Epidemiological Features and Intra-operative Pattern of Gastrointestinal Tract Injury: a Single Center, Descriptive Study.

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Abstract

Background: Delayed diagnosis of gastrointestinal tract injury (GITI) could lead to terrify results and increase morbidity and mortality. Therefore, surgeons should be well-trained regarding the pattern and features of GITIs. In the recent study, we aimed to describe the epidemiological features and intra-operative characteristics of all patients sustaining GITIs.

Methods: A 2-year retrospective, cross-sectional study was conducted in the only referral trauma center in the south of Iran, from June 2018 to September 2020. A well-formed search was conducted within the database of our center to find patients with GITIs. Demographic data, on-arrival vital signs, and the outcomes were extracted from the patients' medical records and our center's database. In addition, intraoperative features of injuries were extracted from the operation note.

Result: Totally, 247 patients were detected 142 (57.5%) had blunt abdominal trauma. The most common mechanism of injury was motor vehicle accidents (116 patients, 46.9%), followed by stabbing (21.9%) among all populations. Of note, patients following blunt injuries were significantly older [38.22 (16.62)] than those with penetrating insults, had longer hospital length of stay (both P-values <0.001), and had significantly higher mortality rate (P-value= 0.001).

The most frequent isolated injury following a blunt trauma was small bowel (S.B) (66.9%), colon (21.0%), and duodenum (7%), respectively. However, in penetrating injury, S.B (26.7%), colon (21.9%), and stomach (13.3%) were the three most frequent injured sites. Liver injury was the most common associated injury following blunt (58.1%) and penetrating (48.1%) trauma

Conclusion: Our study has shown that GITIs are not as uncommon as previously thought. Therefore, all physicians should always search for and consider GITIs in patients sustaining abdominal trauma to avoid patients' morbidity and mortality.

Background:

Trauma is one of the most important leading causes of death in developing countries (1–3). The trauma-related mortality rate was "roughly equal to the number of deaths from HIV/AIDS, malaria, and tuberculosis combined," said Gosselin et al. (4). Therefore, determining the exact clinical and epidemiological patterns of the trauma victims is the first step in better patient management. Although infrequent, especially following blunt trauma, gastrointestinal tract injuries (GITI) could increase the morbidity and mortality rates if not treated promptly (5). However, the exact complications of delayed management still remain unclear (6, 7).

GITI is not suspected and evaluated routinely by the trauma surgeon especially following blunt trauma, unless the clinical conditions suggest otherwise. Thus, the missed care could result in a further increase in morbidity and mortality. On the other hand, the pattern and the mechanisms of injuries differed between countries and region; while in most parts of the world, blunt trauma after a motor vehicle accident account as the most common cause of death, in the United States and South Africa, penetrating injuries following stab and gunshot injuries predominate, respectively (8).

Moreover, no consensus study is available reporting patients' characteristics with GITI in the south of Iran. So, this study aims to describe the frequency and characteristics of intra-abdominal gastrointestinal tract injuries of patients admitted to Rajaee hospital, a level one trauma center in the south of Iran.

Methods:

Study population

This retrospective, cross-sectional study was conducted to describe the epidemiological features and patterns of GIT injuries among all patients presenting to Rajaee Trauma hospital, the only referral trauma center in the south of Iran, from June 2018 to September 2020. This study was approved by the institutional review board and medical ethics committee of Shiraz University of Medical Sciences (SUMS) with the ethics number of IR.SUMS.REC.1400.024.

Included in the study were all patients with proven/suspected injuries to the gastrointestinal tract from the cardio-esophageal junction down to the anus diagnosed clinically or radiologically. The exclusion criteria were dead on arrival and trauma to different parts of the body other than the intra-abdominal GIT. Patients with solid organ injuries without GITI were also excluded.

