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Prophylactic antibiotics in gunshot fractures with concomitant bowel injury to prevent fracture-related infections and other infectious complications

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ABSTRACT

Background: Standard antibiotic therapy for abdominal gunshot wounds (GSWs) with hollow viscus injury involves up to 24 h of prophylactic broad-spectrum antibiotics. However, antibiotic management strategies are poorly defined in treating gunshot wounds with bowel-to-bone trajectories. These injuries threaten fracture-related infection as missiles can carry contaminating material along their intracorporeal trajectory. This study seeks to determine whether the duration of prophylactic antibiotic therapy used in bowel-to-bone injuries is associated with fracture-related infection prevention or overall infectious sequelae.

Methods: This six-year retrospective review identified all patients experiencing abdominal GSWs with a trajectory causing bowel injury and simultaneous fracture. Patient demographics, duration of antibiotic therapy, and subsequent infectious complications were compared with nonparametric tests as indicated.

Results: 140 patients experienced GSWs with bowel-to-bone trajectory; the median duration of prophylactic antibiotic therapy was four days (IQR 2 – 5 days); two patients were diagnosed with fracture-related infection and 65 patients experienced an infectious complication during their index hospitalization. Duration of prophylactic antibiotic therapy was not associated with the development of overall infection ($p = 0.31$). Comparing three days of prophylactic antibiotic therapy to more than three days of therapy, no difference occurred in overall infection ($p = 1.0$).

Conclusion: The development of fracture-related infections in bowel-to-bone gunshot wounds is rare. The duration of prophylactic antibiotic therapy in bowel-to-bone injuries did not correlate with an increase in overall infectious complications. Notably, three days of prophylactic antibiotic therapy was not inferior compared to longer-duration therapy in the development of infectious sequelae. Thus, patients with a bowel-to-bone gunshot trajectory likely do not require extended antibiotic coverage for prevention of fracture-related infections.

Introduction

An estimated 10 % of admissions to urban trauma centers in the United States result from penetrating abdominal trauma, with the small and large bowel being the most frequently affected organs [1]. Among these injuries, the majority are attributed to gunshot wounds [2] A vital component of managing abdominal GSWs is the early initiation of antibiotics to decrease the incidence of intraabdominal sepsis [3] There is robust evidence that a single preoperative dose of broad-spectrum antibiotic – with activity against aerobic and anaerobic bacteria – is sufficient for most penetrating abdominal trauma, with the continuation of antibiotics for up to 24 h in the event of hollow viscus perforation [4, 5].

However, the evidence is less clear regarding the management of antibiotics for gunshot wounds that produce bowel injuries and traumatic fractures. When fired, bullets are not auto-sterilized and can carry contaminating material (e.g., skin, clothing, debris) along their trajectory into the wound cavity. Hollow viscus injury increases the risk of

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wound infection and contamination of surrounding structures [6] Therefore, it is accepted surgical principle that gunshot wounds with both bone and abdominal injuries carry substantial morbidity and mortality [7] Given the serious concern for fracture contamination and fracture-related infection, prolonged prophylactic antibiotic therapy is frequently prescribed in these cases [8].

Evidence-based guidelines regarding the antibiotic management of these injuries are lacking. The Eastern Association for the Surgery of Trauma (EAST) practice guidelines provide loosely associated guidance for managing fractures with fecal contamination, as potentially occurs with bowel-to-bone trajectory GSWs. EAST guidelines state that open fractures with extensive soft tissue injury (Gustilo type III) should be treated with antibiotics covering gram-positive and gram-negative organisms, and high-dose penicillin should be added for fecal or clostridial contamination [9] However, it is unclear whether GSWs with a bowel-to-bone trajectory causing fracture classify as an open fracture, and many do not have the large associated soft tissue defects identified in the EAST guidelines. Furthermore, there is little comprehensive data regarding the optimal duration of antibiotic therapy in bowel-to-bone injury. A recent systematic review assessing antibiotic usage in fractures sustained from gunshot wounds expressly excluded wounds associated with concurrent bowel injury [10].

