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Surgical Management of Trauma-Related Colorectal Injuries: A Five-Year Single-Center Experience

Objective: This study aims to evaluate the surgical treatment methods and outcomes in patients with colon injuries following blunt and penetrating abdominal trauma.

Materials and Methods: Twenty-five patients who underwent surgery for abdominal trauma and were found to have colon injury in our clinic between January 2018 and January 2023 were retrospectively analyzed.

Results: The mean age of the 25 patients was 37±11.4 years (range, 19-74), and 22 (88%) were male. Penetrating abdominal trauma was present in 20 patients (80%), while 5 patients (20%) had blunt abdominal trauma. The most common site of injury was the transverse colon in 11 patients (44%), followed by the rectum in 7 patients (28%). Additional organ injury was detected in 14 patients (56%), most frequently involving the small bowel in 4 patients (16%). The mean Colon Injury Severity Score of the cases was 3.32, and the mean Penetrating Abdominal Trauma Index was 17.4. Primary repair or anastomosis was performed in 18 patients (72%), while fecal diversion (anastomosis or primary repair) was performed in 7 patients (28%). Complications occurred in 7 patients (28%), and the mortality rate was 4%.

Conclusion: Fecal diversion should be considered only in high-risk cases of colon injury. In penetrating trauma, avoidance of fecal diversion is recommended in hemodynamically stable patients with proximal colon injuries who do not require transfusion. Larger, multicenter studies are needed to determine the optimal surgical management of colon injuries.

Key Words: abdominal trauma, colorectal injury, fecal diversion, complication

Travmaya Bağlı Kolorektal Yaralanmaların Cerrahi Tedavisi: Beş Yıllık Tek Merkez Deneyimi

Amaç: Bu çalışma, künt ve penetran karın travması sonrası gelişen kolon yaralanmalarında uygulanan cerrahi tedavi yöntemlerini ve sonuçlarını değerlendirmeyi amaçlamaktadır.

Gereç ve yöntem: Ocak 2018–Ocak 2023 tarihleri arasında kliniğimizde karın travması nedeniyle opere edilip kolon yaralanması saptanan 25 hasta retrospektif olarak incelenmiştir.

Bulgular: Toplam 25 olgunun yaş ortalaması 37±11,4 (19-74) ve 22'si (%88) erkekti. Bunlardan 20 (%80) olguda penetran, 5 (%20) olguda künt karın travması vardı. Yaralanma en sık 11 (%44) hastada transvers kolonda, ardından 7 (%28) hastada rektumda görüldü. Kolorektal yaralanmalarda 14 (%56) hastada ek organ yaralanması görüldü, ek organ yaralanmaları 4 (%16) hasta ile en sık ince barsakta görülmüştür. Vakalarımızın Ortalama Kolon Yaralanma Şiddet Skoru 3,32 ve Penetran Karın Travması İndeksi 17,4 idi. Kolon yaralanmalarında 18 (%72) hastaya primer tamir veya anastomoz, 7 (%28) hastaya fekal diversiyon (anastomoz veya primer tamir) uygulandı. Yedi hastada komplikasyon gelişmiş (%28) olup, mortalite oranı %4 bulunmuştur.

Sonuç: Kolon yaralanmalarında fekal diversiyon yalnızca yüksek riskli olgularda düşünülmelidir. Penetran travma, hemodinamik olarak stabil hastalar, kan transfüzyonu gerektirmeyen ve proksimal kolon yaralanmalarında fekal diversiyondan kaçınılması önerilmektedir. Kolon yaralanmalarında optimal cerrahi yaklaşımı belirlemek için daha geniş serili ve çok merkezli çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: karın travması, kolorektal yaralanma, fekal diversiyon, komplikasyon

Introduction

Colorectal injuries are among the most debated intra-abdominal injuries in terms of optimal surgical repair. Colorectal injuries and their management pose significant challenges due to complications such as surgical site infection, intra-abdominal abscess, anastomotic dehiscence, and mortality related to these complications. The experiences gained in the treatment of colon injuries during the First World War and subsequent conflicts have shaped current civilian surgical practices. Discussions still continue regarding the factors influencing the choice of surgical management methods (primary repair, resection with anastomosis, or diversion). In the 1980s, the concept that military and civilian injuries should be evaluated separately emerged, and primary repair techniques began to be applied more frequently (1, 2).

