

Original Article

## Outcomes of Blunt Colonic Injury in Patients with Polytrauma

Chun-Hsien Wu<sup>1,2</sup>

Yi-Ting Yen<sup>1</sup>

Chih-Jung Wang<sup>1</sup>

Tsung-Han Yang<sup>1</sup>

Kuo-Shu Hung<sup>1</sup>

Wei-Ting Lin<sup>2</sup>

Ren-Hao Chan<sup>2</sup>

Bo-Chuan Chen<sup>2</sup>

Shao-Chieh Lin<sup>2</sup>

Jenq-Chang Lee<sup>2</sup>

Bo-Wen Lin<sup>2</sup>

<sup>1</sup>Division of Trauma and Acute Care Surgery,

<sup>2</sup>Division of Colorectal Surgery, Department of Surgery, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan

**Purpose.** To compare the outcomes of destructive and nondestructive blunt colonic injuries in patients with polytrauma.

**Method.** We retrospectively selected patients with trauma-related blunt colonic injury admitted to National Cheng Kung University Hospital between January 2011 and February 2019. Clinical parameters and outcomes were compared between patients with and without destructive colonic injuries.

**Results.** A total of 21 patients had blunt colonic injury; 7 had destructive colonic injury, and the other 14 had nondestructive colonic injury. No difference was observed between the groups in terms of trauma severity, patient condition, or underlying disease. No differences in diversion rate or colon-related complications were detected. Longer length of stay was observed in the destructive injury group. Mortality had a stronger correlation with initial trauma severity than with local colon condition.

**Conclusion.** The mortality rate of blunt colonic injury in patients with polytrauma was more strongly correlated with the severity of trauma than with the condition of colonic injury.

[J Soc Colon Rectal Surgeon (Taiwan) 2019;30:135-141]

### Key Words

Blunt polytrauma;

Destructive colonic injury

In the 19<sup>th</sup> century, trauma-related colonic injuries used to be devastating, with a mortality rate up to 90%. This high mortality rate was associated with non-operative measures being performed because of the lack of appropriate anesthesia and sterile techniques for implementing surgical approaches and further sepsis control. With surgical advancements, the standard approach gradually evolved to become mandatory laparotomy and proximal diversion, and at this time, which coincided with the Vietnam War (1955-1975), the mortality rate for trauma-related colonic injuries decreased to less than 10%.<sup>1</sup>

In Western countries, reports indicate that most colonic injuries are caused by gunshot and penetrating wounds, with colonic injuries related to blunt abdominal trauma accounting for less than 1% of all trauma cases.<sup>2</sup> Current management of colonic injury in Western countries is primarily focused on penetrating injuries. However, because of social and cultural differences between Asian and Western countries, penetrating injuries are relatively less common in Asia. Instead, most colonic injuries in Asian countries are caused by blunt abdominal trauma incurred during traffic accidents; accordingly, the incidence of blunt

Received: February 26, 2019.

Accepted: July 29, 2019.

Correspondence to: Dr. Bo-Wen Lin, Division of Colorectal Surgery, Department of Surgery, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, No. 138, Sheng-Li Road, Tainan City 704, Taiwan. Tel: 886-6-235-3535 ext. 5181; Fax: 886-6-276-6676; E-mail: wen276@gmail.com

colonic injury is much higher in Asia than in Western countries. Because little research has been conducted on blunt colonic injury, we provide insights into the management methods and outcomes of such patients.

## Materials and Methods

We used the Trauma Division's Registry to retrospectively identify polytrauma patients with blunt colonic injuries operated at National Cheng Kung University Hospital from January 2011 to February 2019. Polytrauma was regarded as Injury Severity Score more than 8 for at least two body regions. Patients who died within 24 hours of arrival to the emergency department and those with rectal injuries were excluded. Patients younger than 18 years were excluded.

Blunt colonic injury was defined as wounding of the colon from blunt trauma. Diagnosis is typically made intraoperatively, either from an initial survey of a computed tomography scan at the emergency department that leads to laparotomy, or from incidental findings during emergent surgery or damage control laparotomy. Colonic injuries with serosal tears, full thickness perforations, or mesentery tears or perforations were included. The location of colonic trauma is typically determined during identification of the wound as ascending colon, transverse colon, descending colon, or sigmoid colon. Patients with serosal tears of more than 50% of the colon circumference, full-thickness perforations, or mesenteric devascularization were regarded as having destructive colonic injury.<sup>3</sup>

Damage control laparotomy is generally performed for patients who remain unstable even after aggressive resuscitation. For such patients, contamination and hemorrhage control are swiftly performed during the initial surgery with temporary closure of the abdomen before the patient is transferred to the intensive care unit for further medical support. After improving patients' status from hypothermia, acidosis, and coagulopathy, definite repair or diversion surgery is then performed.

