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Evaluation of blunt trauma patients according to CT scan and intraoperative findings

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ABSTRACT

Introduction: Abdominal blunt trauma is one of the most important causes of mortality and morbidity in all ages. Predicting the possibility of serious intra-abdominal injury and dividing patients into low-risk and high-risk patients is of great importance in medical and diagnostic decision making. The aim of this study was to evaluate abdominal blunt trauma patients with CT scan and intraoperative findings. *Material and Methods:* This was a descriptive retrospective study. The study population consisted of all

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patients with abdominal blunt trauma referred to Emergency Surgery Shahid Beheshti Hospital, Kashan in 2017, who were CT-scanned and underwent surgery. Patients with abnormal CT scan, or normal CT scan, with only positive clinical symptoms, were candidates for surgery and laparotomy and all injuries to their abdominal organs including spleen, kidney, liver and intestinal injury were then evaluated during surgery. Data were analyzed using SPSS 16.0. *Results:* In this study 199 patients with abdominal blunt trauma were studied. Of the 199 patients, 77 had liver damage, followed by kidney injuries (51 patients), spleen injuries (125 patients) and intestinal damage (27 patients). There were 280 concurrent abdominal injuries in some traumatic patients. Frequency distribution of patients with abdominal blunt trauma according to the type of injury in surgery was related to spleen (123 patients, 38.7%), liver (83 patients, 26%), intestine (62 patients, 19.6%) and kidney (50 patients, 15.7%). *Conclusion:* According to the results of the present study, the diagnostic value of clinical symptoms is comparable to the value of CT scan in traumatic patients and due to the high cost of CT scan and its deleterious effects on individuals, it can be concluded that in patients with positive clinical symptoms, CT scans are not necessary, and CT scans along with clinical symptoms can be helpful if the surgeon is suspicious of the clinical symptoms, therefore, leading to elimination of the financial burden and its effects from the healthcare system.

Keywords: Blunt trauma, abdominal trauma, CT scan.

1. INTRODUCTION

Trauma is defined as damage to the body. This injury is caused by an exchange of energy with the environment, which overwhelms an ability of person to cope. In addition, trauma is the most common cause of death at ages 1 to 44 years. Reports published by the WHO Eastern Mediterranean Region indicate that despite accidents such as infectious diseases and malnutrition, accidents are currently one of the major problems in the region (Zargar and Modaghegh, 2001 and Otieno et al., 2004). Although many of these injuries are considered moderate in severity and require surgical intervention only in a limited number of cases, such injuries are of particular importance because Careful care of these patients is essential and helpful in identifying those requiring surgical treatment (Yamamoto et al., 2005 and Hamidi and Aldaoud et al., 2007). In traumatic patients, it is important to have a definite guideline for the use of diagnostic tests, including radiological examinations. Deciding what trauma patients benefit from is very important in the treatment of patients and their prognosis. On the one hand, in addition to imposing high costs, additional actions may be harmful to the patient (receiving more radiation), on the other hand, failure to timely diagnose the injury may endanger the patient's life. Ultrasound and computed tomography (CT) are the two most commonly used methods for Blunt abdominal trauma. Modern traumatic injuries in the new world require early diagnosis and treatment. Computed tomography (CT) is one of the current methods in the evaluation of traumatic patients (Jorge et al., 2012 and Radhiana and Azian, 2010 and Polat et al., 2014 and Mahmood et al., 2014 and Huber-Wagner et al., 2009). In some centers, CT is performed on arrival of traumatic patients after symptoms stabilize. Proponents of this strategy believe that CT of the body in traumatic patients facilitates the immediate identification and management of all injuries, where delay in the diagnosis of injuries, especially those with poor prognosis and high medical costs, can be avoided and a comprehensive care program can be started from the beginning. They also believe that this type of CT will more reliably permit the discharge of patients who have a negative scan and no other reason for hospitalization. Proponents of this type of scan therefore believe that all patients, such as minor injury and serious injury with poor prognosis, need CT of the body to reduce mortality and disability in these patients (Rieger et al., 2009 and Salim et al., 2006 and Wurmb et al., 2009). Most physicians and researchers are trying to define indications for CT scans in order to reduce treatment costs (Snyder, 2008) and the amount of radiation received in traumatic patients, as death due to CT scans is associated with a 12.5/100,000 individuals in patients undergoing CT (Brenner and Hall, 2007 and Lee et al., 2015). CT scan also has a sensitivity of 97% and a specificity of 95% for the diagnosis of intra-abdominal injuries, which is lower for mesenteric and vascular lesions, while it showed higher specificity for solid organ lesions such as the liver (Hamidi and Aldaoud, 2007). Given the aforementioned findings and research on the beneficial effects of CT in such patients, the aim of this study was to evaluate patients with abdominal blunt trauma in terms of CT-scan and intraoperative findings.

