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Comparative Study between Operative and Conservative Management of Penetrating Anterior Abdominal Stab Injuries

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Abstract

BACKGROUND: Presently, non-operative management of penetrating abdominal stab injuries has been standardized in several trauma centers. This strategy has a promising outcome conserving decreasing morbidity.

AIM: This study aimed to assess the safety and feasibility of SNOM of patients having penetrating abdominal stab injuries not indicating emergent laparotomy and to identify a protocol for selection of patient candidates for non-operative management in a tertiary care hospital in Egypt.

PATIENTS AND METHODS: This is a prospective study that involved patients who presented to the casualty department of Kasr Alainy Teaching Hospital, in the period from August 2018 to August 2020, for the management of a penetrating abdominal stab injuries. Fully conscious, hemodynimacally stable patients were included in the study. Eligible patients were allocated to either SNOM group or immediate operative management (IOM) group.

RESULTS: SNOM group included 64 patients and IOM group included 40 patients. The age of the patients ranged from 16 to 49 years with a mean of 33 ± 6.8 years, and the majority were male (99%). SNOM failed in 4/69 patients (5.7%) who required delayed laparotomy for peritonitis (two cases) and HB drop and hemodynamic instability (two cases). In IOM group, only three cases had therapeutic laparotomies (7.3%). The remaining cases had unnecessary laparotomies (92.7%). Statistically significant higher LOS was seen in SNOM group ($p < 0.05$). However, less unnecessary laparotomies and lower incidences of complications were noted ($p < 0.01$).

CONCLUSION: Vital signs together with abdominal examination are the most important clinical criteria in decision making in penetrating abdominal stab injury patients. When surgery is not absolutely indicated, SNOM is a safe and feasible approach in management of penetrating abdominal stab injury by following proper management algorithm and selection criteria.

Introduction

Mandatory laparotomy was considered the standard of care for all patients with penetrating abdominal stab injury till the first half of the 20th century [1]. However, this approach is associated with high rate of nontherapeutic laparotomies [2].

Presently, non-operative management of penetrating abdominal stab injuries has been introduced in several trauma centers [3].

Patients with penetrating abdominal stab injuries who are hemodynamically stable and have no signs of evisceration or diffuse peritonitis are selected for conservative management. Selective non-operative management (SNOM) shortens the hospital stay length, reduces the rate of non-therapeutic laparotomy, and decreases morbidity and mortality of the patients [4], [5].

The keystone of SNOM is to balance between unnecessary laparotomy and the missed injury morbidity. This could be achieved by close observation for the patient clinical condition, and laboratory and radiological data. Any critical alteration should urge re-assessment for potential laparotomy requirement. An observation period of at least 24 h is recommended by recent literature [6].

To date, there have been few prospective studies assessing the SNOM outcomes in management of penetrating abdominal stab injury and comparing it to laparotomy [7], [8], [9]. Moreover, in Egypt, while non-operative management of hemodynamically stable patients has achieved agreement by most health care providers, debate persists about the selection criteria of the patients and the fitness of local clinical environment in LMICs such as Egypt. This prospective study aimed to assess the feasibility and safety of selective non-operative management in penetrating abdominal stab injury and to identify a protocol for selection of patient candidates for non-operative management in a tertiary care hospital in Egypt.

Patients and Methods

This is a prospective study that involved patients aged more than 16 who presented to the casualty department of Kasr Alainy Teaching Hospital, in the period from August 2018 to August 2020 for management of a penetrating abdominal stab injury. The study was conducted after the approval of the regional research ethics committee.

All patients were primarily managed using the standard advanced trauma life support (ATLS) protocol and then routine laboratory investigations and focused assessment with sonography for trauma (FAST) were performed.

