e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(8); 1658-1663

Original Research Article

An Exploratory Study of Traumatic Hollow Viscus Injuries

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Received: 18-06-2023 / Revised: 15-07-2023 / Accepted: 15-08-2023

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Conflict of interest: Nil

Abstract:

Background: Trauma is a serious health issue in every country, and it sadly accounts for 60–70% of all emergency hospital admissions. Patients who have suffered trauma require the highest level of treatment since they can often be saved the most. For patients between the ages of 12 and 45, traumatic injuries continue to be the primary cause of death and a significant cause of morbidity. Following blunt abdominal trauma, hollow viscus damage is a rare diagnosis. Injuries to the hollow viscus that occur after abdominal trauma range from 2 to 15% in frequency. Traumatic hollow viscus and mesenteric injury (HVMI) has a high mortality and complication rate despite its rarity. Regarding its ideal management, there is no agreement. Hollow viscus injuries (HVIs) have a significant mortality and morbidity rate, however they are a rare but potentially fatal disorder. There are other ceCT scan criteria that have been published for the diagnosis of HVMI, however none of them have, as of yet, been linked to adequate sensitivity and specificity when assessed separately.

Aim: The aim of this study was to analyze patients undergoing surgery for blunt or penetrating bowel trauma to identify prognostic factors with particular attention to the influence of diagnostic delay on outcome.

Material and Method: In the Department of General Surgery, a prospective, nonrandomized, descriptive study was done. Patients present across a wide variety of ages, with the youngest patient being 16 years old and the oldest patient being 65. written authorization signed by the patient or their trusted caregivers after receiving full disclosure. The study included all patients with brutal and penetrating injuries who underwent a pre-operative ceCT followed by a laparotomy. A 64 detector multirow scanner was used to do the multiphasic torso ceCT scan from the base of the skull to the pubis. The contrast agent was injected at a rate of 3–4 ml/sec at 1.7 ml/kg body weight. Pre-contrast, arterial phase with trigger at 150 HU in the thoracic aorta, and venous phase were the three phases of the protocol that were used. Patients who agreed to participate in the trial with their guardians' permission provided signed informed consent.

Results: The values of ceCT and of a single ceCT criteria for substantial HVMI requiring surgical correction in terms of sensitivity, specificity, predictive values, likelihood ratios, and accuracy. With at least one affirmative criterion, preoperative ceCT demonstrated strong sensitivity and a low incidence of false negative instances. The more diagnostic criteria for HVMI there are, the higher the ceCT's positive predictive value becomes. Patients with HVMI were more likely to be men and had more serious thoracic injuries. The most common condition in cases of multiple intestinal traumas was the combination of colon and mesenteric injuries.

Conclusion: In conclusion, when combined with a specific clinical observation, evolving technologies and skill have rendered ceCT in trauma both a viable exam to choose patients for surgical exploration when several criteria are present and a reliable screening test to exclude serious HVMI. Further prospective studies are necessary to better establish not only the diagnostic capacity of ceCT on HVMI but also the capacity to link imaging results with appropriate treatment indications given the significance of these results on the management of trauma patients.

Keywords: Blunt trauma, Penetrating trauma, CT scan, Hollow viscus and Laparotomy.

Introduction

Trauma is a serious health issue in every country, and it sadly accounts for 60–70% of all emergency hospital admissions. Patients who have suffered trauma require the highest level of treatment since they can often be saved the most. For patients between the ages of 12 and 45, traumatic injuries continue to be the primary cause of death and a significant cause of morbidity.[1] Following blunt abdominal trauma, hollow viscus damage is a rare diagnosis.[2] Approximately 1.2% of blunt trauma

patients and 17% of penetrating trauma patients will get traumatic hollow viscus and mesenteric damage (HVMI).[3,4] Different mechanisms can cause this type of injury; the most frequent is the posterior crush caused by an object (such as a seatbelt or steering wheel); the other two primary mechanisms are rapid deceleration and burst injuries. They can result in full thickness contusions, localized devascularization, mural and mesenteric infarction/hematomas, transection of the colon, and localized lacerations to the intestinal wall and mesentery. Even though HVMI is uncommon, patients with equal injury severity scores (ISS) without HVMI appear to have higher mortality and complication rates.[5,6] Hollow viscus injuries (HVIs) are uncommon and found in ~1% of all blunt abdominal trauma patients.7 Bowel injuries are uncommon, therefore there is little experience with them, and there isn't a lot of agreement in the literature about how to diagnose and treat them.[2] In 80% of cases of penetrating trauma, early abdominal exploration is required, and HVI diagnosis is quick and simple. The risk of delayed diagnosis and treatment of intestinal lesions in blunt trauma has been evidently raised by non-operative management of solid organ injury.[8,9] In addition, intestine and/or mesenteric injuries are more challenging to diagnose clinically and radiologically than injuries to other visceral organs, particularly in patients who have experienced repeated trauma and have head and spinal cord injuries or reduced consciousness.[10]

