

Diminishing Differences: Evolving Care for Blunt Solid Organ Injury in Children

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Abstract

The management of pediatric blunt Solid Organ Injury (SOI) has evolved with time. Traditionally, abdominal injuries were managed operatively, but decades of evidence-based research and guidelines have led trauma centers to adopt non-operative management as the primary strategy for pediatric blunt SOI. These guidelines have influenced Length of Stay (LOS), operative management, ICU utilization, bed rest, and activity restrictions. As more centers adopt protocols to manage pediatric trauma, outcomes for children have improved. A majority of the improvement has occurred at adult trauma centers; however, our research demonstrates significant differences remain among adult and pediatric trauma centers. In this review, we comment on the evolution of care, its current state, and areas where improvements might be made to better ensure equal care for all children admitted with blunt SOI.

Keywords: Solid organ injury; Pediatric blunt; Trauma centers; Blunt abdominal Trauma

Introduction

In the United States, trauma is a leading cause of morbidity and mortality among the pediatric population with the prevalence of abdominal trauma being as high as 15% [1]. The optimal management of blunt Solid Organ Injury (SOI) in children has gradually shifted over decades of evidence-based research and illustrates the continued efforts of trauma surgeons towards quality improvement. This review will address the evolution of Non-Operative Management (NOM) among children with blunt SOI and highlight differences we have uncovered between different types of trauma centers.

Historical Perspective

The management of blunt abdominal trauma in children centered on operative exploration, particularly in cases of suspected splenic injury. Upadhyaya and Simpson first proposed NOM for blunt splenic injury in 1968 [2]. Despite widespread criticism, the pediatric surgeons in Toronto persisted. Contemporary management algorithms reflect their refinement and dedication to quality improvement in the management of children admitted for blunt SOI.

The disdain and skepticism directed towards this novel strategy of NOM was borne out of surgical dogma and lack of understanding regarding the physiology of the spleen. The discovery of Tuftsin, an essential component of antigen processing, elucidated the function of the spleen and its role in our immune systems [3]. Its clinical relevance was emphasized in a subsequent report by Singer demonstrating increased mortality in patients due to overwhelming postsplenectomy sepsis [4]. Given this background, NOM gained traction as a strategy to treat children effectively and safely while reducing morbidity and mortality associated with operative intervention. The group in Toronto continued to advocate for this pathway and improved upon their initial successes of NOM [5]. Their perseverance and triumphs eventually convinced skeptics, such as Dr. Haller, to publish their own successful trials of NOM [6].

Current State of Nonoperative Management

Following decades of research, the American Pediatric Surgical Association (APSA) released the first official practice guidelines in 2000 [7]. These guidelines addressed mobility, activity, ICU utilization, LOS based on radiologic criteria. However, since its release, several studies have emerged highlighting the overly restrictive nature of initial guidelines [8,9]. Successive guidelines in 2008 (McVay), 2011 (St. Peter), and 2015 (ATOMAC) have adapted NOM strategies based on the hemodynamic status of patients [10-12]. Most recently, APSA updated guidelines, refocusing on clinical parameters as opposed to radiologic criteria [8].

Despite these successive guideline iterations, some trauma centers have been slow to adapt. Depending on where a child is triaged, the management for blunt SOI differs. In several studies, children admitted to Pediatric Trauma Centers (PTC) were more likely to undergo successful NOM, and the role of PTC as disseminators of successful practices for NOM was solidified [13,14]. This becomes relevant considering 75-80% of pediatric blunt SOI are treated at Adult Trauma Centers (ATC) or Dual Trauma Centers (DTC) [9,14,15]. With further education and dissemination of current guidelines, trauma centers may be able to improve their rates of NOM through protocolization. Trauma centers in Washington State implemented standardized protocols as part of their initiative to reduce splenectomies and were successful in halving their rates [16].

The Differences among Centers

Our research indicates that ATC and DTC have improved their operative rates and LOS, indicating greater adherence to established guidelines for successful NOM. However, disparities still exist when compared with pediatric trauma centers whose operative rates are significantly lower. This may be attributed to older adolescents triaged to ATC and DTC. We demonstrate in a subgroup analysis of children 0-14 years of age that the odds of receiving an operative intervention were 1.91 and 1.82 at ATC and DTC, respectively [17,18]. Although these differences continue to be significant, we also note that operative intervention decreased overall, and this was mainly attributable to changes made at ATC and DTC (PTC rate did not differ significantly, $p=0.68$). Angioembolization represents an important frontier in this area of research. Its rate of utilization continues to increase in ATC and DTC, but its benefit and role remain poorly defined [19].

Analyzing LOS, we found that all centers reduced their median LOS by 1 to 1.5 days [18]. However, all centers fell short of abbreviated bedrest protocols stipulated by guidelines. In 2014, examining the first decade of NOM protocols, Dodgion et al. noted that LOS was lower compared to APSA guidelines and higher than those suggested by St. Peter's bedrest protocol, suggesting hybrid adaptations among trauma centers [20].

Future Directions

Our study highlights several areas for continued research and quality improvement. Given the timeframe of our study, the effects of the ATOMAC and APSA II guidelines released in 2015 and 2019, respectively, could not be fully evaluated. A multi-institutional or national study examining the next timeframe would be necessary to evaluate the impact of these guidelines. In determining the root cause of failures of NOM, a more nuanced approach examining individual trauma center protocols will need to be adopted. This may provide insight into underlying reasons for discrepancies between adult and pediatric trauma centers. Moreover, the poorly defined role of angiography represents an avenue for active research to define how each trauma center should incorporate it into their practice.

Conclusion

NOM has evolved over the course of several decades as the result of the perseverance of pediatric trauma surgeons seeking to improve the quality of care for children admitted with blunt SOI. Using a national database such as the NTDB has allowed us to examine trends for guideline compliance and improvements in NOM. While a majority of the improvements have been made at ATC, the operative discrepancy between adult and pediatric trauma centers remains significant. Even within our subgroup analysis, differences operative rate and LOS in 0-14 year old children remained significant. Although, NOM has evolved significantly since its nascent days, further education and training is necessary for better advocacy on behalf of children with blunt SOI.

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