Selective Non-operative Management of Patients with Abdominal Trauma—Is CECT Scan Mandatory?

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Abstract CECT scan is considered essential for selective non-operative management (SNOM) of patients with abdominal trauma. However, CECT has its own hazards and limitations. We evaluated the safety and efficacy of selective non-operative management of patients with abdominal trauma without the mandatory use of CECT scan in a prospective study. Patients with peritonitis and ongoing intra-abdominal bleed were excluded. Consenting FAST positive, hemodynamically stable patients with blunt and penetrating abdominal trauma between 18 and 60 years of age were included and admitted for SNOM and detailed ultrasonography of the abdomen (in all) with or without CECT abdomen (selectively). Eighty-four patients with abdominal trauma were admitted during the study period. Twenty-two patients did not satisfy the inclusion criteria and 18 required immediate laparotomy based on primary survey. Remaining 44 patients were admitted for SNOM: mean $\pm$ SD age of these patients was 27 ± 8.7 years; 40 (89 %) were males. Thirty-five patients (79.54 %) sustained blunt trauma (RTI = 16, Fall = 16, others = 3) while nine patients (20.45 %) sustained penetrating trauma. SNOM without CECT was successful in 36 (81.82 %) patients.

Five (11.36 %) patients underwent delayed emergency laparotomy based on clinical and detailed USG evaluation. CECT was not done in these patients. Three patients underwent CECT for various reasons; however, they were managed with SNOM. Thus, SNOM without abdominal CECT was successful in 36 (81.82 %) patients. SNOM failed in five patients but abdominal USG was sufficient. SNOM can be practised safely in patients of abdominal trauma with limited use of CECT scan.

Keywords SNOM · Abdominal trauma · Abdominal injuries · Non-operative management · USG evaluation · CECT scan

Introduction

Selective non-operative management (SNOM) of patients with blunt abdominal trauma (BAT) has gained wide acceptance [1–6], and this concept is being increasingly applied to patients with penetrating abdominal trauma (PAT) [7–11]. More recently, some trauma centers have reported success with SNOM for abdominal gunshot injuries also [12, 13].

Patients with stable hemodynamics and intact hollow viscera (Gastrointestinal, Genitourinary) are the right candidates for SNOM. CECT scan is considered an essential investigation in patients being subjected to SNOM [14–17]. However, even CECT scan has its own limitations. It may not always be readily available, is costly, requires a trained person to perform, and an equally trained radiologist to interpret it. In addition, it requires the patient to be shifted out from the “safe domains” of trauma suite to the specialized CT chamber. It also has risk of contrast allergy and contrast-induced nephropathy and confers a small but not negligible risk of cancer [18,

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19]. Although sensitive, CECT scan may miss some gastrointestinal, diaphragmatic, and pancreatic injury [20].

Thus, the question in our mind was: can we do away with CECT which at present is considered a mandate in patients being managed by SNOM?

Till date, combined efficacy of physical examination, USG, and DPL while *using CECT selectively has not been studied*. Therefore, we *hypothesized* that a combination approach, in which we use USG and DPL sequentially, may complement each other in diagnosing patients of abdominal trauma, while restricting the use of CECT scan.

Material and Methods

This prospective study was carried out in the Department of Surgery, University College of Medical Sciences, and associated Guru Teg Bahadur Hospital, New Delhi, from October 2012 to March 2014. The study was approved by the institutional ethics committee. All patients with history of blunt or penetrating abdominal trauma, aged between 18 and 60 years, either gender, FAST positive but hemodynamically normal or responders were included in the study. Patients with evidence of ongoing intra-abdominal bleed, peritonitis, having fresh blood in the naso-gastric tube or on digital rectal examination were planned for immediate laparotomy. Patients with prolapsed bowel with visible perforation or gangrenous changes or escaping of intestinal contents from the abdominal wound or with suspected traumatic diaphragmatic injury were also taken up for laparotomy without any further investigations. Patients with history of PAT but FAST negative or without evidence of peritoneal breach were excluded from the study.

Patients with abdominal trauma were admitted in the surgery emergency and were evaluated by the Advanced Trauma Life Support (ATLS) protocol. In the primary survey, life-threatening conditions were detected and simultaneously treated. Patients responding to the treatment in primary survey were followed up with secondary survey. All patients received intravenous fluid resuscitation and blood component therapy as required and underwent a supine chest x-ray, pelvic x-ray, and FAST within 90 min of arrival to the hospital. FAST was done by the surgeon trained for this purpose.

