



# Contemporary management of blunt colonic injuries – Experience from a level one trauma centre in New Zealand

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## ABSTRACT

**Introduction:** Blunt colonic injury (BCI) is relatively rare, and literature on the topic is sparse. This study reviews our contemporary experience in its management at a level-one trauma centre in New Zealand.

**Materials and Methods:** This was a retrospective study (January 2012 to December 2020) that included all patients who sustained a BCI managed at Waikato Hospital, New Zealand.

**Results:** Of the total of 1181 patients with blunt abdominal trauma, 69 (6%) of them sustained a BCI (49% male, mean age: 36 years). 78 separate colonic injuries were identified in the 69 cases. The most commonly injured segment was the ascending colon 49% (38/78). Eighty percent (55/69) underwent a CT scan, with only 16 showing definite evidence of a colonic injury. AAST Grade 1 was the most common (81%). Fifteen patients underwent damage control surgery. All 11 grade 1 injuries were repaired primarily, whilst the other four grade 4 and 5 colonic injuries were resected, with 3 having a subsequent stoma formation and one delayed anastomosis. There were four mortalities. Patients who had negative or equivocal admission CT findings for colonic injury had delays to the operating theatre and had poorer outcomes.

**Conclusion:** BCI is rare but is associated with a prolonged hospital stay. The treatment of BCI is similar to that of penetrating colonic injury. CT appeared inaccurate in many cases.

## 1. Introduction

Colonic trauma is the focus of intense surgical interest as considerable septic morbidity and mortality are associated with injury to the large bowel [1–3]. The management of colonic trauma has evolved in tandem with new developments and refinements in surgical techniques, resuscitation and critical care over the last hundred years [1–5]. Despite the voluminous literature on colon trauma over the last eighty years, reports on blunt colonic trauma are sparse, as most colonic injuries are secondary to penetrating wounds [1–3]. Blunt abdominal trauma (BAT) is a major problem, and with the ever-increasing levels of motor vehicle use around the world, it is likely to remain a major contributor to the burden of trauma for the foreseeable future [6]. BAT is mostly associated with solid visceral trauma, and only ten percent of cases result in hollow visceral trauma [3]. The hollow viscera most frequently injured

secondary to BAT are the duodenum, small bowel and bladder [7]. Blunt colonic trauma is relatively rare and, consequently, has been overlooked in the literature on trauma [8]. The aim of this study was to describe and categorise the injury pattern and to review management strategies and outcomes, with the intention of providing evidence on which to develop management algorithms for these injuries.

## 2. Materials and methods

### 2.1. Ethics approval

This study was approved by the Clinical Audit Support Unit (CASU) of the Waikato District Health Board (Reference: 4164DTR210325).

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## 2.2. The study

This was a retrospective study undertaken from January 2012 to December 2020 and included all patients who sustained a blunt trauma-related injury to their large bowel. Patients were identified from the Midland Trauma Registry (MTR). Patients with appropriate Abbreviated Injury Scale (AIS) codes or discharge diagnosis containing any of the words 'blunt abdominal trauma and colonic injury' were identified. Case records, operation notes, imaging and blood results were recorded. Other information collected included age, sex, mechanism, investigations, interventions, injuries and complications.

## 2.3. Clinical setting

Waikato Hospital is located in Hamilton, New Zealand. It is a tertiary centre and a university hospital, with the clinical school affiliated with the University of Auckland. It is one of the largest acute hospitals in the country and is the only Royal Australasian College of Surgeons (RACS) certified Level 1 trauma centre in New Zealand. The Waikato District Health Board (WDHB) covers a district catchment population of approximately 458,200 and is a tertiary referral trauma centre for approximately 1 million people in the Te Manawa Taki/Midland Region [9]. It manages approximately 7200 trauma admissions per annum, over 400 of which have an Injury Severity Score (ISS) > 12 [9].

## 3. Results

### 3.1. Overview

Between January 2012 and December 2020, a total of 1181 patients with BAT were admitted, of which 69 (6%) sustained a blunt colonic injury. There were 34 female patients and 35 males. The mean age was 36 years (interquartile range, IQR = 31). The mechanism of injury is summarised in Table 1.

The median ISS was 21 (IQR = 19). 57 patients (81%) had injuries to other body regions. The distribution of injury to other body regions is summarised in Table 2.