Study protocol:

A well-formed search was conducted within the database of our center to find patients with GITIs. To avoid any missing, we also looked for the following keywords, separately: "Stomach/ gastric injury", "Duodenum/ D1-D4", "Jejunum", "Ileum", "Cecum", " Colon", "Sigmoid", "Rectum", "Anus/ Anorectal injury", "Mesentery", " Internal/ External Sphincter". Demographic data such as age, sex, the mechanisms of injury, the anatomical site injury, other associated injuries, the length of hospital stay (HLOS), and the outcomes were extracted from the patients' medical records and our center's database. Vital signs, including arrival systolic and diastolic blood pressure (SBP and DBP, respectively), arrival pulse rate (PR), respiratory rate (RR), the abbreviated injury scale (AIS), and the injury severity scores (ISS), were also extracted. These data were gathered anonymously, and no informed consent was needed due to the survey's retrospective nature.

Definitions:

The ISS were calculated by summing the square of the highest AIS of the most severely injured body regions (9, 10). The calculated ISS were then classified as Minor (ISS = 1–8), Moderate (ISS = 9–15), Severe (ISS = 16–24) and Serious (ISS > = 25) (11, 12). Modified Shock Index (MSI) was calculated to assess the patients' hemodynamic stability (13). The anatomical territories were stratified based on the following: stomach, all four parts of the duodenum, small bowel

(from the jejunum down to the ileocecal valve), ascending colon (from the cecum till the beginning of the hepatic flexure), transverse colon (from hepatic flexure till the end of the splenic flexure), descending colon, sigmoid and the anorectal area. We've classified the injuries into three categories: seromuscular tear or wall hematoma (SMT/WH), perforation, and mesenteric injuries (MIs). Since the external (Ext.) anal sphincter is of paramount importance, we've exclusively divided the anorectal injuries into those with or without Ext. anal sphincter involvement.

If a patient had SMT/WH and perforation, we would document the perforation (the more severe injury). Patients sustaining combined injuries were defined as those with injuries in more than anatomical territories (regardless of the type or the number).

Statistical Analysis

In the recent descriptive study, all gathered data were evaluated using the Statistical Package for Social Sciences software (SPSS. Inc., Chicago, Ill., USA) version 20. Mean with standard deviation (SD) were used to describe quantitative variables, and frequencies with percentages were calculated to describe the qualitative ones. An independent T-test and the Chi-square tests were conducted to compare quantitative and qualitative variables between two groups.

Result:

Out of a total of eighty-nine thousand and ninety-nine trauma admissions, two hundred-forty-seven patients with GITIs abdominal injuries were identified. Therefore, the incidence of GITIs among patients admitted to our center across the total population of Farse province (about 4.8 million) was 2.2 cases per 100,000 people per year. Moreover, eight hundred and eighty-nine death has occurred, fifty of which had GITIs.

The mean age (SD) of the overall included patients were 34.95 (14.80), ranged from 13–75 years old. The majority of involved cases were male (89.1% vs. 10.9%), with a male to female ratio of 8.14. On average, patients were hospitalized for 15.13 days (SD = 16.83). Fifty patients (20.2%) were expired in the hospital course, and the others (79.8%) were fully or partially recovered. Most dismissed cases were expired 72 hours after hospital admission (28 cases, 56.0%). Detailed demographic features of patients were summarized in Table 1. The most common mechanism of injury was motor vehicle accidents (116 patients, 46.9%), followed by stabbing (21.9%) among all included patients. The exact distribution of GITIs by the mechanisms of injury was outlined in Table 2.