Increased rates of hollow viscus injury are the result of a decrease in penetrating abdominal trauma and an increase in blunt abdominal trauma. As a result, the most crucial aspect of management is still early diagnosis and therapy.[11] For both surgeons and anesthesiologists, managing forceful abdominal trauma that results in hollow viscus injury is a significant problem.[12] Early surgical intervention is crucial in cases with hollow viscus injury, in contrast to non-operative therapy of maximum solid visceral injury. Morbidity and death rise when a diagnosis and subsequent course of treatment are delayed.[13,14]

Moreover, due to a sensitivity of 80-96% and a specificity of 48-84%, the use of contrast-enhanced CT scans (ceCT) in stable patients is linked to a high prevalence of missed HVMI. It has been demonstrated that delays in treatment of more than 24 hours increase mortality, complications, and hospital stay.[6,15] On the other side, 30–40% of laparotomies that are not therapeutic are false positives due to the limited specificity of ceCT findings.[16,17] There are other ceCT scan criteria that have been published for the diagnosis of HVMI, however none of them have, as of yet, been linked to adequate sensitivity and specificity when assessed separately.[18,19] Patients with undiagnosed blunt HVI, who could have otherwise received a laparotomy diagnosis, could consequently develop sepsis, multiple organ failure, and death. Despite this, a number of surgeons do not believe that the prognosis for trauma patients in both adult and pediatric populations is significantly impacted by a delay in the identification and operative treatment of HVI.[10,20]

Material and Methods

In the Department of General Surgery, a prospective, nonrandomized, descriptive study was done. Patients present across a wide variety of ages, with the youngest patient being 16 years old and the oldest patient being 65. written authorization signed by the patient or their trusted caregivers after receiving full disclosure. The study included all patients with brutal and penetrating injuries who underwent a pre-operative ceCT followed by a laparotomy. A 64 detector multirow scanner was used to do the multiphasic torso ceCT scan from the base of the skull to the pubis. The contrast agent was injected at a rate of 3–4 ml/sec at 1.7 ml/kg body weight. Pre-contrast, arterial phase with trigger at 150 HU in the thoracic aorta, and venous phase were the three phases of the protocol that were used. Patients who agreed to participate in the trial with their guardians' permission provided signed informed consent.

- Total number of trauma patients admitted to surgical triage ward during the study period – 300.
- Patients suspected of having abdominal injury – 150.
- Patients who were completely evaluated and found to have abdominal injury – 50.
- Patients with solid organ injury alone – 25.
- Patients with hollow viscus injuries – 25.

Inclusion Criteria

- All trauma patients with abdomen injury greater than 13 yrs. of age.
- Both Blunt and Penetrating injuries to abdomen included.

Exclusion Criteria

- Patients with isolated solid organ injuries.
- Paediatrics age group patients

Patients were separated into groups with major HVMI necessitating surgery (full thickness perforation, hemorrhage, ischemic injury, etc.) and those without HVMI or with HVMI not necessitating surgery. There was a correlation between intraoperative results and pre-operative ceCT. genuine positive patients were those with positive ceCT for HVMI with a laparotomy finding of HVMI requiring surgical correction; genuine negative patients were those with negative ceCT for HVMI

and no intraoperative discovery of HVMI or with HVMI not requiring surgical correction. Patients who proceeded immediately to the OR without preoperative ceCT due to hemodynamic instability were included in the study to examine the influence of time-to-therapy on the outcome of patients with HVMI. The examination of ceCT accuracy did not include these individuals. From the registry, the following information was obtained: age, gender, type of trauma (blunt vs. penetrating), systolic blood pressure (SBP), Glasgow Coma Scale (GCS), AIS 98 score for each anatomic district (head, chest, abdomen, and extremities), ISS, TRISS calculated death probability, and observed mortality.