Based on our institutional experience, trauma patients with concurrent bowel and skeletal injuries typically receive three to seven days of extended-coverage antibiotics. However, this practice pattern is based on clinician experience without a robust evidence base. We hypothesized that increased duration of prophylactic antibiotic use would not decrease the risk of fracture-related infection. Importantly, for the purposes of this study, fracture-related infection was defined clinically as the occurrence of bony infection associated with ballistic fracture [11, 12].

The primary purpose of this study was to determine whether a prolonged course of prophylactic antibiotics used to treat gunshot wound victims with a bowel-to-bone trajectory is associated with decreased rates of fracture-related infection. In the context of this study, prolonged duration of prophylactic antibiotic administration was defined as greater than three days of antibiotic therapy. The secondary objective was to assess the impact of prophylactic antibiotic duration on soft tissue infection, deep space infection, organ space infection, and *Clostridioides difficile* infection (as a consequence of antibiotic exposure).

Methods

Study design, patient cohort

Approval was obtained from the Institutional Review Board before data collection, reference number 29,473–0003. A retrospective chart review was conducted to identify all patients presenting to our trauma center with both bowel injury and associated ballistic pelvic, vertebral, or proximal femur fractures between January 1, 2015, and December 31, 2021. Potential cases were identified based on ICD-9/ICD-10 codes for firearms injuries, abdominal injuries, large and small bowel injuries, and traumatic fractures. The search strategy was refined by including CPT codes for exploratory laparoscopy, exploratory laparotomy, and fracture debridement.

Charts were carefully reviewed to verify that the patients to be included sustained penetrating injuries with a verifiable bowel-to-bone trajectory. Missile trajectory was ascertained based on attending surgeon documentation, radiographic and surgical evidence of bowel injury, and fracture of the pelvis, vertebrae, or proximal femoral head along a plausible trajectory of the missile's original path. Cases in which gunshot wounds lacked a clear trajectory causing bowel-to-bone injury were excluded. Pregnant, pediatric, elderly, and incarcerated patients were excluded. Additionally, patients that experienced in-hospital mortality within two weeks following injury were excluded as these deaths were deemed a likely consequence of the severity of injury and unrelated to the bowel-to-bone trajectory. A total of 1286 patients were initially identified, of whom 140 met all inclusion criteria to be included in the final analysis.

Variables

The electronic medical record was reviewed for each identified patient, and data were obtained from chart review, radiologic imaging, operative reports, and follow-up clinic documentation. A standardized data collection tool was utilized to extract all relevant information for each patient. Demographic data of interest included: age, gender, race/ethnicity, body mass index, past medical history, and social history. Injury and treatment-specific information included the number of GSWs sustained, injury severity score (ISS), presenting vital signs, associated injuries, volume of blood products transfused, surgical procedure, intensive care unit (ICU) admission, and mechanical ventilation.

The initial prophylactic antibiotic prescription duration was obtained from a review of patients' electronic orders and the description of antibiotic therapy within progress notes. Prophylactic antibiotic duration was defined as the interval between the initial administration of antibiotics (including intraoperative administration) and antibiotic order termination or change in antibiotic regimen, whichever came first. In contrast, therapeutic antibiotic duration was defined as the period patients were treated with targeted antibiotics to address a presumed or confirmed infection. Patients were considered to have transitioned from prophylactic to therapeutic antibiotics if antibiotic orders were changed, if a clinical change was noted in patients' exam or culture data, or if documentation explicitly stated that antibiotics were broadened to address an infection. The total duration of antibiotic administration was defined as the total length of time patients received antibiotics, including prophylactic and therapeutic dosing.

Infectious complications observed during the initial hospitalization included surgical site infection – stratified as superficial, deep, or organ space – urinary tract infection, pneumonia, bacteremia, fungemia, *Clostridioides difficile* (*C. diff*) infection, and fracture-related infection. Infection was determined based on chart review; these diagnoses were made clinically and summarily abstracted from documentation in the electronic medical record. These outcomes were then analyzed together as a conglomerate term, infectious complications.