2. MATERIALS AND METHODS

This study was a descriptive-retrospective study. The study population consisted of all patients with abdominal blunt trauma referred to Emergency Surgery Shahid Beheshti Hospital, Kashan in 2017, who were CT-scanned and underwent surgery. The study subjects were selected with nonprobability sampling.

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Inclusion criteria included

1. Patients with blunt abdominal trauma who underwent abdominal and pelvic computed tomography and underwent surgery, 2. Having stable vital signs (systolic blood pressure of at least 90 and pulse of > 100) 3. Good vigilance (GCS = 14-15)

Exclusion criteria included

1. Patients with unstable vital signs, 2. Patients with penetrating trauma, 3. Pregnancy 4. Patient's dissatisfaction with the study, 5. traumatic patients who were not CT-scanned, 6. Trauma patients who did not undergo surgery.

Sample size

In order to select the sample size of the study, the sensitivity of CT scan to blunt traumatic abdominal trauma (94.2%), predictive value (98.8%), power (80%) was considered. Considering 95% confidence and 5% accuracy, the sample size was calculated as 204 according to the descriptive study.

$$n = 2\frac{\left(z_{1-\frac{\alpha}{2}} + z_{1-\beta}\right)^2 \overline{pq}}{(p_1 - p_2)^2}$$

After obtaining informed consent, ultrasound was performed according to the usual emergency department instructions, and then the diagnostic program was continued according to the decision of the responsible physician. This program could be repeated ultrasound 6 hours later, CT scan and/or patient observation.

Therefore, there was no interference with the diagnostic procedure, and CT scans were performed only at the request of the treating physician by considering clinical conditions. Patients who did not consent to participate in the study were excluded. Sonography and CT scans were reported and recorded by a radiologist. Other information was obtained by referring to the patient's medical records through a physician and then recorded in a questionnaire. Then patients with abnormal CT scan, or normal CT scan, with only positive clinical symptoms, were candidates for surgery and laparotomy and all injuries to their abdominal organs including spleen, kidney, liver and intestinal injury were then evaluated during surgery. Finally, the diagnostic value of the CT scan and the patient's clinical symptoms for spleen, kidney, liver and intestine injury were determined.

Data analysis

After data collection and refinement, SPSS-16 software was used for descriptive analysis by expressing central and dispersion indices for quantitative variables and distributing absolute and relative frequency for qualitative variables. When statistical assumptions were made, appropriate tests such as chi-square were used for variables. Sensitivity, specificity, positive and negative predictive values were calculated to determine the diagnostic value of CT scan and clinical signs in the diagnosis of abdominal injury. The p-value< 0.05 was considered significant.

Ethical considerations

Ethic code of IR.96141 was approved for this study by Kashan University of Medical Science, Kashan, Iran.

3. RESULTS

In this study, 199 patients with abdominal blunt trauma were studied. The results of the statistical analysis are shown in the respective tables. Table 1 shows the frequency distribution of patients with abdominal blunt trauma in terms of the type and severity of the injuries in the CT scan. Of the 199 patients, 77 had liver injury, followed by kidney injury (51 patients), spleen injury (125 patients), intestinal injury (27 patients) and 280 concurrent abdominal injuries.

Frequency distribution of patients with abdominal blunt trauma according to type of injury achieved in surgery. The most common types of injuries were spleen (123 cases, 38.7%), followed by liver (83 cases, 26%), intestines (62 cases, 19.6%) and kidneys (50 cases, 15.7%). Table 2 shows the statistical variables of age, GSC, heart rate, respiratory rate, systolic and diastolic blood pressure in patients with abdominal blunt trauma.

