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Research Article

Antibiotic Use in the Open Abdomen

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Abstract

Background: The duration of antibiotics for patients managed with an open abdomen (OA) has not been well defined. We hypothesized that short course (SC) antimicrobial therapy is superior to long course (LC) in non-traumatic, OA management.

Methods: A retrospective review of emergency surgery patients (non-trauma), managed with an OA from 6/2013 to 6/2014 was performed. The primary outcome was SSI and all other in-hospital infections.Patients were divided into SC antibiotics (<7 days), and LC (> 7 days).

Results: 87 patients met inclusion criteria for the study: 25 patients had a SC of antibiotics, 62 had LC. The median duration of antibiotic therapy was 17 days, with a median of 5 days (IQR 3-6) in the SC group, compared to 23.5 days in the LC group (IQR 16-38). Median days of OA were 3 days in the SC (IQR1-4) and 4 days in the LC (IQR 2-8). There was a 16% incidence of secondary infection (pneumonia, Clostridium Difficile, UTI, and Bacteremia) in the SC group, compared to 56% in the LT group.

Conclusion: In the current population of non-trauma patients managed with an OA, those that received SC antibiotics had less secondary infections than those with LC.

Keywords: Open Abdomen; Antibiotics use in open abdomens; Secondary infections

Introduction

Damage control laparotomy with temporary abdominal closure has been well described for emergency general surgery (EGS) and trauma. In the EGS population, open abdomens (OA) with temporary abdominal closure can be a treatment technique for abdominal compartment syndrome (ACS), necrotizing pancreatitis, intra-abdominal sepsis, coagulopathy, or other reasons for second-look laparotomy. Source control remains the major predictor of outcome for intra-abdominal sepsis [1]. While there are now guidelines for fascial closure, nutrition, resuscitation strategies and some complications such as fascial dehiscence, there are few recommendations for antibiotic use in this population [2,3]. Extended antibiotic use has been associated with antibiotic resistance, multidrug resistant organisms (MDRO), and secondary infections such as Clostridium Difficile. Kyne et. al demonstrated that in the C. difficile patient population there was an increase hospital length of stay (HLOS) by 3.6 days, increased mortality rates compared to patients without C.difficile, and increased hospital cost, now exceeding one billion dollars a year [4]. As the antibiotic crisis continues at epidemic proportions, new studies such as the STOP-IT trial have emerged to show that longer courses (LC) of antibiotics are equivalent to short courses (SC) once source control has been obtained [5]. These data are important in terms of decreasing antibiotic use, in the hope to prevent MDRO and secondary infections.While this appears to be the new standard, it does not address patients with OA.EGS patients tend to have OAs for a protracted period due to ongoing sepsis, and multiple co-morbid conditions that may potentially invalidate the use of SC antibiotics. We conducted a retrospective study to compare duration of antibiotic therapy in this challenging surgical population. We hypothesized that the administration of antibiotic therapy as a short course (less than

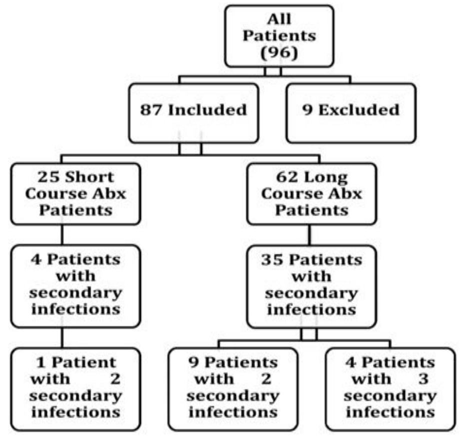
7 days) would lead to equivalent outcomes.

Methods

After obtaining Institutional Review Board approval, we retrospectively reviewed all patients admitted to, and consulted by the EGS service, at University of Maryland Medical Center, between the dates of June 2013 to July 2014, who had an abdominal exploration and temporary abdominal closure. Data were obtained from an EGS-specific.Medical records were analyzed for patient demographics, infection rates, antibiotic use and duration, and operative details. Demographics included age, gender and co-morbid conditions. Hospital length of stay (LOS), ICU LOS, ventilator days and in-hospital mortalities were obtained.OA was defined as any exploratory laparotomy that concluded with placement of a temporary abdominal closure system device (commercially available wound vac system or adhesive covering/closed suction device), rather than primary fascial closure. Peri-operative variables included pre-operative diagnosis, duration (days) of OA, packing, and number of operations until fascial or definitive closure (mesh, skin-only).We reviewed types of operations and visceral resection preformed, if required.Washouts were defined as return to the operating roomfor anticipated procedure such as re-look laparotomy, removal of packs, further infection control, or other procedure. Antibiotics use and infections were divided by total days of antibiotics, surgical site infections (SSI) including superficial, deep and organ space, secondary infections including: pneumonia, UTI, bacteremia, and C.difficile. Pneumonia was defined as chest x-ray or CT scan with infiltrate and positive sputum or bronchial cultures. UTI was defined asurine culture with greater than or equal to 103 colony forming units per mL.Bacteremia was defined as two consecutively positive blood cultures from separate locations. After collection of data, patients were divided by antibiotic duration: those who received 7 days or less were put into the SC group, while those with greater than 7 days of antibiotics were placed in the LC of antibiotics.

