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Traumatic thoracic rib cage hernias: Operative management and proposal for a new anatomic-based grading system

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ABSTRACT

Background: Traumatic Rib Cage Hernias (TRCH) requiring operative repair are rare and there is currently no literature to guiding surgical management.

Methods: Perioperative review of TRCH over 32 years. Five operative grades were developed based on extent of tissue/bone damage, size, and location.

Results: Twenty-four patients (20 blunt, 4 penetrating) underwent operative repair. Lung was the herniated organ in 88% with a median of 4 rib fractures and average size of 60.25 cm. Types of operation were well clustered by assigned TRCH grade. The majority required mesh (75%) and/or rib plating (79%). Complex tissue flap reconstruction was required in 10%. Full range-of-motion was maintained in 88% with 79% returning to pre-injury activity levels. Five patients had continued pain at final follow up (mean = 7 months).

Conclusion: The size and degree of injury has important implications in the optimal surgical management of TRCHs. These operative grades effectively direct surgical care for these rare and complex injuries.

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1. Introduction

Traumatic rib cage hernias (TRCH) are defined by the protrusion of either abdominal or thoracic viscera through a defect beyond the borders of the chest wall, cervical outlet, or the diaphragm. These can range from small occult hernias identified only on imaging to large and dramatic appearing defects that are immediately obvious on presentation (Fig. 1). Historically, these hernias have been characterized by the Morel-Lavallee classification system using etiology and location.¹ However, this system is quite outdated as it was developed at the end of the 19th century, does not provide anatomic distinction by degree/size of the hernia or its contents, and provides no useful information to guide operative approaches or repair strategies in the modern era.

Although TRCH are a relatively uncommon injury, there may be an increasing incidence of this type of traumatic injury related to

increasing high velocity trauma as well as the destructive capabilities available through modern weaponry. Furthermore, the rise of global terrorism has brought the dramatic injuries seen in the forms of blast injury or high velocity rifle wounds from the battlefield to civilian trauma setting.^{2,3} Finally, the increasing utilization of highly sensitive imaging such as computed tomography has undoubtedly increased the recognition of these lesions. The current literature on traumatically-induced hernias has focused almost solely on the surgical management of traumatic abdominal or groin hernias.^{4–6} However, very little guidance is available for the operative management of TRCH.^{7–9}

We sought to utilize three decades of experience to describe a large series of TRCH requiring operative intervention. Using characteristics of these thoracic injuries we have developed and propose the use of updated grading system to guide the treatment and surgical decision making of these dramatic injuries, and assessed the correlation of this grading system with select outcome measures.

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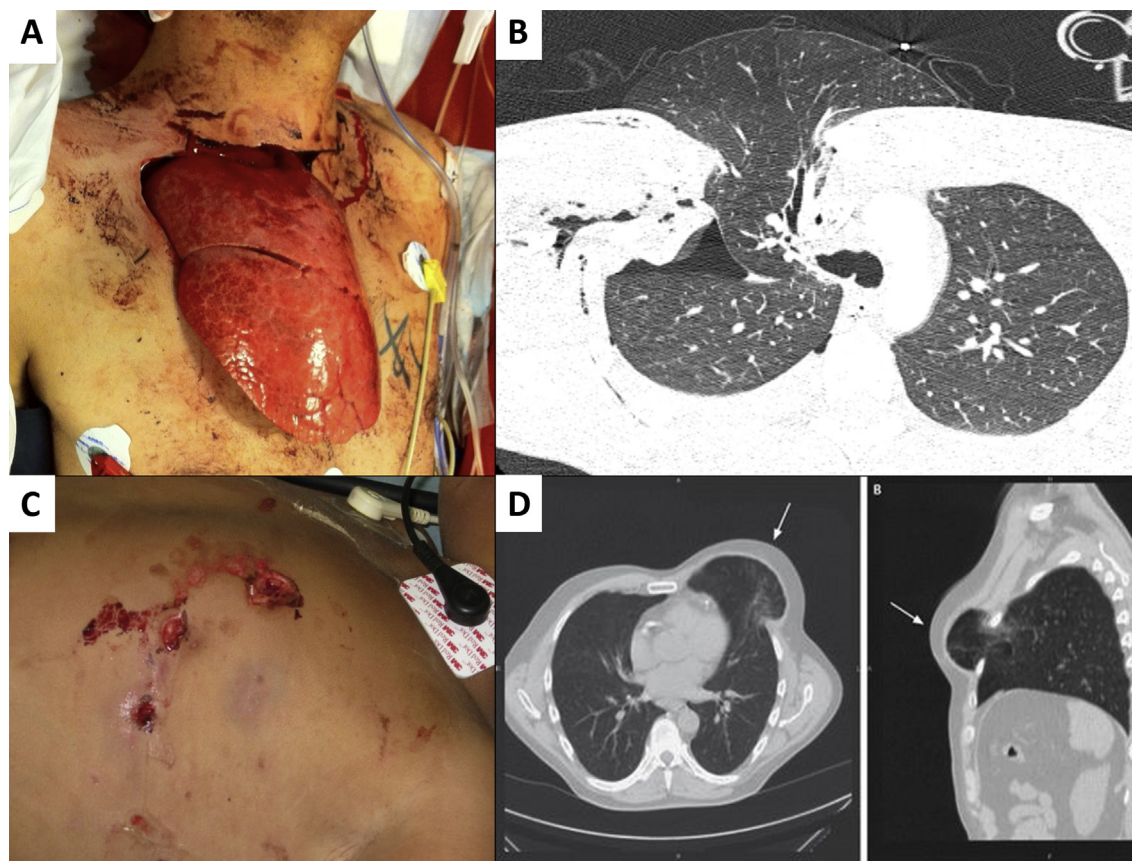


