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Outcomes of non-operative management of penetrating abdominal trauma

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Background: Selective non-operative management (SNOM) of penetrating abdominal trauma (PAT) is routinely practised in our trauma centre. This study aims to report the outcomes of patients who have failed SNOM.
Methods: Patients presenting with PAT from 1 May 2015 – 31 January 2018 were reviewed. They were categorised into immediate laparotomy and delayed operative management (DOM) groups. Outcomes compared were postoperative complications, length of hospital stay and mortality.
Results: A total of 944 patients with PAT were reviewed. After excluding 100 patients undergoing damage control surgery, 402 (47.6%) and 542 (52.4%) were managed non-operatively and operatively, respectively. In the SNOM cohort, 359 (89.3%) were managed successfully without laparotomy. Thirty-seven (86.0%) patients in the DOM group had a therapeutic laparotomy, and six (14.0%) had an unnecessary laparotomy. Nine (20.9%) patients in the DOM group developed complications. The DOM group had lesser complications. However, the two groups had no difference in hospital length of stay (LOS). There was no mortality in the non-operative management (NOM) group.
Conclusion: In this study, we demonstrated no mortality and less morbidity in the DOM group when appropriately selected compared to the immediate laparotomy group. This supports the selective NOM approach for PAT in high volume trauma centres.
Keywords: penetrating abdominal trauma, failed non-operative management, delayed operative management

Introduction

The management of trauma in general and specifically penetrating abdominal trauma (PAT) continues to represent a considerable burden on the local healthcare system. The management of PAT has evolved over the last five decades from routine mandatory laparotomy to selective non-operative management (SNOM). SNOM has been embraced as a safe alternative for stab wounds (SW) to the abdomen since the initial reports by Shaftan and Stein.[1-3] More recently, large studies from South Africa by Muckart et al. and Demetriades et al. suggested that using repeated clinical abdominal examination, SNOM can be applied safely to a specific group of patients with gunshot wounds (GSWs) to the abdomen.[4,5] Since then, the SNOM of GSW has gained momentum as an acceptable treatment strategy. Despite accepting SNOM as a routine practice for PAT in high-volume trauma centres, there is a lack of reporting of the outcomes of unsuccessful SNOM. A better understanding of this particular group is required to guide an effective and safe approach for patients with PAT, especially those selected for non-operative management (NOM). This study aims to investigate the outcomes of unsuccessful SNOM, or more appropriately labelled delayed operative management (DOM) with patients undergoing immediate laparotomy.[6,7]

Materials and methods

This was a single-centre observational study of all patients presenting with PAT to the Groote Schuur Hospital Trauma Centre (GSHTC) in Cape Town, South Africa, from 1 May 2015 to 31 January 2018. Patients were managed according to established GSHTC protocols for PAT.[6-9] The study was approved by the Human Research Ethics Committee of the University of Cape Town (HREC 770/2017). Only patients excluded were those undergoing an index damage control laparotomy.

Patient demographics, vital signs, clinical findings and trauma severity scores were recorded. The indications for immediate laparotomy include hemodynamic instability and peritonism (tenderness, rebound, guarding, rigidity, and diminished or absent bowel sounds). The protocol is modified for patients presenting with blood per rectum, evisceration (omentum – if no indication for immediate laparotomy, for SNOM; organ evisceration – immediate laparotomy), and computed tomography (CT) findings suggestive of hollow visceral injury (free/loculated air, free fluid, bowel wall oedema and mesenteric stranding).[9,10] CT scans were indicated in stable patients without peritonitis presenting with haematuria or right upper quadrant missile trajectory to exclude urinary tract and liver injury, respectively. A CT cystogram was performed in the presence of haematuria, where trajectory traversed the pelvis. CT scan is also indicated when there is uncertainty about whether a

clinically suspected tangential bullet trajectory has breached the peritoneal cavity. CT scans of the abdomen were done in the radiology department using 128 channel scanner with a high-power injection of 100 mL of intravenous contrast at 5 mL/second. Arterial, portovenous, and delayed phases were routinely acquired. Patients presenting with PAT who did not satisfy the above indications for immediate laparotomy were selected for a trial of NOM.

