressure until the parenchyma bursts, producing lacerations. Second, decompression of the chest and increasingly negative intrathoracic pressure allow the elastic tissue of the lung to recoil, permitting the formation of small cavities filled with air or fluid [15]. Each cavity then continues to grow in size until the pressure within the cavity is equal to that of the surrounding parenchyma [11].

The mechanism of TPP formation following penetrating trauma is not well-described and requires further investigation. Some authors propose that these lesions develop in a “one-way” or “check-valve” mechanism where air enters a laceration in the pulmonary parenchyma created by penetrating trauma, such as a stab wound. If the defect seals quickly, the air becomes trapped and is unable to escape the pleural space resulting in pseudocyst formation [8]. TPPs that develop specifically in mechanically ventilated patients are not heavily researched but are thought to be a consequence of continuous positive airway pressure [16].

Clinical features

Most traumatic pulmonary pseudocysts present within 24–48 h following blunt chest trauma [17,18]. The clinical presentation is variable and ranges from asymptomatic to acute respiratory distress. Chest pain, dyspnea, cough, and hemoptysis are commonly reported [19]. Hemoptysis, which is present in up to 56% of cases, may continue for several days [7]. These symptoms are typical of injury to lung parenchyma and are not specific to pseudocysts [20]. Patients may present with mild fever and leukocytosis secondary to absorption of damaged lung tissue [21,22]. In almost all reported cases, associated injuries such as rib fractures and pulmonary contusion were present [4]. In the setting of TPP, acute respiratory failure is related to the presence of an associated pulmonary contusion [5].

Traumatic pulmonary pseudocysts can be single or multiple, unilateral or bilateral, and located in any part of the lung. It is well documented in the literature that the lower lobes are most frequently involved while the apices are usually spared. Additional studies have confirmed this finding [6,8,14,23,24]. It is important to note that the lesion may not be located in the immediate region of chest wall injury. In some cases of TPP, the traumatic force is transmitted in a contracoup manner [14]. The velocity of impact and degree of chest wall displacement may also contribute to the location of TPP. In an experimental rabbit model, Lau et al [25] demonstrated that a high velocity impact produces peripheral alveolar injury while a low velocity, high displacement impact produces central parenchymal injury. This theory was supported by Athanassiadi et al [20]; all patients with TPPs were involved in a study of high-speed accidents, and every TPP developed peripherally.

The size of traumatic pseudocysts reported in the literature ranges from 1 to 14 centimeters in diameter [5]. Relationships between size of the lesion and severity of the inciting chest trauma