Results

During the one-year study period, ninety-six patients were managed with an OA. Nine were excluded based on admitting diagnosis of extra-abdominal infections including infected aortograft, endocarditis, and on admission UTI. Solid organ transplants were also excluded, leaving a total study population of 87 patients.Of the 87 patients, 25 patients were categorized as SC antibiotic use versus 62 patients who met inclusion criteria for the LC group (Figure 1).



The median age of both groups was equivalent (63-years SC and 61-years LC) with 48% females in the SC group and 52% in the LC. There was no difference in comorbidites or admission labs including lactate, WBC count and base deficit between groups. (Table 1).

	All Patients	Short Course	Long Course	P-Value
Female n(%)	44 (51%)	12 (48)	32 (52%)	0.76
Age, median (IQR)	61 (50-68)	63 (53-66)	61 (50-68)	0.82[a]
MI, n(%)	13 (15%)	3 (12%)	10 (16%)	0.75[b]
CHF, n(%)	14 (16%)	4 (16%)	10 (16%)	1.0[b]
PVD, n(%)	28 (32%)	8 (32%)	20 (32%)	0.98
DM, n(%)	20 (23%)	5 (20%)	15 (24%)	0.67
DM+organ dmg, n (%)	8 (9%)	3 (12%)	5 (8%)	0.68[b]
WBC, median (IQR)	13.5 (8.2-19.2)	10.7 (8.4-17.7)	13.6 (8.2-21.6)	0.44[a]
Lactate, median (IQR)	2.3 (1.4-4.6)	2.4 (1.5-6.4)	2.3 (1.4-3.5)	0.46a
Base deficit, mean (SD)	-4.7 (-1.6--8.7)	-7 (-2.2- -9)	-4.25 (-0.75-7.8)	0.70c

p-value calculated by Pearson's Chi-square unless noted: [a]Wilcoxon Rank Sum, [b]Fisher's Exact, [c]Pooled t-test

Table 1: Patient demographics, co--morbidities before admission, and admission labs. Univariate analysis.

HLOS, ICU LOS, and ventilator days were all higher in the LC group of patients (Table 2).

	All Patients	Short Course	Long Course	P-Value
HLOS, Median (IQR)	23 (15-48)	13 (7-15)	32 (20-54)	<0.001a
ICU LOS, Median (IQR)	16 (7-27)	6 (4-12)	20 (12-37)	<0.001a
Vent Days, Median (IQR)	13 (5-26)	4 (3-7)	16 (7-35)	<0.001a

p-value calculated by Pearson's Chi-square unless noted: aWilcoxon Rank Sum, bFisher's Exact, cPooled t-test

Table 2: Patient outcomes. Univariate analysis.

The SC group received 5 days of antibiotics compared to the LC group, which received 23.5 days (p-value: <0.0001). Comparing days of OA, the median days for the SC group were 3 versus 4 in the LC group (p-value =0.03).Median number of washouts for the SC group was 1, with 12 % of patients having laparotomy pads packed at the index operation. In the LC group, the median number of washouts was 2, with 34% having laparotomy pads packed during the previous operation.The most common operation performed in both groups was enteric resection (80% in SC and 86% in LC). The most common type of enteric resection in both groups was small bowel (40 % in SC vs 58% in LC), followed by large bowel and stomach. Only 14 patients had no bowel resected (20% in SC vs 14% in LC). Median number of washouts was 1 in the SC group compared to 2 in the LC group (Table 3).

Number of Washouts	Total	Short Course	Long Course	P-Value
Median (IQR)	2 (1-3)	1 (1-2)	2 (1-4)	0.0164a
1,n(%)	35 (40)	13 (52)	22 (35.5)	0.068,
2,n(%)	18 (21%)	7 (28)	11 (18)	
3+, n(%)	34 (39)	5 (20)	29 (47)	

p-value calculated by Pearson's Chi-square unless noted: a Wilcoxon Rank Sum, bFisher's Exact

Table 3: Number of washouts.

