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A novel practical scoring for early diagnosis of traumatic bowel injury without obvious solid organ injury in hemodynamically stable patients



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ABSTRACT

Objectives: To develop a scoring tool based on clinical and radiological findings for early diagnosis and intervention in hemodynamically stable patients with traumatic bowel and mesenteric injury (TBMI) without obvious solid organ injury (SOI).

Methods: A retrospective analysis was conducted for all traumatic abdominal injury patients in Qatar from 2008 to 2011. Data included demographics and clinical, radiological and operative findings. Multivariate logistic regression was performed to analyze the predictors for the need of therapeutic laparotomy.

Results: A total of 105 patients met the inclusion criteria with a mean age of 33 ± 15 . Motor Vehicle Crashes (58%) and fall (21%) were the major MOI. Using Receiver operating characteristic curve, Z-score of >9 was the cutoff point (AUC = 0.98) for high probability of the presence of TBMI requiring surgical intervention. Z-Score >9 was found to have sensitivity (96.7%), specificity (97.4%), PPV (93.5%) and NPV (98.7%). Multivariate regression analysis found Z-score (>9) to be an independent predictor for the need of exploratory laparotomy (OR7.0; 95% CI: 2.46–19.78, $p = 0.001$).

Conclusion: This novel tool for early diagnosis of TBMI is found to be simple and helpful in selecting stable patients with free intra-abdominal fluid without SOI for exploratory Laparotomy. However, further prospective studies are warranted.

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1. Introduction

In 1899, Geill reported an 11% incidence of bowel injury among patients sustaining blunt abdominal injury. This number is consistent with the reported rates in other series (5–15%), making the intestine the third most commonly injured organ in blunt abdominal trauma [1]. Despite of this fact, the optimum management of patients who are hemodynamically stable with free intra-abdominal fluid (FIAF) on CT scan and without obvious solid organ injury (SOI) remains unclear.

Furthermore, delay in the diagnosis of bowel injuries is associated with significant morbidities and mortalities [2–5].

In hemodynamically stable patients who had (FIAF) on abdominal CT scan with SOI, a non-operative approach is usually considered. However, the management of patients with detectable FIAF without an obvious SOI is a challenging task for surgeons [4,6,7]. Although, there is contemporary advancement in imaging modalities with multi-detector computed tomography (MDCT), the diagnosis and interpretation of such injuries remains difficult or delayed [8,9]. Despite the fact that many studies found computed tomography (CT) to be highly accurate and specific for diagnosing mesenteric and hollow viscus injury, others studies believe CT to be unreliable [10]. There are subtle findings such as FIAF, focal fluid-filled thick-walled bowel loops, and mesenteric infiltrations which are suggestive of

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intestinal or mesenteric injury; none with the exception of free intraperitoneal air dictates an immediate exploration [7,11]. Different studies concluded that CT alone cannot be used as a screening tool for hollow viscus injury and the decision to operate on hollow viscus injury should be based on injury mechanism and clinical findings in conjunction with radiological evidence [10,12].

Literature review revealed no solid answer to the exact management of hemodynamically stable patients with FIAF on abdominal CT scan without signs of SOI. Though, immediate surgical intervention is necessary for hemodynamically unstable patients with FIAF regardless of the solid organ status. However, the current literature supports the need for a reliable tool which might be useful for surgeons to make an objective decision for the management of hollow viscus injury on timely fashion [3,6,13,14]. We aim to develop a novel scoring criteria for early diagnosis of traumatic bowel and mesenteric injury without obvious SOI in hemodynamically stable patients based on a combination of clinical as well as radiological findings with specific emphasis on high yield signs and symptoms.

2. Methods

A retrospective analysis for all blunt traumatic abdominal injury patients who were admitted to the only tertiary trauma center at Hamad General Hospital (HGH) in Qatar was conducted between January 2008 and January 2011. Data were extracted from HGH trauma registry. This trauma registry has been established late in 2008. Data included demographics, mechanism of injury, hemodynamic stability in terms of vital signs, findings on physical examination (abdominal pain/tenderness and external abdominal marks), and CT findings such as amount of FIAF, and operative findings. Inclusion criteria included all stable patients sustained blunt abdominal trauma that required abdominal CT scan for evaluation in the initial assessment and found to have free intraperitoneal fluid. Exclusion criteria included patients with solid organ injury, free intraperitoneal air, extra-luminal contrast leak, bowel transection by CT scan and/or hemodynamically unstable, penetrating injury and CT findings suspicious for ovarian pathological findings.