Table 1
Demographic features and clinical characteristics by the mechanism of injury, (n = 247)

		Mechanism of injury		
	Overall (n = 247)	**Blunt (n = 142)**	**Penetrating (n = 105)**	**P-value**
Age (y/o); mean (SD)	34.95 (14.80)	38.22 (16.62)	30.53 (10.46)	**< 0.001**
HLOS (days); mean (SD)	15.13 (16.83)	18.61 (19.24)	10.41 (11.37)	**< 0.001**
ISS				
Minor, n (%)	43 (17.4)	13 (9.2)	30 (28.6)	**< 0.001**
Moderate, n (%)	88 (35.6)	51 (35.9)	37 (35.2)	
Severe, n (%)	57 (23.1)	37 (26.1)	20 (19.0)	
Serious, n (%)	59 (23.9)	41 (28.9)	18 (17.1)	
MSI*				
≤ 1.3, n (%)	163 (68.5)	82 (60.3)	81 (79.4)	**0.002**
> 1.3, n (%)	75 (31.5)	54 (39.7)	21 (20.6)	
Outcome				
dead, n (%)	50 (20.2)	43 (30.3)	7 (6.7)	**0.001**
alive, n (%)	197 (79.8)	99 (69.7)	98 (93.3)	
Death				
< 24 hr.	16 (32.0)	15 (93.75)	1 (6.25)	0.141
24–72 hr.	6 (12.0)	6 (100.0)	-	
> 72 hr.	28 (56.0)	22 (78.6)	6 (21.4)	
Gender				
Female, n (%)	27(10.9)	16 (11.3)	11 (10.5)	0.864
Male, n (%)	220 (89.1)	126 (88.7)	94 (89.5)	
Associated injury, n (%)	133 (53.8)	94 (70.7)	39 (29.3)	**0.05**
Arrival SBP (mmHg); mean (SD)*	114.97 (29.96)	111.95 (24.35)	118.98 (20.38)	**0.019**
Arrival DBP (mmHg); mean (SD)	73.55 (16.10)	72.63 (15.9.4)	74.76 (16.31)	0.313
Arrival P.R. (beat/min); mean (SD)	99.60 (23.77)	105.14 (24.76)	92.11 (20.17)	**< 0.001**
Arrival R.R. (beat/min); mean (SD)	18.23 (3.29)	18.53 (3.56)	17.91 (2.96)	0.172

y/o, years-old; SD, Standard Deviation; ISS, Injury Severity Scale; MSI, Modified Shock Index; mmHg, millimeter of Mercury; hr., hours; SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; P.R., Pulse Rate; RR, Respiratory Rate.

*The Systolic Blood Pressure in nine patients was missed, and we could not calculate the MSI for these patients.

Table 2
The detailed pattern of Gastrointestinal Tract injuries by the mechanism of injury.

		Mechanism of injury						
		Penetrating				Blunt		
		Stabbing (n = 54)	G.S (n = 21)	S.G (n = 4)	Others (n = 26)	MVA (n = 116)	F.D (n = 17)	AB (n = 9)
Isolated Stomach [n = 19(%)]	SMT/ WH	5(26.3)	-	-	1(5.3%)	4(21.1)	-	-
	Perforation	5(26.3)	1(5.3%)	1(5.3%)	1(5.3%)	-	1(5.3%)	-
Isolated Duodenum [n = 12(%)]	SMT/ WH	1(8.3)	-	-	-	2(16.7)	-	-
	Perforation	-	1(8.3)	-	-	7(58.3)	1(8.3)	-
Isolated S.B. [n = 95(%)]	MI	3(3.2)	-	-	-	21(22.1)	4(4.2)	1(1.1)
	SMT/ WH	5(5.3)	1(1.1)	-	-	14(14.7)	1(1.1)	-
	Perforation	18(18.9)	1(1.1)	-	-	18(18.9)	4(4.2)	4(4.2)
Isolated Asc.Colon [n = 16(%)]	MI	-	-	-	-	3(18.8)	-	1(6.3)
	SMT/ WH	1(6.3)	1(6.3)	-	1(6.3)	2(12.5)	1(6.3)	1(6.3)
	Perforation	2(12.5)	1(6.3)	-	-	2(12.5)	-	-
Isolated T. Colon [n = 20(%)]	MI	1(5.0)	-	-	2(10.0)	4(20.0)	-	-
	SMT/ WH	-	1(5.0)	-	-	4(20.0)	2(10.0)	1(5.0)
	Perforation	2(10.0)	2(10.0)	1(5.0)	-	-	-	-
Isolated Desc.Colon [n = 7(%)]	MI	-	-	-	-	1(14.3)	-	-
	SMT/ WH	4(57.1)	-	-	-	1(14.3)	1(14.3)	-
	Perforation	-	-	-	-	-	-	-
Isolated Sigmoid [n = 10(%)]	MI	-	-	-	-	1(10.0)	1(10.0)	-
	SMT/ WH	-	2(20.0)	-	-	3(30.0)	-	-
	Perforation	1(10.0)	-	1(10.0)	-	1(10.0)	-	-
Isolated Anorectal [n = 26(%)]	With Sphincter	-	-	-	10(38.5)	2(7.6)	-	-
	Without Sphincter	-	-	-	10(38.5)	4(15.4)	-	-
Combined injuries [n = 42(%)]		6(14.3)	10(23.8)	1(2.4)	1(2.4)	22(52.3)	1(2.4)	1(2.4)