There were 78 separate blunt colonic injuries identified in the 69 patients. Table 3 lists the anatomical distribution of each colonic injury according to location. The ascending colon was the most commonly injured in 38 cases (49%).

### 3.2. Clinical management

Figure 1 summarises the initial management pathway of all 69 patients upon arrival at our hospital. FAST scan was performed in 25 (35%) patients, and in 18 (72%) patients was positive. Fourteen patients did not undergo a CT scan. Of this cohort, 12 proceeded directly to an operation, and a further two were observed prior to undergoing an operation as a result of clinical deterioration.

Fifty-five patients proceeded directly to abdominal CT scan. In 21 patients, the CT scan did not report signs of a colonic injury; in 18, the CT findings were equivocal; and in 16, there was radiological evidence of a colonic injury. CT findings highly suspicious for colonic injury but not conclusive were labelled equivocal. Of the patients who had CT, twelve patients were initially observed, and five went on to need an

**Table 1**  
Mechanism of injury.

Mechanism	Frequency (%)
Motor Vehicle Crash	58 (84)
Motorbike Crash	3 (4)
Fall	3 (4)
Other	5 (7)
Total	69

**Table 2**  
Associated injuries.

Distribution	Frequency (%)
Head	12 (17)
Neck	6 (9)
Chest	33 (48)
Pelvis	9 (13)
Limbs	44 (64)
Spine	18 (26)
Total	122

**Table 3**  
Distribution of colonic injury.

Distribution	Frequency (%)
Ascending	38 (49)
Transverse	16 (20)
Descending	10 (13)
Sigmoid	14 (18)
Total	78

operation. In seven patients, the blunt colonic injury was managed without an operation. These were patients who had equivocal findings on CT for colonic injury, and as such, the definitive diagnosis of colonic injury was not confirmed at the operation. The remaining 43 patients proceeded directly to surgery.

### 3.3. Operative management

Figure 2 summarises the management approach for patients who underwent surgery. Table 4 compares the different operative approaches for the management of these separate colonic injuries. The patients who underwent laparoscopy as the initial approach all sustained a grade one colonic injury and had a higher pH and lower lactate, lower number of associated intra-abdominal injuries and lower Injury Severity Scale scores than the direct-to-laparotomy patients. Only one patient in the laparoscopy-only cohort underwent a therapeutic laparoscopy. The laparoscopic converted to laparotomy and the direct-to-laparotomy patients all required resection of the colonic injury, whereas none of the laparoscopy-only patients required bowel resection. Patients who underwent laparotomy had a higher incidence of complications, length of stay and mortality. The mean length of stay in the direct-to-laparotomy patients was 17.5 days (IQR=12) compared to the laparoscopy-only patients at 6.6 days (IQR=5). There were four mortalities in 69 patients with blunt colonic injury. All of these were in the direct-to-laparotomy patient cohort. These mortalities, seen in the direct-to-laparotomy patients, almost certainly reflect that these patients were more severely injured than those who were observed or stable enough to undergo a CT scan.

### 3.4. Comparison by grade - physiology, management, and outcomes

Table 5 summarises the 78 separate blunt colonic injuries according to AAST Colon Injury grade and compares the different grades in relation to pH and Lactate levels, whether these patients had pre-operation CT scans and whether the scans were positive, negative or equivocal for bowel injury as well as the number of patients who had surgery, the operative management in regards to repair or resection of the colon injury and whether an anastomosis or stoma was performed. This table also compares all complications encountered, length of stay and mortality amongst the different grades of colonic injury.

Grade 1 colonic injury was the most common grade of injury (81%). Lactate level was highest in the group with grade 5 colonic injuries. CT scan diagnosed only 26 percent of grade 1 injuries correctly. The sensitivity of CT for grade 4 and 5 injuries was 100% and 67%, respectively. Seventy-six percent (76%) of patients with a grade one