Other outcomes of interest also included acute kidney injury, postoperative visit attendance, readmission rate, and need for additional intervention after initial discharge.

Statistical analysis

Categorical variables were presented as frequencies and percentages, while continuous variables were reported as medians with interquartile range. Continuous variables were assessed for normality by analysis of quantile-quantile plots. All variables were determined to be non-normally distributed and were thus evaluated with the Mann-Whitney *U* test. Categorical variables were compared with Fisher's exact test, reporting the p-value as twice the exact one-tailed probability, subject to a maximum value of one. A multivariable logistic regression model was generated through best-subset selection. Linearity of the logit was tested with the Box-Tidwell test; continuous predictors in the model were confirmed to have a linear relationship with the outcome variable. Variables were selected for inclusion based on statistical significance observed on initial univariable analysis and established clinical relevance. All statistical analyses were performed using IBM SPSS Statistics, version 29.0 (IBM Corporation, Armonk, NY).

Results

Demographics

One hundred forty patients were identified as having experienced

penetrating trauma with a bowel-to-bone injury during the study period. Patients were predominately male (96 %). Approximately 71 % were African American, and 19 % of the population identified as Hispanic. The median age was 28 years (IQR 22 – 34 years). Medical comorbidity was relatively uncommon in this cohort, with 9.1 % diagnosed with hypertension, 4 % diagnosed with diabetes mellitus, and 3 % diagnosed with asthma or COPD prior to injury. The median injury severity score was 18 (IQR 13 – 26). Twenty-seven patients (19 %) required initial intubation on presentation, and five (3.5 %) underwent resuscitative thoracotomy on arrival to the trauma bay.

Injury pattern

All patients included in the study sustained at least one hollow viscus injury and required exploratory laparoscopy or laparotomy. The most common traumatic fracture sustained was to the pelvis (74 %), followed by vertebral fractures (32 %) and proximal femur fractures (9 %). The ileum (34 %) was the most commonly injured organ, followed by injury to the ascending colon (26 %). Twenty-eight (20 %) patients underwent operative repair for their traumatic fractures, and 11 cases (8 %) required debridement or bullectomy.

The most commonly associated intraabdominal injury was liver injury (23 %), followed by arterial injury (21 %) and urologic injury to the kidney, ureter, or bladder (22 %).

Antibiotic duration

The median duration of prophylactic antibiotics received was four days (IQR 2 – 5 days). Notably, 10 % of patients received a single day of prophylactic antibiotics. Fig. 1**A** shows the distribution of prophylactic antibiotic duration. All prophylactic antibiotics were administered parenterally. The most frequently prescribed prophylactic antibiotics were cefazolin (95 % of cases) and metronidazole (84 % of cases). The median total duration of antibiotics was six days (IQR 3 – 13 days), Fig. 1**B**.

Infectious complications

Sixty-two patients (44 %) experienced at least one infectious complication during their hospitalization; 21 patients experienced two infectious complications, four experienced three, and two experienced four. The most common infectious complication was surgical site infection (19 %), most of which were due to organ space infections (50 %). Two patients (1.4 %) experienced fracture-related infection during their index hospitalization, and four (2.9 %) were diagnosed with *C. diff* infection.

Postoperative outcomes

The median length of stay for this cohort was 13 days (IQR 10 - 23 days). One hundred eight (77 %) patients required admission to the intensive care unit; the median ICU length of stay was four days (IQR 2 - 9 days). In patients requiring mechanical ventilation, the median time on the ventilator was three days (IQR 1 - 9 days). Thirty-five patients (25 %) underwent initial damage control surgery and came out of the operating room with an open abdomen with a subsequent planned return to the OR. Patients received a median of two units of packed red blood cells (IQR 0 - 6 units). Acute kidney injury occurred in 15 % of patients; wound dehiscence occurred in 6 % of patients.