Patients who were hemodynamically unstable, and those with omental or bowel evisceration or signs of peritonitis underwent immediate laparotomy and were excluded from the study. Furthermore, patients underwent surgical interference in another hospital, patients died in the emergency room, and those had other major extra-abdominal injuries were excluded from the study. Other exclusion criteria were disturbed patient consciousness (e.g., brain injury or intoxication), the presence of multiple penetrating injuries or back penetrating injury, implemented object, or suspected visceral injury. Finally, fully conscious (with Glasgow coma scale of 15), hemodynimacally stable patients were included in the study.

CT tractography was performed for the patients. The criteria of violated peritoneum in stab wounds were contrast tracking into peritoneum, intraperitoneal air, free intraperitoneal fluid, or solid organ injury.

Patients with proved non-penetrating injuries or those with CT signs of solid/hollow organ injury indicating laparotomy were further excluded from the study. Eligible patients were allocated to either SNOM group or immediate operative management (IOM) group according to the patient preference after discussion with the surgeon. Patients in the SNOM group had additional CT abdomen with oral and IV contrast. Those having CT signs of intra-abdominal hollow organ injury as evidenced by discontinuity of GI wall, contrast leak from the bowel, active bleeding into GI lumen, mesenteric hemorrhage, or laparotomy indicating solid organ injury, were offered laparotomy instead of SNOM and excluded from the study.

An informed consent was taken from each patient after thorough explanation of the pros and cons of management strategies, and the possible need of laparotomy in case of failed conservative management.

For SNOM group, all patients were admitted in the ward under conservative management for 3 days with oral fluids allowed. Patients had their wound dressed. Antibiotics (2^{nd} generation cephalosporin), PPIs, and analgesics were prescribed. Vital signs were assessed and physical examinations were repeated 3 times, 2 h apart, then every 6 h for 3 days by the same surgeon. CBC analysis and FAST examination were carried out on admission and after 6 h then every 12 h.

Conservative management was terminated and delayed laparotomy was conducted if the patient turned vitally unstable, had signs of a generalized peritonitis, had significant intra-abdominal hemorrhage as shown in FAST, and showed drop in hemoglobin levels by >2gm/dl per 24 h, or elevation in WBCs count together with fever and abdominal symptoms or with absent signs of extra-abdominal infection.

If no abnormality was detected during conservative management, the patients were safely discharged after 72 h, followed up after 1 week in the outpatient clinic.

In regard to the IOM group, patients underwent the classic pathway of diagnostic laparotomy or laparoscopy with recording of the surgical finding, intervention, post-operative complications (Dindo-Clavien scoring), and hospital stay length in days.

Patients in both groups were informed to present to the hospital if they experienced any complications.

Study outcomes

The primary outcomes of interest were the rate of failed SNOM (patients who required delayed laparotomy) and unnecessary laparotomies in the IOM group. Unnecessary laparotomy was defined as non-therapeutic (when the present injury did not require surgical intervention) or blank laparotomy (when no injury was found).

Secondary outcomes were hospital length of stay (LOS) and short-term morbidity in groups.

Statistical analysis

Data entering and tabulation were performed and statistical analysis was carried out using Statistical Package of the Social Science Software (SPSS) program, version 22 (IBM SPSS Statistics. Armonk, NY: IBM Corp.).

Numerical data were presented as range, mean, and standard deviation, while categorical data were presented as frequency and percentage. Comparison between groups was performed using Chi-square or Fisher's exact tests for categorical variables, and two sample t-test for numerical variables. Binary logistic regression analysis was conducted to test variables predicting SNOM failure. $p \leq 0.05$ were considered statistically significant, and values ≤ 0.001 were considered statistically high significant.

Results

The study patients inclusion according to the eligibility criteria and the management algorithm are shown in Figure 1. SNOM group included 64 patients and IOM group included 40 patients. The age of the patients ranged from 16 to 49 years with a mean of 33 ± 6.8 years, and the majority were males (98.4%). Both groups were matched in the basic patients characteristics, and vital signs with no statistically significant differences (Table 1). Male gender predominance was evident in both groups (98.4% and 100%, respectively). The majority of injuries were predominantly located at the upper abdomen (70.7% years).

