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Colonic injuries and the damage control abdomen: does management strategy matter?

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ABSTRACT

Background: The optimal management of colon injury patients requiring damage control laparotomy (DCL) is controversial. The objective of this study was to assess the safety of colonic resection and anastomosis versus fecal diversion in trauma patients requiring DCL. **Methods:** Patients with traumatic colon injuries undergoing DCL between 2000 and 2010 were identified by the database and chart review. Those who died within 48 h were excluded. Patients were divided into two groups: those undergoing one or more colonic anastomoses with or without distal colostomy (group 1) and those undergoing colostomy only or one or more colonic anastomoses with a protecting proximal ostomy (group 2). Variables were compared using Wilcoxon rank sum, χ^2 , or Fisher exact tests as appropriate. **Results:** Sixty-one patients were included (group 1, $n = 28$ and group 2, $n = 33$). Fascial closure rates (group 1, 50% versus group 2, 61%; $P = 0.45$), hospital length of stay (29 versus 23 d; $P = 0.89$), and in-patient mortality (11% versus 12%; $P = 1.0$) were similar between groups. There were a total of 11 anastomotic leaks, five of which were related to non-colonic enteric repairs. Colonic anastomosis leak rates were 16% overall (six of the 38 patients), 14% in group 1 (four of the 28 patients), and 20% in group 2 (two of the 10 patients). Compared with patients who did not leak, patients who leaked had a higher median age (37 versus 25 y; $P = 0.05$), greater likelihood of not achieving fascial closure before post-injury day 5 (18% versus 2%; $P = 0.003$), and a longer hospital length of stay (46 versus 25 d; $P = 0.003$). **Conclusions:** Outcomes after colonic injury in the setting of DCL were similar regardless of the surgical management strategy. Based on these findings, a strategy of diversion over anastomosis cannot be strongly recommended.

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1. Introduction

After >2 decades of widespread use, the concept of damage control has fundamentally altered the management of severely injured patients [1–3]. The damage control process is characterized by a staged approach in which an abbreviated surgery

is used to control the immediate threats of coagulopathy, hypothermia, and metabolic acidosis, followed by physiological restoration in the intensive care unit (ICU) and eventual return to the operating room (OR) for definitive repair [4]. In patients with destructive abdominal injuries, the use of damage control laparotomy (DCL) is now widely accepted as the

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standard of care in critically injured patients [1,4–12]. However, DCL is not without significant short- and long-term complications, including intra-abdominal infections, enterocutaneous fistulae, and ventral hernias requiring complicated repair [12].

During the damage control process, an injured bowel is often left in discontinuity. On returning to the OR for definitive repair, the surgeon is left with an important decision: restore bowel continuity with a colonic anastomosis or create an ostomy for fecal diversion. Although there is evidence supporting a colonic anastomosis in the non-damage control setting [13–16], there remains limited data regarding the optimal approach to restoring bowel continuity in the patient undergoing DCL. Few studies have specifically evaluated colon wound management after DCL and those that have offer conflicting results [17–23]. In these series, leak rates were variable, ranging from 0% to 27%, and a myriad of risk factors were associated with the development of anastomotic leak, including higher 12-h heart rate, elevated base deficit, left-sided injury, greater transfusion requirements, and abdominal closure after post-injury day 5.

With significant morbidity associated with failed repair, the decision to construct an anastomosis *versus* ostomy has major implications. We hypothesized that the colonic anastomosis would result in a greater number of complications and worse clinical outcomes than fecal diversion in DCL patients. The objectives of this study were to assess the safety of colonic resection and anastomosis *versus* fecal diversion in trauma patients requiring DCL and identify the potential risk factors for anastomotic leakage.

2. Methods

This study was approved by the Institutional Review Board of University of Pennsylvania. Patients were initially identified by query of our institutional Pennsylvania Trauma Outcome Study trauma registry over the period of 2000–2010. The study inclusion criteria included age >18 y, traumatic colon injury, and an initial operation consisting of DCL. DCL was defined as an emergent laparotomy in which temporary wound closure methods are used with the intention of returning to the OR for definitive repair after correction of physiological abnormalities. Patients were excluded if they died within 48 h of admission, if they did not undergo colonic anastomosis or fecal diversion to repair their colonic injuries, or if there were insufficient data available (Figure). Additional clinical data not available from the trauma registry were obtained via a comprehensive chart review, which included the review of all operative and daily progress notes, radiology reports, and discharge documentation. There was no specific hospital-wide protocol for the management of traumatic colon injuries in place at the time of this study. As such, all treatment decisions were made on a case-by-case basis by the operating surgeon.

Demographic data included age, race, sex, and mechanism of injury. The injury severity was classified via Injury Severity Score (ISS) [24] and abdominal Abbreviated Injury Scale (AIS) score [25]. Physiological derangement was assessed by vital signs on admission (heart rate and systolic blood pressure), laboratory values during the first 24 h of admission (lactate, hemoglobin, and international normalized ratio), lowest body

temperature during the first operative procedure, and transfusion and resuscitation requirements during the first operative procedure. The surgical approach was characterized by the total number and timing of abdominal surgeries, including repairs of both the large bowel and small bowel (SB). The total number and location of four types of surgical repair were included: (1) primary repairs (defined as bowel injury managed by suture repair), (2) resection and anastomosis constructed solely with suture, (3) resection and anastomosis constructed primarily with mechanical stapling devices, and (4) ostomies.

Primary outcomes of interest included anastomotic leak, intra-abdominal abscess, and the development of enterocutaneous fistulae. If a patient had an anastomotic leak and an adjacent abscess, only the leak was counted as a complication. Secondary outcomes of interest included hospital length of stay, ICU length of stay (ICU LOS), in-hospital mortality, and the status and timing of abdominal closure. When evaluating the relationship between anastomotic leak and the duration of fascial non-closure, a cutoff of 5 d was chosen based on the previous literature [23].

Two primary analyses were conducted. First, patients were divided into two groups for comparison based on the primary surgical management strategy (i.e., anastomosis *versus* diversion, respectively): those undergoing *one or more* colonic anastomoses with or without distal colostomy (group 1) and those undergoing colostomy only or *one or more* colonic anastomoses with a protecting proximal ostomy (group 2). Three patients underwent primary repair as their only colon intervention (primary repair group) and were excluded from comparative analysis. Second, patients were divided into two groups for comparison based on the development of anastomotic leak (leak *versus* no leak group).

For comparison between groups, the Wilcoxon rank sum test was used for continuous variables, whereas χ^2 or Fisher exact test was used for categorical variables as appropriate. Only 12 patients met the primary endpoint of the study (anastomotic leak), limiting the utility of multivariable logistic regression. Statistical significance was set at $P < 0.05$ (two sided). Analysis was performed using SPSS software (v19; IBM SPSS Statistics, Chicago, IL).

3. Results

During the 10-y study period, 78 patients with traumatic colon injury met the inclusion criteria. Seventeen patients were excluded; 12 patients died within 48 h of admission, three underwent a colonic primary repair as their sole means of injury management, and two had insufficient data. Sixty-one patients were included in the final analysis. Group 1 (those undergoing one or more colonic anastomoses with or without distal colostomy) included 28 patients and group 2 (those undergoing colostomy only or one or more colonic anastomoses with a protecting proximal ostomy) 33 patients. Of the 28 patients in group 1, three had their colonic anastomosis proximal to their colonic anastomosis. Of the 33 patients in group 2, 10 underwent concurrent colonic anastomosis distal to the ostomy (referred to hereafter as defunctionalized anastomoses) (Figure). Fifty-six patients (92%) suffered from penetrating trauma and five from blunt injury.

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