Subsequently, FAST positive patients with aforementioned inclusion criteria were identified and grouped together for SNOM. These patients were subjected to detailed abdominal USG as early as possible after being selected for SNOM. This detailed abdominal USG was done by the same radiologist. These patients then underwent DPL by open technique (mid-line infra-umbilical incision) immediately after the detailed USG. DPL was done only after the detailed USG so as to avoid interference with the USG findings. The effluent fluid was examined both grossly and microscopically, and the findings were divided into four categories:

1. Gross hemo-peritoneum: 10 ml or more blood aspirated
2. Grossly enteric: visible enteric content or vegetable matter
3. Positive with no enteric content:
 - a. RBCs > 1,00,000/ml
 - b. WBCs > 500/ml
 - c. Presence of amylase, bile pigment, bile salt, urea, bacteria, or vegetable matter
4. Negative
 - a. RBCs < 1,00,000/ml
 - b. WBCs < 500/ml
 - c. Absence of amylase, bile pigment, bile salt, urea, bacteria, or vegetable matter

Patients with enteric effluent were taken for immediate laparotomy and excluded from the SNOM group. On the other hand, patients with gross or microscopic hemo-peritoneum remained in SNOM group provided they were hemodynamically normal or responders.

Patients being managed by SNOM underwent serial abdominal examination for signs of improvement or deterioration. If they improved, observation continued and patient was discharged from hospital after appropriate period of observation. CECT of the abdomen was done only if they deteriorated or did not improve or the detailed USG findings were equivocal or the patient refused for further evaluation by USG or DPL. Subsequent management of patients undergoing CECT of the abdomen was decided by the CECT findings.

Results

Eighty-four patients with abdominal trauma were admitted from October 2012 to March 2014. Eighteen patients were subjected to emergency laparotomy, and 22 patients did not meet the inclusion criteria for SNOM. Thus, 40 patients were excluded from the study.

The mean age of patients was 27 ± 8.7 years. Forty (89 %) of these were males. Thirty-five (79.54 %) patients sustained BAT (RTI = 16, Fall = 16, others = 3) while 9 (20.45 %) patients sustained PAT due to stab.

Detailed USG was highly suggestive of pancreatic injury in two patients and suspicious of pancreatic injury in one and intra-peritoneal rupture of urinary bladder in two patients. DPL was not performed in two patients where pancreatic injury was highly suggested on detailed USG scan. However, it was done in one patient where pancreatic injury was suspected; the return was subjected to amylase estimation which was within normal limits. However, since the patient was complaining persistent epigastric pain, a laparotomy was performed. Laparotomy confirmed pancreatic injury in all these three patients. Since urinary bladder injury was only suspected (and not confirmed) on

detailed USG scan, we proceeded with DPL and the effluent was subjected to urea estimation which was normal. But in view of clinical suspicion, a cystogram was performed in both these patients which confirmed intra-peritoneal bladder rupture.

From the remaining 39 patients, in two patients, detailed USG scan did not pick any injury and no free fluid was detected; DPL too was negative in these patients. Therefore, it can be said that FAST was false positive in these two patients. All these three patients were successfully managed by SNOM.

In nine patients, detailed USG scan confirmed the presence of fluid (subsequently confirmed by DPL in all) but the injured organ could not be specified by the radiologist. These patients gradually improved on while being managed in the SNOM group and were not subjected to CECT scan.

In 28 patients, specific injuries (Table 1) could be diagnosed on detailed USG scan, and DPL was positive for blood in all but one. The patient with negative DPL had extra-peritoneal rupture of the bladder. All these patients were successfully managed in the SNOM group.

CECT scan of the abdomen was done only in three out of 39 patients who were being managed by SNOM for following reasons: concomitant chest and abdominal trauma ($n = 1$), suspicion of splenic artery aneurysm ($n = 1$), and persistent hematuria despite a normal USG scan ($n = 1$). CECT revealed lung contusion along with liver injury in patient with concomitant chest and abdominal trauma, was helpful in ruling out splenic artery aneurysm, and identified a healing rent in the posterior wall of urinary bladder in the patient who had persistent hematuria despite normal USG scan.

There was no mortality in the SNOM group ($n = 39$) and in patients who underwent laparotomy following detailed USG ($n = 5$). However, two of the three patients who had pancreatic injury developed pancreatic fistulae which healed on prolonged conservative management. One of the two patients who underwent repair of the intra-peritoneal rupture of urinary bladder developed urinary tract infection which responded to medical therapy.