Currently, while some authors recommend primary repair in all civilian colon injuries, others advocate alternative surgical strategies based on the presence of specific risk factors. Factors influencing morbidity and mortality in colorectal trauma include patient age, type and location of the injury, volume of blood loss, degree of fecal peritoneal contamination, and time elapsed before surgery (3, 4). Considering the reduced quality of life and complications associated with stoma creation and closure, the literature largely supports primary anastomosis (5). However, a few studies recommend stoma formation in cases of massive blood loss, hypotension, significant comorbidities, or delayed fecal contamination (6, 7).

Penetrating trauma, which is generally more easily identified and managed by trauma surgeons, accounts for the majority of colorectal injuries. In contrast, blunt colonic trauma may lead to delayed perforation and extensive intra-abdominal contamination, which can be overlooked during the initial assessment, operation, or even postoperative period. The concept of damage control surgery, introduced for hemodynamically unstable patients in recent years, has further diversified surgical treatment approaches for traumatic colon injuries. Damage control surgery aims to achieve temporary control of bleeding and contamination before performing definitive repair, once the patient's physiological condition has stabilized (8, 9).

Therefore, the aim of the present study was to evaluate the treatment approaches and outcomes of colon injuries resulting from both penetrating and blunt abdominal trauma. The primary objective was to assess surgical management strategies, while secondary objectives included analyzing postoperative complications such as anastomotic leakage and intra-abdominal infection.

Materials and Methods

Research and Publication Ethics: This study was approved by The Local Ethical Committee of Istanbul Kartal Dr Lütfi Kırdar City Hospital (Approval number: 2022/514/219/4, approval date: 09.02.2022).

Patients who were admitted to the emergency surgery department of our hospital between January 2018 and January 2023 due to blunt abdominal trauma, stab wounds, or gunshot injuries were evaluated. A total of 25 patients who underwent surgery for abdominal trauma in the emergency surgery department of our clinic and were intraoperatively diagnosed with colonic injury were included in the study. The medical records of these patients were retrospectively reviewed.

Demographic data (age, sex), type of injury, time to surgery, preoperative clinical condition, imaging findings, operative duration, presence of concomitant organ injury, surgical treatment methods, length of hospital stay, morbidity, and mortality rates were analyzed.

The American Association for the Surgery of Trauma (AAST) developed a grading system for colon injuries that is useful for predicting complications and comparing therapeutic interventions (10). The Colon Injury Severity Score (CISS) proposed by the AAST was used to determine the extent of colonic injury, whereas the Penetrating Abdominal Trauma Index (PATI) was applied to assess the severity of associated intra-abdominal organ injuries (11).

Statistical Analysis: The data obtained in our study were collected and analyzed using SPSS version 20.0 and statistical evaluation of the data was made with Fisher's accuracy test, Kruskal Wallis and Mann-Whitney U tests. $p < 0.05$ values were found to be significant.

Results

Colon injuries were identified in a total of 25 patients. Among them, 22 (88%) were male and 3 (12%) were female. The mean age was 37 ± 11.4 years (range, 19–74). Colon injuries were observed in patients who underwent emergency surgery due to penetrating stab injuries (PSI) in 12 (48%) cases, gunshot injuries (GSI) in 8 (32%), vehicle traffic accidents (VTA) in 4 (16%), and blunt abdominal trauma (BAT) in 1 (4%) case (Table 1).

The mean white blood cell (WBC) count of the patients was $15.64 \times 10^9/L$ (range, 5.95–32.33), hemoglobin was 14.1 g/dL (range, 9.9–17.4), and hematocrit was 42.4% (range, 32–52). Abdominal computed tomography (CT) was performed in 18 (72%) patients. Pathological findings were detected in 11 (44%) cases, whereas 7 (28%) CT scans were reported as normal. Since 7 (28%) patients were hemodynamically unstable, they were taken directly to the operating room without preoperative imaging. An average of 3.25 (2–6) units of blood was transfused to 4 (16%) patients before or during surgery, while 21 (84%) patients did not require transfusion.

