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Original Article

The compatibility of Focused Assessment with Sonography in Trauma (FAST) in the supine position vs FAST in the Trendelenburg position in determining free fluid in blunt abdominopelvic trauma patients

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Abstract

Introduction: Focused Assessment with Sonography for Trauma (FAST) is found to be a diagnostic tool initially to detect intra-abdominal fluid in abdominal trauma. This study examined the compatibility of FAST in the supine position vs FAST in the Trendelenburg position in determining of free fluid in blunt abdominopelvic trauma patients.

Materials and Methods: This descriptive cross-sectional study was conducted prospectively on all patients with blunt abdominal trauma during 2019-2021 in Shahid Rahnemoon Yazd Teaching Hospital. sampling method was convenient. An emergency medicine specialist did FAST, on the abdominal and pelvic trauma patients, in the supine position. The patients were placed in the Trendelenburg position for 3 minutes and FAST was performed again. Demographic information and the results obtained from both FAST ultrasounds of the patients were recorded. The sensitivity and Specificity of the supine test, Positive predictive value (PPV), and negative predictive value of the supine (NPV) test were assessed.

Results: In this study, in the FAST performed in the supine position free fluid was seen in 13.4%(n=16) of the patients while in the Trendelenburg position, 29.4% (n=35) of the patients clearly showed free fluid in the abdomen and pelvis. The overall Sensitivity, Specificity, PPV, and NPV of the supine test were 30.55%, 93.97%, 68.75%, and 75.72% respectively.

Conclusion: using the Trendelenburg position, for the detection of free fluid in patients with blunt abdominal trauma and stable hemodynamics with or without abdominal pain, which first-time FAST exam is not reliable or is suspected of free fluid presence, is recommended.

Keywords: Abdominal Injuries, Focused Assessment with Sonography for Trauma, Supine Position, Head-Down Tilt

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Introduction

Trauma is the fourth cause of mortality in developing countries and the first cause of mortality among young people in Iran(1). Abdominal injuries are one of the most common causes of death in trauma patients (2). The most important issue in the treatment of patients with blunt abdominal trauma is the careful and quick examination of those who need immediate surgery; various studies have shown that clinical examinations are not very reliable for judgment. Purposive assessment of trauma patients using "focused assessment with sonography for trauma (FAST)" is a part of the initial examination and also a valuable aid for emergency care of patients with blunt abdominal trauma(2). In cases of blunt trauma to the abdomen (BTA), free fluid is because of bleeding in abdominal organs, especially the kidney, liver, and spleen. It can contribute to life-threatening conditions and needs fast and important actions such as surgery. FAST is found to be a diagnostic tool initially to detect intra-abdominal fluid in abdominal trauma (2). In a study by Mohammadi et al., the results showed that FAST has 75.1% sensitivity, 91.7% specificity,94.1% positive predictive value, 77.2%negative predictive value and 83.7% accuracy in diagnosing free abdominal fluid (3). Cheap cost, lack of patient radiation, detection of free fluid in the abdomen and availability were among the most important advantages of this diagnostic modality (3). In fact, in the supine position, gravity causes fluid to move to the lowest point of the peritoneum, i.e., the recto vesicular, rectouterine, and hepatorenal spaces. On the other hand, in the Trendelenburg position and with the body at an angle of 15-30 degrees, the legs will be higher than the forehead level, leading to the inclination of the abdominal contents and liquid downwards. For instance, it was shown in a study that although the minimum fluid to be seen in the perihepatic space is 620 cc in the supine position, the minimum fluid for diagnosis can be reduced to 444 cc in the Trendelenburg position (4). This study aimed to evaluate the compatibility of FAST in the supine position vs FAST in the Trendelenburg position in blunt abdominopelvic trauma patients.

Materials and Methods

This descriptive cross-sectional study was conducted prospectively on all patients with blunt abdominal trauma during 2019-2021 in Shahid Rahnemoon Yazd Teaching Hospital. In this study, all stages of the research were approved by the Committee of Ethics in Human Research at Shahid Sadoughi University of Medical Sciences, Yazd. Research ethics committee's certificate:IR.SSU.MEDICINE.REC.1400.277.

According to the ethics guideline in research, all patients' information was completely confidential during this study, and at first the necessary explanations about the research were given to the patient and his legal guardian; then, the consent of the patient or his legal guardian was obtained to participate in the research.

The following issues were also observed:
-Voluntary participation in research.
-Description of all research objectives to all patients.
-The patients were given the necessary assurance regarding the confidentiality of the information.
-Ethical principles were considered in writing materials and using scientific books and resources.
-In the implementation of this research, no additional costs were imposed on the patients.