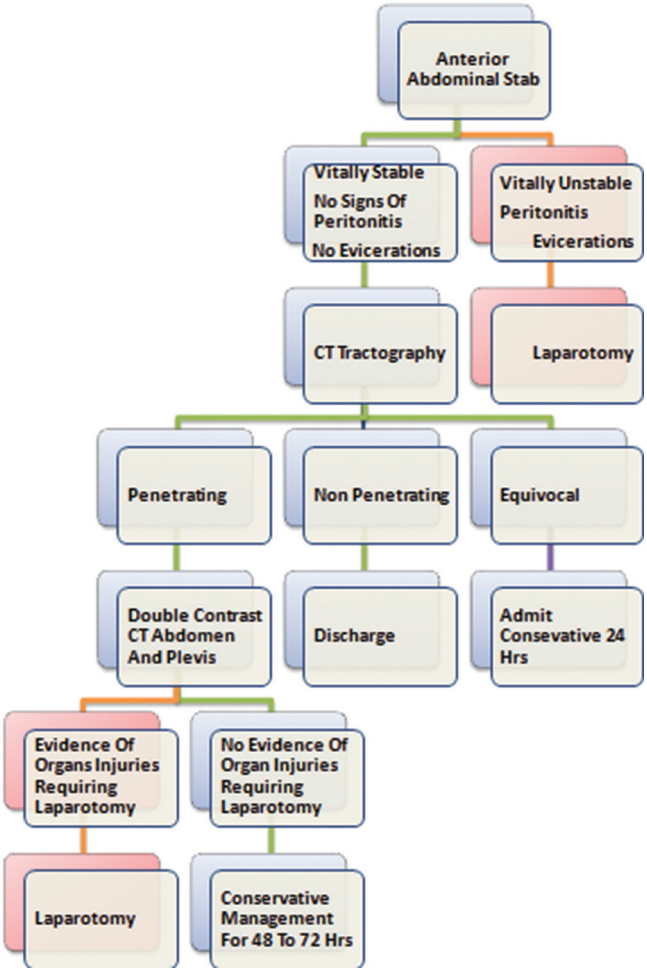

Figure 1: The study patients inclusion according to the eligibility criteria and the management algorithm

SNOM failed in 4/64 patients (6.2%) who required delayed laparotomy for peritonitis (two cases) and HB drop and hemodynamic instability (two cases).

The exploration of failed SNOM patients revealed bowel injury in two patients (one had 5 cm jejunal injury at the antimesentric border and was repaired in two layer Vicryl sutures and the other had 4 cm sigmoid injury with no soiling and underwent primary repair), greater omentum hematoma in one patient (managed by securing hemostasis and under-running sutures), and Grade II liver injury with no active bleeding in the last patient (non-therapeutic laparotomy).

Table 1: The basic characteristics of the study groups

Basic Characteristics	SNOM group (n = 64)	IOM group (n = 40)	Test	p
Age, mean ± SD	32.5 ± 6.6	34 ± 7.1	t = 1.12	0.265
Gender, n (%)				
Male	36 (98.6)	40 (100)		1^{FE}
Female	1 (1.4)	0		
Location of injury, n (%)				
Epigastrium	17 (24.6)	13 (31.7)	$\chi^2 = 3.18$	0.922
Right hypochondrium	12 (17.4)	6 (14.6)		
Left hypochondrium	19 (27.5)	10 (24.4)		
Periumbilical	5 (7.2)	4 (9.8)		
Right lumbar	3 (4.3)	1 (2.4)		
Left lumbar	3 (4.3)	1 (2.4)		
Right iliac	1 (1.4)	1 (2.4)		
Left iliac	4 (5.8)	4 (9.8)		
Heart rate, mean ± SD	90.7 ± 6.9	92.6 ± 4.9	t = −1.5	0.15
Systolic BP, mean ± SD	121.6 ± 6.4	120.4 ± 6.7	t = 0.955	0.342
Diastolic BP, mean ± SD	74.8 ± 5.6	72.9 ± 6.4	t = 1.63	0.106
Respiratory rate, mean ± SD	16.4 ± 2.3	16 ± 1.9	t = 0.83	0.406
Oxygen saturation, mean ± SD	96.6 ± 1.2	96.8 ± 1.2	t = 0.67	0.49