Postoperative information included follow-up and clinical events. From the database, information on mortality, morbidity, and length of hospital stay (LOS) was also extracted. Any death resulting from trauma within the first 30 days or throughout the whole hospital stay was defined as mortality. Our study's main goal was to identify reliable indicators of morbidity/mortality and LOS. The association between diagnostic delays and morbidity, mortality, and LOS in HVI were secondary objectives, as were the evaluation of a validated diagnostic delay cut-off time capable of predicting the mortality/morbidity rates.

Statistical Analysis

MedCalc for Windows, version 10.2.0.0, was used to conduct statistical analyses. Means and standard deviations (SD) were used to evaluate quantitative variables, whereas frequencies and percentages were used to analyze categorical variables. For continuous variables, the Student's t-test and analysis of variance (ANOVA) test were used to determine distributional differences. For categorical variables, the chi-square test or Fisher's exact test was used, depending on how many instances were in each subgroup.

Result

The jejunum was the most often affected bowel tract (65% of cases), followed by the mesenteric and colonic localisation, in 25 patients. The connection of intestinal and mesenteric injuries was the most common circumstance when numerous gut traumas were identified.

Table 1: Comparison between HVMI positive and negative groups

Variables	HVMI+ (N=25)		HVMI – (N=50)	
	Value	%	Value	%
Gender (male)	20	91.7	35	72.7
Age(median/IQR)	43	31.75–52	37	23.5–57.5
Trauma(blunt)	16	75%	19	74.2
GCS (median/IQR)	12	14–15	12	14–15
SBP on admission (median/IQR)	100	103.75–140	95	91.25–133
ISS (median/IQR)	18.5	14–37.25	15	13.75–41
Head AIS ≥ 3	4	12.5	10	22.7
Chest AIS ≥ 3	17	43.8	13	65.2
Abdominal AIS ≥ 3	17	77.1	16	69.7

Of the remaining 100 patients, 40 had a positive ceCT for HVMI and were used as genuine positives. Of the remaining 25, HVMI requiring surgical repair was verified after laparotomy. Due to a negative ceCT scan and a minor bowel perforation at laparotomy, one patient was a false-negative case. The other 50 patients included 21 who received surgical exploration for other causes and had no intraoperative evidence of HVMI, 19 who had HVMI not requiring surgical correction at laparotomy, 10 who underwent non-therapeutic laparotomies, and 19 who underwent laparotomies. Twelve of them were regarded as true negatives since their ceCT results were negative, whereas thirteen were false positives because their ceCT results were positive. Table 1 displays a descriptive analysis of the study population. Patients with HVMI were more likely to be men and had more serious thoracic injuries.

Table 2: Values of contrast-enhanced CT (considered positive in presence of at least one criterion) and of the single ceCT criteria for HVMI requiring surgical correction (perforation, bleeding injury, ischemic injury)

	Sn	NPV	−LR(CI95%)	Sp.	PPV	+LR(CI95%)	Accuracy
ceCT	95.7%	95.5%	0.03 (0.004-0.22)	61.6%	65.2%	2.69 (1.95–3.71)	74%
Free intraperitoneal air	33.4%	64.3%	0.69 (0.56–0.87)	90.4%	75.2%	4.25 (1.85–11,8)	64.6%
Free fluid without solid organ injury	73%	80.2%	0.29 (0.17–0.48)	82.5%	76.1%	4.95 (2.7–8.9)	77.5%
Intramesenteric fluid	43.4%	64.1%	0.58 (0.44–0.76)	89.4%	78.4%	6.05 (2.4–14.8)	70.9%
Blushing	40.7%	67.3%	0.6 (0.46–0.78)	90.4%	77.7%	5.7 (2.3–14.2)	71.8%
GI wall alteration	36.5%	63.9%	0.71 (0.56–0.9)	85.8%	64.2%	3 (1.4–6.5)	65.6%
Mesenteric alteration	70.9%	74.5%	0.33 (0.2–0.5)	79.6%	72.2%	3.63 (2.3–6.8)	73.2%

Table 2 lists the values of ceCT's sensitivity, specificity, predictive values, probability ratios, and accuracy for substantial HVMI requiring surgical correction (considered positive in the presence of at least one criterion). With at least one affirmative criterion, preoperative ceCT demonstrated strong sensitivity and a low incidence of false negative instances. The more diagnostic criteria for HVMI there are, the higher the ceCT's positive predictive value becomes.