Inclusion Criteria include all patients with blunt abdominal trauma (such as motor vehicle accident) and abdominal pain at the age of 18-65 were included. Exclusion criteria included BMI above 30, unstable vital signs, associated penetrating abdominal trauma, associated underlying diseases such as malignancy, cirrhosis, heart failure, and kidney failure, and lack of consent of patients to participate in the study. sampling method was convenient. After explaining the objectives of the study to the participants and the necessary instructions, informed consent was obtained from the patients. The studied patients were

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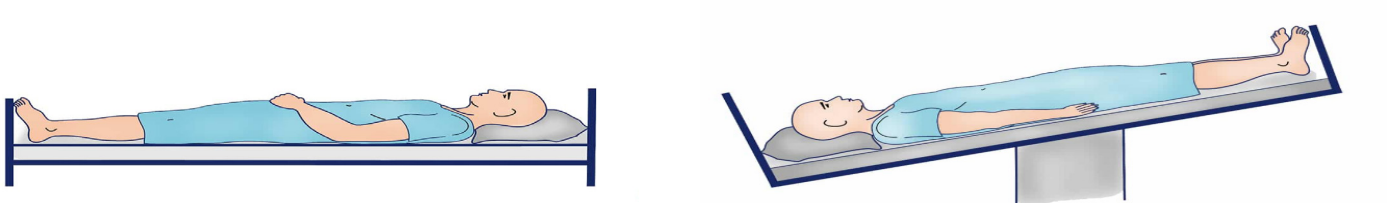
first subjected to FAST exam in the supine position in Figure 1.A using an ultrasound machine made by Fujifilm Sono Site with the aid of a specialist in emergency medicine and an emergency medicine resident together. (only these 2 persons were responsible for FAST) Subsequently, the patients were placed in the Trendelenburg position (15 degrees according to Figure 1. B) for three minutes, and the FAST exam was performed again in terms of the presence of free fluid in the abdomen and pelvis in this position. The Trendelenburg position was the same and constant for all of the patients. (the bed has two modes one supine and the other Trendelenburg so the degree was constant for all patients). Demographic information and the results obtained from both FAST ultrasounds of the patients were recorded in Excel spreadsheet. Finally, according to the objectives of the study, the collected data were analyzed. Sensitivity and Specificity of the supine test, PPV, and NPV test were assessed.



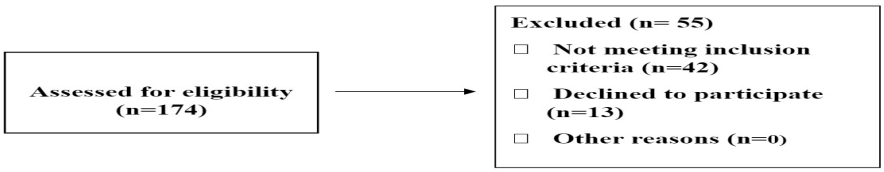
A B

Figure 1. A) Supine Position B) Trendelenburg Position

Results

174 patients were enrolled in the study. The data of 119 patients were finally analyzed in flow diagram 1. 85(%71.43) of the patients were women and 34(%28.57) were men as shown in Table 1. Table 2 shows the presence of free fluid was 29.4%(n=35), in the Trendelenburg position.

According to Table 3, 88.2%(n=30) hadn`t free fluid in the supine position, whereas 67.6%(n=23) in Trendelenburg position.



Flow Diagram 1. Patients Flow

Table 1. The results of demographic indicators under study

Variables	Age	N (%)
Males	37.3912.83± years	85(71.43)
Females	35.3312.64± years	34(28.57)
Total	**36.5312.73± years**	**119**

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Table 2. The Frequency of presence of free fluid in FAST in positions under study in terms of gender

Position	Status	Gender	N (%)	Total, N (%)
Supine	**Not seen**	Male	73 (85.9)	103(86.6)
		Female	30 (88.2)	
	Suspected	Male	12 (14.1)	16(13.4)
		Female	4 (11.8)	
Trendelenburg	**Not seen**	Male	60 (70.6)	83(69.7)
		Female	23 (67.6)	
	Seen	Male	25 (29.4)	35(29.4)
		Female	10 (29.4)	
	Suspected	Male	- -	1(0.8)
		Female	1 (2.9)	

Table 3. The results of the presence of free fluid in the abdomen and pelvis in FAST in the supine and Trendelenburg positions

Position		Trendelenburg	
		Free Fluid **not seen**	Free Fluid **seen+ Suspected**
Supine	Free Fluid not seen	78	24+1
	Suspected	5	11
Total		83	36

-Sensitivity of supine test:11/11+25=30.55%

-Specificity of supine test: 78/78+5=93.97%

-Positive predictive value of supine test:11/11+5=68.75%

-Negative predictive value of supine test:78/78+25 =75.72%

Discussion

Multiple trauma (and so blunt abdominal trauma) is one of the communal causes of patients suffering. Abdominal organs (such as the liver or spleen) hematoma or hemorrhage are concealed in most cases and are even fatal. FAST, is the sonographic examination of the pelvis, abdomen (hepatorenal, splenorenal, and rectovesical recesses), and chest(pericardium) for the detection of the presence of free fluid. Fast exams, due to could reduce interval between trauma and bleeding detection, reduce the inadequate and lack of appropriate surgical treatment is used wholly in Emergency departments (2, 5). Coordination of trauma resuscitation requires a true understanding of the pathophysiology of trauma and the ability to think logically in a chaotic situation. There are many investigative options for blunt abdominal trauma patient management including physical examination, laboratory tests such as hemoglobin level changes, serial ultrasound (FAST), and multi-slice(6) Purposive