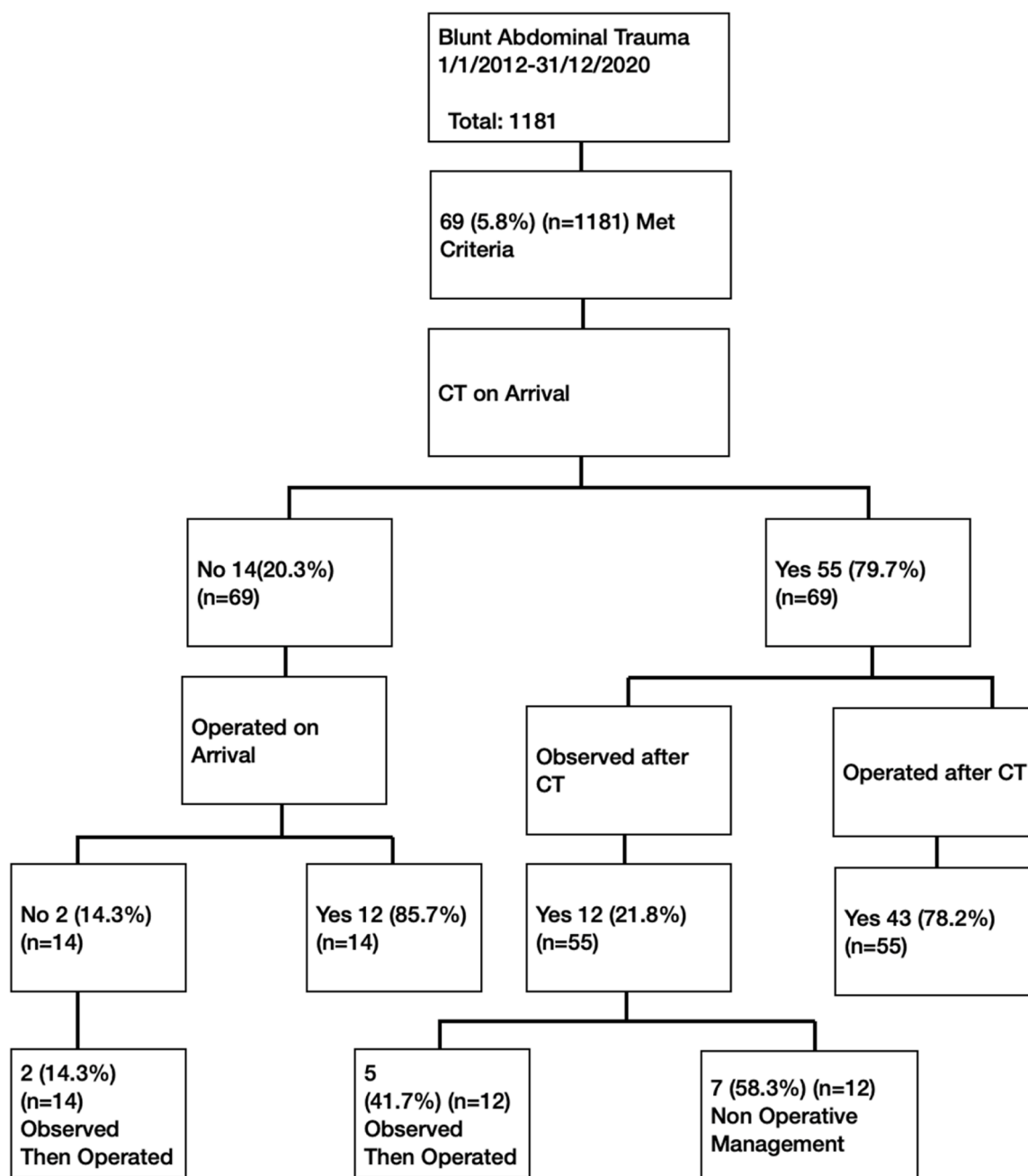


Fig. 1. Initial Management pathway.

injury underwent an operation. This is summarised in Table 6.

All patients with Grade 2,3,4, and 5 injuries required surgery. Fifty-seven percent (57%) of all grade one injuries underwent a primary repair, and 23% required a resection. Twenty percent of all patients with a grade one injury underwent resection and anastomosis, whilst five percent had a stoma fashioned at the index laparotomy. All (100%) patients with grades 2,3,4, or 5 injuries required a resection. There was an increased rate of stoma formation in the higher-grade injury cohort. There were associated small bowel injuries in 51% ( $n = 35$ ) of patients, liver injuries in 16% ( $n = 11$ ), splenic injuries in 14% ( $n = 10$ ) and diaphragmatic injuries in 9% ( $n = 6$ ).

At least 33% of patients with any grade of colonic injury had a concomitant small bowel injury. Complications in all patients included ileus in 26% ( $n = 18$ ), post-operative pneumonia in 19% ( $n = 13$ ), wound sepsis in 6% ( $n = 4$ ), and renal dysfunction in 4% ( $n = 3$ ). No patients developed an anastomotic leak. The mean length of stay for all

patients was 15 days (IQR= 12.5). Four patients died, and the remaining survived to discharge.