Twelve (48%) patients underwent surgery within the first hour after injury, 10 (40%) within three hours, two (8%) within 12 hours, and one (4%) within 24 hours. The mean time interval between injury and initiation of treatment was 3.6 hours (range, 1–24).

Injury localization was most frequently observed in the transverse colon (11 cases, 44%), followed by the rectum (7 cases, 28%), the sigmoid/left colon (4 cases, 16%), and least commonly in the cecum/right colon (3 cases, 12%). Concomitant organ injury was observed in 14 (56%) patients. The most frequently injured additional organ was the small intestine (4 patients, 16%). Other associated injuries included diaphragm (3 cases), liver (2 cases), stomach (2 cases), pelvic fracture (1 case), spleen (1 case), and major vascular injury (1 case) (Table 2). The mean Colon Injury Severity Score of the cases was 3.32, and the mean Penetrating Abdominal Trauma Index was 17.4 (Table 3).

Table 1. Distribution of patients according to the causes of colon injury

Parameter	PSI	GSI	VAT	BAT	All patients	
					Mean±SD (min-max)	Total (n, %)
n (%)	12 (48.0)	8 (32.0)	4 (16.0)	1 (4.0)		25 (100.0)
M/F	10/2	7/1	4/0	1/0		22/0 (88.0/12.0)
Mean age (min-max)	32 (19-74)	42 (22-59)	36 (29-40)	24	37±11.4 (19-74)	
Resection + anastomosis/Primary repair, n (%)	9 (36.0)	6 (24.0)	3 (12.0)	-		18 (72.0)
Fecal diversion, n (%)	3 (12.0)	2 (8.0)	1 (4.0)	1 (4.0)		7 (28.0)
Localization, n (%)	Caecum/ Right colon	1 (4.0)	1 (4.0)	-	1 (4.0)	3 (12.0)
	Transverse colon	3 (12.0)	7 (28.0)	1 (4.0)	-	11 (44.0)
	Sigmoid/ Left colon	2 (8.0)	1 (4.0)	1 (4.0)	-	3 (12.0)
	Rectum	2 (8.0)	3 (12.0)	2 (8.0)	-	7 (28.0)
Mean operation time, min (min-max)	83.3 (40-170)	106.8 (70-300)	142.5 (60-100)	120	101.8±27.2 (40-300)	
Mean hospital stay, days (min-max)	10 (3-25)	9 (4-16)	5 (2-9)	6	9±15.28 (2-25)	
Complication, n (%)	5 (20.0)	1 (4.0)	1 (4.0)	-		7 (28.0)

PSI: penetrating stab injuries; GSI: gunshot injury; VTA: vehicle traffic accident; BAT: blunt abdominal trauma; SD: standard deviation; n: number; M/F: Male /Female

Table 2. Additional organ injury

Localization	n (%)
Small bowel	4 (16)
Diaphragm	3 (12)
Liver	2 (8)
Stomach	2 (8)
Spleen	1 (4)
Pelvic fracture	1 (4)
Major vascular injury	1 (4)
Total	14 (56)

Table 3. Morbidity rates and statistical analysis results according to patient groups

Parameter	Group	n (%)	Patients with complication (n, %)	p value
CISS	I-III	13 (52%)	6 (46%)	0.005*
	IV-V	12 (48%)	1 (8%)	
PATI	<17.4	16 (64%)	3 (19%)	0.45*
	>17.4	9 (36%)	4 (44%)	

*Fisher's exact test; CISS: Colon injury severity score; PATI: Penetrating abdominal trauma index; n: number

The most frequently performed surgical procedure was primary repair (13 patients, 52%), followed by resection and anastomosis (5 patients, 20%), resection and anastomosis with ostomy (5 patients, 20%), and primary repair with ostomy (2 patients, 8%). According to the Colon Injury Severity Score (CISS), 3 (12%) patients had grade I, 6 (24%) grade II, 4 (16%) grade III, 4 (16%) grade IV, and 8 (32%) grade V injuries. Primary repair was applied in CISS grades I-III, whereas fecal diversion (colostomy) was performed in grades IV-V (Table 4). The mean operative time was 101.8±27.2 minutes (range, 40-300).