GS, Gunshot; SG, Shotgun; MVA, Motor Vehicle Accident; FD, Falling Down; AB, Assault Blunt; SMT/WH, Seromuscular Tear or Wall Hematoma; MI, Mesenteric Injury; SB, Small Bowel; Asc. Colon, Ascending Colon; T. Colon; Transverse Colon; Desc.Colon; Descending Colon.

We've reported the results in four distinct parts regarding the overall mechanism of injury isolated/combined injuries; at first, the data of blunt trauma were assessed, and then we were describing patients with penetrating injuries. The third section introduced the pattern and characteristics of combined injuries, and the last part described the anorectal injuries.

Isolated Blunt trauma

Totally, one hundred forty-two patients (57.5%) were transferred to the operating room (OR) following blunt trauma. Similar to the overall population, most of them were male (126 patients, 88.7%) and had moderate-ranged (between 9–15) ISS (51 patients, 35.9%). The detailed clinical characteristics and demographic features by the mechanism of injury were outlined in Table 1. Of note, patients following blunt injuries were significantly older [38.22 (16.62)] than those with penetrating insults, and also the HLOS was significantly longer in blunt trauma than the other group (both had P-value < 0.001). Fifty-four (39.7%) individuals had MSI > 1.3, and therefore they were in shock on hospital arrival, which was significantly more frequent than the penetrating group (P-value = 0.002). Moreover, the mortality rate was higher in patients who have sustained blunt abdominal trauma (43 cases, 86.0% of dismissed patients) than those following penetrating injuries (P-value = 0.001).

Table 2 summarized the detailed anatomical pattern of gastrointestinal tract injuries among patients who suffered by the mechanism of injury. Sixty-seven (47.2%) had isolated small bowel injuries; twenty-six of them (38.8%) had small bowel perforation as the most frequent injury. Unlike the small bowel, perforation was infrequent in all parts of the colon. Among patients with isolated ascending colon and sigmoid injure, only two (12.5%) and one (10.0%) had perforation, respectively, while no perforating injury to the transverse colon and descending colon were detected. The most frequent injuries following a MVAs

were combined injuries (22 cases, 52.4%), isolated small bowel mesenteric injuries (21 patients, 16.7%), and isolated small bowel perforation (18 cases, 18.9%), respectively.

One hundred and thirty-three individuals (53.8% of all included patients) had at least one associated intraabdominal injury, seventy-four of which (55.6%) had associated insults following blunt trauma (Table 1). The most frequent associated injuries were as follows in a descending order frequency: forty-three cases (58.1%) had a liver injury, thirty-eight (51.4%) had associated pelvic fractures, and spleen lacerations/ruptures occurred in thirty-seven individuals (50.0%). The sum of each associated injury has exceeded the overall frequency because some patients had more than one associated abdominopelvic organ involvement. Table 3 has stratified the associated injuries by the anatomical location of GITIs. For a decent description, we have separated the isolated injuries and the combined ones. The latter was discussed in its relevant part.

