

Research Article

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The efficacy and safety of non operative management in abdominal injury in a high volume but resource stretched setting

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ABSTRACT

Background: Injury to the abdomen is a significant cause of mortality and morbidity. The study was to describe the clinical profile and analyse the efficacy and safety of Non Operative Management (NOM) in a high volume but resource stretched setting.

Methods: A prospective observational study was conducted on patients with abdominal injury. The clinical profile; interventions, morbidity and mortality were studied.

Results: Of the 130 cases of serious injury to the abdomen, 16 patients died during resuscitation, 52 were taken up for immediate laparotomy due to hemodynamic instability/peritonitis and 62 patients were initially managed by NOM. The failure rate in NOM was 34% mainly due to delayed manifestations of bowel injury. However the mortality rate directly attributable to missed bowel injury was 2 %.

Conclusions: Injury to the abdomen is one of the leading causes of morbidity and mortality. The efficacy and safety of NOM in our facility is comparable to published validated studies. The mortality rate directly attributable to missed bowel injury was 2 %, is acceptable to avoid the 50% chance of negative/non therapeutic laparotomy. We have identified a few red herrings in our study ,which could further increase safety, in our high volume but resource stretched setting.

Keywords: Abdominal trauma, Non Operative Management, Damage control, Missed injuries, Hepatoportal fistula, Chylous ascites

INTRODUCTION

Abdominal trauma is present in 7-10% of all trauma victims with 85% being blunt.¹ Patients can present anywhere in the spectrum of walking talking group to the agonal/peri cardiac arrest. Patients who are undisputedly haemodynamically unstable or have frank peritonitis will need laparotomy regardless whether blunt or penetrating

(Level 1).² Non Operative Management (NOM) in blunt trauma, especially in stable patients is routine in mature trauma systems. Peritoneal violation in penetrating injury that mandated exploration, is slowly giving way to a more conservative approach. These concepts are validated by retrospective studies that have revealed negative /non therapeutic laparotomy rates of up to 53% and complications directly linked to the laparotomy is 8 to 41%.³ However there are inherent dangers in NOM.²

NOM is being more adopted in high volume trauma centers where surgeons are getting more confident with the favourable evidence from mostly retrospective studies but prospective studies have a higher failure rate⁴. We are following non operative management more frequently since 2004. The confidence level of the surgeons coupled with technology has helped in offering NOM to more patients now. We looked into the failure rate, the reasons and the complications of NOM.

METHODS

This prospective observational study included all cases presenting with abdominal injury to the headquarters hospital and Indira Gandhi medical college in the union territory of Puducherry over a period of 18 months from January 2011 to June 2012.

Ethical considerations

Prior to study commencement, the Medical Superintendent of the Indira Gandhi Government General Hospital, and Indira Gandhi Medical college Puducherry granted permission to conduct this study.

Data collection techniques

The participants or their caregivers provided informed consent. We included all significant abdominal blunt traumas of AIS4 and above. All penetrating trauma with violation of peritoneum regardless of the AIS was included.

A partially open ended semi structured case study format was used to note down the socio-demographic characteristics of the patients, the mechanism of injury, prehospital time, associated injuries, interventions, and postoperative outcome variables. Patients were resuscitated according to standard trauma protocols.

1. Non responders/hard signs of peritonitis necessitated immediate laparotomy.
2. Responders had detailed USG/CT scan depending on the circumstances.
3. Patients with initial hypotension that resuscitated were observed in trauma intensive care, and stable patients in the general ward.
4. Detioration in hemodynamic parameters or appearance of peritonitis in NOM group at any time necessitated immediate laparotomy.

Operative management included simple haemostatic measures, individual bleeding vessel ligation, partial resection/total resection for solid organs and appropriate surgery for bowel injury. 3 patients had damage control. There was uniform quality of care and protocols regarding NOM across units.

The Abbreviated Injury score (AIS) as described by Moore⁵ was calculated for the extra abdominal and

intraabdominal injury by imaging/ intraoperative findings or at post-mortem. The Injury Severity Score (ISS) was calculated finally. All cases of death had post-mortem. In a few cases there was mild to moderate disparity between the antemortem and post-mortem AIS for both extra abdominal and abdominal injury. Injuries that were assigned a higher grade on post-mortem were taken as final score.

Those patients declared dead before primary survey, referred elsewhere or lost to evaluation were excluded from the study.

Statistical methods

No formal sample size was calculated. All the cases that met the inclusion criteria during the study period were analysed. The collected data was analysed using means and proportions, data were represented as figures.

RESULTS



Figure 1: Impaled wooden splinter.

