

# Blunt colonic injury: a 64-case series

## Künt kalın bağırsak yaralanması: 64 olguluk seri

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### BACKGROUND

Blunt colonic injuries are rare but can complicate the management of the blunt trauma patient and worsen the outcome. We analyzed in this study the colonic injuries caused by blunt abdominal trauma.

### METHODS

The records of 64 patients (60 male, 4 female; mean age 39.3 years; range 16 to 69 years) were investigated retrospectively. The records were reviewed for clinical presentation, investigations, diagnostic methods, associated injuries, time from injury to operation, site of colon injury, operative management, morbidity, and mortality.

### RESULTS

One-stage operation was performed in 53 cases (82.8%) and two-stage operation in 11 cases (17.2%). The treatment chosen was strongly related with the degree of fecal contamination and grade of colonic injury ( $p<0.01$ ). The overall incidence of colonic injury-related abdominal complications was 26.5% (17 cases). There were six non-colon-related and one colon-related mortalities. Shock at presentation, severe fecal contamination, colon injury scale (CIS) grade, and associated injuries were related with complications and mortality.

### CONCLUSION

We conclude that in patients with shock at presentation, severe fecal contamination and higher CIS grade, two-staged operation is appropriate.

**Key Words:** Blunt trauma; colon; injury.

### AMAÇ

Künt kalın bağırsak yaralanmaları nadirdir ancak, künt travma hastasının tedavisini zorlaştırıp sonucu kötüleştirebilirler. Bu çalışmada, künt karın travması sonucu oluşan kalın bağırsak yaralanmaları incelendi.

### GEREÇ VE YÖNTEM

Altmış dört hastanın (60 erkek, 4 kadın; ort. yaş 39,3; dağılım 16-69) kayıtları geriye dönük olarak incelendi. Kayıtlar, klinik prezentasyon, araştırmalar, tanısal yöntemler, eşlik eden yaralanmalar, yaralanma ile ameliyat arasında geçen zaman, kalın bağırsak yaralanmasının yeri, ameliyatta yapılan işlemler, morbidite ve mortalite açısından incelendi.

### BULGULAR

Olguların 53'üne tek aşamalı ameliyat uygulanırken (%82,8), 11'inde (%17,2) iki aşamalı ameliyat tercih edildi. Seçilen cerrahi yöntem, fekal bulaşın ve kalın bağırsak yaralanmasının derecesi ile kuvvetli bir şekilde ilişkili bulundu ( $p<0,01$ ). Kalın bağırsak yaralanmasına bağlı karın komplikasyonlarının genel oranı %26,5 (n=17) idi. Kalın bağırsak yaralanmasına bağlı olmayan 6, bağlı olan 1 ölüm oldu. Müracaatta şok olması, şiddetli fekal bulaş, kalın bağırsak yaralanması skalası (CIS) ve eşlik eden yaralanmalar, komplikasyon ve ölümlerle ilişkili bulundu.

### SONUÇ

Başvuruda şokta olan, şiddetli fekal bulaş olan ve yüksek CIS derecesi olan hastalarda iki aşamalı ameliyatın uygun olduğu çıkarımına varıldı.

**Anahtar Sözcükler:** Künt travma, kalın barsak, yaralanma.

The colon is mostly injured with penetrating trauma. Blunt colonic injury (BCI) is thought to be rare, but with the increase in blunt injuries and especially

traffic accidents, the incidence of BCIs has been increasing.<sup>[1,2]</sup> In contrast with penetrating injuries, the diagnosis of BCI is often overlooked or

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delayed.<sup>[1,2]</sup> In this study, patients with BCI were analyzed retrospectively.

## MATERIALS AND METHODS

The study included blunt trauma patients with colonic injuries who were operated in the Department of General Surgery at Atatürk University School of Medicine between January 1995 and July 2007. Patients with concomitant blunt and penetrating injuries, rectal injuries or age under 15 years were excluded from the study, as were any patients who were operated at another clinic and referred to our clinic after the first surgical intervention. Patient charts were reviewed for clinical presentation, investigations, diagnostic methods, other associated intraabdominal injuries, major injuries of the head, thorax, pelvis, axial skeleton, major blood vessels and long bones, time from injury to operation, site of colon injury (right colon defined as right of the middle colic vessels, left colon defined as left of the vessels to the peritoneal reflexion), operative management, morbidity, and mortality.