Following discharge, 83 % of patients attended at least one follow-up visit; patients attended a median of two follow-up visits (IQR 1 – 3 visits) with trauma surgeons in the outpatient setting. Approximately 26 % of patients were readmitted to the hospital for additional intervention; the most common reason for readmission was a concern for infection given the patient's clinical exam status (occurring in 47 % of the cases of readmission).

Statistical relationships

Fracture-related infection descriptive summary

Two patients were identified during the study period who developed fracture-related infection. These patients received three and five days of prophylactic antibiotics, respectively. These patients presented with ISS of 13 and 41 respectively and summarily received a total antibiotic duration of 21 and 24 days, respectively.

Conversely, those patients who did not develop fracture related infection had a median duration of prophylactic antibiotics of four days (IQR 2 – 5 days). Likewise, patients not developing fracture related injury presented with median ISS of 18 (IQR 13 – 26).

Clostridioides difficile infection descriptive summary

Four patients developed *Clostridioides difficile* infection during the study period. Median duration of prophylactic antibiotics received was four days (IQR 3 – 6.5 days). The median total duration of antibiotics for this group was 19 days (IQR 14.5 – 25 days). Median ISS for the group was 34, IQR (28 – 41). Patients that did not develop *C. diff* infection received a median course of prophylactic antibiotics of four days (IQR 2 – 5 days). The median total duration of antibiotics was six days (IQR 3 – 12.8 days). Median ISS in this group was 17 (IQR 13 – 25).

There were no instances in which patients who developed fracture-related infection subsequently developed C. *diff* infection.

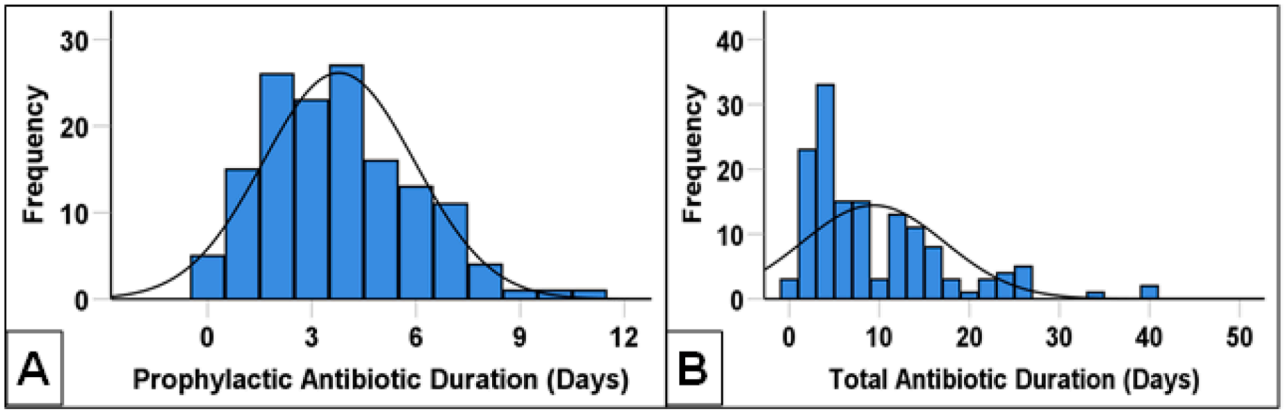

Fig. 1. A: Histogram demonstrating distribution of prophylactic antibiotic duration. Fig. 1B: Histogram demonstrating distribution of total antibiotic duration. Note that a normal curve is superimposed on both graphs.

Comparing three days of prophylactic antibiotics to longer duration prophylactic therapy

The characteristics of patients receiving three days or less of prophylactic antibiotics compared to more than three days of prophylactic antibiotics are presented in Table 1. There were no statistical differences in infectious outcomes between these groups.

