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# Surgical vs. nonsurgical management of post-traumatic intercostal lung herniation in children

Mila Kolar[a,*], Ayca Toprak[a], Andrea Winthrop[a], Lloyd Sly[b], Donald Soboleski[b]

[a] Department of Surgery, Queen's University, Kingston, Ontario, Canada
[b] Department of Radiology, Queen's University, Kingston, Ontario, Canada

## ABSTRACT

*Background:* Intercostal lung herniation (ILH) is an exceptionally rare condition in pediatric patients, characterized by disruption of fascial planes and intercostal musculature allowing for protrusion of a portion of the lung parenchyma into this space. In most cases it is a consequence of blunt chest trauma. Due to the rarity of the condition, diagnostic and management approaches are based on the experience in adults, where CT is the most often used diagnostic tool, and surgery is the primary management approach. Recent published experience in adult and pediatric patients supports the use of less invasive imaging and management strategies, particularly in otherwise asymptomatic patients, giving us the opportunity to reconsider our clinical approaches in the diagnosis and management of these patients.

*Methods:* We present a recent case of posttraumatic ILH. In addition, we conducted a systematic review of the literature. A search of the PubMed, Embase, Ovid, Scopus and Cochrane databases was conducted using a combination of the following search terms: intercostal lung hernia in children, lung herniation in children, traumatic intercostal lung hernia in children. Two authors independently extracted data, reviewed the abstracts, and assessed them for inclusion in the review.

*Results:* All reported cases were single case reports, with total of 16 including our patient. All ILH were unilateral. The most common etiology was bicycle handle bar injury 10 (63%). Herniation was found on the anterior chest wall in 13 (81%) patients, and in 3 (19%) was on the anterolateral chest wall. To confirm the diagnosis chest x-ray was used in 14 (88%) patients, CT chest in 7 (44)%, fluoroscopy in 1 (6%), chest ultrasound in 3 (19%), and in 1 patient there was no imaging documented. Management was surgical in 10 patients (63%) including thoracotomy with primary closure in 8 patients and thoracoscopic repair in 2 patients. Six patients (37%) had nonsurgical management by chest strapping, with complete resolution of herniation within 2–6 weeks. There was no reported complications or recurrence following either type of management.

*Conclusions:* Postraumatic intercostal lung herniation in children is a rare condition. Including our case reported here, there are only 16 reported cases. In children ILH is mostly seen after blunt chest trauma caused by bicycle handle bar injury. Given the rarity of the condition, the pediatric literature on this subject is scarce, with no published guidelines or evidence based recommendations for imaging and management approaches (surgical vs. nonsurgical). Although rare, the pediatric surgeon should be familiar with this condition in order to avoid potentially harmful, invasive or unnecessary diagnostic and therapeutic approaches that are extrapolated from experience in adult patients. Noninvasive imaging modalities including chest radiographs and ultrasound, and nonsurgical management of posttraumatic intercostal lung herniation should be considered as an initial treatment option in the management of asymptomatic patients.

## 1. Introduction

Lung hernias are defined as a protrusion of a portion of the lung parenchyma through a defect in the thoracic wall. They can be classified by anatomic location as cervical and intercostal. While herniation through the thoracic wall can be congenital in the vast majority of cases these hernias are acquired (82%) [1,2]. Acquired intercostal lung hernias can be classified as traumatic, spontaneous, iatrogenic or pathologic (3,4). Intercostal hernias' constitutes around 83% of all lung hernias in adults with nearly two-thirds being a result of trauma. Regardless of their anatomic location or etiology, lung hernias are distinctly rare [5,6].

* Corresponding author.
*E-mail address:* mila.kolar@queensu.ca (M. Kolar).

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In the pediatric age group, posttraumatic intercostal lung hernias are exceptionally rare, with only 15 cases reported, based on the literature review conducted for this report [7–21]. Although rare, pediatric surgeons should be familiar with this condition because of the potential for complications and difficulty identifying these hernias on imaging studies without specialized maneuvers [4]. Given the rarity of the condition in pediatric patients and the lack of diagnostic and management guidelines, when faced with this condition pediatric surgeons mostly rely on published reports in adults. However, the clinical presentation, including the mechanism and severity of injury, differs significantly between adult and pediatric patients.

We present a case report and a systematic literature review of pediatric posttraumatic intercostal lung herniations. Our goal is to assist in the development of more pediatric focused diagnostic and management approaches for this condition by outlining the currently available pediatric evidence, broadening the scope of acceptable imaging choices and management options. By addressing the clinical, physiological and long term outcome differences between children and adults, pediatric surgeons could avoid potentially harmful, invasive, or unnecessary diagnostic and therapeutic approaches that are extrapolated from the adult literature.

## 2. Case report

An 8-year-old male sustained blunt trauma to the left anterior chest after falling over a fence while playing. He experienced sudden, intense localized pain at the affected area, but no other symptoms. The pain gradually resolved. One hour later while coughing, the child noticed a bulge at the site of the injury and brought this to the attention of his parents. The child presented to the emergency department 2 h after the injury, with mild localized chest wall pain and no respiratory symptoms. Physical examination of his chest was normal. At rest there was no visible bulging. The skin over the injured site in the fifth intercostal space had two small abrasions, but no bruising. When coughing or performing a Valsalva maneuver a soft, reducible subareolar intercostal bulge measuring 5 cm × 3 cm in diameter was evident (Fig. 1). There was slight tenderness to palpation of the intercostal muscles at the affected area. The muscles felt more attenuated in the central area of approximately 3 cm × 2 cm, but no well defined intercostal muscular defect was palpable. No abnormalities were detected on posteroanterior and lateral chest radiographs that were done without the Valsalva maneuver. Pediatric surgery was consulted and an ultrasound of the affected chest area was completed, demonstrating intercostal lung herniation with coughing and deep breathing. It was not possible to measure the absolute diameter or size of the intercostal defect (Figs. 2–4).