^{FE}Fisher's exact test. χ^2: Chi-square test, t: independent t-test, SD: Standard deviation, SNOM: Selective non-operative management, IOM: Immediate operative management

A logistic regression analysis was performed to assess the potential predictive value of initial radiologic and laboratory characteristics of the patients on the likelihood SNOM failure. Table 2 shows that the logistic regression model was statistically high significant (p = 0.001). The model explained 100% of the variance in cases and correctly classified 100% of the cases. However, no single variable showed statistically significant association with the SNOM failure.

Table 2: Multivariate logistic regression analysis for the parameters affecting requirement of delayed laparotomy

Independent variable	B	SE	*p*
CT findings	-197.415	43960.664	0.996
Total leukocytes count	28.291	2428.646	0.991
Hemoglobin	0.455	125.395	0.997
FAST findings	72.123	30314.849	0.998

Nagelkerke $R^2 = 1$, $\chi^2 = 30.55$, * p = 0.001. SE: Standard deviation

In IOM group, only three cases had therapeutic laparotomies (7.5%), where exploration revealed bowel injuries, those were repaired accordingly. The remaining cases had unnecessary laparotomies (92.5%), either non-therapeutic (36.6%), or blank laparotomies (56.1%) (Table 3).

Table 3: Laparotomy types in immediate operative management group

Laparotomy type	Findings	Management	n (%)
Therapeutic	Transverse colon injury	Primary repair	1 (2.4)
	Small tear in small bowel	Primary repair	2 (4.9)
	Total		3 (7.3)
Nontherapeutic	Solid organ injury not indicating laparotomy		14 (36)
Blank	-		23 (56.1)

Comparison between both groups revealed statistically significant higher LOS in SNOM group (p<0.05). However, less unnecessary laparotomies and lower incidences of wound infection, pulmonary complications, and paralytic ileus, with statistically high significant differences, were noted (p<0.01). No statistically significant differences were shown concerning the incidence of incisional hernia, burst

abdomen, or adhesive small bowel obstruction (p>0.05) (Table 4).

Table 4: The outcome of the study groups

Outcome	SNOM group (n = 64)	IOM group (n = 40)	Test	p
Hospital stay length (days), mean ± SD	3.3 ± 1.5	2.7 ± 1	t = 2.28	0.0248
Unnecessary laparotomy, n (%)				
Nontherapeutic laparotomy	1 (1.4)	14 (36.6)	χ^2 = 14.9	0.00
Blank laparotomy	0	23 (56.1)		
Complications, n (%)				
Wound infections	11 (15.9)	21 (51.2)	χ^2 = 15.52	0.00
Pulmonary complications	2 (2.9)	11 (26.8)	χ^2 = 14.13	0.00
Paralytic ileus	1 (1.4)	9 (22)	χ^2 = 13.08	0.00
Burst abdomen	0	1 (2.4)	χ^2 = 1.7	0.19
Incisional hernia	0	1 (2.4)	χ^2 = 1.7	0.19
ASBO	0	2 (4.9)	χ^2 = 3.24	0.06

t: Independent t-test, χ^2: Chi-square test, SD: Standard deviation, SNOM: Selective non-operative management, IOM: Immediate operative management, ASBO: Adhesive small bowel obstruction.

Discussion

The unnecessary laparotomy was documented to have post-operative morbidity rate of 14% to 41% [10]. Selective non-operative management (SNOM) of abdominal stab injuries was introduced in many trauma centers for the hemodynamically stable patients those have no signs of diffuses peritonitis. Data have shown that proper population selection for SNOM leads to considerable reduction of unnecessary laparotomies, morbidity, and mortality [5].