Overall infectious complications and antibiotic duration

The duration of prophylactic antibiotics received did not significantly differ between patients who did and did not develop an infectious complication ($p = 0.39$). Additionally, there was no difference in pre-injury history of diabetes ($p = 0.65$), small bowel injuries ($p = 0.42$), or large bowel injuries ($p = 0.15$) between groups. However, significant differences were noted between these groups in terms of initial hemoglobin ($p = 0.01$), injury severity score ($p < 0.001$), total days mechanical ventilation ($p < 0.001$) vertebral fracture location ($p = 0.049$), intraoperative hypotension ($p = 0.020$), open abdomen after initial damage control procedure ($p < 0.001$), ICU length of stay ($p < 0.001$), days of mechanical ventilation ($p < 0.001$), total number of packed red blood cells transfused during the hospital stay ($p < 0.001$), total duration of antibiotics ($p < 0.001$), overall length of hospital stay ($p < 0.001$), and total volume of packed red blood cells transfused during the hospital stay ($p < 0.001$), Table 2.

Three days of prophylactic antibiotics, as compared to more than three days of prophylactic antibiotics, was not associated with increased or decreased infectious complications ($p = 1.0$), Fig. 2.

On multivariable logistic regression model, the factors that correlated with infectious complications included open abdomen following initial damage control surgery (OR 4.59, 95 % CI 1.7 – 12.7), operative intervention for ballistic fracture (OR 2.68, 95 % CI 1.04 – 6.93), and increasing injury severity score at initial presentation (OR 1.05, 95 % CI 1.00 – 1.09). Duration of prophylactic antibiotics, initial hemoglobin, and pRBC transfusion volume were not significantly associated with infectious complications. These results are demonstrated in Table 3.

Discussion

Penetrating abdominal trauma with bowel-to-bone injury represents a unique challenge for the trauma surgeon. The early initiation of broad-spectrum antibiotics has decreased rates of intraperitoneal sepsis and overwhelming infection [5] Given the concern for fracture-related infection and its attendant severe complications, clinicians frequently treat bowel-to-bone injuries with an extended durations of antibiotics. However, the overzealous use of prophylactic antibiotics must be tempered with concerns surrounding superinfection with organisms like *Clostridioides difficile,* multidrug-resistant bacteria, allergic reactions, and increased costs to patients and health systems [13,14] Without clear guidelines regarding the appropriate duration of prophylactic antibiotics, this study sought to examine rates of infection as related to the duration of prophylactic antibiotics prescribed in a cohort of patients with bowel-to-bone injuries in penetrating trauma.

This retrospective cohort study identified 140 patients over a six-

Table 1
Injury pattern and outcome comparison for three days of prophylactic antibiotics.

Variable	Prophylactic antibiotics ≤ Three Days ($N = 68$)	Prophylactic antibiotics > Three Days ($N = 72$)	p-Value
Age, Median (IQR)	26 (22 – 31)	29 (23 – 37)	0.96
ISS, Median (IQR)	17 (13 – 22)	18 (13 – 27)	0.51
LOS (days), Median (IQR)	13 (9 – 22)	14 (11 – 24)	0.18
Small bowel injury, N (%)	32 (47)	44 (61)	0.13
Large bowel injury, N (%)	46 (68)	43 (60)	0.38
Fracture-related infection, N(%)	1 (1)	1 (1)	1.0
C.diff infection, N(%)	2 (3)	2 (3)	1.0
Superficial soft tissue infection, N(%)	1 (1)	4 (6)	0.37
Deep tissue infection, N(%)	5 (7)	3 (4)	0.49
Organ space infection, N(%)	6 (9)	7 (10)	1.0
Overall infectious complications, N (%)	27 (40)	32 (44)	0.60

Abbreviations: ISS, Injury Severity Score; ICU LOS, intensive care unit length of stay; LOS, length of stay; *C. diff, Clostridioides difficile*. Continuous variables analyzed by Mann-Whitney U test, categorical variables analyzed by Fisher Exact test.

Table 2
Demographic data and injury pattern for all infectious complications.