In the postoperative period, wound infection occurred in 3 (12%) patients, intra-abdominal abscess in 1 (4%), pleural effusion in 1 (4%), neurological deficit in 1 (4%), and minor postoperative bleeding in 1 (4%) patient (Table 5). A percutaneous drainage catheter was inserted in the patient with intra-abdominal abscess, and blood transfusion was administered to the patient with postoperative bleeding. None of the patients with complications required reoperation.

Complications occurred in 7 patients, corresponding to a morbidity rate of 28%. The mean length of hospital stay was 9 ± 15.28 days (range, 1-25). One patient (4%) died on the first postoperative day due to multiple organ trauma. Thus, the overall mortality rate was 4%.

Table 4. Distribution by type of surgery in colon injuries

Type of operation		Primary repair	Resection + Anastomosis	Resection + Anastomosis+ Ostomy	Primer Repair + Ostomy	All Patients	
						Mean±SD (min-max)	Total (n, %)
n (%)		13 (52.0)	5 (20.0)	5 (20.0)	2 (8.0)	25 (100.0)	
Localization	Caecum/ Right colon	1(4.0)	-	1(4.0)	1(4.0)	3 (12.0)	
	Transversecolon	7 (28.0)	1 (4.0)	2 (8.0)	-	10 (40.0)	
	Sigmoid/ Left colon	1 (4.0)	2 (8.0)	2 (8.0)	1 (4.0)	6 (24.0)	
	Rectum	4 (16.0)	2 (8.0)	-	-	6 (24.0)	
CISS	I	3 (12.0)	-	-	-	3 (12.0)	
	II	6 (24.0)	-	-	-	6 (24.0)	
	III	4 (16.0)	-	-	-	4 (16.0)	
	IV	-	2 (8.0)	2 (8.0)	-	4 (16.0)	
	V	-	3 (12.0)	3 (12.0)	2 (8.0)	8 (32.0)	
PATI (mean)		15	17.2	18.4	31	17.4	

CISS: Colon injury severity score; PATI: Penetrating abdominal trauma index; n: number; SD: standard deviation

Table 5. Postoperative complications

Parameter	n (%)
Wound infection	3 (12)
Intra-abdominal abscess	1 (4)
Pleural effusion	1 (4)
Neurological deficit	1 (4)
Minor bleeding	1 (4)
Total	7 (28)

Discussion

In the past century, the frequency of fecal diversion in penetrating colorectal injuries has progressively declined. The shortening of the interval between trauma and definitive treatment, more effective early management, improvements in intensive care conditions, the increased feasibility of damage-control surgery, and advances in surgical technology and experience have substantially transformed the management of colon injuries. As a result of these developments, treatment strategies have increasingly shifted away from colostomy and brought non-diversional surgical approaches to the forefront. In addition, the comprehensive evaluation of concomitant organ injuries and the development of various injury-severity and scoring systems (such as APACHE, CISS, and PATI) have contributed to standardizing surgical treatment approaches in colorectal trauma.

Colon injuries are more common in young male patients and most frequently result from stab wounds, gunshot injuries, traffic accidents, and iatrogenic causes, in that order. It has also been reported that gunshot wounds tend to cause more severe injuries (5, 6). Most of the patients with colorectal injuries in our study were young males. The most common etiology of colorectal

injury was penetrating stab injury (PSI) with 12 (48%) cases, followed by gunshot injury (GSI) in 8 (32%), vehicle traffic accident (VTA) in 4 (16%), and blunt abdominal trauma (BAT) in 1 (4%) case. In the study by Carap et al. (16), all patients were reported to be male, and, unlike our series, the injuries predominantly resulted from blunt trauma. Thus, the predominance of male patients emerges as a common feature shared by both studies.