Discussion

This study shows that a ceCT without any indication of HVMI has a sensitivity of about 97% for ruling out the existence of this damage. In 97% of patients where the ceCT reveals the existence of four or more diagnostic indications, an HVMI necessitating surgical repair exists. Only 0.3% of patients with blunt trauma will have a perforated small intestinal injury, and less than 1% of patients with blunt trauma will have an HVI. [15,21]

The absence of established consensus or clear international recommendations for the best diagnostic method is linked to the decreased expertise of trauma surgeons.[22] In the emergency scenario, diagnostic peritoneal lavage has gradually lost clinical utility, and abdominal CT scan frequently still cannot detect covert indicators of traumatic bowel rupture.[23] With the advent and widespread use of dual-phase multidetector computer tomography with multiplanar reconstruction, bowel and mesenteric injuries can now be diagnosed more accurately, but this radiologic diagnosis is still difficult due to radiologists' limited exposure to these uncommon lesions and the concurrent presence of injuries to other abdominal organs.[24,25]

In cases where clinical and imaging results are ambiguous, laparoscopy may be useful as an additional diagnostic technique. It must be stressed that increased intracranial pressure and hemodynamic instability are contraindications to laparoscopy.[26] The use of intubation and sedation is advised in a few specific situations, such as those involving patients with isolated free fluid without solid organ injuries and doubtful clinical examination, anterior abdominal stab wounds for peritoneal violation cases requiring urgent-emergent interventions other than laparotomies, or patients with anesthesiologic indications for intubation and sedation. A skilled team is always advised because the diagnostic laparoscopy's typical sensitivity and specificity are subpar.[27, 28] Even if therapeutic laparoscopy has been reported to be used, HVMI findings and any lingering question should justify conversion to laparotomy.[28]

Accordingly, Faria et al 2012 [29] observed, in their series of 102 patients with both blunt and penetrating bowel injuries, that all postoperative deaths occurred in patients operated on after the first 24 hours. Letton and Worrell201020, in a multicenter study analyzing 358 pediatric patients, demonstrated that any significant statistical difference in terms of morbidity and mortality was found when patients were divided into four groups depending on treatment delay (0–6 hours, 6–12 hours, 12–24 hours, and .24 hours). Some studies, however, demonstrated that delay of treatment significantly affects postoperative mortality as well; Fakhry et al 2003 [15], enrolling 198 patients from the registries of eight US trauma centers, demonstrated that mortality rates increased from 2% for patients treated within the first 8 hours from ER admission, to 9.1%, 16.7%, and 30.8% for patients treated after 8–16, 16–24, and 24 hours, respectively. McNutt et al 2015 [30] recently introduced a new effective

predictive score for blunt bowel and mesenteric injury.

More research is required to establish best practices for clinically observing these patients, how to respond to changes in the clinical picture, and the validity of further studies, while also taking into account the possibility that late intestinal necrosis or perforation may manifest days or even weeks after the original shock.31 Numerous research put out scores and algorithms to help us better distinguish between individuals who need non-operative treatment and those who have substantial HVMI.[32–33] The moderate-to-small number of patients with substantial HVMI and the retrospective form of data gathering are the study's main limitations. Another drawback is that individuals in our control group had HVMI that wasn't surgically correctable and other surgical reasons. We also neglected to account for the quantity and quality of free fluid in the absence of solid organ injury, where the ratio of blood to low density fluids like bile in terms of Hounsfield Units has been shown to be a reliable indicator of intestinal injury.[34,35] Additionally, the current trial was unable to produce notable outcomes for patients at low risk. In their eyes, rather than reported results, our management proposal is more based on the data found in the literature.

Conclusion

In conclusion, when combined with a specific clinical observation, evolving technologies and skill have rendered ceCT in trauma both a viable exam to choose patients for surgical exploration when several criteria are present and a reliable screening test to exclude serious HVMI. Further prospective studies are necessary to better establish not only the diagnostic capacity of ceCT on HVMI but also the capacity to link imaging results with appropriate treatment indications given the significance of these results on the management of trauma patients. There should be more efforts made to increase the preoperative detection rate of HVIs; new and efficient predictive radiological tools in conjunction with physical and hematological parameters (BIPS) appear to increase the diagnostic sensitivity and shorten the treatment delay to less than 6–12 hours after ER admission. We draw the conclusion that trauma patients with these relatively uncommon injuries can absolutely be saved with early diagnosis, prompt reference, early surgical intervention, and intense postoperative care. A quick referral to a tertiary trauma care center and adequate knowledge of the symptoms of suspected intra-abdominal injuries can make a significant difference in these patients' prognoses.

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