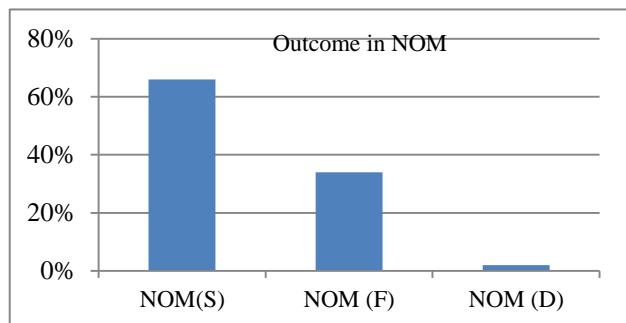


Figure 2: NOM (S) = successful, NOM (F) = failed, (NOM D) = Died.

Injury to the abdomen either isolated or part of multi system trauma was identified in 9 % of the total trauma cohort (130 patients in 1445 seriously injured patients) during the study period. Seventy three percent had blunt (mostly RTA), 25% had penetrating (assaults with knife) while 3% had both blunt and penetrating trauma. Death during resuscitation (DR) occurred in 16 (12%), immediate laparotomy (IL) was needed in 52 (40%) and Non Operative Management (NOM) in 62 (48%). The

NOM group was further classified as successful (NOM-S) in 41 (66%) and failed (NOM-F) in 21 (34%). The male to female ratio ranged from 12:1 to 17:5 across various groups. Age ranged from median of 30-35 for the various groups (Table 1).

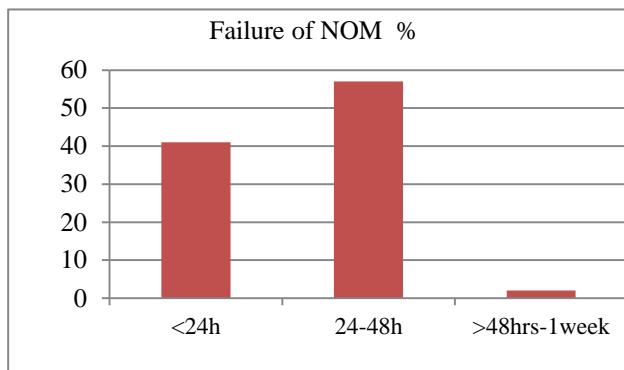


Figure 3: Timing of failure of NOM.

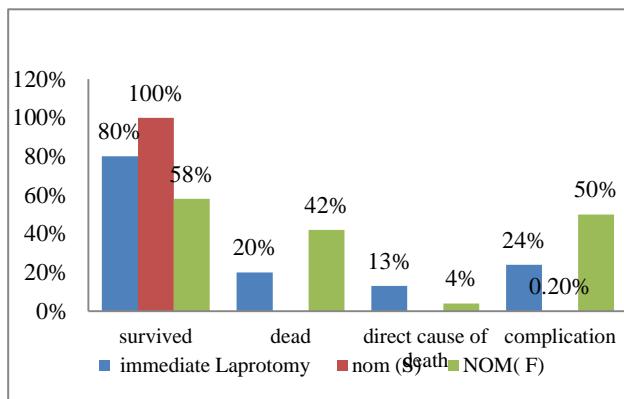


Figure 4: Complication and survival rates.

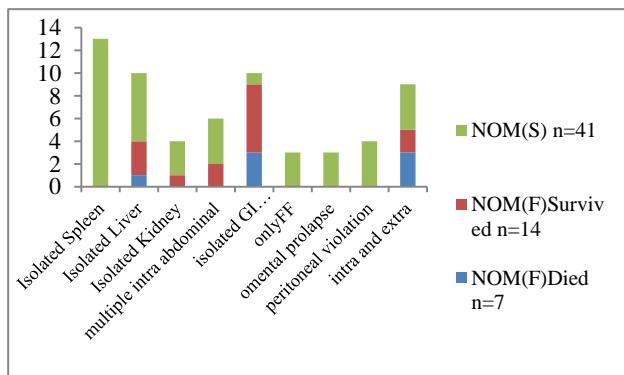


Figure 5: Organ specific success in NOM.

The NOM-F was further classified as salvageable (n=12) and died (n=9). The median Revised trauma score (RTS) was 6 (DR), 8 (IL) that survived, 7.5 (IL) that died, and 9 in the NOM group irrespective of outcome (Table 2).