Hemodynamic status was determined based on heart rate and systolic blood pressure (BP) on admission. A systolic BP  $\leq 90$  mmHg on admission was interpreted as hemodynamic instability or presence of shock.

The severity of colon injury was graded according to the colon injury scale (CIS) score,<sup>[3]</sup> which was defined as follows:

Grade 1: contusion and serosal tear without devascularization;

Grade 2: laceration of  $<50\%$  of the wall;

Grade 3: laceration of  $\geq 50\%$  of the wall;

Grade 4: 100% transection of the wall;

Grade 5: complete transection with tissue loss and devascularization and advanced grade for multiple injuries to the colon.

The degree of fecal spillage (the gross extent of intraabdominal fecal contamination) was categorized as;

mild: stool contamination local or on 1 quadrant;

moderate: stool contamination on 2 to 3 quadrants;

severe: stool contamination on all 4 quadrants.

The data were analyzed statistically with SPSS 13.0 (SPSS for Windows, Chicago, IL, USA) statis-

tical software. Analysis was performed using the Student's t test for continuous variables, and chi-square test or Fisher exact test for categorical variables. Independent predictors for postoperative complications and mortality were determined by entering potential confounders into a multivariate stepwise (backward elimination) logistic regression. Variables considered included age, shock on admission, CIS, degree of peritoneal fecal contamination, location of colon injury, and associated intraabdominal injury. A value of  $p < 0.05$  was considered statistically significant.

## RESULTS

The study involved 64 patients (60 male, 97.8%; 4 female, 5.9%). The age range of the patients was 16-69 years, with a mean of 39.3 years. Colonic injury in 32 patients (50%) was due to motor vehicle accidents, in 13 (20.3%) due to fall from height, in 12 (18.7%) due to crash, and in 7 (11 %) due to criminal assault.

The clinical examination findings of the abdomen were as follows: in 4 (6%) patients, the abdomen could not be evaluated adequately because of low consciousness level, 5 (7.8%) patients had no positive abdominal examination finding, 16 (25%) had localized or diffuse muscular defense and rebound tenderness, which were strongly suggestive for peritonitis, and the remaining 39 (60.9%) had suspicious abdominal findings. Six patients presented signs and symptoms of shock (9.3%).

Plain abdominal radiograph was performed in 56 patients, and free intraperitoneal air was observed in 5 patients. Diagnostic peritoneal lavage (DPL) or paracentesis was performed in 40 patients, which was positive in 25 patients (defibrinated blood in 17 patients; bile or intestinal contents in 8 patients). Abdominal ultrasonography (US) was performed in 62 and computed tomography (CT) in 41 patients. The main findings of the abdominal US were free intraabdominal fluid (47 patients) and solid organ injuries (34 patients). CT revealed free intraabdominal fluid (34 patients), solid organ injuries (30 patients) and free intraperitoneal air (4 patients).

Fifty-six (87.5%) patients had one or more associated intraabdominal injuries and 27 had one or more extraabdominal injuries (42.1%) (Table 1). The most commonly associated intraabdominal injury occurred in the small bowel (26 cases, 40.6%), followed by the spleen, liver and pancreas. Multiple

**Table 1.** Associated injuries

Injured organ	Number of patients
Small bowel	26
Liver	14
Spleen	14
Thorax	10
Cranium	9
Urologic	7
Long bone	6
Spinal cord or vertebral column	4
Pancreas	4
Duodenum	3

colonic wounds were observed in 2 patients (3.1%) and isolated colon injury in 7 patients (10.9%).

The time between injury and operational intervention was  $11 \pm 7.8$  hours (2-24h). Laparotomy was performed immediately (<2 h after injury) in 6 patients (9.3%), 2-6 h after injury in 7 patients (10.9%) and 6-12 h in 30 patients (46.8%). Five patients (7.8%) were operated after 12 h, and 16 patients (25%) were operated with a delay of over 24 h.

Indications for surgery were positive abdominal signs with evidence of peritonitis on admission or during observation in 38 patients (59.4%) and positive DPL or paracentesis or positive diagnostic or suspicious findings on abdominal US or abdominal CT in the remaining 26 patients (40.6%).

Sixty-four patients had 66 colonic injuries. The left colon was the most often injured side (30 cases, 46.8%). Right and transverse colon injury was detected in 17 patients each (26.6%).