### 3.5. Damage control versus non damage control

Fifteen patients underwent a damage control surgery procedure (DCS). Eleven of these patients had a single grade 1 injury, and four patients had either grade 4 or grade 5 colonic injuries. All grade 1 injuries were repaired primarily, whilst the other grade 4 and 5 colonic injuries were resected at the initial operation in a clip and drop strategy, with three having a stoma fashioned and one patient undergoing a delayed anastomosis at the subsequent return to theatre.

Forty-seven patients had non-DCS. Eight of these patients had either grade 2,3, or 5 injuries, whilst 39 other patients had grade 1 injuries. In total, there were 51 colonic injuries in these 47 patients. The management of grade 1 injuries in this cohort varies. Of the 41 grade 1 injuries,

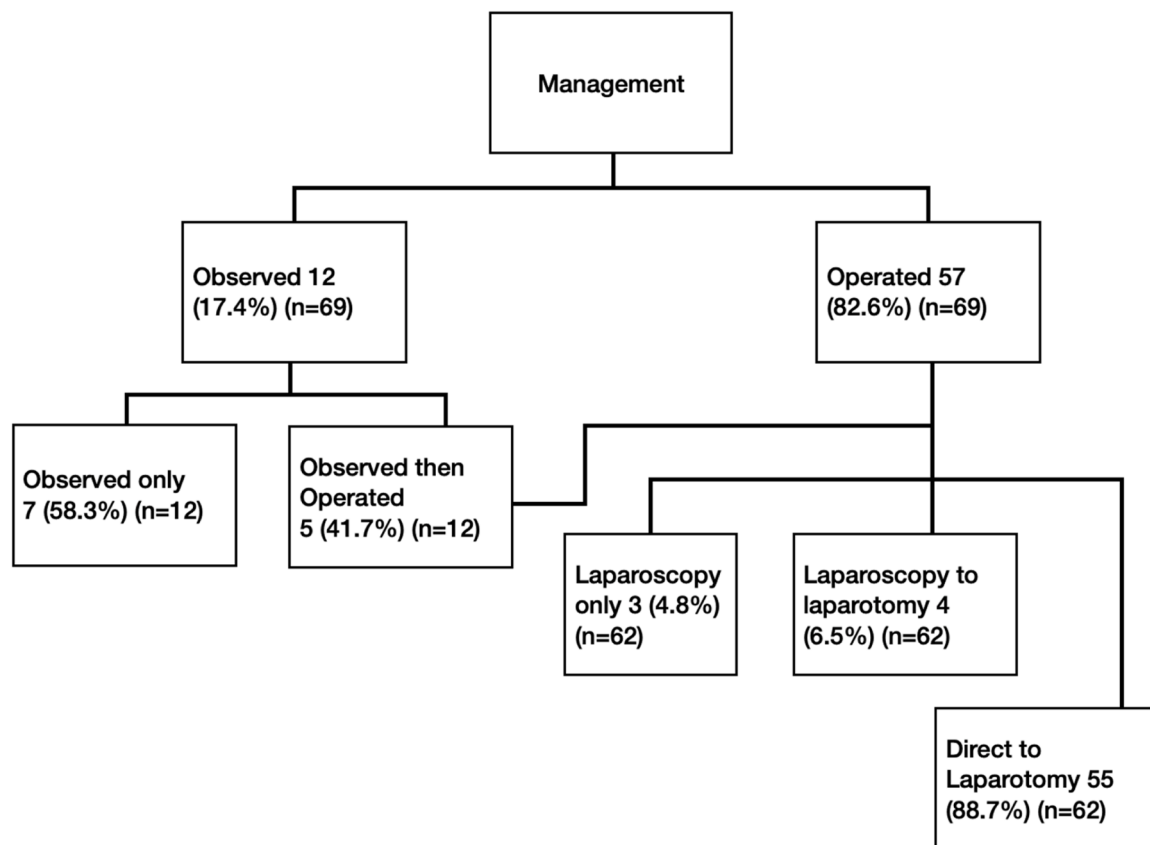


Fig. 2. Operative management pathway.

Table 4  
Operative management.