Table 3
The pattern of Gastrointestinal Tract injury by abdominopelvic associated injuries.

	Spleen		Liver		Diaphragm		Pancreas		UT		Pelvic	
	Blunt (n = 37)	Penetrating (n = 12)	Blunt (n = 43)	Penetrating (n = 13)	Blunt (n = 6)	Penetrating (n = 13)	Blunt (n = 16)	Penetrating (n = 2)	Blunt (n = 19)	Penetrating (n = 13)	Blunt (n = 37)	Penetrating (n = 4)
Isolated Stomach [n = 19(%)]	4 (21.1)	1 (5.3)	4 (21.1)	3 (15.8)	2 (10.5)	2 (10.5)	2 (10.5)	1 (5.3)	2 (10.5)	1 (5.3)	-	-
Isolated Duodenum [(n = 12(%)]	-	-	2 (16.7)	1 (8.3)	-	-	-	-	1 (8.3)	1 (8.3)	-	-
Isolated SB [(n = 95(%)]	17 (17.9)	1 (1.1)	15 (15.8)	1 (1.1)	-	2 (2.1)	3 (3.2)	-	6 (6.3)	-	16 (16.8)	-
Isolated Asc.Colon [(n = 16(%)]	2 (12.5)	-	3 (18.8)	1 (6.3)	-	1 (6.3)	-	-	1 (6.3)	1 (6.3)	2 (12.5)	-
Isolated T.Colon [(n = 20(%)]	5 (25.0)	4 (20.0)	5 (25.0)	2 (10.0)	-	5 (25.0)	2 (10.0)	1 (5.0)	1 (5.0)	-	3 (15.0)	1 (5.0)
Isolated Desc.Colon [(n = 7(%)]	1 (14.3)	2 (28.6)	1 (14.3)	-	-	-	-	-	-	2 (28.6)	2 (28.6)	2 (28.6)
Isolated Sigmoid [(n = 10(%)]	1 (10.0)	2 (20.0)	1 (10.0)	-	1 (10.0)	-	1 (10.0)	-	1 (10.0)	1 (10.0)	2 (20.0)	-
Isolated Anorectal [(n = 26(%)]	2 (7.7)	-	1 (3.8)	-	1 (3.8)	-	-	-	2 (7.7)	-	6 (23.1)	1 (3.8)
Combined injuries [(n = 42(%)]	5 (11.9)	2 (4.8)	11 (26.2)	5 (11.9)	2 (4.8)	3 (7.1)	8 (19.0)	-	5 (11.9)	7 (16.7)	6 (14.3)	-

UT, Urinary Tract; RPH, Retroperitoneal Hematoma; SB, Small Bowel; Asc. Colon, Ascending Colon; T. Colon; Transverse Colon; Desc.Colon; Descending Colon.

Isolated penetrating trauma

One hundred five patients (42.5%) were admitted to our center following a penetrating injury between 2018–2020, with a mean age (SD) of 30.53 (10.46) years old ranged 14–70 years of age. Most of them were male (94 patients, 89.5%) and, similar to that of the blunt group, had moderate-ranged ISS (37 cases, 35.2%). The detailed demographic features were demarcated in Table 1.

Among penetrating trauma, twenty-eight patients (26.7%) had small bowel injury, nineteen (67.8%) of which had perforation, six had SMT/WH (21.4%), and the other three had MI (10.8%). Moreover, stomach and T. Colon injuries were the second and third most frequent penetrating GITIs in fourteen (13.3%) and nine (8.6%) patients excluding the anorecta injuries. The exact pattern of penetrating GITIs was shown in Table 2.

The most frequent mechanisms of injuries were stabbing (55 cases, 52.4%), other sharp injuries (26 cases, 24.8%), and gunshot injuries (21 cases, 20.0%), while the injuries resulting from a shotgun were the least common and occurred in four patients (3.8%). Other injuries were falling on sharp objects,

occupational injuries, and undetermined penetrating trauma. Table 2 summarized the pattern of GITIs by the mechanism of injury. Stabbing resulted in isolated small bowel perforation among eighteen patients (18.9% of all isolated small bowel injuries). Of note, no isolated ascending colon, descending colon, and sigmoid MIs were seen in patients sustaining penetrating trauma.