2.1. Definitions

The novel scoring system, arbitrary called (Z-Score) was calculated for all patients to determine the cutoff score that was associated with high probability of positive therapeutic laparotomy. The score was graded as shown in Table 1; the minimum and maximum scores were 0 and 14, respectively. The scoring criteria included abdominal pain/tenderness (0–3), external abdominal signs (0–3), abdominal CT scan FIAF (0–4) and CT scan signs of bowel/mesenteric injury (0–4). The diagnostic weight of each category and its grade was based on their clinical implications in the previous studies [8,15–19].

Abdominal pain/tenderness was graded using visual analogue scale (VAS) and numeric rating scale (NRS) for assessment of pain intensity (0: no pain, 1–3 mild pain, 4–6 moderate pain and 7–10 severe pain) and external abdominal marks (contusions, abrasions or lacerations) that were determined by physical examination based on its location (lateral, anterior and antero-lateral). CT scans were performed on Siemens Medical Systems, 64-slice scanners using 120 mL of Omnipaque injected at 3 mL/s. CT Images were analyzed by qualified radiologists.

FIAF-collections were graded according to the presence of fluid in different quadrants (one quadrant, two quadrants, three quadrants and four quadrants). Signs of bowel injury were fat stranding, mesenteric thickening/infiltration, bowel wall thickening/enhancement and mesenteric blush/extravasations.

Table 1
Practical scoring criteria for the early diagnosis of bowel injury.^a

Criteria	Z-score points
<i>A-Clinical</i>	
Abdominal pain/tenderness^b:	
Not present/±not applicable (0)	0
Mild (1–3)	1
Moderate (4–6)	2
Severe (7–10)	3
External abdominal marks	
Not present	0
Lateral	1
Anterior	2
Anterolateral	3
<i>B-Radiological findings by CT scan:</i>	
Free fluid:	
No free fluid	0
One quadrant	1
Two quadrants	2
Three quadrants	3
Four quadrants	4
Signs of bowel injury; if more than one, choose the highest one	
No signs of bowel injury	0
Fat stranding (NOS)	1
Mesenteric thickening/infiltration/hematoma	2
Bowel wall thickening/bowel-wall enhancement	3
Mesenteric blush/extravasation	4
Z-score range 0–14	

^a Patients with solid organ injury, free intraperitoneal air, extra-luminal contrast leak, bowel transection by CT scan and/or hemodynamically unstable are excluded from this criteria.

^b Pain is scored according to visual analogue scale (VAS) and numeric rating scale (NRS) for assessment of pain intensity (0 = No pain, 1–3 = Mild pain nagging, annoying, interfering little with Activities of Daily Living (ADLs), 4–6 = Moderate pain (interferes significantly with ADLs), 7–10 = Severe pain (disabling; unable to perform ADLs), NOS = not otherwise specified).

Fat stranding was defined as an abnormal increased attenuation in fat (in the mesentery, omentum, retroperitoneum, or subcutaneous fat).

Mesenteric fat stranding/infiltration/thickening were referred to haziness and fat stranding in the mesentery which might indicates mesenteric injury with or without bowel wall injury. *Bowel wall thickening* referred to disproportionate thickening compared with normal segments or bowel-wall thickness greater than 3 mm with adequate bowel distention is considered abnormal.

Bowel wall enhancement although is not uniform, referred to enhancement greater than that of the psoas muscle, or enhancement equal to that of adjacent blood vessels.

Mesenteric Extravasation/blush referred to an active contrast medium extravasation from mesenteric vessels associated with contrast enhanced abdominal CT scan.

Laparotomy was defined as therapeutic, if measures were taken to repair or resect the bowel and/or the mesentery, or to control active hemorrhage from the bowel or mesentery.

Patients who underwent a non-operative course of management were admitted for observation and associated injuries were treated according to their usual standards of care.

Successful observation was defined as a patient who did not require exploratory laparotomy or laparoscopy during the hospital admission, or who did not re-present to the hospital after discharge. All decisions to proceed with laparotomy were made according to the discretion of the attending trauma surgeon.

This study was approved by the Medical Research Center (IRB# 10076/10) at Hamad Medical Corporation, Doha, Qatar.

2.2. Statistical analysis

Data were presented as mean ± standard deviation (SD) or total (percentage) as appropriate. Baseline demographic characteristics,

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