Patients selected for NOM were admitted to the trauma high-care ward. These patients underwent continuous monitoring of vital signs and serial clinical examinations. Oral intake was introduced after 24 hours of uneventful observation. A patient was discharged once tolerating normal diet with an abdominal injury form indicating the warning signs for immediate return. Patients selected for NOM with increasing abdominal tenderness, haemodynamic instability, or features of sepsis underwent DOM. Delayed operative management refers to any surgical intervention after an initial decision for NOM, regardless of time. The present study defines a laparotomy as therapeutic if intraoperative injuries identified required intervention. Where no intra-abdominal injuries were identified, laparotomies were considered negative laparotomies (NL). Non-therapeutic laparotomies (NTL) refer to injuries confirmed on laparotomy, but not requiring any intervention. Unnecessary laparotomy includes both NTL and NL.

Statistical computations were made using RStudio (RStudio Team, 2021. RStudio: Integrated Development Environment for R, Boston, MA).[11] Statistical significance was set at $p < 0.05$. Categorical data were reported as numbers and percentages, and groups were compared using Pearson's chi-square test. Fisher's exact test was used for 2 x 2 contingency tables. Continuous data were reported as the median and interquartile range (IQR) and mean with 95% confidence interval, with groups compared using the Wilcoxon rank-sum test and student t-test, respectively.

Results

After excluding 100 haemodynamically unstable patients who underwent damage control surgery at the index laparotomy, the records of 844 clinically evaluable and haemodynamically stable patients were analysed. Of these, 402 (47.6%) were initially selected for NOM, and the remaining 442 (52.4%) underwent immediate laparotomy. Of the 402 patients selected for NOM, 359 (89.3%) were managed successfully without laparotomy, and the remaining 43 (10.7%) underwent DOM. Of 442 patients who underwent immediate laparotomy, 399 (90.3%) experienced a therapeutic laparotomy, and 43 (9.7%) patients had either a NL or NTL; 20 (4.5%) and 23 (5.2%), respectively. The treatment pathways and mechanism of injury are illustrated in Figure 1.

The immediate laparotomy and DOM groups were compared for patient demographics, mechanism of injury, trauma severity scores, admission vital signs, biochemistry results, and abdominal clinical findings (Table I). There were no differences in the patient's age, demographics, and haemoglobin levels in the emergency department between the two groups. However, more patients became haemodynamically unstable ($p < 0.001$) and required blood transfusion ($p < 0.001$) in the immediate laparotomy group. As expected, the mechanism of injury was more distributed towards GSW in the immediate laparotomy group. The