The decision to perform repair or diversion is made by the trauma surgeon. Repair surgery is defined as follows: 1) debridement and primary closure

and 2) resection of affected colon segments and anastomosis. Diversion surgery is defined as follows: 1) resection of the injured colon with proximal exteriorization and closure of distal segments and 2) either simple closure or resection and anastomosis of the trauma site with a proximal protective stoma.

Medical comorbidities are regarded as underlying diseases that affect wound healing, such as diabetes mellitus, congestive heart failure, chronic kidney disease, alcoholism, cirrhosis, acquired immunodeficiency syndrome, and conditions requiring chronic steroid treatment (e.g., rheumatic arthritis). Colon-related complications were considered to be anastomosis leakage or failure, local abscess formation, or wound infection. Colon-related mortality was defined as death caused by colon-related complications.

Clinical parameters were collected and analyzed regarding patient demographics, vital signs, general evaluations upon arrival (injury severity score [ISS] score and abdominal Abbreviated Injury Scale score), injury mechanisms, associated injuries, location and severity of colonic injury, operation methods, and outcomes.

Fischer's exact test and Mann-Whitney U test were used to analyze parameter associations between the two groups. Data were statistically analyzed using SPSS version 18. Statistical significance was defined as  $p < 0.05$  for all results.

## Results

### Overall population

A total of 21 patients were included in this study. Their median age was 44 years, and 16 (76.2%) were men. The median ISS score was 29. Overall, 20 out of 21 patients sustained their injuries from motor vehicle accidents; the remaining patient had crushing injuries caused by the collapse of a building. The most common injury site was the transverse colon in 9 (42.9%) patients, followed by the sigmoid colon in 5 (23.8%) patients and the ascending colon in 3 (14.3%) patients. Destructive colonic injuries accounted for 7 (33.3%) patients. A total of 8 (38.1%) patients under-

went damage control laparotomy. Diversion surgery was performed in 3 (14.3%) patients. No delayed diagnosis was noted. The median intensive care unit admission duration was 11.5 days, and the median duration of stay was 23 days. Overall, 3 patients had colon-related complications; one was an intra-abdominal abscess and the other two were wound infections. No colon-related mortality was noted. The overall mortality rate was 28.6% (6 patients). A summary of the clinical characteristics of patients with blunt colonic injury is presented in Table 1.

### Comparison between destructive and non-destructive colonic injuries

Among 21 patients, 7 had destructive colonic injuries. A comparison of clinical characteristics between patients with and without destructive colonic injury is detailed in Table 2. No significant difference was noted between the two populations with respect to ISS score, systolic blood pressure less than 100 mmHg status, out patient cardiac arrest status, presence of medical comorbidities, damage control laparotomy rate, diversion surgery rate, and colon-related complication rate. No difference in the admission duration in the intensive care unit was observed. A longer total admission duration was observed in patients with destructive colonic injury (median 37 days for patients with destructive injuries compared with 12 days for patients with nondestructive injuries,  $p = 0.036$ ).

**Table 1.** Clinical characteristics in blunt colonic injury patients (n = 21)

Variables	N
Age, mean, median (SD)	45.19, 44 (19.61)
Male sex (%)	16 (76.2)
ISS, mean, median (SD)	29.38, 29 (13.06)
Abd. AIS $\geq$ 4 (%)	8 (38.1)
SBP < 100 mmHg (%)	8 (38.1)
GCS, mean, median (SD)	10.81, 14 (5.07)
OHCA (%)	2 (9.5)
Trauma mechanism (%)	
MVA	20 (95.2)
Crushing injury	1 (4.8)
Medical comorbidity (%)	7 (33.3)
Colon injury sites (%)	
Ascending	3 (14.3)
Transverse	9 (42.9)
Descending	2 (9.5)
Sigmoid	5 (23.8)
Others*	2 (9.5)
Destructive colon injury (%)	7 (33.3)
Damage control laparotomy (%)	8 (38.1)
Diversion (%)	3 (14.3)
Admission days	
ICU, mean, median (SD)	14.14, 11 (17.16)
Total, mean, median (SD)	37.67, 23 (59.75)
Complication, colon-related (%)	3 (14.3)
Overall-mortality (%)	6 (28.6)