Peritonitis was the main reason for immediate laparotomy in 55%, followed by hemodynamic instability 25%, evisceration in 12% and mandatory laparotomy for

peritoneal violation in 2% and impaled foreign body (Figure 1). One patient had tension viscerothorax due to diaphragmatic hernia that needed immediate laparotomy and decompression. Multiple intra-abdominal injuries were found in (23%). Intestines was the most common isolated injury (24%) followed by liver (19%), spleen (14%), kidney (4%), major vessels (4%).



Figure 6: Mesenteric rent with bowel gangrene.

NOM failed in 21 out of 62 (34%) However 14 (66%) was still salvageable in the failed NOM group (Figure 2). Failure occurred mainly at 24 to 48 h (Figure 3). Most common cause was delayed presentation of bowel injury 9 out of 21 cases (42%).

Complication rate was highest in the NOM failed group at 50% followed by 24% in immediate laparotomy .0.2% of patients managed successfully by NOM had late complications (Figure 4) .Length of hospital stay median of 3h (DR), 5 h in died (IL), 10 d in survived (IL), 6 d in NOM (S) and 18 days in the failed NOM-F but salvaged groups.

Death occurred in 20% of immediate lap and 13% in NOM group. Organ specific success rate for isolated injury was 100% for spleen 75% for kidney and 60% for liver Fig 5.The causes of death overall was bleeding in (55%) and was maximum in 48h .Sepsis which occurred in (41%) had a gradual increase after 48h, and peaked along with MOF at one week. Injury Severity Score (ISS) median was 30 (DR), 23.5 in (IL), 16 in NOM (S) and 16 in NOM (F).

Median ISS was 29 in the NOM F group who died compared to ISS of 16 in the NOM-F but were salvageable.

DISCUSSION

Abdominal injury was found in 9% of the trauma cohort either isolated or as part of multisystem trauma in accordance with 7-10%, but far lower than 24% in Oman.^{1,6} 73% was due to blunt injury lesser than 44% from Orissa, India.⁷ This discrepancy may be due to the prevalence of interpersonal violence. Twenty five percent had penetrating and 3% had both blunt and penetrating trauma against 17%.⁷ 78% was accidental mostly due to

road traffic accidents. 20% was homicidal and mostly stabs.

Sixteen (12%) patients had died during resuscitation. Almost all (90%) was due to bleeding from liver, spleen, major vessels and kidney in that order. These patients could be helped with prompt trauma surgery facility and prevention programmes.

Fifty two (40%) were taken for immediate laparotomy after positive FAST, higher than 28% and 19.98%, in mature trauma systems where prehospital care is well developed.^{4,6} Patients who are haemodynamically unstable or who have diffuse abdominal tenderness should be taken emergently for laparotomy (level 1).² Bleeding in 34%, peritonitis in 44%, bleeding and peritonitis in 4% and others that included evisceration, tension viscerothorax and impaled foreign body in 18%. Delays of up to 90 minutes to arrest bleeding impacts adversely on outcome.⁸ Our study had a high percentage of peritonitis (44%) that was due to bowel injury. Peritonitis, even in the setting of normal hemodynamics,

has a 97% likelihood of surgically significant injury and therefore warrants immediate laparotomy.⁹ Our trauma service caters to a radius of 200km. Even though they belong to immediate laparotomy group in effect they had presented more than 12 hrs from the time of injury. Moreover majority of our RTA are compression/crush forces rather than acceleration/deceleration injury where pedicles of major solid organs are involved. Hence intestinal injury accounted for 50% in the immediate laparotomy group. Liver was the most single solid organ injured (12%), spleen (5%) and multiple solid organs (12%). Early deaths of 17% (deaths during resuscitation and after immediate laparotomy higher than 11% were mainly due to bleeding 82%, intestinal injury 4% and a single case of tension viscerothorax).⁷ There was 100% mortality when major vessels were injured, compared to 56% reported by Lund et al.¹⁰ Damage control was done in 2 patients for liver injury. Damage control surgery is associated with improved outcome in liver trauma and major vessel injury.^{11,12} In hind sight patients all our patients with major vessel injury could have been attempted damage control.

Table 1: Demography.

	Died during resuscitation (DR) n=16 12%	Immediate laparotomy(IL) n=52 40%	NOM n=62 48%		Total=130
			NOM S N=41(66%)	Nom F n=21(34%)	
Age median	35(7-70)	36(7-70)	34(12-70)	30(20-65)	-
M:F	12:01	43:09:00	2:01	17:05	-
accidental	15	40	30	17	102 78
Homicidal	1	11	9	4	25 20
Suicidal	0	1	2		3 2
Blunt	15	34	31	15	95 73
Penetrating	0	15	11	6	32 25
penetrating and Blunt	0	3	0	0	3 2
prehospital time (median)	2.5h(30m-24h)	5h(1-96h)	3h(30m-96h)	3h(30m-10h)	-
Referred n%	14	30	24	13	81

Only 62 patients (48%) were decided to be managed Non Operatively against 89.91% in Oman.⁶ Hemodynamic stability and absence of peritoneal signs were the main consideration for NOM irrespective of severity of organ injury. All of them had detailed USG/CT for the amount of fluid in the abdomen and the severity of organ injury. NOM was successful in 66% (n=41). In the failed group 12 out of 21 were salvageable. Organ specific success was 100% in spleen, 75% kidney, 60% liver and 60 % of multiple solid organ injury (Figure 5).