The presence of shock and the need for blood transfusion are important indicators of injury severity and significant determinants of prognosis. Prolonged hypotension and impaired tissue perfusion may lead to bacterial translocation and immune dysfunction, facilitating the development of sepsis (2, 4). Preoperatively or intraoperatively, an average of 3.25 units of blood (range, 2–6 units) was transfused to 4 patients (16%). Kahya et al. (12) and Hughes et al. (13) reported that the mean time from injury to surgery was approximately 11 hours in their respective studies. In our series, the mean interval between injury and initiation of treatment was 3.6 hours (range, 1–24). Colon injuries caused by gunshot wounds had the shortest preoperative interval (1 hour), whereas the longest interval (24 hours) was observed in a patient with a stab injury (PSI). Although the initial imaging findings of this patient were normal, laparotomy was performed 24 hours later due to the development of acute abdomen.

The presence of concomitant intra-abdominal or extra-abdominal organ injury in patients with colon injury is a marker of trauma severity and a major factor influencing the choice of surgical procedure. The Penetrating Abdominal Trauma Index (PATI) defined by Moore et al. (14) and revised in 2016 is one of the preferred systems for evaluating the severity of abdominal trauma (11). In our study, additional organ injuries were present in 14 (56%) patients. In the study

by Kahya et al. (12), the rate of associated organ injury was 65%. Similarly, Köksal et al. (15) reported that small bowel injury was the most frequent concomitant injury in colorectal trauma, with a rate of 54.2%.

In the study by Carâp et al. (16), the most common injury sites were the sigmoid and transverse colon (63%). Similarly, Cheng et al. (17) reported that the sigmoid colon (35%) was the most commonly affected region. In our study, injuries were most frequently localized in the transverse colon, followed by the rectum.

Although primary repair and resection–anastomosis are the most commonly preferred surgical techniques, fecal diversion may be required in certain situations to protect the anastomosis or the primary repair site. The high bacterial load of the large intestine often prompts surgeons to consider such protective measures. However, since some patients still benefit from fecal diversion, the complete elimination of stoma formation following colon injury is unlikely. Prospective clinical studies conducted by Demetriades, Gonzalez, Sasaki, and the meta-analysis by Singer et al. reported that primary repair or resection with anastomosis can be safely performed in all colon injuries, regardless of risk factors. (2-4, 18) In our study, primary repair or resection with anastomosis was performed in 18 (72%) cases, whereas fecal diversion was performed in 7 (28%) cases.

Complications were more frequent in patients with CISS grades I–III than in those with grades IV–V; however, these were predominantly minor wound infections. A major complication occurred in one patient with a CISS grade V injury. It has been reported that a PATI score above the mean value increases morbidity and mortality. (14) However, in our study, higher PATI scores were not associated with increased complication rates. Our findings are consistent with those of Kahya et al. (12), who evaluated outcomes according to CISS grading. In many studies, the reported rates of anastomotic leakage and fistula formation vary between 1.2% and 12.7% (19-21). In our study, intra-abdominal abscess developed in only one patient, who was

successfully treated with percutaneous drainage catheter insertion. In colorectal injuries, additional complications may arise due to concomitant multi-organ trauma. Indeed, in our study, complications unrelated to colonic injury were observed in two patients, and one patient died on the first postoperative day as a result of multiple organ trauma. Interestingly, in our study, the complication rate was higher in patients with lower CISS scores (I–III); this finding may be explained by the frequent use of primary repair in low-CISS cases, whereas protective fecal diversion was preferred in patients with high CISS scores (IV–V). Therefore, the lower complication rates observed in the high-CISS group may be attributed to the protective effect of the surgical approach, suggesting that the CISS score alone may be insufficient to predict complication risk. In our study, although higher PATI scores appeared to increase the likelihood of complications, this association was not found to be statistically significant ($p=0.45$); this may indicate that the limited sample size reduced the statistical power to demonstrate a meaningful relationship between PATI and postoperative complications.

The limitations of this study include its retrospective design and relatively small sample size. Nevertheless, well-designed, prospective, and controlled studies with larger patient populations are needed to further elucidate optimal management strategies for colon injuries.

In conclusion, primary repair and resection–anastomosis can be safely performed in penetrating colorectal injuries with low morbidity and mortality rates. However, because not all patients share the same clinical risk profile, fecal diversion may still provide additional protection in certain cases; therefore, the need for a stoma cannot be completely eliminated. In this context, surgical management of colorectal injuries should be individualized by carefully assessing the severity of the injury, the presence of associated organ damage, and patient-specific risk factors.

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