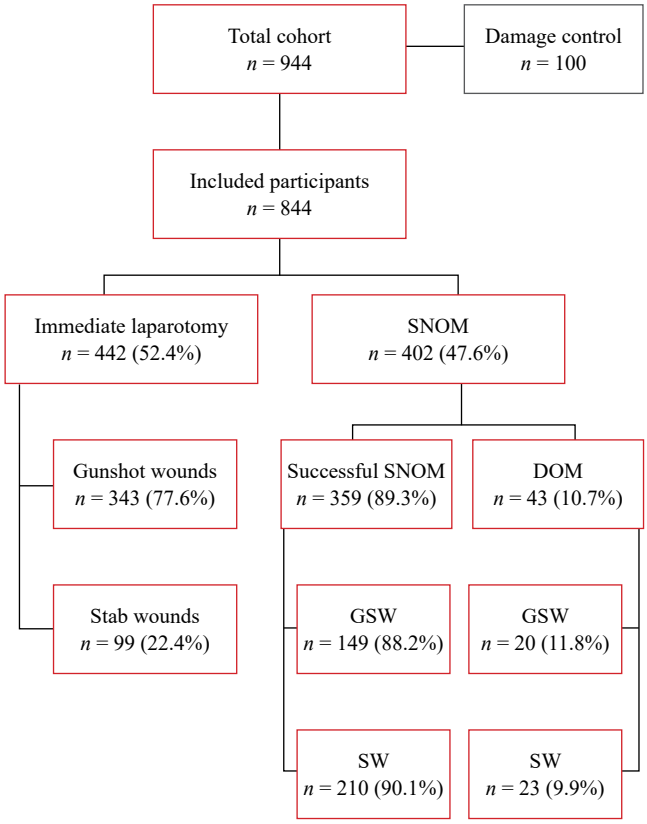

Figure 1: Schematic representation of patients presenting with penetrating abdominal trauma to Groote Schuur Hospital.

patients in the immediate laparotomy group presented to the emergency centre with higher trauma scores than the NOM group. However, there was no significant difference in the number of patients presenting with GSW and SW in the DOM group, 20 (46.5%) with GSW and 23 (53.5%) with SW.

Two hundred and fifty-two (62.7%) patients in the SNOM group had a CT scan on admission. Of these, 29 (11.5%) patients with negative scans failed abdominal observations and underwent a delayed laparotomy. The indications for surgical interventions in the DOM group were increasing abdominal tenderness in 37.2% (4 GSW, 12 SW), concern of sepsis in 25.6% (3 GSW, 8 SW), and either repeat or delayed first time CT study results in 32.6% (11 GSW, 3 SW). In contrast, peritonitis was the most common indication for surgery in the immediate laparotomy group, followed by radiological findings and development of haemodynamic instability (Table II). However, two patients in the NOM group became haemodynamically unstable. The first patient was referred with a single GSW to his lower back (left side). CT scan demonstrated a grade IV splenic laceration with minor haemoperitoneum. The patient dropped his haemoglobin from 10 g/dl to 7 g/dl with compensated shock a day later. The patient went for an emergency laparotomy and had a splenectomy. The second patient presented with GSW to the right flank. CT scan showed grade II liver and right kidney injuries. The patient underwent DOM after a significant drop in the haemoglobin to 8 g/dl with compensated shock. He had a NTL with findings consistent with the CT findings, and no hollow organ injury was identified.

Table I: Patients demographics, injury severity scores, presenting features, and injury profile

Variable		Immediate laparotomy (*n* = 442)	Failed SNOM (*n* = 43)	*p*-value
Patient demographics	Age: median (IQR)	27 (22–30)	30 (22.5–36)	NS
	Sex:			
	Male: *n* (%)	416 (94)	38 (88.4)	
	Female: *n* (%)	26 (5.9)	5 (11.6)	NS
Injury characteristics: *n* (%)	GSW	343 (77.6)	20 (46.5)	
	SW	99 (22.4)	23 (53.5)	*< 0.001*
Trauma scores: median (IQR)	PATI score	8.5 (4–19)	6 (3–11.2)	NS
	AIS abdomen	3 (3–4)	3 (1–3)	*< 0.001*
	Revised trauma score	7.84 (7–7.8)	7.84 (7–7.8)	NS
	ASA score	1 (1–2)	1 (1–2)	NS
	Kampala score	14 (14–15)	14 (14–15)	NS
Admission characteristics:	Systolic BP	131 (129–133)	131 (124–138)	NS
Mean (CI 95%)	HR	95 (93–96)	90 (85–95)	NS
	PH	7.3 (7.3–7.3)	7.40 (7.3–7.34)	NS
	Lactate	2.8 (2.6–3)	1.9 (1.6–2.2)	*< 0.001*
	Haemoglobin	12.2 (12–12.5)	12.4 (11.9–13)	NS
	Bicarbonate	21 (20.7–21.3)	22.3 (21.1–23.4)	0.02
Haemodynamic stability: *n* (%)	Responder	54 (9.5)	2 (4.7)	< 0.001
	Stable	368 (82.9)	41 (95.3)	< 0.001
	Unstable	22 (5)	0 (0)	< 0.001
Evisceration: *n* (%)	Omentum	24 (5.4)	4 (9.3)	< 0.001
	Viscera	31 (7)	0 (0)	< 0.001
Blood transfusion: *n* (%)	PRBC*	42 (9.5)	3 (7)	< 0.001