AIS 14 (9-34), ISS 16 (9-45) for Successful NOM (Table 2) comparable to ISS 14+-9 in NOM-S and 18+-9 in NOM-F at level 1 trauma centre.⁴ Three patients who had only free fluid without intra-abdominal injury were managed successfully by NOM. This is a challenging situation. There are various options, ranging from serial examination, to additional imaging to laparotomy itself. The volume of free fluid itself could help in decision making as large volume would foretell a failure rate of 89%. Exposure to such cases in the course of one's career is infrequent, making it difficult to rely on general experience alone to correctly diagnose and adequately

treat such injuries.¹³ Hence serial examinations in particular, remains an important part of the assessment of patients being considered for NOM.³

Failure rate of 34% in NOM compares well with 33% in a prospective study by Velmahos but far higher than 10.06% and 10%.^{4,6,7} AIS 16 (4-44) and ISS 16 (9-53) for NOM (F) lower than ISS of 21.8 by Christine et al.¹⁴ Failure was due to intestinal /mesenteric injuries (38%)

(8/21) followed by liver 17% (4/21) and multiple solid organs 8% (2/21). 30% (6/21) had multiple solid organ and extra abdominal injuries. Failure in NOM was due to bleeding from another organ other than liver, spleen, and kidney. It was due to mesenteric tear or intestinal injury.⁴ 38% of missed injuries were due to intestinal injury in our study which is comparable to 39% by Kolb but higher than 19% and 10%.^{6,15,16}

Table 2: Injury severity and outcome.

died during resuscitation n=16	Immediate laprotomy n=52		Nom S n=41	Nom Failed n=21	
	Survived n=42	Died n=10	Nom S n=41	Survived n=21	died n=9
AIS for Extra abdominal	9 (1-27)	9 (9-35)	13 (9-18)	12 (7-18)	16 (6-44) 25 (9-43)
AIS for intra-abdominal	25 (9-34)	16 (1-41)	16 (4-45)	14 (9-34)	16 (4-44) 16 (4-29)
ISS	30 (12-54)	16 (1-45)	23.5 (8-45)	16 (9-45)	16 (9-53) 29 (9-45)
RTS at presentation	6 (4-10)	8 (5-11)	7.5 (6-10)	9 (6-10)	9 (6-12) 9 (6-12)
Time in hospital	3h (2-24h)	10 dys (3-60)	5 dys (1-60)	6 dys (3-21)	18 dys (7-32) 5 dys (3-7)
Immediate complication	Not applicable	8 (20%)	Not applicable	0	10 (50%) Not applicable
long term complication 1-2yrs	Not applicable	4 (10%)	Not applicable	2 (5%)	2 (10%) Not applicable

Bowel injuries are not always associated with conclusive evidence on CT. Hence even serious injuries can be initially missed. Unfortunately, missed bowel injuries have a high morbidity, with mortality reaching 31% if undiagnosed for more than 24 hours.¹⁷ Timing of non-operative failure peaked after 24 hrs and declined after 48 h in keeping with the high rate of intestinal injuries which manifest late (Figure 3). Signs of peritonitis may take hours before becoming clinically evident, which is an important downside of this strategy.¹⁸ Hence serial examination that is easily available is followed in our setting. A seat belt sign and free fluid without solid organ injury and no evidence of hollow viscus on CT should still heighten the due to saree avulsion to the abdomen conveyor belt had contusion and abrasions to the suspicion of bowel injury.¹⁹ In hind sight one patient had avulsion injury to abdomen akin to seat belt sign albeit transversely. Splenic contusion and minimal free fluid was found on imaging. The patient died due to missed bowel perforation. One patient had no free fluid /free air on imaging but just deterioration vitals and death. Post mortem revealed mesenteric tear and gangrene of small intestine with no perforation similar to a report by Reza.⁶ Smoldering gangrene due to mesenteric injury are more

likely to be missed than frank perforation (Figure 6). With this index case when CT is normal but there suspicion of bowel injury we have used DPL/diagnostic lap and proceeded to laprotomy avoiding morbidity and mortality. This is to emphasize that DPL/CT/diagnostic laparoscopy need not be seen as exclusionary nor strictly sequential.