Variable	Infectious Complications ($N = 59$)	No infectious complication ($N = 81$)	p-Value
Sex			1.0
Male, N (%)	57 (97)	78 (96)	
Female, N (%)	2 (3)	3 (4)	
Race			
African American, N(%)	43 (73)	56 (69)	0.71
Caucasian, N(%)	1 (2)	6 (7)	0.24
Hispanic, N(%)	11 (19)	16 (20)	1.0
Asian, N(%)	0 (0)	1 (1)	1.0
Pacific Islander, N(%)	0 (0)	1 (1)	1.0
Other, N(%)	7 (12)	6 (7)	0.42
BMI Median, (IQR)	24 (22 – 27)	24 (22 – 29)	0.29
Age Median, (IQR)	30 (25 – 33)	26 (22 – 35)	0.9
HTN, N(%)	5 (8)	8 (10)	1.0
DM, N(%)	3 (5)	2 (2)	0.65
CAD, N(%)	1 (2)	1 (1)	1.0
HIV Infection, N(%)	0 (0)	0 (0)	–
Initial hemoglobin (g/dl), Median (IQR)	12.8 (11.1 – 13.9)	13.5 (12.5 –14.8)	**0.005**
Ventilator Days, Median (IQR)	2.0 (0.0 –9.0)	0.0 (0.0 – 0.5)	< 0.001
Units of pRBC transfused, Median (IQR)	2 (1 – 3)	2 (1 – 2.5)	**< 0.001**
GSW Median, (IQR)	4 (3 – 9)	3 (2 – 5)	**0.016**
ISS Median (IQR)	23 (14 – 29)	14 (10 – 20)	**< 0.001**
Stomach injury, N (%)	9 (15)	6 (7)	0.17
Small bowel injury, N (%)	30 (51)	46 (57)	0.42
Large bowel injury, N (%)	41 (69)	48 (59)	0.15
Rectal injury, N (%)	16 (27)	20 (25)	0.71
Vertebral fracture, N (%)	24 (41)	21 (26)	**0.049**
Pelvic fracture, N (%)	43 (73)	64 (79)	0.45
Operation for fracture, N (%)	17 (29)	11 (14)	**0.03**
Intraoperative hypotension, N (%)	47 (80)	52 (64)	**0.04**
Initial open abdomen, N (%)	25 (42)	7 (9)	**< 0.001**
Prophylactic antibiotic (days), Median (IQR)	4 (2 – 6)	3 (2 – 5)	0.39
Total antibiotic (days), Median (IQR)	13 (8 – 18)	4 (2 – 6)	**< 0.001**
ICU LOS (hours), Median (IQR)	188 (96 – 419)	65 (41 – 96)	**< 0.001**
Mechanical ventilation (days), Median (IQR)	7 (2 – 15)	2 (1 – 3)	**< 0.001**
Hospital LOS (days), Median (IQR)	23 (15 – 37)	10 (8 –14)	**< 0.001**

Abbreviations: DM, diabetes mellitus; HTN, hypertension; CAD, coronary artery disease; pRBC, packed red blood cells, ICU LOS, intensive care unit length of stay; ISS, Injury Severity Score; LOS, length of stay; GSW, gunshot wound.