GSW – gunshot wound, SW – stab wound, PATI – penetrating abdominal trauma index, AIS – abbreviated injury scale, ASA – American Society of Anaesthesiologists, BP – blood pressure, HR – heart rate, PRBC – packed red blood cells

Table II: Summary of the indications for laparotomy

Indications, *n* (%)	Immediate laparotomy (*n* = 442)	Failed SNOM (*n* = 43)	*p*-value
Peritonitis	298 (67.4)	16 (37.2)	< 0.001
Radiology findings	72 (16.3)	14 (32.6)	< 0.001
Hemodynamically unstable	19 (4.3)	2 (4.7)	< 0.001
Unreliable physical examination	22 (5)	0	< 0.001
Evisceration	31 (7)	0	< 0.001
Concern of sepsis	0	11 (25.6)	< 0.001
Delay to OR in hours, median (IQR)	5 (2–8)	32.5 (25.25–61.5)	*< 0.001*

SNOM – selective non-operative management, IQR – interquartile range, OR – operating room

Table III: Laparotomy results and intraoperative findings

Intraoperative findings		Immediate laparotomy (*n* = 442)	DOM (*n* = 43)	*p*-value
Results of surgery	Negative	20 (4.5)	3 (7)	< 0.001
n (%)	Non-therapeutic	23 (5.2)	3 (7)	< 0.001
	Therapeutic	399 (90.3)	37 (86)	
				< 0.001
Organ injury	Organ perforation	355 (79.8)	24 (55.8)	*< 0.001*
n (%)	Stomach	88 (19.8)	7 (16.3)	*< 0.001*
	Small bowel	208 (46.7)	6 (14)	*< 0.001*
	Colorectal	156 (35.1)	10 (23.3)	*< 0.001*
	Liver	73 (16.4)	1 (2.3)	*< 0.001*
	Spleen	39 (8.8)	3 (7.0)	*< 0.001*
	Kidney	24 (5.4)	2 (4.7)	*< 0.001*
	Urinary bladder	31 (7)	1 (2.3)	*< 0.001*
	Pancreas	14 (3.1)	1 (2.3)	*< 0.001*
	Ureter	9 (2)	1 (2.3)	*0.011*
	Diaphragm	67 (15.1)	5 (11.6)	*< 0.001*

DOM – delayed operative management

Table IV: Penetrating trauma wound location in the immediate laparotomy and failed NOM group

Wound locations, *n* (%)	Immediate laparotomy (*n* = 442)	Failed SNOM (*n* = 43)	*p*-value
Thoracoabdominal left	99 (16.3)	11 (15.9)	NS
Thoracoabdominal right	67 (11.0)	5 (7.9)	
Flank left	133 (21.8)	18 (28.6)	
Flank right	85 (14.0)	10 (15.9)	
Anterior	171 (28.1)	11 (17.5)	
Pelvis	54 (8.9)	8 (12.7)	

SNOM – selective non-operative management

Table V: Postoperative outcomes

Outcomes, *n* (%)	Immediate laparotomy (*n* = 442)	DOM (*n* = 43)	*p*-value
Death	28 (6.3)	0 (0)	< 0.001
Complications			
Minor complications*	48 (10.8)	6 (13.9)	< 0.001
Major complications**	74 (16.7)	3 (6.9)	< 0.001
ICU LOS, median (IQR), days	3 (2–4)	3 (2–3)	NS
Hospital LOS, median (IQR), days	7 (5–12)	8 (6–11)	NS

*Clavien-Dindo I-II, **Clavien-Dindo III-IV, ICU – intensive care unit, LOS – length of stay, IQR – interquartile range