The high rates of morbidity associated with unnecessary laparotomies, advances in the CT, emergence of the CT tractography and the need for a simple, and cost-effective algorithm for the management of penetrating abdominal wall wounds have all been the motive behind this study to minimize the number of negative interventions and the morbidity associated with them. This study aimed to assess the safety and feasibility of SNOM of patients having penetrating abdominal trauma, not indicating emergent laparotomy.

This is the first study in Egypt assessing SNOM of penetrating abdominal trauma. The study was conducted on 104 patients who presented to the Cairo University hospitals with penetrating abdominal injuries. The adopted management algorithm was applied, and finally, 64 patients (61.5%) were assigned to SNOM, and 40 (38.4%) were assigned to IOM group. The age of the patients ranged from 16 to 49 years with a mean of 33±6.8 years, and the majority were male (98.4%). Accordingly, most of the previous studies showed male gender predominance with percentages ranging from 88% to100% [11], [12], [13].

In this study, four cases (6.3%) demonstrated SNOM failure and required delayed laparotomy. The SNOM success rate was 93.7%; this is comparable with the literature figures which ranged between 87.2 and 95.2% [8], [13], [14], [15]. The failed cases were identified and taken to laparotomy, where they were managed accordingly.

A logistic regression analysis was performed to assess the potential value of the initial radiological and laboratory data for prediction of SNOM failure. The logistic model was statistically high significant (p = 0.001) and explained 100% of the variance in cases (Nagelkerke R^2 = 1). However, no single variable was significantly associated with the SNOM failure. This is mostly due to the small sample size and the small number of failed cases (only 4).

In our study, the IOM group showed a high unnecessary exploration rate (37/40; 92.5%), including blank and non-therapeutic laparotomy. This rate is much higher than those reported in the literature, where the unnecessary laparotomy rates ranged between 21 and 59%. This, however, was to somewhat expected. Our cases underwent meticulous selection based on the clinical and CT criteria, as each case had the potential to be allocated to the SNOM group.

Regarding morbidity rates in the two groups, the IOM group showed high rate of unnecessary laparotomy (92.5%) compared to SNOM group (1.5%) (P-value = 0.000). Significantly higher rates of wound infection, pulmonary complications and paralytic ileus were shown also in IOM group (p = 0.000). In IOM group, one case had burst abdomen and was complicated later by incisional hernia. Another two cases were as complicated by adhesive small bowel obstruction (ASBO) after 3–4 months, one of them was managed conservatively and the other was managed by open adhesiolysis. This was not experienced in SNOM group. However, the differences were non-significant concerning the rates of burst abdomen, incisional hernia or adhesive small bowel obstruction.

The higher morbidity rates of operative management were extensively described in the literature [5], [14], [16]. Schellenberg *et al*. (2021) concluded that complications of penetrating abdominal injuries operative management were uniformly higher than SNOM, even in case of SNOM failure. In our study as well, the small number showing SNOM failure could eventually be picked by close follow-up and then managed accordingly. This is emphasizing the SNOM safety.

The present study revealed that SNOM group had statistically significant longer hospital stay (p = 0.025), with a mean of 3.3 ± 1.5 days in SNOM group compared to 2.7 ± 1 days in IOM group. Our finding is inconsistent with the previously reported SNOM associated shorter hospital stay [2], [4], [5], [13], [15], [16], [17].

This could be attributed to the provided longer time for patient observation in SNOM group according to the hospital protocol. This cautious attitude is due to the recent introduction of SNOM approach in our trauma team.

Strength and limitations

The strength of the present work is being a prospective study, being the first study investigating safety and feasibility of SNOM in patients with penetrating abdominal trauma in Egypt. However, it is limited by the relatively small sample size and the non-randomized design.

Conclusion

Our study emphasize that, when surgery is not absolutely indicated, SNOM is a safe and feasible approach in management of penetrating abdominal stab injuries by following proper management algorithm and selection criteria. A high successful rate is achievable with no extra morbidity in patients taken to delayed laparotomies.

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