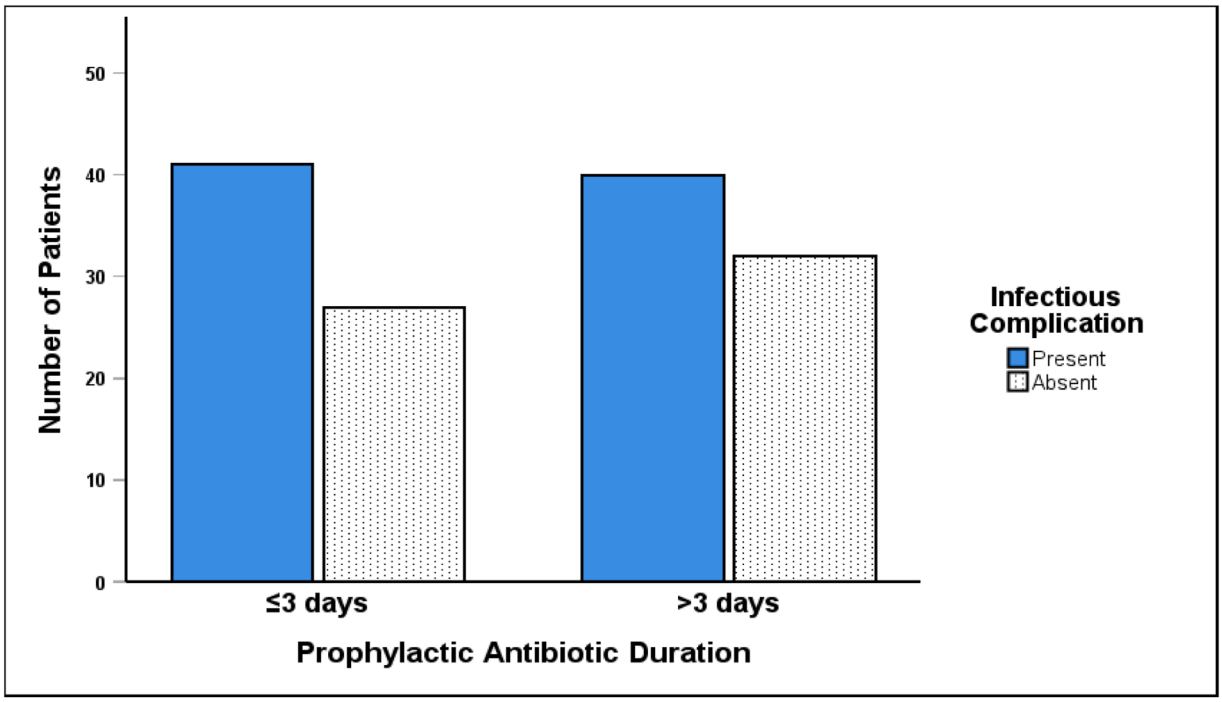

Fig. 2. Overall complications in patients who received three days or fewer of prophylactic antibiotics compared to patients who received more than three days of prophylactic antibiotics. There was no statistically significant difference between groups ($p = 1.0$).

Table 3
Multivariable logistic regression for all infectious complications ($n = 139$).

Variable	Odds Ratio	95 % Confidence Interval	p-Value
Open abdomen following damage control laparotomy	4.59	1.66 – 12.67	**<0.001**
Operative intervention for fracture	2.68	1.04 – 6.93	**0.04**
Injury Severity Score	1.05	1.00 – 1.09	**0.05**
Duration of prophylactic antibiotics	0.99	0.83 – 1.20	0.95
Total volume of pRBC transfused	1.00	0.99 – 1.02	0.65
Initial hemoglobin	0.90	0.74 – 1.10	0.31

Abbreviations: pRBC, packed red blood cells.

year period experiencing 669 gunshot wounds that resulted in bowel-to-bone trauma. Two patients experienced fracture-related infection, four patients experienced *C. diff* infection, and 62 patients experienced an infectious complication of any type.

Overall, the duration of prophylactic antibiotic therapy neither protected against nor was associated with the development of infectious complications. Further analysis showed no discernible difference between three days of prophylactic antibiotic therapy and more than three days of prophylactic therapy in terms of all infectious outcomes. While the study failed to detect significant complications related to prophylactic antibiotic course, there was also no benefit from prolonged courses of antibiotics. These findings suggest that prescribing practices of providing two to seven days (or more) of prophylactic antibiotics may be unnecessary.

Much of the existing literature regarding bowel-and-bone trauma focuses on penetrating trauma that leads to spinal fractures. Concern is high in these injuries for the development of untoward outcomes, including fracture-related infection, meningitis, and paraspinal abscess [15] A recent systematic review recommends a standard two-day prophylactic antibiotic course for most penetrating trauma with spinal fracture, though injuries with colonic contamination may benefit from extended prophylaxis [16] This review notes that fracture-related infection and spinal infection in these scenarios are uncommon events – the rates recorded range from 1/51 to 1/67 developing infection. These results mirror the low rate of fracture-related infection observed in the present study (approximately 1/75). However, the individual studies included in the review provided recommendations solely based on expert opinion and institutional protocol, as opposed to statistical modeling. Likewise, the composite studies generally relied solely upon first- or second-generation cephalosporins for coverage or failed to include information regarding the antibiotic regimen implemented entirely [17] As our study demonstrates, initiating even extended-spectrum antibiotics with activity against both aerobic and anaerobic bacteria may negate the need for prolonged prophylactic therapy.