Table 1 Detailed USG findings and results of DPL ($n = 28$)

Patients with BAT ($n = 24$)		
Organ injured	Number (%)	DPL findings ^a
Liver	16 (66.67)	GH = 13; MH = 3
Spleen	10 (41.67)	GH = 9; MH = 1
Kidney	1 (4.67)	MH = 1
Urinary bladder	1 (4.67)	Negative = 1
Patients with PAT ($n = 4$)		
Organ	Number (%)	
Liver	2 (50)	GH = 1; MH = 1
Kidney	1 (25)	MH = 1
Urinary bladder	1 (25)	MH = 1

^a DPL findings: GH gross hemo-peritoneum, MH microscopic hemo-peritoneum

Discussion

Before the later part of last century, abdominal injuries were primarily managed by laparotomy. Over the past two decades, there has been a paradigm shift in this approach. Traumatologists caring for the adult patients began to follow the footsteps of their counterparts from pediatrics after an increasing amount of evidence supported the SNOM of splenic and hepatic injuries [1]. It was subsequently shown that even the presence of hemo-peritoneum and altered mental status does not seem to negate the initial non-operative management in patients with blunt abdominal trauma, irrespective of the grade of injury or age of the patient [2]. Although SNOM initially met with some resistance, it is being practised successfully in patients with abdominal stabs in most centers managing trauma patients [10, 11]. More recently, some trauma centers have reported success with SNOM for abdominal gunshot injuries also [12, 13]. Apart from avoiding unnecessary operative intervention, according to some authors, this selective approach in the management of abdominal trauma has led to a decrease in the perioperative complications of unnecessary laparotomies for trauma, which in earlier studies have ranged from 3.5 to 37 % [21, 22].

Accurate and timely evaluation of abdominal injuries is the cornerstone for successful SNOM. However, clinical evaluation alone of the abdominal injuries is difficult and may not be accurate all the time especially in patients with altered mental status (due to drugs, alcohol, or head trauma) and altered sensations due to concomitant spinal injuries and pain due to associated lower chest or pelvic trauma. This underlies the role of investigations to supplement the clinical findings which is usually done by a CECT scan in a hemodynamically stable patient [23].

However, CECT is an advanced investigation and the facility and expertise may not always be available, especially in rural set-ups and even in metros in poor countries. Furthermore, it adds to the cost of care, the risk of contrast allergy, and contrast-induced nephropathy. In addition, the patient needs to be shifted to the CT chamber where clinician loses active control on the critically injured patients, especially the ones with airway intubation and chest drains.

Abdominal USG, on the other hand, allows the treating surgeon to retain full control on the patient care, is cheap, less time consuming, free of the risk of contrast-induced allergy or renal damage, and is available even in small peripheral hospitals. This study explored the feasibility and safety of SNOM protocol without an essential CECT and routine detailed USG and DPL.

By following this protocol, we could successfully manage almost 82 % of our patients conservatively *with limited use of CECT irrespective of the mode of injury*. Success rate of SNOM with limited use of CECT in patients with BAT was close to 80 %, whereas in patients with PAT, this rate was

90 %. More importantly, detailed USG of the abdomen suggested significant intra-abdominal injuries in five patients, based on which, SNOM was terminated and operative management carried out. This decision to do operative management turned out to be 100 % correct.

DPL was added to the protocol to allow for detection of significant hollow viscus and pancreatic injuries. Addition of DPL did not serve the purpose of detecting bowel injuries as these cases were always clinically apparent. Further, DPL was not helpful in detecting pancreatic injuries and intra-peritoneal rupture of urinary bladder in our series. Therefore, we will not recommend its usage any more.

We did not encounter any missed injuries in our patients who were managed by SNOM and there was no morbidity or mortality in patients managed with SNOM. Injury detection rate on the basis of detailed USG scan was close to 77 %. Earlier reports also suggest that sensitivity of detailed USG in detecting intra-abdominal injuries ranges from 63 to 90 % [24, 25]. In our study, radiologist could not specify any intra-abdominal injury in 23 % patients on detailed USG; however, these patients were reconfirmed to be true FAST positive (as proved on subsequent DPL). Although these patients were successfully managed by SNOM using meticulous physical examination alone *without a CECT scan*, it is felt that this subset of patients may be the one who shall benefit from CECT of the abdomen.

Limitations of study

The main weakness of our study is the small number of patients. Though it gives an insight to the emerging idea of SNOM *without a mandatory CECT*, to extrapolate the results to different parts of the world, with different scenarios and patient profile, a study with larger number of patients is required. Another limitation of our study was that we initially proposed to do a DPL followed by a detailed USG; however, since it appeared that DPL might influence the findings of detailed USG, we had to perform the detailed USG first.

Conclusions

Blunt and penetrating abdominal trauma can be managed by selective non-operative management, for which CECT is not always essential as most injuries can be evaluated by a detailed ultrasound.

Compliance with Ethical Standards

Conflict of Interest The author and all co-authors declare that they have no conflict of interest.

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