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Table 1 Frequency Distribution of Patients with Abdominal Blunt Trauma by CT scan and Severity of Injury

Severity of Injury / Injury type	Mild	moderate	severe	total
liver	25	37	15	77
kidney	12	15	24	51
spleen	33	63	29	125
intestinal	5	9	13	27
total	75	124	41	280

Table 2 Statistical indicators

Statistical indicators	Age	GCS	Heart rate	The number of breaths per minute	Systolic pressure (mm / hg)	Diastolic pressure (mm / hg)
Mean	32.08	14.48	98.43	17.73	108.95	67.62
Standard deviation	16.14	1.69	16.23	2.19	14.62	10.69
Minimum	4.0	13.0	10.0	12.0	75.0	10.0
Maximum	87.0	15.0	140	30	199	100

Frequency distribution of abdominal pain, abdominal tenderness, abdominal guarding, rectoragy, haematemesis, hematuria, and rebound in patients with abdominal blunt trauma referred to the hospital were evaluated. Of the 199 patients, 170 (85.4%) had abdominal pain followed by no abdominal pain (29 patients, 14.6%), abdominal tenderness (168 patients (84.4%), no abdominal pain (31 patients), no abdominal guarding (152, 76.4%) and abdominal guarding (47, 23.6%). In terms of rectoragy, 4 (2%) had rectoragy and 195 (98%) did not. Haematemesis was seen in only 3 (1.5%) and 196 (98.5%) patients did not have vomiting with blood, hematuria was not seen in 183 (92%) while 16 (8%) showed this complication. 57 (28.6%) were positive for rebound and 142 (71.4%) negative.

In Tables 3 to 6, the diagnostic values of clinical signs for the diagnosis of liver, spleen, kidney and intestinal injuries are indicated. The diagnostic value of clinical symptoms for liver injury is summarized in Table 3, and the highest diagnostic value is associated with a rebound sensitivity of 88.4% and a positive predictive value of 84.5%.

Table 3 Diagnostic value of clinical symptoms for diagnosis of liver injury

	Sensitivity (CI 95%)	Property (CI 95%)	Positive predictive value (CI 95%)	Negative predictive value (CI 95%)
Abdominal pain	75.4%	78%	82.8%	86.5%
tenderness,	71.4%	65%	80.8%	75.5%
rebound	88.4%	87%	84.5%	85.6%
guarding	72%	70.2%	78%	75.6%

Table 4 Diagnostic value of clinical symptoms for the diagnosis of spleen injury

	Sensitivity (CI 95%)	Property (CI95%)	Positive predictive value (CI 95%)	Negative predictive value (CI95%)
Abdominal pain	56%	66.2%	79%	84.5%
tenderness,	96%	82.3%	74.1%	95.4%
rebound	83.8%	74.1%	75.1%	82.4%
guarding	60.6%	67.1%	70.4%	68.7%

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In Table 4, the diagnostic value of clinical signs for the diagnosis of spleen injury was examined and the highest diagnostic value was found to be linked to tenderness with sensitivity of 96%.

The diagnostic value of clinical symptoms for renal injury was indicated in Table 5 and the highest diagnostic value for hematuria, with 73% predictive value, was seen.

Table 5 Diagnostic value of clinical symptoms for diagnosis of kidney injury

	Sensitivity (CI 95%)	Property (CI95%)	Positive predictive value (CI 95%)	Negative predictive value (CI95%)
Abdominal pain	20%	67.3%	15.1%	79.4%
tenderness,	87%	55%	35.1%	89.4%
rebound	20%	86%	33%	76.4%
guarding	32%	36%	30%	39.4%
hematuria	71%	80%	73%	75.4%

The diagnostic value of the clinical symptoms for intestinal injury was examined (Table 6), the highest diagnostic value for the diagnosis of intestinal injury was guarding with a specificity of 93% and a negative predictive value of 91.4%.

Table 6 Diagnostic value of clinical symptoms for diagnosis of bowel injury

	Sensitivity (CI 95%)	Property (CI95%)	Positive predictive value (CI 95%)	Negative predictive value (CI95%)
Abdominal pain	75%	67%	80%	79.4%
tenderness,	90%	5%	85%	90.4%
rebound	86%	81%	96%	80.4%
guarding	89%	93%	95%	91.4%

Table 7 shows the frequency distribution of the surgical findings based on the CT scan findings for the liver injury and it was found that out of 199 patients 93 patients had liver injury and 106 patients had no liver injury. Of the 93 patients, 73 showed injury by surgery and CT, and 20 were also confirmed by surgical findings, while were not confirmed by CT. Of the 106 patients without liver injury, 102 were confirmed by CT scans and surgery, but 4 were not confirmed using surgical findings, while they had been also confirmatory findings in CT scan (figure 1 – 5).