The mean CIS score was 2.43. There were 13 patients with grade I, 25 patients with grade II, 15 patients with grade III, 7 patients with grade IV, and 4 patients with grade V injuries. The degree of fecal contamination was classified by the operating surgeon as mild in 42 patients (65.6%), moderate in 11 (17.1%), and severe in 11 (17.1%).

Treatment options were two-stage management for those with any type of fecal diversion and one-stage management for those undergoing primary repair of the injured colon with anastomosis or primary suture repair. One-stage operation was performed in 53 patients (82.8%). Primary suture repair was performed in 40 patients, and resection and primary anastomosis in the remaining 13 patients. Two-stage operation was performed in 11 patients

(17.2%) including repair and protective ostomy in 4 cases, exteriorization of the repaired bowel in 2 patients, and Hartmann's operation in 5 patients. The determination of treatment option was strongly related with the degree of fecal contamination and grade of colonic injury ( $p < 0.01$ ,  $p < 0.01$ ). Diversion operations were performed in patients with high CIS grade colon injury and severe fecal contamination. However, no relationship could be established between shock, associated injuries and site of colonic injury and the treatment option.

The overall incidence of colonic injury-related abdominal complications was 26.5% (17 patients). The most common complications were wound infection and dehiscence (9 patients), sepsis (4 patients), intraabdominal abscess (3 patients), and postoperative bleeding (1 patient). Non-colon-related complications included pulmonary complications (5 patients), non-colon-related sepsis (2 patients) and deep venous thrombosis (1 patient). There were no leaks from the anastomosis or primary repair sites. There was a significant relation between the complications and shock on admission ( $p < 0.01$ ), fecal contamination ( $p < 0.01$ ), use of colostomy ( $p < 0.05$ ), and degree of colon injury (CIS score) ( $p < 0.01$ ).

The overall mortality rate was 10.9% (7 patients). There were 6 non-colon-related (cerebral contusion in 3, massive hemorrhage in 2 and pulmonary contusion and pulmonary insufficiency in 1) and 1 colon-related (intraabdominal abscess and sepsis) deaths. Shock on admission ( $p < 0.01$ ), associated intraabdominal injuries ( $p < 0.01$ ) and degree of colon injury (CIS score) ( $p < 0.05$ ) were correlated with the mortality.

## DISCUSSION

Although the colon is often injured in cases of penetrating abdominal trauma, a significant proportion of colonic injuries are caused by blunt traumas, which can be very destructive, associated with damage to multiple organs and cause significant clinical compromises.<sup>[4]</sup> The overall incidence of BCI is low. Carrillo et al.<sup>[5]</sup> found a 0.5% incidence of BCI in a retrospective study, and Ng et al.<sup>[6]</sup> reported an incidence of less than 0.1% in a study involving 1,367 blunt trauma patients at one center. Malhotra et al.<sup>[7]</sup> reported a similarly low incidence of only three colon perforations discovered in over 8,100 evaluations. Blunt abdominal trauma accounts for approximately 5-15% of all operative abdominal injuries, and BCI is reported to be at the same rates in patients

who underwent laparotomy for blunt abdominal trauma.<sup>[8]</sup> Ross et al.<sup>[9]</sup> found a slightly higher than 10% incidence of colonic injury among patients undergoing laparotomy after blunt trauma. Williams et al.<sup>[2]</sup> reported this incidence as 13% in the results of the EAST multi-institutional hollow viscus injury study. In our study, 493 patients were operated for blunt abdominal trauma during the period indicated, and a rate of 12.9% (64) colon injuries was determined in the patients undergoing laparotomy for blunt abdominal injury. These results show that the colon is mostly injured by penetrating abdominal trauma, as suggested in the literature. Although rarely seen, traumatic blunt injuries to the colon can be destructive and are generally associated with damage to multiple organ systems.