Table VI: Summary of patients with delayed operative management complications

Patient	GSW/SW	Hours from injury to OR	Organ/s injured	Complications	CD grade	Intervention	ICU LOS	Total LOS
1	SW	57	Spleen/diaphragm laceration	ileus	II	No	No	15
2	GSW	96	Splenic flexure colon injury	Early necrotising fasciitis of GSW track	IIIb	Yes	No	14
3	SW	120	Haemoperitoneum, serosal tear of transverse colon and terminal ileum	No complication of DOM. However, the patient was discharged and returned with incarcerated omentum and haemoperitoneum	-	No	No	5
4	GSW	24	Pelvic hematoma	Ileus	II	No	No	9
5	GSW	89	Small bowel and descending colon injury (SB resection and primary anastomosis and left hemicolectomy and stoma)	Stoma creation because of the delay	I	No	No	11
6	GSW	16	Small bowel and intraperitoneal rectal injury Had repair and loop colostomy	Small bowel obstruction secondary to parastomal hernia	IIIb	Relook for SBO	No	18
7	GSW	63	Pseudoaneurysm and right renal artery-IVC fistula. Grade II liver laceration Had nephrectomy and patch repair of the IVC injury	IVC thrombosis Acute kidney injury Ileus	IV	No	2	19
8	GSW	26	Grade IV splenic injury and grade I pancreatic tail injury	Readmission day 13 postoperative with ileus and mild acute pancreatitis	II	No	No	8 + 3
9	SW	53	Grade II laceration of the left kidney	Urinary tract sepsis	II	No	No	8

CD – Clavien-Dindo, ICU – intensive care unit, LOS – length of stay, SBO – small bowel obstruction, OR – operating room, GSW – gunshot wound

Time in hours from admission to surgery was significantly longer in the DOM patients (Table II). The median time from admission to surgery in the DOM group was 32 (IQR 25–61) hours. This time interval was significantly longer than the immediate laparotomy group, where most patients went to the theatre within five hours of admission (p = 0.001).

Three hundred and ninety-nine (90.3%) patients underwent immediate laparotomy with therapeutic interventions. The remaining 43 (9.7%) had a NL or NTL, 4.5% and 5.2%, respectively. Thirty-seven (86.0%) patients in the DOM group had a therapeutic laparotomy, and six (14.0%) had an unnecessary laparotomy, of which three (7.0%) were

Table VII: Summary of penetrating abdominal trauma from the large series in the last three decades