SD, standard deviation; ISS, Injury Severity Score; Abd. AIS, abdomen Abbreviated Injury Scale; SBP, systolic blood pressure; GCS, Glasgow coma scale; OHCA, out-of-hospital cardiac arrest; MVA, motor vehicle accidents, ICU, intensive care unit.

\* Both transverse and sigmoid colon injury.

**Table 2.** Comparison of clinical variables in destructive and non-destructive patients

	Destructive (7)	Non-destructive (14)	<i>p</i>
ISS, mean, median (SD)	24.14, 22 (10.09)	32, 34 (13.91)	0.217
SBP < 100 mmHg (%)	3 (42.9)	5 (35.7)	0.999
OHCA (%)	1 (14.3)	1 (7.1)	0.999
Medical comorbidity (%)	3 (42.9)	4 (28.6)	0.638
Damage control laparotomy (%)	1 (14.3)	7 (50.0)	0.174
Diversion (%)	2 (28.6)	1 (7.1)	0.247
Admission days			
ICU, mean, median (SD)	17.57, 12 (18.89)	12.43, 9.5 (16.70)	0.361
Total, mean, median (SD)	38.14, 37 (15.46)	37.43, 12(73.36)	0.036
Complication, colon-related (%)	2 (28.6)	1 (7.1)	0.247
Mortality (%)	0	6 (42.9)	0.047

ISS, Injury Severity Score; SD, standard deviation; SBP, systolic blood pressure; OHCA, out-of-hospital cardiac arrest; ICU, intensive care unit.

A significant difference was noted in terms of the mortality rate ( $p = 0.047$ ): 6 (42.9%) patients died in the nondestructive group, whereas no patients died in the destructive group. Fig. 1 displays the distribution of mortality among patients in the destructive or non-destructive and damage-control or non-damage-control surgery groups.

### Mortality analysis

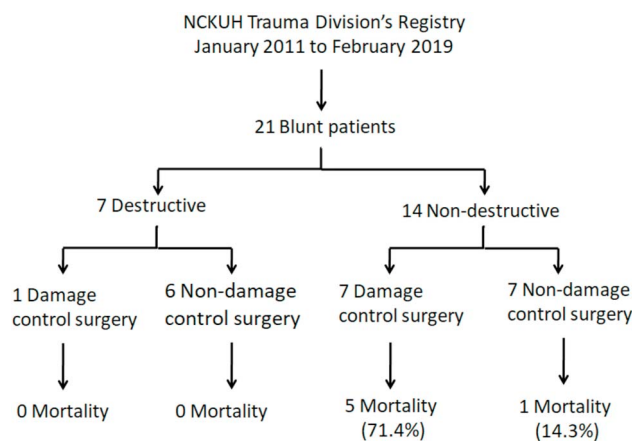
Table 3 lists the characteristics of six patients who had mortality. One patient had rheumatoid arthritis and was a chronic steroid user. One patient had alcoholism. All six patients had an ISS score greater 16, with a median of 39.5 (22-57); the median score on

the abdominal Abbreviated Injury Scale was 3 (2-5). Three had a Glasgow Coma Scale of less than 10. Shock status was noted in five patients. Damage control laparotomy was performed in five patients. A total of two patients died within 2 days, of which one died due to respiratory failure from severe bilateral lung contusion with hemo and pneumothorax and multiple rib fractures. For the other patient, consent was provided by the patient’s family to refrain from further resuscitation. The other four patients died in 10-14 days, with a median of 12 days. Overall, 2 patients died from central nervous system failure, one from sepsis, and one from respiratory failure.

### Discussion

According to our study, the survival of blunt colonic injury in patients with polytrauma was mainly correlated with trauma severity and not with the local colon condition. Destructive blunt colonic injury was not associated with a poorer trauma condition or with poorer outcomes.