The diagnosis of gastrointestinal injury from blunt trauma continues to be plagued by diagnostic delays. Clinical assessment of blunt injury victims is often difficult and mostly unreliable due to distracting injuries, head and spinal cord injuries, and shock, particularly in children.<sup>[10]</sup> Thirty-eight (59.4%) of our patients had positive abdominal findings correlating with other diagnostic studies that could be an indication for laparotomy, and the remaining 26 patients (40.6%) were operated because of positive DPL or paracentesis or positive diagnostic or suspicious findings on abdominal US or abdominal CT. Only 7 (10.9%) of our patients had isolated colonic injuries. All of these patients had positive abdominal findings. It is reported that less than 50% of gastrointestinal tract injuries resulting from blunt trauma have sufficient clinical findings to indicate the need for laparotomy.<sup>[4,10]</sup> It is also reported that laparotomy based on clinical assessment alone may result in negative exploration rates up to 40% with an associated morbidity between 5 and 20%.<sup>[10]</sup>

In our study, US was generally used as the first step of the diagnostic studies, which was performed in 62 patients. Unfortunately, only a few of these US procedures were performed as focused assessment with sonography for trauma (FAST). A positive US is defined as evidence of free fluid or solid organ parenchymal injury. Williams et al.<sup>[2]</sup> reported in the results of the EAST multi-institutional hollow viscus injury study that FAST has 50% sensitivity and a 60% positive predictive value. In our study, US revealed positive findings in 47 patients with the findings of free fluid and solid organ parenchymal injury. These findings could guide blunt abdominal

injury, but it cannot be said that US is very useful for the diagnosis of colonic injuries in blunt trauma victims.

Computed tomography scanning has been the most commonly used and controversial test. In our study, CT was used in 41 patients, with positive findings in 34. Malhotra et al.<sup>[7]</sup> found CT scanning to be 88.3% sensitive and 99.4% specific for blunt bowel/mesenteric injuries. In another study, the characteristics of bowel or mesenteric injuries were described with a sensitivity of 64% and specificity of 97%.<sup>[7]</sup> Williams et al.<sup>[2]</sup> reported that CT scanning had less than 50% negative predictive value in the results of the EAST multi-institutional hollow viscus injury study. It was suggested that a finding of free fluid with or without solid organ injury is a marker of surgical abnormality in the abdomen.<sup>[2]</sup> Our CT findings were free intraabdominal fluid, solid organ injuries, and/or free intraperitoneal air. All these findings were associated with a surgical abnormality. It was also reported that the lack of these findings is a reliable indication that no operative intervention is necessary.<sup>[2]</sup> However, it can be speculated that serosal tears, which would not present any clinical or radiological findings, could further complicate the course of the patient. This has to be further investigated. On the other hand, it was reported that neither extravasation of oral contrast nor free fluid without solid organ injury is useful for definitive diagnosis.<sup>[2]</sup> We used diagnostic paracentesis or DPL for the definition of the nature of the free fluid that was detected by US or CT. Diagnostic paracentesis to detect possible intraabdominal injuries in cardiovascularly stable patients has been used routinely to differentiate between injuries that require a therapeutic laparotomy and those that do not.<sup>[2]</sup> DPL has a sensitivity greater than 90% in detecting gastrointestinal tract injuries and hemoperitoneum with a negative predictive value of 80%.<sup>[2,4,10]</sup> Besides this high sensitivity, it is reported that DPL has a high rate of non-therapeutic laparotomy.<sup>[4]</sup> However, in our series, DPL was the most useful tool for the definition of the free fluid, and we had no negative laparotomies resulting from its misinterpretation. The peritoneal lavage cell count and an alkaline phosphatase (ALP) level of 10 IU/L in the lavage fluid could be positive indicators for hollow viscus injury.<sup>[2,4]</sup> However, it is reported that CT has the advantage of providing more information than DPL, including the site and the extent of injuries.

The difficulties in diagnosing BCI, particularly when additional injuries are not present, cause significant delays in the operative intervention. It is reported that delayed management of colonic injuries results in a high incidence of morbidity<sup>[11]</sup> and in penetrating colonic injuries. Adesanya et al.<sup>[12]</sup> reported that delay of the operation is an important factor for the development of fecal contamination. The delay between injury and operation was  $11 \pm 7.8$  hours (2-24 h) in the present study. Most of the patients (43 patients, 67%) were operated in the first 12 hours, and most of them had mild fecal contamination.