Surgical Approach	Laparoscopy only	Laparoscopy to laparotomy	Laparotomy
Colon AAST 1	3	4	49
Colon AAST 2,3,4,5	0	0	15
Negative/Equivocal CT (%)	2 (67)	3 (75)	35 (63)
Mean pH (IQR)	7.37 (0.08)	7.33 (0.08)	7.26 (0.09)
Mean Lactate (IQR)	1.6 (1.1)	2.15 (1.7)	3.14 (1.79)
Other Intrabdominal Injuries (%)	0	1 (25)	21 (38)
Mean ISS (IQR)	15	12.25 (6.5)	22.22 (18.5)
Repair	1	1	34
Resect	0	3	27
All Complications (%)	0	1 (25)	22 (39)
Leak (%)	0	0	0
Mean LOS (IQR)	6.6 (3)	10.5 (10)	17.5 (12)
Mortality (%)	0	0	4 (7)

AAST: American Association for the surgery of trauma injury score.

CT: Computed Tomography.

ISS: Injury Severity Score.

Resect: Resection.

LOS: Length Of Stay.

six did not require any intervention, 24 underwent primary repair, 11 were resected with ten anastomoses fashioned, and one stoma fashioned. All grade 2 and higher colonic injuries (10) required resection. Five of these patients had an anastomosis, and five had a stoma fashioned at index procedure. In total, six stomas were fashioned in the non-DCS cohort, four of which were for descending or sigmoid colon injuries. Left-sided colonic injuries were more likely to undergo a diversion following resection. Fifteen anastomoses were fashioned in the non-DCS

Table 5  
Physiology, management, and outcome by colonic injury grade.

Colon AAST	1	2	3	4	5
Frequency (%)	63 (81)	5 (6)	3 (4)	1 (1)	6 (8)
Mean pH (IQR)	7.27 (0.09)	7.35 (0.125)	7.2	7.31	7.26 (0.135)
Mean Lactate (IQR)	2.95 (1.84)	2.6 (1)	3.1	3.6	3.64 (3.1)
Pre OT CT (%)	53 (84)	3 (60)	1 (33)	1 (100)	3 (50)
Positive CT (%)	14 (26)	0	0	1 (100)	2 (67)
Negative CT (%)	20 (38)	1 (33)	1 (100)	0	1 (33)
Equivocal CT (%)	19 (36)	2 (67)	0	0	0
OT (%)	56 (89)	5 (100)	3 (100)	1 (100)	6 (100)
Primary Repair (%)	36(57)	0	0	0	0
Resection (%)	15 (23)	5 (100)	3 (100)	1 (100)	6 (100)
Anastomosis (%)	13 (20)	4 (80)	1 (33)	0	5 (83)
Stoma (%)	2 (3)	1 (20)	2 (67)	1 (100)	1 (17)
All complications (%)	18 (29)	1 (20)	1 (33)	0	6 (100)
Leak (%)	0	0	0	0	0
Mean LOS (IQR)	14.9 (13)	13.75 (15.5)	16	26	22.1 (23)
Mortality (%)	4 (6)	0	0	0	0

AAST: American Association for the surgery of trauma injury score.

OT: Operating Theatre.

CT: Computed Tomography.

LOS: Length Of Stay.

**Table 6**

Management comparison – Grade 1 vs Grade 2 - 5.

Grade	Frequency	Not intervened	Primary Repair	Resect	Anastomosis	Stoma
1 (%)	63 (81)	7 (11)	36 (57)	15 (23)	13 (20)	2 (3)
2,3,4,5 (%)	15 (19)	0	0	15 (100)	10 (50)	5 (50)

cohort, all for right-sided ascending and transverse colon resections.

### 3.6. Concurrent intra-abdominal injury

Table 7 compares the different colonic injury grades with the frequency of small bowel injuries, the breakdown of these small bowel injuries according to AAST grade, as well as frequency of other associated intra-abdominal injuries.

### 3.7. Delayed operation

When comparing the patients with positive radiological evidence for colonic injury on CT who then proceeded to operation - Non-Delayed cohort (NDC) versus the patients with a negative or equivocal CT scan for colonic injury, whose operation was delayed - Delayed Cohort (DC), the mean time to theatre for NDC was 573 min (IQR = 370) whereas the mean time to theatre for the DC was 1375 min (IQR = 793.5). The mean length of stay for patients in the NDC was 9.2 days (IQR = 11) compared to 15 days (IQR = 12.5) in the DC. A single death in a patient who had CT occurred in the DC. Just under one-third (31%) of the NDC sustained at least one complication compared with 41% of the DC.

