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Primary repair for pediatric colonic injury: Are there differences among adult and pediatric trauma centers?

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ABSTRACT

Background: Management of colonic injuries (colostomy [CO] *versus* primary anastomosis [PA]) among pediatric patients remains controversial. The aim of this study was to assess outcomes in pediatric trauma patient with colonic injury undergoing operative intervention.

Methods: The National Trauma Data Bank (2011-2012) was queried including patients with isolated colonic injury undergoing exploratory laparotomy with PA or CO with age ≤18 y. Missing value analysis was performed. Patients were stratified into two groups: PA and CO. Outcome measures were mortality, in-hospital complications, and hospital length of stay. Multivariate regression analysis was performed.

Results: A total of 1151 patients included. Mean ± standard deviation age was 11.61 ± 2.8 y, and median [IQR] Injury Severity Score was 12 [8-16]; 39% ($n = 449$) of the patients had CO, and 35.6% ($n = 410$) were managed in pediatric trauma centers (PC). Patients with CO had a higher Injury Severity Score ($P < 0.001$), a trend toward lower blood pressure ($P = 0.40$), and an older age ($P < 0.001$). There was no difference in mortality between the PA and CO groups. However, patients who underwent PA had a shorter length of stay ($P < 0.001$) and lower in-hospital complications ($P < 0.001$). A subanalysis shows that, after controlling for all confounding factors, patients managed in PC were 1.2 times (1.2 [1.1-2.1], $P = 0.04$) more likely to receive a CO than those patients managed in adult trauma centers (AC). Moreover, there was no difference in mortality between the AC and the PC ($P = 0.79$).

Conclusions: Our data demonstrate no difference in mortality in pediatric trauma patients with colonic injury who undergo primary repair or CO. However, adult trauma centers had lower rates of CO performed as compared to a similar cohort of patients managed in pediatric trauma centers. Further assessment of the reasons underlying such differences will help improve patient outcomes.

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Introduction

Colonic injury is rare in children, but when it does occur, it is frequently associated with penetrative injuries to the abdomen. The most common mechanism of penetrating injury is gunshot and stab wounds; blunt trauma causing colonic injuries is extremely rare.[1] Colonic injury ranked second after small bowel injuries in gunshot wound and third after liver and small bowel in stab abdominal injuries and is usually associated with other intra-abdominal injuries.[2] The mortality rate after colonic injury was 90% in World War I, and it decreased to 40% in World War II. Nonetheless, the mortality rate is still 3% after colonic injury, but the morbidity rate is still more than 20% with abdominal sepsis being the most important one.[3]

The management of colonic injuries evolved over the past decade. The approach to surgical management of colonic injuries depends on three major factors: the patient and types of injuries, the surgical team, and available facilities. Management of colonic injury in children has not been discussed since Slims' series[4] of 44 children with both blunt and penetrating colorectal injuries in 1984 and only penetrating colorectal injuries by Haut *et al.*[5] in 2004. Colostomy (CO), which once considered the mainstay of treatment, has now taken a secondary role. However, there is still controversy about the indications for either primary anastomosis (PA) or CO for the management of traumatic colonic injuries.[6] PA of colonic injuries has become a standard of care for the majority of minor and moderately severe colonic injuries that can be performed safely in trauma patients.[7] The literature shows that bowel resection followed by PA is well accepted for the right colonic injuries,[8] while CO is reserved for patients with severe colonic injuries (serious associated injuries or significant underlying disease).[6]

Currently, there are about 67 designated pediatric trauma centers (PC) verified by the American College of Surgeons in the United States.[9] Still, this number of PC is not enough to cater to all of the pediatric trauma population. It has been estimated that only 71.5% of pediatric patients have rapid access to a verified PC, leaving more than approximately 17.4 million children to be managed in adult trauma centers (AC).[10] Some studies have shown that patients treated at a designated PC do have improved survival and better functional outcomes than those treated at an AC or at a children's hospital that is not a verified trauma center.[11,12] However, there are no studies available in variability in management of colonic injury in AC and PC.

To date, there are no studies about the definitive management of colonic injuries after trauma in the pediatric population, or the impact of a PC or an AC on outcomes after operative intervention. The aim of this study was, therefore, to assess outcomes in pediatric trauma patients with colonic injuries who underwent operative intervention (PA *versus* CO), and to evaluate trends in the management of colonic injury in AC and PC.

Methods

We conducted a 2-y (2011-2012) retrospective analysis of National Trauma Data Bank (NTDB), version 7.2. The NTDB is the largest collection of trauma index cases, and is maintained by the American College of Surgeons (Chicago, IL). The NTDB contains information on more than 1.8 million patients that is provided by over 900 trauma centers across the United States. To ensure homogenous population reports, we adjusted for facilities that were consistently reporting data during the whole study period. We identified patients with an isolated colonic injury who underwent an exploratory laparotomy with either PA or CO by using the ICD-9 diagnosis and procedure codes. Patients were stratified into two groups based on the operative procedures: PA and CO groups.

Inclusion and exclusion criteria

We included all patients aged $\leq$18 y with isolated colonic injury who underwent exploratory laparotomy with either PA or CO at level I/II centers. Those who had rectal injuries or died within 24 h of injury were excluded from the analysis.

Data points

We retrieved the following data points from the NTDB: demographics (age, gender, race, and ethnicity), vitals on presentation (heart rate, systolic blood pressure, and temperature), Injury Severity Score (ISS), Abdominal-Abbreviated Injury Scale, type of operative intervention (PA and CO), in-hospital complications, hospital length of stay (LOS), and in-hospital mortality. Complications were defined as unplanned return to operating room (as surrogate marker for leaks), infectious complications (superficial/deep/organ surgical site infections and severe sepsis), and acute renal failure. ICD-9 diagnosis and procedure codes used were: colonic injury (863.5-563.54), CO (46.1, 46.11, and 46.13), for resection (45.70-45.76, 45.97, 45.8, 45.82, and 46.04), PA (45.92-45.94), and repair (46.75).

Outcomes measures

Primary outcome measures were in-hospital complications, hospital LOS, discharge disposition, that is, home, rehab/skilled nursing facility (SNIF), and in-hospital mortality rate in patients who underwent PA *versus* CO. Secondary outcome measures were in-hospital complications, hospital LOS, discharge disposition, that is, home, rehab/SNIF, and in-hospital mortality rate in patients who were managed in designated PC *versus* AC.

Data analysis

Data are reported as mean (with standard deviation) for continuous parametric data, as median (with interquartile range) for nonparametric data, and as proportion for categorical data. We used the Mann–Whitney *U*-test and the Student's *t*-test to explore differences in the two groups (PA and CO) concerning nonparametric and parametric continuous