The patient was managed non-surgically with a pressure dressing (gauze with a self adhesive tape) and followed clinically with weekly assessments in the ambulatory clinic. Management by pressure dressing resulted in consistent clinical improvement with a gradually decreasing size of the hernia bulge, and complete clinical resolution by week five. A follow up ultrasound was performed 6 weeks following the injury, showing no spontaneous or inducible herniation, supporting the conclusion that the intercostal musculofascial defect had healed. Pressure dressing management was discontinued at 6 weeks. The patient had full

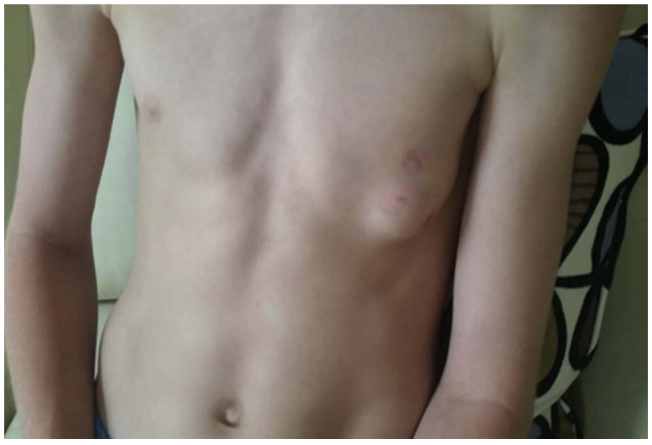

**Fig. 1.** Intercostal hernia bulge during Valsalva maneuver.

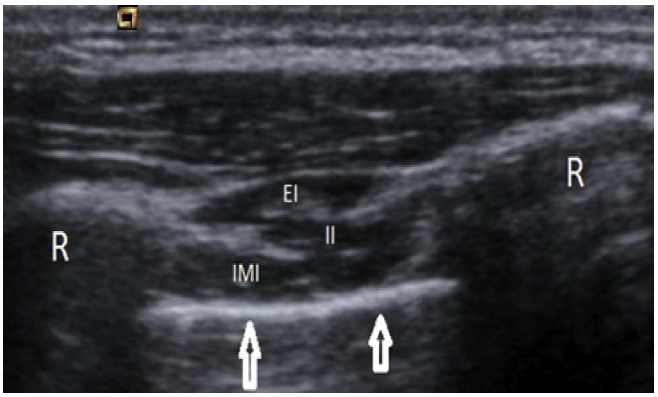


**Fig. 2.** Image 1 - The normal anatomy visualized on sonography. The sagittal scan plane depicts the external (EI), internal (IE) and innermost intercostal (IMI) between rib margins (R). Arrows delineate bright echogenic interface of pleura which demonstrates no protrusion into intercostal space with exertion.

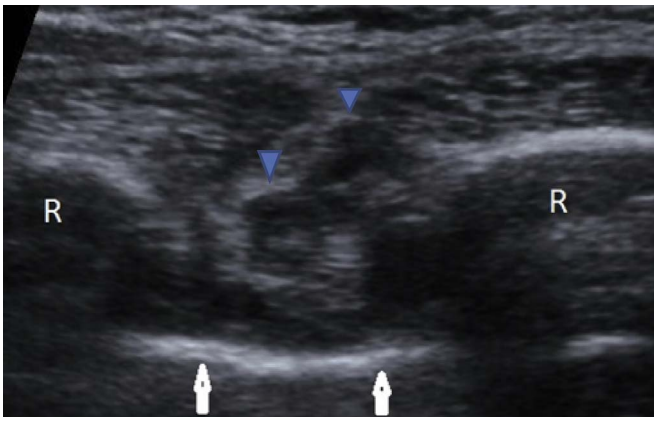


**Fig. 3.** Image 2 - Post trauma - The normal visualization of fascial planes separating intercostal musculature is lost with inhomogeneity, increased bulk and lobularity of disrupted musculature (blue arrowheads) at this site.

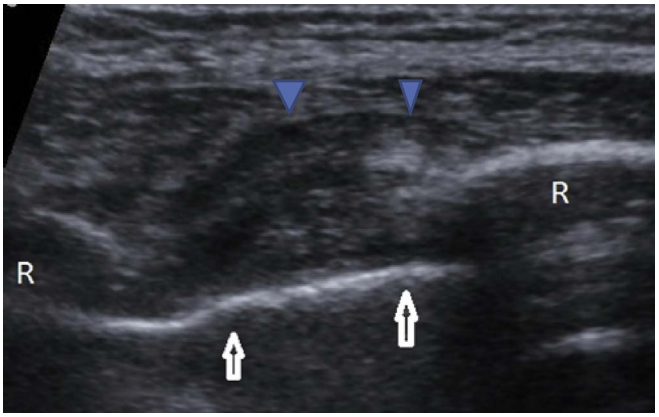


**Fig. 4.** Image 3 - Illustrates the protrusion of pleura (white arrows) into intercostal space with herniation of disrupted musculature (blue arrowheads) anteriorly resulting in the palpable mass exaggerated with exertion.