Multiple organ injuries, age >55, ISS >25 are all indicators for potential failure.²⁰ Age did not appear to be risk factor for failed NOM as mean age in NOM-F was (30) compared to mean age (35) in the NOM -S group. AIS for extra abdominal and intra-abdominal injury were higher in the failed group than the successful group. Both the NOM-S and NOM-F had median AIS of 16. In The NOM-F, ISS of 29 was associated with death compared to ISS of 16 in patients who survived (Table 2). Hence the total scores had more impact on outcome than the scores for the abdominal injury. Extra abdominal injuries are independent prognostic variable.²¹ Death in NOM was 9/21 (42%) but the direct cause of death was in 2/42 (5%) in the NOM-F. Peitzman had mortality rate of 12.6% in failed NOM.²² Mortality when NOM fails is 7 times higher and 70% preventable.^{4,22} One patient needed

splenectomy after NOM failed as intraoperative attempts at splenic conservation was unsuccessful.

NOM in low velocity penetrating injury even with evisceration has been adopted in our institution. Nineteen out of 33 patients (57%) were decided for NOM. It failed in one patient after 72 h and needed nephrectomy for grade 3 injury. 10% of renal injuries will need operation for delayed or ongoing bleeding and kidney loss is higher with grades of 3 and above.^{4,24} Negative laprotomy from civilian, low-velocity wounding can be 23-53%. A routine laparotomy is not indicated in haemodynamically stable patients with abdominal stab wounds without signs of peritonitis in centers with surgical expertise. Como et al.² There is considerable cost benefit in NOM. In fact negative laprotomy is being even discussed as medical error.⁴ Non-therapeutic laprotomy is not a benign procedures 11 % can have early and late complications including death.³ Hence we feel that the mortality rate of 2% directly attributed to NOM is acceptable in preventing the 50% negative/non therapeutic laprotomy that would result. But we do recognize the morbidity of failed NOM can be definitely reduced further by looking for red herrings that our own study has thrown up. In fact we were diligently incorporating these precautions in our treatment algorithm.

However acceptance of NOM is lagging behind even in developed countries where the negative /non therapeutic laprotomy rates reached 50% with no decline since 1996.²⁵ In gunshot wounds the disparity in NOM is stark across the Atlantic 74% in US and 14% in Britain.²⁶ Although the rate of nontherapeutic laprotomy for penetrating wounds to the abdomen should be minimized; this should never be at the expense of a delay in the diagnosis and treatment of injury.

We had unusual late complications after injury to the abdomen, which deserve mention. One patient who had damage control for liver injury was followed up to six months with ultra sound .He returned a year later with a progressive hepatoportal fistula. We do not routinely image solid organs for healing beyond 3 months due to stretched resources. Liver healing is 60 days in a single largest study and routine imaging is not needed in asymptomatic patients.²⁷ Stab to the L kidney was managed non-operatively. 2 months later patient had chylous ascites that also resolved on conservative treatment. Majority of chylous ascites with no underlying malignancy/congenital defects will close spontaneously.²⁸

Managing more patients by Non Operative Management may deny surgical training to young surgeons in isolated trauma units. This concern has been raised by Bullinski who suggested simulation, inanimate models and anything else that the future may offer.²⁹ However our residents due to the sheer workload of associated general surgery both elective and emergency are able to circumvent this fall out now and for next many more years to follow.

Strength of the study

Most studies on NOM are retrospective. Prospective studies have shown higher failure rates. Ours is a prospective study. Most studies have been conducted in well-equipped and academic centres not necessarily high volume centres. Ours is a high volume centre. The surgical skill is available 24x7 but the back up like intensive care, blood availability etc. The high degree of completeness of data also allowed us to control for important confounders that needed to be considered in the analysis of this nonrandomized study.

CONCLUSION

In our centre we are following Non Operative Management aggressively for both blunt and penetrating injury since 2004 with the advent of USG, CT Scan and the dedicated trauma services. The confidence level of the surgeons coupled with technology has helped in offering NOM to more sick patients now. In our study, the failure rate was 34% but still salvageable albeit with high complication rates and prolonged hospital stay. The eventual death rate was 5% directly attributable to NOM. We did avoid a negative/non therapeutic laprotomy rate of 66%. This indicates that the selected treatment algorithm at admission was correctly chosen. However we will strive for finer tuning of our algorithm so that the end user of this study the trauma patient will get the maximum benefit.

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