Fig. 1. Examples from our cohort of gross (A/C) and corresponding radiographic (B/D) imaging of acute TRCH.

2. Methods

After receiving institutional review board approval, an international multi-center retrospective review was conducted of all post traumatic rib cage hernias from 1990 to 2017. Inclusion criteria were defined as all diagnosed TRCH sustained after either blunt or penetrating trauma in patients who underwent operative repair. TRCH was confirmed by physical exam and/or diagnostic imaging (chest x-ray or CT scan) as seen in Fig. 1(C/D). Standardized data collection sheets that included demographics, injury description and characterization, operative interventions, short-term post-operative outcomes, and then functional outcomes at the most final follow-up were completed by the managing surgeons.

Cohort descriptive data included age, sex, height, weight, time to diagnosis and time to repair. Injuries were characterized by type of trauma, number of associated rib fractures, presence of a flail segment, size of the hernia and type of herniating organ. Location of the hernia on the chest wall was categorized first by laterality then as parasternal, anterolateral, lateral, posterior-lateral, paravertebral or a combination. Sub groups were created based on either blunt or penetrating mechanism of injury for comparison as well as injury severity as defined by number of rib fractures. Operative data tracked the use of rib fixation, use and type of mesh, and need for internal organ repair. Follow up noted any recurrence and functional outcome determined by post-operative range of motion (ROM), pain control and return to pre-injury activity levels.

Descriptive analysis was completed using the above data characteristics. Comparison analysis was completed between sub groups. Statistical analysis was performed with SPSS v. 22 (IBM

Corp., Chicago, IL). Comparative statistics were completed using mean ratios of the data sets using Fischer's exact, Chi Square testing, two tailed student's T-tests, multivariate ANOVA and one way ANOVA testing. Non parametric data was analyzed using Kruskal Wallis testing with post-hoc analysis. Statistical significance was defined as a p value <.05 (CI 95%).

A grading system to aide with determining severity and operative repair was then developed using these statistics and were adjusted by expert consensus panel of the study's senior surgeons (JSD, RKJ, MJM, and WL), including two board-certified Trauma/Critical Care surgeons and two board-certified Thoracic surgeons. Severity as defined by the grading system was correlated with complications and the type of successful repair for clinical use.

3. Results

Twenty-four patients met inclusion criteria and were evaluated. Descriptive statistics and characteristics are shown in the first column of Table 1. Notably, most patients required mesh repair (75%), rib fixation (79%), with 46% requiring repair of the herniated organ. Vicryl mesh was most commonly used (71%) and lung was the organ herniated 88% of patients. Location of the hernia was equally distributed with 42% having a combination of locations. Mean follow up was at 7 months with full ROM seen in 83% of patients. One of these patients had restricted ROM due to obesity. Nineteen patients (78%) were able to return to pre-injury activity levels with 5 (21%) having ongoing pain. One of these 5 did have a prior history of documented narcotic dependence and was methadone dependent.

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