The mechanism of blunt abdominal trauma was either crushing injury incurred by direct impact with a vehicle or the shearing force from deceleration during collisions.<sup>2,4,5</sup> According to published results, blunt colonic injuries have higher morbidity and mortality rates than do penetrating colonic injuries; moreover, the high likelihood of delayed perforation and diagnosis for blunt colonic injuries makes the decision to



**Fig. 1.** Distribution of mortality patients among destructive/ non-destructive and damage control surgery/non-damage control surgery groups. NCKUH, National Cheng Kung University Hospital.

**Table 3.** List of mortality cases

Age/ sex	Medical morbidity	ISS, Abd. AIS, GCS	Shock status*	Damage control surgery	ADM days	Cause
37, M	nil	38, 2, 3	Y	Splenectomy, partial omentectomy, colon repair	2	Respiratory failure
23, M	nil	57, 3, 3	Y	CODA balloon placement, TAE, hepatorrhaphy, splenorrhaphy, colon and small bowel repair	10	CNS failure
63, F	RA	50, 3, 13	N	TAE, abdominal compartment syndrome decompression, colon repair	12	Respiratory failure
84, F	nil	33, 5, 14	Y	Nil	12	Sepsis
74, M	Alcoholism	22, 3, 14	Y	Colon and colon mesentery repair	2	DNR
23, M	nil	41, 3, 6	Y	Partial omentectomy, colon mesentery repair	14	CNS failure

ISS, Injury Severity Score; Abd. AIS, abdomen Abbreviated Injury Scale; GCS, Glasgow coma scale; ADM days, admission days; TAE, transcatheter arterial embolism; CNS, central nervous system; DNR, do-not-resuscitate consent.

\* Shock status: SBP < 100 mmHg or HR > 120/min.

perform repair surgery less common, meaning that these injuries are more severe than penetrating injuries. The reported rate of repair for blunt trauma was only approximately 40% before the 21st century, whereas that for penetrating injuries was 60% to 93%.<sup>2,4,6,7</sup>

Since the beginning of 21st century, with improvements in diagnostic tools for trauma evaluation and trauma management techniques, published data have indicated improved outcomes of blunt colonic injury. Three studies have focused specifically on blunt colonic injury. These data reported a diversion rate of approximately 17% to 19%, colon-related morbidity ranging from 7.3% to 26.5%, and colon related mortality less than 10%.<sup>3,5,8</sup> One used ISS for measuring trauma severity and reported an average ISS score of 28. The leading cause of trauma was mostly motor vehicle accidents, accounting for 50% to 83% of cases. In our study, the average ISS score was 29, colon-related morbidity rate was 14.3%, diversion rate was 14.3%, and overall mortality rate was 28.6%, with no colon-related mortality noted. The results were similar between ours and those previously reported.

Destructive colonic wounds are injuries with loss of colonic wall integrity or with mesentery segmental devascularization. Destructive penetrating colonic injuries are associated with high-velocity gunshot wounds or close-range shotgun blasts.<sup>9</sup> Due to more severe trauma mechanisms, reports have revealed higher anastomotic leakage and mortality rates as well as greater numbers of overall complications and intra-abdominal abscess formations.<sup>10,11</sup> Although the current literature favors the application of resection with anastomosis for treating penetrating destructive colonic injuries, the decision should still be made on a case-by-case basis.<sup>12-14</sup> No published studies have compared the trauma-related characteristics and outcomes of blunt colonic injuries according to their destructive or nondestructive status. In our study, destructive blunt colonic injury was not associated with a more severe trauma mechanism or correlated with poor initial patient presentation. The diversion rate was similar between patients with destructive and nondestructive status, and no difference was observed in terms of colon-related complications. A longer overall admission duration was noted in the destruc-

tive group, with no difference in the intensive care unit admission duration between the two groups.

Patients with mortality tended to have higher ISS scores and were more likely to present with shock status upon arrival at the emergency department, have a higher damage control laparotomy rate, and have a shorter admission duration. No patient died in the destructive colonic injury group, but a mortality rate of up to 50% was detected in nondestructive patients. In other words, mortality in polytrauma patients with blunt colonic injury had a stronger correlation with the initial trauma severity than with the condition or severity of colonic injury.

This study has several limitations. The total number of included cases was 21, meaning that our study was underpowered. Moreover, it was nonrandomized and retrospective in nature. We did not follow patients long enough to include the takedown of colostomy, which may have affected the results of this study with respect to the possible complications of takedown surgery. Research including a greater number of cases, longer follow-up period, and further prospective randomized trials are necessary to validate the results of this study.