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assessment of trauma patients using FAST is a part of the initial examination and also a valuable aid for emergency care of patients with blunt abdominal trauma (7, 8). Nonetheless, the most important point is the position in which FAST is performed, considering the time limit and the risk to the patient's life. most of the emergency specialists perform FAST on patients in the supine position without prior attention. Trendelenburg's position made it easier to view even insignificant free fluids in the abdomen because of fluid accumulation, especially at hepatorenal recess, so it can be the preferable method of FAST exam at the earlier times of multiple trauma patient`s arrival, as mentioned in Abram`s study (4). Unfortunately, in the current study, no method was considered as a gold standard because sonography has much sensitivity for checking the amount of free fluid inside the abdomen so only the observation or non-observation of free fluid was examined; yet, the results were consistent with the results of the above study and both studies showed higher diagnostic sensitivity and accuracy of FAST ultrasounds in the Trendelenburg position compared to the supine position. In this descriptive study, in the FAST performed in the supine position free fluid was seen in 13.4%(n=16) of the patients while in the Trendelenburg position, 29.4% (n=35) of the patients clearly showed free fluid in the abdomen and pelvis. The overall Sensitivity, Specificity, PPV, and NPV of the supine test were 30.55%, 93.97%, 68.75%, and 75.72% respectively. In many cases of abdominal trauma with suspected FAST results, the physician may repeat the FAST and search for free fluids after3-6 hours infusion of intravenous fluid, or perform enhanced abdominal (Computerized tomography) CT scan, for determining of hematomas or few free fluids, which takes time, and may not be applicable in some patients or in some hospitals which don`t have CT scan, so Trendelenburg position in such situations is helpful (9, 10). Gerhard Achatz et al, in a systematic review, showed that abdominal CT scan is the gold standard diagnostic modality with high sensitivity and specificity in blunt abdominal trauma patients, while the Trendelenburg position takes no time and is used more easily (11).There are some situations such as Pelvic fractures, in which the accuracy of FAST is limited because free fluid could be because of retroperitoneal hematoma, or intraperitoneal (hemoperitoneum or uroperitoneum) caused by significant intra-abdominal organ injury. In major pelvic fractures without diagnostic FAST results, abdominal CT scan should be performed to detect occult injuries, such as hollow viscous organ injuries or vascular injuries, which might be missed (12). Trendelenburg's position could be useful in such situations. In pediatric stable abdominal traumas, the research paper provides insights into the current practice patterns of pediatric surgeons caring for stable patients with traumatic solid organ injuries in children. It highlights the low number of failures in nonoperative management, indicating the effectiveness of this approach in treating such injuries in children, the paper offers a potential framework for optimizing care and improving outcomes in this patient population. Our study excluded children, but it seems that Trendelenburg's position should be generalized to pediatrics without any side effects(13, 14). A single study conducted a retrospective cohort analysis of pregnant trauma patients at two level 1 trauma centers from 2003 to 2019.

Four distinct imaging categories were recognized:

absence of intraabdominal imaging, sole application of focused assessment with sonography for trauma, exclusive utilization of computed tomography of the abdomen/pelvis, and a combination of both imaging techniques. Comparative analysis of clinical variables and outcomes was conducted among the imaging groups utilizing analysis of variance and chi-square tests. Multinomial logistic regression was utilized to assess the connections between the chosen imaging modality and clinical variables. The precision of focused assessment with sonography for trauma was gauged by juxtaposing it against computed tomography of the abdomen/pelvis as the benchmark standard (15). Our study excluded pregnant patients, but Trendelenburg's position should be generalized to them, without any side effects. One of the limitations of the present study was that the Trendelenburg position is not convenient for patients, so it`s not practicable

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for all patients.

The authors of the paper suggest that future research can focus on the following topics:

1. Investigating the sensitivity, specificity, and diagnostic accuracy of free intra-abdominal fluid in FAST in other positions including the Reverse Trendelenburg position.
2. Investigating the sensitivity, specifici\ty, and diagnostic accuracy of free intra-abdominal fluid in FAST in Trendelenburg position and comparing it with the results obtained from CT-scan of patients as the gold standard of diagnosis.
3. perform a meta-analysis study to determine the accuracy of FAST in Trendelenburg position.

Conclusion

The physician would rather this modality and position (Trendelenburg) than perform an abdominopelvic CT scan. so the authors suggest this decision rule:

1. Is the patient stable? Then do FAST in supine.
2. FAST in the supine position is suspected? Then do the Trendelenburg position for about 3 minutes and do FAST again perform an IV contrast-enhanced abdominopelvic CT scan, or repeat supine FAST after 3-6 hours.

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Conflict of Interest

The authors declare no conflict of interest.

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