Table 7 Frequency distribution of surgical findings in terms of CT scan for liver injury

Surgical findings / CT	yes	no
yes	73	4
no	20	102
total	93	106

Frequency of surgical findings based on CT scan findings for splenic injury was evaluated and it was found that 123 out of 199 patients had spleen injury and 76 patients did not. Of the 123 affected patients, 120 were confirmed by both surgical and CT findings and 3 were also confirmed by surgical findings but did not reveal this injury in the CT scan. Of the 76 patients without spleen injury, 71 patients were approved by CT scans and surgical findings, and 5 patients were also confirmed by CT scans, while surgical findings indicated the opposite results for them.

Frequency distribution of CT findings for kidney injury revealed that 50 out of 199 patients had kidney damage and 149 did not. Of the 50 patients with kidney injury, both surgical and CT findings confirmed 43 patients, and only 7 kidney injuries were

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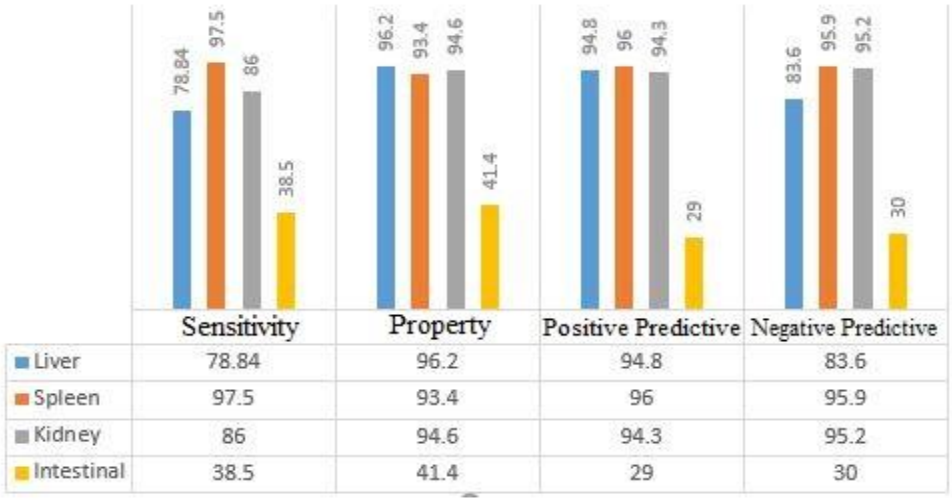
documented in the surgery, while CT scan had a negative response. Of the 149 patients without kidney injury, 141 patients were approved for both procedures, and only 8 patients had surgical findings as no kidney injury, while CT scan confirmed the injury.

Frequency distribution of surgical findings was evaluated in terms of CT scan findings for intestinal injury. Of the 199 patients with abdominal blunt, 62 had intestinal injury and 137 had not. Of the 62 patients with intestinal injury, 25 patients had confirmed both procedures as intestinal injury and 37 patients confirmed the surgical findings, but were not confirmed by CT scan. Of the 137 patients without intestinal injury, 135 patients were confirmed by both surgical and CT findings as lack of intestinal injury and only 2 patients were considered to have intestinal injury by CT scan, but were not confirmed by its surgical findings. Diagnostic values of CT scan for abdominal injuries were evaluated (Table 8 & graph 1) and the most diagnostic value was found for spleen with sensitivity of 97.5%.

Table 8 Diagnostic value of CT scan for diagnosis of abdominal injuries

	Sensitivity (CI 95%)	Property (CI95%)	Positive predictive value (CI 95%)	Negative predictive value (CI95%)
Liver	78.4%	96.2%	94.8%	83.6%
Spleen	97.5%	93.4%	96%	95.9%
Kidney	86%	94.6%	84.3%	95.2%
Intestinal	38.5%	41.4%	29%	30%



Graph 1 Diagnostic value of CT scan for diagnosis of abdominal injuries

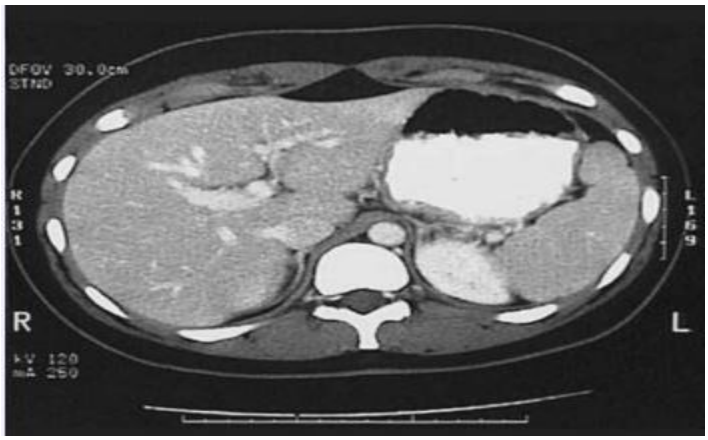


Figure 1 Normal CT scan

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Figure 2 Liver Abnormal CT scan