## Conclusion

The mortality rate among patients with polytrauma who sustained blunt colonic injury exhibited a stronger correlation with the severity of trauma than with the status of the colonic injury.

## Acknowledgement

This manuscript was edited by Wallace Academic Editing.

Thanks for Yen Shu-Ting and Kuo Yu-Ching in data collection and analysis.

## Sources of Financial Support

None.

## References

1. Greer LT, Gillem SM, Vertrees AE. Evolving colon injury management: a review. *Am Surg* 2013;79(2):119-27.
2. Carrillo EH, et al. Blunt traumatic injuries to the colon and rectum. *J Am Coll Surg* 1996;183(6):548-52.
3. Sharpe JP, et al. Applicability of an established management algorithm for colon injuries following blunt trauma. *J Trauma Acute Care Surg* 2013;74(2):419-24; discussion 424-5.
4. Ricciardi R, et al. Independent predictors of morbidity and mortality in blunt colon trauma. *Am Surg* 2004;70(1):75-9.
5. Zheng YX, et al. Diagnosis and management of colonic injuries following blunt trauma. *World J Gastroenterol* 2007; 13(4):633-6.
6. Ross SE, et al. Blunt colonic injury--a multicenter review. *J Trauma* 1992;33(3):379-84.
7. Chappuis CW, et al. Management of penetrating colon injuries. A prospective randomized trial. *Ann Surg* 1991;213(5): 492-7; discussion 497-8.
8. Ozturk G, et al. Blunt colonic injury: a 64-case series. *Ulus Travma Acil Cerrahi Derg* 2009;15(4):347-52.
9. Demetriades D, Charalambides D, Pantanowitz D. Gunshot wounds of the colon: role of primary repair. *Ann R Coll Surg Engl* 1992;74(6):381-4.
10. Maxwell RA, Fabian TC. Current management of colon trauma. *World J Surg* 2003;27(6):632-9.
11. Johnson JW, et al. Evolution in damage control for exsanguinating penetrating abdominal injury. *J Trauma* 2001; 51(2):261-9; discussion 269-71.
12. Stewart RM, et al. Is resection with primary anastomosis following destructive colon wounds always safe? *Am J Surg* 1994;168(4):316-9.
13. Sasaki LS, et al. Primary repair of colon injuries: a prospective randomized study. *J Trauma* 1995;39(5):895-901.
14. Gonzalez RP, Falimirski ME, Holevar MR. Further evaluation of colostomy in penetrating colon injury. *Am Surg* 2000; 66(4):342-6; discussion 346-7.

原 著

## 多重外傷併大腸鈍傷病人之癒後比較

吳俊賢<sup>1,2</sup> 顏亦廷<sup>1</sup> 王志榮<sup>1</sup> 楊宗翰<sup>1</sup> 洪國書<sup>1</sup> 林威廷<sup>2</sup>  
詹仁豪<sup>2</sup> 陳柏全<sup>2</sup> 林劭潔<sup>2</sup> 李政昌<sup>2</sup> 林博文<sup>2</sup>

<sup>1</sup>國立成功大學附設醫院 外科部 外傷科

<sup>2</sup>國立成功大學附設醫院 外科部 大腸直腸外科

**目的** 在多重外傷併大腸鈍傷的病人中，比較破壞性與非破壞性大腸損傷癒後之差異。

**方法** 回溯性的統計 2011 年一月到 2019 年二月，在成大醫院因創傷性大腸鈍傷的病人中，破壞性與非破壞性大腸損傷，並分析其臨床參數及預後上的差異。

**結果** 共有 21 位病人，7 人為破壞性大腸損傷，14 人為非破壞性大腸損傷。經分析後，在創傷嚴重程度、病人狀況、醫學合併症上沒有明顯差異。在預後的比較，進行造口手術的比例、大腸相關併發症上沒有明顯差異。破壞性大腸損傷之病人總住院天數較長。死亡率與一開始創傷的嚴重程度較有關，與大腸損傷的嚴重程度較無關。

**結論** 在多重外傷併大腸鈍傷的病人中，死亡率與創傷的嚴重程度有關，與大腸損傷的狀況較無關。

**關鍵詞** 鈍性多重外傷、大腸破壞性損傷。