When all infectious complications were examined – a composite endpoint predominately made up of surgical site infections – traditional risk factors for complications emerged. Patients more severely injured or requiring prolonged time in an intensive care setting were more likely to experience infectious complications. As has been shown previously, patients with open abdomen following damage control laparotomy and increasing Injury Severity Score experienced higher odds of infectious complications [18–20] Interestingly, patients who ultimately required operative repair for ballistic fracture also experienced increased odds of infectious complication. As other authors have shown, ballistic fractures requiring operative intervention are associated with increased infectious complication rates as compared to fractures treated nonoperatively [21–23] The pathophysiology underlying this phenomenon is thought to include the high localized transfer of energy occurring in these ballistic injuries, the use of hardware in a potentially infected field, thermal injury, and associated major vascular injuries.

The multivariable regression analysis also showed that duration of prophylactic antibiotics did not improve or worsen infectious outcomes. Though more research into this question is required, these results provide further evidence that 72 h or less of antibiotics may be all that is warranted to prevent most infection in patients with bowel injuries.

This study is not without limitations. Only two cases of fracture-related infection and four cases of *C. diff* infection were observed, respectively, which limits the generalizability of this study. Sample size analysis indicates that between 130 and 477 cases per study arm (based

on estimated large and medium effect sizes, respectively) would be needed to detect a meaningful difference in prophylactic antibiotic duration among these groups. The retrospective nature of the data collection further limits the strength of the conclusions that can be drawn. The study relied upon adequate documentation in the electronic chart to monitor postoperative infectious complications; it is possible that some complications were miscategorized, inadequately described, or otherwise missed in the process of chart review. Additionally, the follow-up period for this patient cohort was relatively short, as most patients were seen in the clinic only twice after discharge. Furthermore, 17 % of patients were lost to follow-up and did not attend any post-discharge appointments with trauma staff. Accordingly, it is possible that some instances of fracture-related infection or other infectious sequelae were missed in the final analysis. As a preliminary study, we hope that the results from this work will drive prospective studies comparing the limited duration of prophylactic antibiotic therapy to more conventional therapy practices.

Conclusions

In penetrating trauma with bowel-to-bone trajectory, the development of fracture-related infectious complication is rare. Furthermore, the duration of prophylactic antibiotic therapy prescribed does not correlate with the development or prevention of overall infectious complications. Limited duration antibiotic coverage targeting typical bowel flora may be equivalent to more extended duration therapy in preventing unfavorable outcomes following bowel-to-bone trauma. Larger studies are required to more fully elucidate the effects of prophylactic antibiotic duration on the development of fracture-related injury and overall infectious complications.

CRediT authorship contribution statement

Dylan Kahler: Writing – review & editing, Writing – original draft, Visualization, Validation, Investigation, Formal analysis, Data curation, Conceptualization. **Natalie DeWitte:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Megan Thompson:** Investigation, Data curation, Conceptualization. **Saqib Rehman:** Writing – review & editing, Visualization, Validation, Supervision, Project administration, Conceptualization. **Jeffrey Anderson:** Writing – review & editing, Visualization, Validation, Supervision, Project administration, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

There are no conflicts of interest for any authors listed

Financial Disclosure Statement

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Previous Presentations

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Ethics statement

This research article represents original work and has not been previously published or submitted elsewhere. The study was conducted in accordance with ethical standards and was exempt from IRB review, as it did not involve any procedures or data collections that require human subjects' oversight under the guidelines of our institution's IRB committee. No artificial intelligence tools or software were used in the creation, writing, or analysis of this article's content. All findings, interpretations, and conclusions are solely the result of the authors' independent research efforts.

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