Figure 3 Spleen Abnormal CT scan

Figure 4 Kidney Abnormal CT scan

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Figure 5 GL Abnormal CT scan

4. DISCUSSION

Today, the use of ultrasonography and CT scan, due to their high speed in diagnosis and their high sensitivity, is highly acceptable in the diagnosis of these types of injuries. However, ultrasonography and CT scan are not reliable in the diagnosis of some traumas such as mesenchymal and intestinal injuries (Hajibandeh and Hajibandeh, 2015). The aim of this study was to evaluate blunt trauma patients according to CT scan and intraoperative findings.

Based on the findings of the present study, it can be concluded that CT scans do not need to be performed in low risk patients with appropriate consciousness. Therefore, clinical examinations and symptom assessment have a high sensitivity and accuracy in identifying abdominal blunt trauma in the early hours of referral to the emergency. Clinical examination and getting medical history or anamnesis can be helpful in identifying blunt injuries, reducing costs and high number of patients. In this study, CT scans were of high diagnostic value, but were also highly valuable (high sensitivity and specificity) in comparison with clinical symptoms. However, intestinal CT scans did not help much in diagnosing; however, clinical examination of intestinal injury has a high value and can be reliable in this regard.

Kendall et al. evaluated 1169 patients during 2 years where 29% of patients underwent abdominal and pelvic CT scan and 6% of patients were admitted to the hospital for further treatment by a follow-up and care unit. The results obtained from this study suggest that most patients with abdominal blunt trauma, who are not positive in the initial emergency assessment, have a low risk for intra-abdominal injuries but still require a combination of some care and CT scans. However, another subgroup of patients with abdominal blunt trauma may also be discharged only after initial evaluations without the need for care or CT scans. In confirming the findings of this study, Kendall and colleagues stated that low-risk patients without abdominal CT scan or any additional testing can be discharged (Kendall et al., 2011). In a study by Safari et al., 205 patients were included. Prevalence of clinical signs of abdominal injury, concurrent abdominal signs and symptoms, clinical signs and symptoms of abdominal visceral injuries and three factors including Clinical signs, hematuria and shock index above 0.8 was found to be higher in patients with abdominal injury as compared to discharged patients.

The sensitivity, specificity, negative and positive predictive values of the three factors were 100%, 45%, 100% and 17%, respectively. The findings of the present study suggest that low risk patients with abdominal blunt injury can be discharged without the need for a CT scan (Safari, 2013). Gonzalez et al. Emphasize that physical examinations are a reliable method of identifying abdominal and pelvic injuries in conscious patients and that radiography does not assist in the diagnosis of abdominal injuries and its consequences (Gonzalez et al., 2002). The results of this study were consistent with our findings. A study by Hashemi et al. investigated the records of 120 patients with solid visceral trauma (liver, spleen and kidney) who had a CT scan and a laparotomy report over an 8-year period. The diagnostic value of the CT scan was found to be lower than that reported in other studies, which was inconsistent with the present study. This difference may be linked to failure to detect delayed splenic rupture due to conventional CT scans, failure to use Spiral CT at all times of the day, failure to perform standard CT scans for trauma cases and disagreement among radiologists in interpreting CT scans of traumatic patients. Therefore, given the current circumstances and cost of performing such assessments for patients and the health system, it is recommended to place more emphasis on physical examination rather than the unmet demand for para-clinical evaluation (Heshemi et al., 2006).

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5. CONCLUSION

According to the results of the present study, the diagnostic value of clinical symptoms is comparable to the value of CT scan in traumatic patients and due to the high cost of CT scan and its deleterious effects on individuals, it can be concluded that in patients with positive clinical symptoms, CT scans are not necessary, and when the surgeon suspects clinical symptoms, CT scans can be assisted along with clinical symptoms thus, eliminating the high cost and its effects from the healthcare system. On the other hand, it can be concluded that CT scan in intestines rupture and intestinal injuries has not high diagnostic value as clinical symptoms and only clinical examination should be performed in this regard.

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Conflicts of Interest: The authors declare no conflict of interest.

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