Authors, year	Total number of patients, *n* (SW/ GSW)	Number of SNOM in SW	Number of SNOM in GSW	Unnecessary laparotomy in the immediate laparotomy SW/GSW	Number of DOM in SW: GSW	Unnecessary laparotomy in the DOM SW/GSW	DOM morbidity in SW: GSW	DOM deaths in SW: GSW
Demetriades et al.[5] GSW anterior abdomen	146 (0/146)	N/A	41 (28.0%)	6 (5.7%), 1 NTL and 5 negative laparotomies	0:7 (17.1%)	0	0:2 (33.3%) SSI	0:0
Demetriades et al.[25] GSW anterior abdomen	309 (0/309)	N/A	106 (34.3%)	20 (10.8%), 4 NTL and 16 negative laparotomies	0:14 (13.2%)	9 (64.2%), 2 NTL and 7 negative laparotomies	0:2 (14.3%) Psoas abscess and ARDS	0:0
Velmahos et al.[26] GSW to the back	188 (0/188)	N/A	130 (69.1%)	2 (3.4%), both were negative laparotomy	0:4 (3.1%)	4 (100%), all were NTL	N/A	0:0
Velmahos et al.[33] GSW abdomen	1856 (0/1856)	N/A	792 (42.7%)	140 (13.2%), NTL and negative were not specified	80 (10.1%)	23 (28.8%), NTL vs negative not specified	0:5 (6.3%) 4 intra-abdominal abscess and one ARDS	0:0
Navsaria et al.[22] SW abdomen	186 (186/0)	112 (60.2%)	N/A	8 (10.8%), 3 NTL and 5 negative laparotomies	12 (10.7%)	4 (33.3%), 2 NTL and 2 negative laparotomies	N/A	0
Clarke et al.[32] SW abdomen	340 (340/0)	148 (43.5%)	N/A	4 (2.1%)	30 (20.2%)	N/A	13 (43.3%)	0
Inaba et al.[37] GSW torso	787 (0/787)	N/A	636 (80.8%)	N/A	29 (4.6%)	2 (6.9%), 1 NTL and 1 negative laparotomy	N/A	N/A
Navsaria et al.[38] GSW pelvis	239 (0/239)	N/A	63 (26.4%)	4 (2.3%) all NTL	0	N/A	N/A	0
Zafar et al.[27] PAT abdomen	25737 (13030/12707)	5211 (40.0%)	3564 (28.0%)	2849 (36.4%)/1685 (18.4%)	791 (15.2%)/740 (20.8%)	278 (35.1%)/ 140(18.9%)	N/A	9 (1.1%)/ 20 (2.7%)
Navsaria et al.[28] GSW abdomen	1106 (0/1106)	N/A	272 (24.6%)	29 (3.5%), 17 NTL and 12 negative laparotomies	13 (4.8%)	3 (23.1%), 2 NTL and 1 negative laparotomy	0/7	1
Peponis et al.[39] GSW abdomen	922 (0/922)	N/A	215 (23.3%)	104 (14.7%) NTL and negative laparotomy are not specified	18 (8.4%)	1 (5.6%) NTL	9 (50%) Not directly related to delayed surgery	0
Al Rawahi et al.[29] PAT abdomen	22847 (0/22847)	N/A	6777 (29.7%)	N/A	1019 (15.0%)	N/A	N/A	N/A
Sten Saar et al.[40] PAT abdomen	119 (115/4)	55 (46.2%)	0	16 (30.8%)	3 (5.5%)	0	1 patient developed AKI not requiring dialysis	0
Sander et al.[7] PAT abdomen	805 (303/502)	184 (60.7%)	147 (29.3%)	17/29	13 (7.1%)/ 11 (7.5%)	(4/1)	N/A	N/A

SW – stab wound, GSW – gunshot wound, SNOM – selective non-operative management, DOM – delayed operative management, NTL – non--therapeutic laparotomy, ARDS – acute respiratory distress syndrome, AKI – acute kidney injury

negative, and three (7.0%) were non-therapeutic. Hollow viscus perforation was found in 355 (79.8%) patients in the immediate laparotomy group and 24 (55.8%) in the DOM group. The small bowel was the most frequently injured organ in the immediate laparotomy group, followed by the colon. Ten (23.3%) patients in the DOM group had colon injuries as the most frequently injured organ. A detailed description of the intraoperative finding is summarised in Table III.

The distribution of the wound location between the two groups was insignificant (p = 0.39). Most immediate laparotomy patients sustained a penetrating injury to the anterior abdomen or left flank, 28.1% and 21.8%, respectively. Most DOM patients sustained a penetrating injury to the left flank region, 28.6%. The wound location and detailed description for both groups are shown in Table IV. There were fewer complications according to the Clavien-Dindo classification (CD) in the DOM groups. Major complications (CD III and IV) were observed in three patients, and minor complications (CD I and II) in six patients. The secondary outcome of mortality showed 6.3% deaths in the immediate laparotomy group and no deaths in the DOM group. Table V summarises the outcomes, including deaths, complications and ICU and hospital LOS. A detailed description of the complications in the nine patients undergoing DOM is presented in Table VI.

Discussion

The management of PAT has evolved and undergone substantial paradigm shifts over the last century. In view of the low mortality rate associated with unnecessary laparotomies and the perceived potential morbid outcomes related to DOM, the opponents of SNOM swear by a philosophy of "look and see" rather than "wait and see" for PAT.[1,12,13] Despite the low mortality rate associated with the unnecessary laparotomy, it is not a benign intervention. Reported complication rates between 2.5–41.0% include sepsis, postoperative ileus, and pneumonia, with long-term complications such as incisional hernia and small bowel obstruction also documented.[2,14-18] The emergence of SNOM has been a ground-breaking change in the management of civilian PAT.[1,2,12,19,20] SNOM has been reported not to be associated with increased mortality and morbidity.[21] In the current study, 70.2% of the patients with SW to the abdomen were selected for NOM with a 90.1% success rate, and 9.9% underwent DOM.[22]

