

TEACHING CASE REPORT

Abdominal crunches as an unusual cause of empyema

The case: A 28-year-old woman, previously healthy, came to our emergency department after 2 days of progressive left-sided chest pain. The onset had been sudden, in the midst of her doing a few abdominal crunches. She described the pain as sharp, nonradiating and pleuritic. Physical examination found her to be afebrile, with stable vital signs and no evidence of respiratory distress. Faint crackles could, however, be heard on the left side of her chest.

Two hours after her arrival, the patient developed fever and worsening chest pain. Re-examination revealed decreased air entry into the left lobes of the lung. Chest radiography showed a 7.5-cm mass arising from her left posterior mediastinum (Fig. 1). This later progressed to a large left-pleural effusion (Fig. 2); upon thoracentesis, it was found to be empyematous.

CT scans revealed a left-sided, posterior, heterogeneous, multicystic mass with punctate areas of calcification



Fig. 1: Radiographic views of the chest — lateral (left) and posteroanterior (right) — showing the pulmonary sequestration arising from the left posterior mediastinum.

(Fig. 3). Via angiography, the blood vessels feeding it were identified as branches of the inferior phrenic and left gastric arteries; drainage was via both the systemic and portal venous systems. The patient was admitted to hospital and administered ciprofloxacin and clindamycin intravenously. A chest tube was inserted into her left pleural space. After consultation about

exploration and mass excision, our thoracic surgery service recommended surgical management. Forty-eight hours before the operation, the vessels feeding the mass were embolized with angiographic guidance.

A multicystic extralobar sequestration was uncovered and resected from the left lower lobe of her lung. This mass was found to be perforated; when

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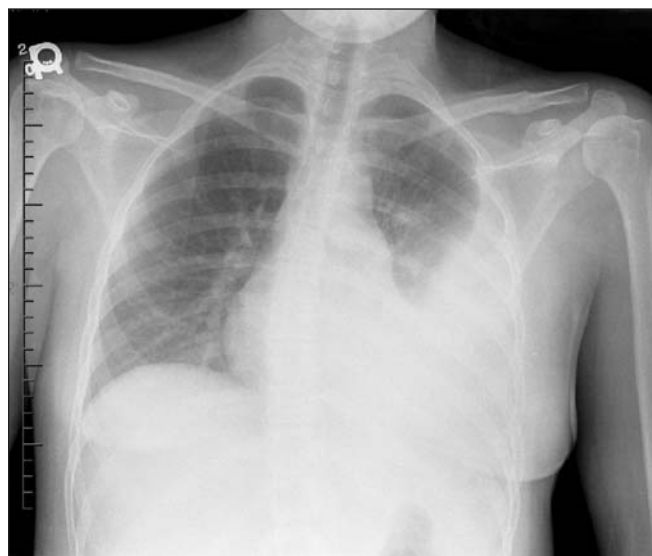


Fig. 2: A posteroanterior chest radiograph showing the evolution of the left pleural effusion.



Fig. 3: CT scan of the patient's chest, showing a left-sided, posterior, heterogeneous, multicystic mass with punctate areas of calcification.

manipulated, it exuded pus. The patient's postoperative recovery was uneventful; she was discharged within 2 weeks of hospital admission.

Described is a case of empyema secondary to rupture of a pulmonary sequestration induced by abdominal crunch exercises. A rare congenital malformation, the incidence of these pulmonary "cysts" has been reported¹ as being about 1.5–17 per thousand population — an underestimate, given that they are usually asymptomatic. A pulmonary sequestration (also called a bronchopulmonary sequestration) is a segment of lower-respiratory-tract parenchyma that is nonfunctional, with no communication with the rest of the tracheobronchial tree. Its arterial supply derives from the systemic vasculature of the developing embryo. Pulmonary sequestration may arise in the womb from traction of the lung bud by migrating abdominal organs, from caudal migration of a tracheobronchial bud along with its blood supply, or from accessory lung buds.²