## 4. Discussion

While there is a plethora of literature on penetrating colon trauma, studies focusing on blunt colonic injury are limited [1–3]. The mechanism of blunt trauma exerts a different force on the tissues than penetrating trauma, and this increases the likelihood of a penumbra of crushed or ischemic tissue around the injury [4,5]. In addition, blunt abdominal trauma is generally associated with fewer other intra-abdominal injuries than penetrating trauma [10]. This is especially the case with abdominal gunshot wounds. With penetrating colonic trauma, there has been a move away from universal diversion to primary repair [1–3,5]. Many previous contra-indications to primary repair have been discredited over the last five decades [5,11]. These include associated renal and small bowel injury, left-sided colonic injury and the grade of colonic injury [11,12]. Primary repair is now considered reasonable in all these situations. From our study, it would appear that most grade-one blunt colon injuries are suitable for primary repair. With higher-grade injuries, primary repair is not feasible, and the injured segment of the colon must be resected. If resection is necessary, anastomosis is a safe option.

However, there is a much higher rate of stoma formation in the high-grade blunt colonic injury group and in patients with left-sided injuries.

**Table 7**

Concurrent intra-abdominal injury.

Colon AAST	1	2	3	4	5
SB Injuries (%)	26 (41)	2 (40)	1 (33)	1 (100)	5 (83)
SB AAST 1 (%)	6 (23)	1 (50)	0	0	0
SB AAST 2 & 3 (%)	11 (42)	1 (50)	0	1 (100)	2 (40)
SB AAST 4 (%)	2 (8)	0	0	0	1 (20)
SB AAST 5 (%)	7 (27)	0	1 (100)	0	2 (40)
Other Intrabdominal Injuries (%)	20 (32)	0	0	0	2 (33)
Mean ISS (IQR)	21.2 (20)	15.25 (21.5)	30	17	20.6 (6)

It would appear that grade and distribution of injury remain important considerations for surgeons when deciding on the need for resection and for choosing between an anastomosis or a stoma.

In this series, there was an increased use of DCS as the grade of colonic injury increased. The emergence of damage control surgery (DCS) has impacted the contemporary approaches to colon trauma [5, 10]. DCS eschews complex definitive surgery in favour of abbreviated techniques designed to control sepsis and bleeding whilst the patient's physiology is restored [13]. Once a degree of homeostasis has been achieved, the patient is returned to the operating room for definitive repair. If DCS is undertaken, then neither complex primary repair nor primary diversion should be performed. The injured colon should be divided using staples, and the ends of the colon should be placed into the abdomen [13]. This is colloquially referred to as a clip-and-drop approach. On return to the operating room, a decision must be made as whether to perform a delayed primary repair or colon diversion. This approach should be applied to blunt colonic trauma.

It would appear that the algorithms applied to the management of penetrating colon trauma can be extrapolated to the management of blunt colonic trauma [4]. The Memphis group retrospectively reviewed 151 blunt colon injuries, which had been managed with the identical algorithm which that centre used for penetrating colon trauma [4]. They regarded blunt destructive colon injuries as having a tear of the serosa extending for 50% or more of the colon wall diameter, a mesenteric tear, or a full-thickness perforation of the colonic wall [4]. In keeping with reports on penetrating injuries, these authors showed that primary diversion was associated with increased septic complications and concluded that non-destructive wounds should be definitively repaired at the index operation.

## 5. Conclusion

Blunt colonic injury is rare but is associated with prolonged hospital and ICU stay. The diagnostic accuracy of BCI is poor on CT and a negative or equivocal CT for BCI may lead to unnecessary delays in management and adverse outcomes. Clinical judgement and established trauma guidelines for management of blunt abdominal trauma should be utilised despite a negative or equivocal CT finding for BCI. When BCI is confirmed, there is an increased risk of concurrent small bowel injury.

The treatment of BCI is similar to that of penetrating colonic injury. Primary repair, including resection and anastomosis, is generally safe for patients who do not require DCS. If DCS is indicated, then a so-called clip-and-drop strategy is necessary and only at the repeat operation can a decision be made as to whether to proceed with delayed anastomosis or delayed stoma formation.

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## Research data

The research data used for this study is available on request.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

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