Indications for operations were similar in both groups. The most common reason was perforated viscus/pneumoperitoneum, followed by mesenteric ischemia and gastrointestinal bleeding (Table 4).

Indications for OR n(%)	All Patients	Short Course	Long Course	*0.0916
Elective Procedure/ Other	8 (9)	2(8)	6 (10)	
Bowel obstruction	8 (9)	1 (4)	7 (11)	
Mesenteric ischemia	15 (17)	8 (32)	7 (11)	
Incarcerated hernia	7 (8)	3 (12)	4 (6.5)	
Pneumoperitoneum/ Perf. Viscuc	30 (34.5)	5 (20)	25 (40)	
ACS	4 (5)	2 (8)	2 (3)	
GI Bleed	10 (11.5)	4 (16)	6 (10)	
Pancreatitis	5 (6)	0 (0)	5 (8)	

p-value calculated by Fisher's Exact test

Table 5: Surgical Site Infections

Overall, the rate of secondary infections in the LC group was 56%, compared to 16% in the SC group(p-value =0.0006) . The LC group also had a significantly longer HLOS a median of 31.5 days vs 13 days (P<0.001), ICU LOS(6 days vs 20 days, p <0.001) and ventilator days (4 vs 16, p <0.001). The LC group course of antibiotics was a median of 34 days compared to the SC group that was only 5.5 days (p-value =0.02).

A post-hoc analysis was done looking at all patients with secondary infections.In the SC group, 1 patient had 2 secondary infections. In the LC group 9 patients had 2 secondary infections and 4 had 3 secondary infections.

The most common secondary infection was pneumonia with 23 patients (21 being in the LC group), followed by bacteremia diagnosed in 12 total patients, all in the LC group. Both Pneumonia and bacteremia are statistically significant in the LC group C. Difficile infection and UTI was the third most common infection with 11 patients in each group (Table 6).

Infection	Total	Short Course	Long Course	p-value
None	48	21	27	<0.001
Pneumonia	23	2	21	0.02
C. Difficile	11	2	9	0.5
UTI	11	1	10	0.17
Bacteremia	12	0	12	0.02

Table 6: Characteristics of Secondary Infections.

Discussion

Patients in the current study had similar overall outcomes when comparing SC to LC antibiotics, showing that longer duration of antibiotic therapy did not improve outcomes. There was a significant decrease in secondary infections, with the SC group having less pneumonia and bacteremia. To our knowledge this is the first retrospective review comparing antibiotic duration in patients with open abdomens with significant comorbid disease.

In this retrospective review, the data suggests that long-term antibiotics may predispose patients to more secondary infections, specifically pneumonia and bacteremia. This finding was similar in Riccio et al, who found that LC antibiotics for intra-abdominal infections (IAI) increased risk for extra-abdominal infection (EAI) [6]. EAI were divided by urine, lung, blood, incision and vascular catheter. While Riccio et al. noted an increase in mortality, this study did not replicate these findings.

Patients were divided into SC and LC, similar to Riccio et al, who divided patients into groups < and > 7 days. Due to a lack of randomization and small patient population, this study was unable to use 4 days or greater, as used in the STOP-IT trial [5]. This study population also varied widely in disease state compared to the STOP-IT trial. To further investigate reasons for antibiotic days we reviewed if packing was left in the abdomen for a second look laparotomy, types of bowel resections preformed, and number of abdominal washout before closure. These variables did not contribute to antibiotic duration or morbidity as expected. Joint guidelines from the Surgical Infection Society and the Infectious Disease Society of America recommend 4 to 7 days of antimicrobial therapy for complicated intra-abdominal infections [7]. This data has extended to include patients with sepsis and septic shock with related intra-abdominal infection as noted by Rattan et al, though Rattan excluded non-perforated intestinal ischemia, infected necrotizing pancreatitis, and high likelihood of death within 72 hours [8]. The study above augments the data, showing that SC antibiotic therapy is not inferior to LC therapy and potentially has less secondary infections.

While shorter courses of antibiotics seem to be equivalent to longer courses after appropriate source control, this data has not been proven in the open abdomen population. In EGS patients, OA approach for severe intra-abdominal infection may be required for: damage control surgery in patients with severely deranged physiology [9], second look for ischemia and delayed closure so as to prevent ACS due to initial resuscitation requirements [10-12]. The OA technique allows the surgeon to preform subsequent laparotomies for further source control, optimization of volume resuscitation and mechanical ventilation, correction of coagulopathy and hypothermia, and monitoring in attempt to prevent ACS development [13]. Due to lack of data from prospective studies, the duration of antibiotics these patients have commonly been based on custom and expert opinion [14, 15]. The study above, retrospectively, shows that SC therapy has no difference in primary outcomes and improved outcomes in some secondary infections.