Pulmonary sequestrations are classified as intralobar or extralobar, with a respective relative prevalence of 6:1 (Table 1).³ They have several clinical manifestations, which may appear at any age. They may be discovered during prenatal ultrasound; upon investigation of postnatal respiratory distress, recurrent pneumonia and bronchitis, or hemoptysis; and incidentally in radiologic findings, even when asymptomatic. Cases of

empyema, hemothorax and pneumo-hemoperitoneum resulting from cystic rupture have also been described.²

Cyst wall degeneration and subsequent rupture has been associated with activities that cause a physiologic increase in intra-abdominal pressure.⁴ Hepatic cyst rupture with fatal complications has been described in conjunction with physiologic activities such as coughing episodes.³ A variety of exercises and manoeuvres have been shown to increase intra-abdominal pressures from an at-rest range of 1–6 mm Hg (Table 2);⁵ abdominal crunch-type exercises, for example, can increase them to 130 mm Hg.⁶ Because diaphragm elevation transmits these high pressures to the thorax and the intrapleural cavity, similar sequelae in the thorax are not surprising.

We hypothesize that the increase in intra-abdominal pressure with abdominal crunch exercises caused the rupture of our patient's pulmonary sequestration and her subsequent empyema. When evaluating patients with intra-abdominal or -thoracic cyst ruptures, clinicians should enquire about activities that may raise intra-compartmental pressures.

Patients with ruptured cysts are best managed surgically, with perioperative antibiotic therapy. Intralobar sequestration is corrected by lobectomy rather than by segmental resection, although extralobar sequestrations can be completely removed without disturbing the remaining lobes. Despite the risks of

Table 1: Comparative characteristics of intralobar and extralobar pulmonary sequestrations

Feature	Intralobar sequestrations	Extralobar sequestrations
Lung parenchyma	Contiguous, functional	Noncontiguous but functional
Age at diagnosis	> 20 yr in over half of cases	Mostly neonates, young children
Sex distribution	Equal	80% of affected patients are male
Location	Intrathoracic	At the diaphragmatic crus or mediastinum, or in the abdominal cavity or retroperitoneal space
Pleura	Distinct visceral pleura	No pleural covering

Information source: *Radiographics* 2002;22(Spec No):S25–43.³

Table 2: Intra-abdominal pressure changes during various activities

Activity	Pressure generated, mm Hg	
	Minimum	Maximum
Lying supine	-1	6
Coughing	40	127
Abdominal crunches	14	130
Bench presses	2	34
Valsalva's manoeuvre	20	64
Jumping jacks	43	140

Data sources: *J Surg Res* 2005;129:231-5⁴ and *Obstet Gynecol* 2006;107(2 Pt 1):305-9.⁶

intraoperative exsanguination from anomalous vasculature, rates of complications, illness and death are low if the resection is done before infections have become recurrent. The postoperative prognosis is uniformly good. Patients with incidentally discovered cysts that are asymptomatic should be warned away from activities that can raise intra-thoracic pressure.

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REFERENCES

- Weinbaum PJ, Bors-Koefoed R, Green KW, et al. Antenatal sonographic findings in a case of intra-abdominal pulmonary sequestrations. *Obstet Gynecol* 1989;73:860-2.
- Halkic N, Cuenoud PF, Cortes ME, et al. Pulmonary sequestration: a review of 26 cases. *Eur J Cardiothorac Surg* 1998;14:127-33.
- Zylak CJ, Eyster WR, Spizarny DL, et al. Developmental lung anomalies in the adult: radiologic-pathologic correlation [review]. *Radiographics* 2002;22 Spec No:S25-43.
- Erdogmus B, Yazici B, Akcan Y, et al. Latent fatality due to hydatid cyst rupture after a severe cough episode. *Tohoku J Exp Med* 2005;205:293-6.
- Cobb WS, Burns JM, Kercher KW, et al. Normal intraabdominal pressure in healthy adults. *J Surg Res* 2005;129:231-5.
- Weir LF, Nygaard IE, Wilken J, et al. Postoperative activity restrictions: any evidence? *Obstet Gynecol* 2006;107(2 Pt 1):305-9.