Dauterive et al.<sup>[13]</sup> and Wisner et al.<sup>[14]</sup> reported that 12 out of 34 major colonic injuries (35%) to the right colon were associated with multiple injuries elsewhere. Nevertheless, this was not seen in our series. In our series, 66 colonic injuries in 64 patients were detected. Although it is reported that the transverse colon is the most vulnerable portion of the colon in blunt trauma due to its exposure,<sup>[10]</sup> in our series, left colon injuries were more common (30 patients, 46.8%). Right and transverse colon injuries were found in 17 patients each (26.6%). The sigmoid colon is relatively exposed and at risk of closed loop perforations. The often-redundant mesentery is also predisposed to avulsion-type injuries.<sup>[10]</sup> Hughes et al.<sup>[10]</sup> reported that they had treated all left-sided injuries with resection and proximal end colostomy, and this approach was used largely due to the severity of associated injuries. However, we were unable to determine a correlation with the side of the injury and postoperative complications or mortality. Furthermore, the decision of the treatment was also not associated with the side of the injury.

The treatment of colonic injuries following blunt or penetrating injuries continues to be debated. Currently, the use of primary closure or resection and anastomosis has been suggested.<sup>[4]</sup> Primary closure reduces postoperative complications, avoids a second operation and stoma complications, and eases financial burden.<sup>[4]</sup> Primary repair, however, should not be used in patients with shock, major blood loss, more than two injured organs, fecal contamination higher than mild, delay of repair more than 8 hours, and destructive wound of the colon and abdominal wall requiring resection.<sup>[15,16]</sup> These rules generally guide penetrating colonic injuries.

In our patients, shock on admission, CIS grade, peritoneal fecal contamination, use of stoma, and

associated injuries were associated with complications and mortality. For blunt colonic injuries, Ross et al.<sup>[9]</sup> reported that gross fecal contamination, particularly in the presence of major extraabdominal injuries, is the most significant contraindication for primary repair or anastomosis.<sup>[9]</sup> Peritoneal fecal contamination has been shown to have a significant predictive value for complications.<sup>[4]</sup> In our study, fecal contamination was associated with postoperative complications, but had no impact on mortality.

We can understand from the analyses of our data that operating surgeons mostly preferred diversion in patients with high CIS grade and severe fecal contamination, and complications occurred mostly in these patients. This could explain the relation between complications and stoma formation. Although postoperative complications in our series usually occurred in patients with associated injuries, the difference was not statistically significant, and in contrast to Ross et al.,<sup>[9]</sup> the occurrence of intra- or extraabdominal associated injuries was not taken into consideration in decision-making for the treatment choice because there was no statistical correlation between the associated injuries and the treatment choice. Associated intraabdominal injuries were correlated with the mortality. The mortality rate following BCI was reported to be 18.9% by Williams et al.<sup>[2]</sup> The overall mortality rate in our series was 10.9% (7 patients). There were six non-colon-related (cerebral contusion in 3, massive hemorrhage in 2 and pulmonary contusion and pulmonary insufficiency in 1) and one colon-related (intraabdominal abscess and sepsis) deaths. It can be speculated that with the increasing severity of the injury and blunt trauma affecting the abdomen, the number of associated intra- and extraabdominal injuries will increase and this can contribute to the mortality. Both complications and mortality were associated with shock on admission. It would be better to evaluate the patients with trauma scoring systems. This would provide a better assessment of associated injuries and shock on admission together. Unfortunately, our study was retrospective and we could not provide all detailed recordings.

It has been reported that the grade of colonic injuries tends to be independently associated with intraabdominal complications.<sup>[4,17]</sup> However, neither grade nor stoma formation demonstrated a significant impact on morbidity.<sup>[4,17,18]</sup> Grade of colonic injury was associated with complication in our study as well, but the contribution of CIS grade to mortal-

ity in our study is not clear, because there was an only one colon-related death.

In conclusion, BCI is rare and hard to diagnose especially when the trauma victim does not have additional intraabdominal injuries. This type of colonic injury might be easily overlooked in the occurrence of extraabdominal injuries particularly in association with intraabdominal injuries, which will be managed non-operatively. Unfortunately, there are no specific diagnostic modalities or combination of diagnostic methods currently available to detect BCI. Therefore, it is important for the trauma surgeon to keep BCI in mind to facilitate its timely diagnosis and management.

We can conclude that in patients with shock on presentation, severe fecal contamination and higher CIS grade, two-staged operation is appropriate and the complication rate will be higher. Associated injuries were related with mortality. We think that associated injuries should be considered in the choice of operation when they cause hemodynamic instability and shock. In patients with mild or moderate fecal contamination, lower CIS grade and without shock, primary repair could be the first choice. However, the limitation of our study was the small number of patients and its design (retrospective). Prospective studies must be planned to establish better guidelines.

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