Twenty-seven out of one hundred and thirty-three individuals (20.3%) had at least one associated injury resulting from penetrating trauma (Table 1). Each of the liver laceration/hematoma, diaphragm perforation, and urinary tract injuries (kidney laceration/hematoma, ureter rupture, and bladder injuries) occurred in thirteen patients (48.1%). They accounted as the most common injuries associated with penetrating isolated GITIs, as demonstrated in Table 3. Of note, overall associated injuries occurred more frequently in blunt trauma than those following a penetrating insult, which was statistically significant (P-value = 0.05). However, unlike the overall statistic, diaphragm rupture was more frequent in patients with penetrating trauma (48.1%) than those following blunt trauma (6 cases, 8.1%).

Combined injuries

Totally, forty-two cases (17.0%) had combined GITIs, most of which occurred after blunt trauma (24 cases, 57.1%). Similar to the overall population, the most common mechanism of injury was MVAs (22 cases, 52.4%). Interestingly, the gunshot was responsible for penetrating injuries in ten other individuals (23.8%) and was the second most frequent associated injuries. The most frequent combined injuries were small bowel and ascending colon injury (9 patients, 21.4 %), followed by small bowel-T. Colon and duodenum-T. Colon injuries; each occurred in six patients (14.3%). Figure 1 has demonstrated the detailed patterns of combined GITI.

Thirty-two patients had at least one associated injury, nineteen (59.4%) and thirteen (40.6%) of them had blunt and penetrating trauma, respectively. Eleven patients (26.2%) associated with blunt liver injury and blunt pancreas injury were detected in eight patients (19.0%). Of note, no pancreas injury and pelvic fracture were seen in association with combined injuries following penetrating and blunt insults, respectively (Table 3).

Trauma to the anorectal area

Twenty-six operated anorectal injuries were detected, twelve of which were accompanied by internal and/or external anal sphincter involvement (46.2%). Most anorectal injuries (20 injuries, 76.9%) took place following penetrating trauma (Table 4). Two patients in whom the external sphincters were also involved had anal lacerations less than five centimeters away from the anal wedge, and another one (3.9%) patient with injury > 25 Cm^2 was detected. Finally, a colostomy was placed for eleven patients (42.3%).

Table 4
Clinical characteristics of patients with isolated anorectal injuries (n = 26)

characteristics	Number (%)
Site of Injury	
Rectum	9 (34.6)
Anus	20 (76.9)
Both	3 (11.5)
Distance from Anal Wedge	
< 5cm	2 (7.7)
> 5cm	24 (92.3)
Extend of Injury	
< 25cm^2	25 (96.2)
> 25cm^2	1 (3.8)
Internal / External Sphincter*	12 (46.2)
MSI > 1.3**	5 (19.2)
Intra-abdominal Injury	7 (26.9)
Mechanism of Injury	
MVA	6 (23.1)
Other sharp objects	20 (76.9)
Pelvic Fractures	7 (26.9)
Colostomy Insertion	11 (42.3)

MSI, Modified Shock Index; MVA, Motor Vehicle Accident

*Two patients had concomitant internal and External Sphincter injuries

**In the other two patients, the vital signs could not be detected.

Discussion:

Considering the time frame and single-center nature of our study, we believed that this is one of the biggest surveys trying to describe the epidemiological characteristics and anatomical pattern of GITIs after the Eastern Association for the Surgery of Trauma (EAST) study published in 2003 (14). Therefore, we thought that our study provided detailed and more updated information regarding the exact pattern of GITIs.