Unlike abdominal SW, SNOM for abdominal GSW has not gained full acceptance and has faced initial resistance due to the higher rate of intra-abdominal injuries.[23,24] The concept of mandatory laparotomy for GSWs to the abdomen has become less dogmatic. Demetriades et al. and Velmahos et al. published a series of prospective studies that showed that GSW to the abdomen could be managed safely without operative exploration in selected patients. Their figures suggest that SNOM would be successful in one-third of patients with GSW to the anterior abdomen and two-thirds of patients with GSW to the back.[25,26] Similarly, in this study, 33.0% of patients presenting with GSW to the abdomen were selected for NOM. The success rate was 88.2%, and the delayed operative rate was 11.8%, within the range observed in the literature.[27-29] Navsaria et al. had previously demonstrated that SNOM of GSW to solid organs (liver and kidneys) is a feasible and safe option in selected patients with no peritoneal signs and after a careful evaluation with CT scan.[8,28,30,31]

Despite the undeniable benefits of SNOM, DOM is perceived to be associated with increased morbidity and mortality. NOM is found to have reduced negative laparotomy rates, overall complications, reduced LOS and lowered costs in both SW and GSW to the abdomen.[22,32,33] There is considerable divergence of opinions between different authors. Zafar et al. reviewed the outcome of NOM of PAT from the North America national trauma database and found that NOM is generally successful; however, its failure is associated with increased mortality compared to the successful non-operative group.[27] On the other hand, a systematic review by Lamb et al. in 2014 included more than 18 000 patients with abdominal GSW; 32.2% of the patients underwent NOM. Of these patients, 15% underwent delayed laparotomy. They observed that the delayed laparotomy group had similar outcomes to the immediate laparotomy group.[34] Similarly, Peev et al. stated that delayed surgical treatment in patients who failed SNOM for PAT does not cause unnecessary mortality or morbidity if performed in a structured protocol.[35] Furthermore, a more recent systematic review in 2018 by Al Rawahi et al. analysed 6 777 patients who underwent SNOM after GSW to the abdomen and concluded that non-operative management is safe.[29] Table VII summarises the most recent large series of PAT.

NOM is a dynamic process; it starts with the appropriate selection of the patient for NOM, followed by specialised radiology, close observation and serial clinical examination. Should the patient develop a change in abdominal signs or features suggestive of intra-abdominal sepsis or haemodynamic instability, the patient should be considered for a delayed laparotomy.[36] A negative CT scan does not exclude intra-abdominal injuries. We observed that 29 patients with negative CT scan subsequently had a delayed laparotomy. This emphasises the absolute need for admission and serial clinical examination. In the current study, the DOM rate was 10.7%, with 7.0% negative and 7.0% NTL rates, similar to previous studies.[17,22] Conversely, the therapeutic laparotomy rate following DOM was 86.0% in this study, which compares with the calculated mean therapeutic laparotomy rate of 75% (R 36.0–100) in the recent literature.

This study showed that outcomes, including complications and mortality, are less in the DOM when compared with the immediate laparotomy group. The LOS in patients with PAT is no different in patients undergoing DOM than in those undergoing immediate laparotomy (Tables V and VI). We included both SW and GSW in our analysis as we believe that the principles of selective conservative management hold in both GSW and SW to the abdomen, and the treatment algorithm should be the same as we have demonstrated in our recent study.[7]

Conclusion

In this study, we demonstrated no mortality and less morbidity in the DOM group when appropriately selected compared to the immediate laparotomy group. This supports the selective NOM approach for PAT in high-volume trauma centres.

Conflict of interest

The authors declare no conflict of interest.

Ethical approval

University of Cape Town Human Ethics Research Committee approval no. (UCT/HREC: 770/2017).

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