The major weakness in this study is the retrospective nature of data collection and analysis. Due to lack of randomization, antibiotic courses for patients were not able to be set, as done in the STOP-IT trial. It is also difficult to determine if patients required LC antibiotics due to their secondary infection or LC antibiotics from their initial disease process predispose to secondary infection. Since ventilator days were much longer in the LC group there is a concern that prolonged respiratory support predisposed patients to pneumonia versus their long course of antibiotics.Firm conclusions on antibiotic duration were not able to be made.

Conclusion

Open abdomens in the EGS population are complex and fraught with complications. The concern for overuse of antibiotics is also associated with morbidity and poor outcomes.This data suggests there is a detrimental effect of LC antibiotics in the OA population. Rates of secondary infection, HLOS and ICU LOS, and ventilator days are all increased. Based on this retrospective study, we currently recommend SC antibiotic therapy for less than seven days for patients requiring OA management. A randomized prospective study will better help define guidelines for emergency general surgeons and their management of antibiotics in this extremely challenging patient population.

References

1. Diaz JJ Jr, Cullinane DC, Dutton WD, Jerome R, Bagdonas R, et al. (2010) The Management of the Open Abdomen in Trauma and Emergency General Surgery: Part 1-Damage Control. J Trauma 68:1425-1438.

2. Undurraga Perl VJ, Leroux B, Cook MR, Watson J, Fair K, et al. (2016) Damage control resusciatation and emergency laparotomy: Findings from the PROPPR study. J Trauma Acute Care Surg80: 568-574.

3. O'Meara L, Ahmad SB, Glaser J, Diaz JJ, Bruns BR (2015) Outcomes of primary fascial closure after open abdomen for nontrauma emergency general surgery patients. Am J Surg 210:1126-1130.

4. Kyne L, Hamel MB, Polavaram R, Kelly CP (2002) Health Care Costs and Mortality Associated with Nosocomial Diarrhea Due to Clostridium difficile. Clin Infect Dis 34:346-353.

5. Sawyer RG,Claridge JA, Nathens AB, Rotstein OD, Duane TM, et al. (2015) Trial of Short Course Antimicrobial Therapy for Intraabdominal Infection. N Engl J Med 372:1996-2005

6. Riccio LM, Popovsky KA, Hanjec T, Politano AD, Rosenberger LH, et al. (2014) Association of excessive duration of antibiotic therapy for intra-abdominal infection with subsequent extra-abdominal infection and death: a study of 2,552 consecutive infections. Surg Infect 15: 417-24.

7. Dellinger RP, Levy MM, Rhodes A,Annane D, Gerlach H, et al. (2013) Surviving Sepsis campaign: international guidelines for management of severe sepsis and septic shock: 2012. Crit Care Med 41:580-637.

8. Rattan R, Allen CJ, Sawyer RG,Askari R, Banton KL, et al. (2016) Patients with Complicated Intra-Abdominal Infection Presenting with sepsis do not require longer duration of antimicrobial therapy. J Am Coll Surg222:440-446.

9. Waibel BH and Rotondo MF (2010) Damage Control in Trauma and abdominal sepsis. Crit Care Med 38:S421-30.

10. Jansen JO and Loudon MA (2007) Damage Control Surgery in a non-trauma setting. Br J Surg 94:789-790.

11. Amin AI and Shaikh IA (2009) Topical negative pressure in managing severe peritonitis: a positive contribution? World J Gastroenterol 15:3394-3397.

12. Schmelze M, Alldinger I, Matthaei H, Aydin F, Wallert I, et al. (2010) WT: Long-term vacuum-assisted closure in open abdomen due to secondary peritonitis: a retrospective evaluation of a selected group of patients. Dig Surg 27:272-278.

13. Sertalli M, Catena F, Di Saverio S,Ansaloni L, Malangoni M, et al. (2014) Current concept of abdominal sepsis: WSES position paper. World J EmergSurg 9:22.

14. Solomkin JS (2010) Evaluating evidence and grading recommendations: The SIS/IDSA guidelines for the treatment of complicated intra-abdominal infections. Surg Infect (Larchmt) 11:269-274.

15. Solomkin JS, Mazuski JE, Bradley JS, Keith A. Rodvold,7,8 Ellie J. C. Goldstein, et al. (2010) Diagnosis and management of complicated intra-abdominal infections in adults and children: Guidelines by the Surgical Infection Society and the Infectious Disease Society of America. Surg Infect (Larchmt) 11:79-109.