Trauma is a leading preventable cause of death and disability worldwide, especially in developing countries (7, 15). The time interval between the patient's arrival and management is of paramount importance and could predict his/her outcome (16). Management of patients sustaining penetrating insults is more straightforward than those with blunt trauma. GITIs were thought to be infrequent following blunt trauma, mainly when associated with other intra-abdominal solid organ injuries, complicating the management and even patients' outcomes (17).

Consistent with our survey, previously conducted studies have shown that the small bowel is the most frequently injured site following blunt trauma (18, 19). GITIs could occur via two distinct mechanisms or, more commonly, a combination of both in the setting of blunt trauma. The first is the compressive forces against a solid, fixed organ such as the lumbar vertebra, and the second is shearing, linear forces after deceleration injuries. These mechanisms explained the higher prevalence of injuries in centrally-located small bowel than in the large colon, which lacked redundancy, avoiding closed-loop formation (20, 21). Duodenal injuries were the third most frequent isolated GITIs following blunt trauma. Duodenal perforation occurred in eight out of ten patients, while SMT/WHs were detected in only two individuals. Duodenum is located retroperitoneally adjacent to the vertebral and is more infrequent among adult populations than children (22).

The small bowel, especially the jejunum, is not enzymatically and microbiologically active; therefore, any small bowel perforation could be easily missed if the clinicians do not consider the injury. Moreover, other types of injury such as SMT/WH and MI might remain undiagnosed until the organ gangrene or bleeding developed. So, surgeons or even radiologists should always consider GITIs for early detection and patients management because delayed intervention could lead to worse outcomes and increase mortality (23). A diagnostic delay of more than 24 hours increases mortality by threefold (24). In our recent study, however, fifty dismissed cases were detected, thirty-eight of which were transferred to the operating room within 24 hours after hospital admission. Therefore, the mortality rate could not be attributed to the delayed intervention. Neurological damage and other associated injuries are thought to be responsible for this mortality rate (25).

The recent study has shown that the most common associated injuries in patients with blunt trauma were liver and splenic injuries, as would be expected (26). GITIs associated with trauma to the solid organs may be complicated by catastrophic bleeding and hypovolemic shock. The presence of such associations might distract physicians from GITIs because the recent trend in the management of solid organ injuries is a conservative treatment leading to more delayed surgical treatment of GITIs (7).

Based on our survey, patients sustaining penetrating injuries were significantly younger and had fewer associated injuries than those following blunt trauma. They were more hemodynamically stable, had shorter HLOS, and better outcomes. We hypothesized that this better outcome could result from more localized injuries after penetrating insults, specifically stabbing as the most common mechanism of injury in penetrating trauma. This led to less frequent associated injuries and, together with the younger age and less comorbid conditions, improved in-hospital outcomes.

The proper management of anorectal injuries is crucial since these injuries might result in morbidity and mortality primarily when associated with concomitant vascular injuries. *Steel et al.* reported that more than one-third of patients with rectal and vascular injuries died within the first week following the trauma (27). In our study, however, only two cases with anorectal injuries died. They admitted to our center following MVAs and had associated pelvic fractures and vascular injuries. Actually, all MVA-induced anorectal injuries were associated with pelvic fractures. They were died 72 hours after hospital admission.

Diagnosis of GITIs, especially in patients following blunt trauma, is still challenging and is primarily based on clinical and radiological findings (17). Multiple scoring systems have been developed for early detection and prompt management of patients with GITs, although they could not predict the injury in all situations; "Z score" and "Bowel Injury Prediction Score (BIPS)" were not adequately applicable in the presence of intraabdominal free fluid. *Raharimanantsoa et al.* developed a scoring system based on the mechanism of injury, serum lactate level, presence of long bone fracture, and intraabdominal free fluid on CT images (24). The routine clinical signs and symptoms such as abdominal pain and tenderness may be absent early in hospital arrival; on the other hand, intoxication and decreased level of consciousness due to neurological damages or sedations may mask the symptoms. Moreover, studies have shown that CT images have 88.3% and 99.4 sensitivity and specificity. However, the false-negative results are not uncommon because CT images could not detect the exact source of intraabdominal free fluid when the injury is associated with solid organ injuries (28).

Our study had some limitations; first of all, the retrospective nature of the study is prone to recall bias. However, we thought that this is insignificant due to the high sample size described within the study. Second, the radiological findings were not reported because we wanted to exclusively focused on intra-operative results and characteristics of GITIs. However, the CT findings were indirectly reported in the ISS.

Conclusion:

The recent survey was one of the largest epidemiological studies considering the GITIs. Based on our findings, the most frequent mechanisms of GITIs in our center were MVA and stabbing in blunt and penetrating trauma, respectively. Similar to previously conducted studies and EAST survey, S.B, colon, and duodenum were the three most frequent intraabdominal injured sites following blunt trauma, and S.B, colon, and anorectal injuries were the most common injuries in penetrating injuries. Our study has shown that GITIs are not as uncommon as previously thought, and developed scoring systems cannot detect all injuries. Therefore, all physicians should always search for and consider GITIs in patients sustaining blunt abdominal trauma to avoid further morbidity and mortality.

List Of Abbreviation:

GITI	Gastrointestinal Tract Injury
SB	Small Bowel
SUMS	Shiraz University of Medical Sciences
HLOS	Hospital Length of Stay
SBP	Systolic Blood Pressure
DBP	Diastolic Blood Pressure
PR	Pulse Rate
RR	Respiratory Rate
AIS	Abbreviated Injury Scale
MSI	Modified Shock Index
SMT/WH	Seromuscular Tear/ Wall Hematoma
MI	Mesenteric Injury
Ext.	External
SD	Standard Deviation
MVA	Motor Vehicle Accident
Asc.	Ascending
T.	Transvers
Desc.	Descending
EAST	Eastern Association for the Surgery of Trauma

Declarations:

Ethic approval and consent to participate:

This study was approved by the institutional review board and ethic committee of Shiraz University of Medical Sciences. Ethic number: IR.SUMS.REC.1400.024

Consent for publication:

Not applicable

Availability of data and materials:

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests:

The authors declare that they have no competing interests

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Authors' contributions:

AMB, RB, SP, and HA designed the study. RB, and HA were responsible for data collection. RB conducted the analysis and interpretation of data. AMB, RB drafted the manuscript and AMB, SP and HA revised it critically for important content. All authors read and approved the final manuscript

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Figures

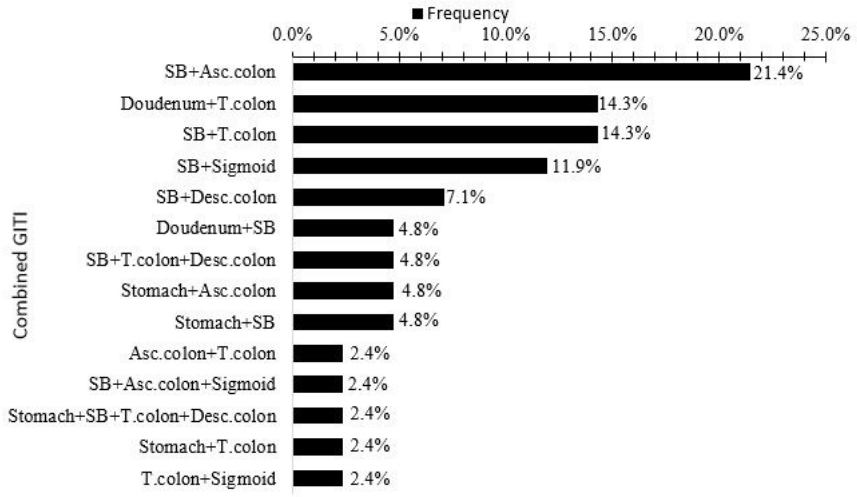

Figure 1

The frequency of concomitant gastrointestinal tract injures (n= 42). SB, Small Bowel; Asc. Colon, Ascending Colon; T. Colon; Transverse Colon; Desc.Colon; Descending Colon.