Investigation of Accuracy of FAST Findings of Multitrauma Patients in Comparison with Abdominal CT Results

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Abstract

Objective: In our study, we aimed to investigate the accuracy of Focused Assessment Sonography for Trauma (FAST) findings of multitrauma patients in comparison with abdominal CT results.

Material and Methods: Age, gender, demographic properties, trauma type, arrival method to the emergency service, abdominal USG results, abdominal CT results, results of other CT scans, hospitalization data, and hemoglobin (Hb) and white blood cell count (WBC) values of the patients were recorded.

Results: One hundred eighty (79.6%) males and 46 (20.4%) females (total 226 patients) were included to our study. Mean age was 38.74±17.18; 203 (89.8%) patients were traffic accidents, and 23 (10.2%) patients were falls from heights. The sensitivity of FAST was 50% and specificity was 93.7%. The positive predictive value (PPV) was 60 and negative predictive value was 90.8%.

Conclusion: Multiple trauma patients with positive USG findings according to their hemodynamic situations and multitrauma patients with suspicious USG findings should undergo abdominal CT scan in the emergency service. *(JAEM 2014; 13: 104-7)*

Key words: Emergency service, multitrauma, FAST

Introduction

Trauma is still the most important cause of death among the young population. Most deaths from trauma occur in the first hour, which is known as the ''golden hour.'' Multiple studies have been performed on prehospital, triage, and first hospital admission time for decreasing these first hour deaths. Emergency doctors use many diagnostic tests for evaluating trauma patients in the emergency rooms. These diagnostic procedures can be classified as invasive and non-invasive procedures. In generally, cases are investigated according to classic patient examination algorithms, but in multitraumatic and unconscious patients, the algorithm may not be adopted. Time is important in emergency surgery-requiring patients, and diagnostic procedures should be applied immediately in these patients. The bleeding region should be determined, and bleeding should be stopped, especially in hemodynamically unstable patients (1).

Intra-abdominal bleeding may be fatal. Physical examination-suspected cases may undergo diagnostic peritoneal lavage (DPL), ultrasonography (USG), or computed tomography (CT) for diagnosis. Clinicians can decide the method according to the patient's situation. In recent years, USG has usually been used in emergency services for intra-abdominal bleeding. It is known as Focused Assessment Sonography for Trauma (FAST) (2, 3).

In this 'FAST and Abdominal CT' study, we aimed to investigate the accuracy of FAST findings of multitrauma patients in comparison with abdominal CT results. We also investigated other accompanying regional CT findings and blood parameters associated with abdominal CT and USG usage.

Material and Methods

After ethics committee approval, we included all multitrauma (traffic accidents and falls from heights) patients who were admitted to our emergency service between 01.01.2012 and 01.12.2012 and underwent USG and abdominal CT. An informed consent form was signed by each patient.

Age, gender, demographic properties, trauma type, arrival method to the emergency service, abdominal USG results, abdominal CT results, results of other CT scans, hospitalization data, and hemoglobin (Hb) and white blood cell count (WBC) values of the patients were recorded.

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Four diagnosis groups for USG (normal, free abdominal fluid, solid tissue damage, visceral tissue damage) and 5 diagnosis groups for CT (normal, free abdominal fluid, solid tissue damage, visceral tissue damage, retroperitoneal injury) were constituted. FAST evaluation of trauma patients was performed by senior radiology residents

We also noted the first admission time, 2-3-hour Hb, and WBC values of the patients. Some of these data were obtained from clinics at which the patients were hospitalized. Patients who were given erythrocyte suspension were excluded from the study. Complete blood count (CBC) analyses were made with "Beckman Coulter maha LH-780" device. The "Digi Prince DP-9900" USG was used on abdominal USG evaluation. WBC over 11,000 mm^3 was accepted as leukocytosis (reference: 4300–10,300 mm^3).

Statistical Analysis

Statistical analysis was performed with Statistical Package for Social Sciences 15.0 (SPSS Inc., Chicago, IL, USA) with 95% confidence. Student t-test and one-way ANOVA (Bonferroni for further evaluation) tests were used for quantitative data comparison. Spearman correlation test was used for correlation analyses. Chi-square and Fisher exact chi-square tests were used for qualitative data comparison. Comparison of groups was made with chi-square, Fisher's exact, and chi-square trend tests. Means of groups were compared with independent sample t-test, and consecutive Hb and WBC values were evaluated with paired sample t-test. ROC analyses were made for the USG and BT results. The significance level was $p<0.05$.

Results

One hundred and eighty (79.6%) males and 46 (20.4%) females totally 226 patients were included to our study. Mean age was 38.74±17.18. 203 (89.8%) patients were traffic accident and 23 (10.2%) patients were fall from height. 170 (83.7%) traffic accident patients and and 14 (60.9%) fall from height patients were brought by ambulance. 128 (69.5%) of these 184 patients and were hospitalised. 42 patients (18.6%) has arrived to the emergency service by themselves and 19 (12.9%) of those were hospitalised. Admission method (ambulance-by their own opportunity) was significantly different between trauma type (p=0.019) and hospitalisation (p=0.003).

Patients' accompanying CT scans are given in Table 1.

Eighteen (50%) of 30 (13.3%) USG (+) cases had a positive finding on abdominal CT; 12 (6.3%) did not. Eighteen (50%) of 196 (86.7%) USG (-) cases had a positive finding on abdominal CT, and 178 (93.7%) did not.

The sensitivity of USG was 50% and specificity was 93.7%. The positive predictive value (PPV) was 60 and negative predictive value was 90.8%. Area under the ROC curve was 72.8%. USG results with CT were statistically significant (AUC p=0.001) (Figure 1).

In total, 147 patients were hospitalized: 45 (30.6%) patients were hospitalized into the general surgery clinic, 38 (25.9%) to orthopedics, 44 (29.9%) to neurosurgery, 6 (4.1%) to the intensive care unit, and 14 (9.5%) to other clinics. Also, 115 (78.2%) hospitalized patients underwent cranial CT, 91 (61.9%) underwent cervical CT, 101 (68.7%) underwent thorax CT, 11 (7.5%) underwent lumbar CT, 10 (6.8%) underwent pelvic CT, and 16 (10.9%) underwent other CT.

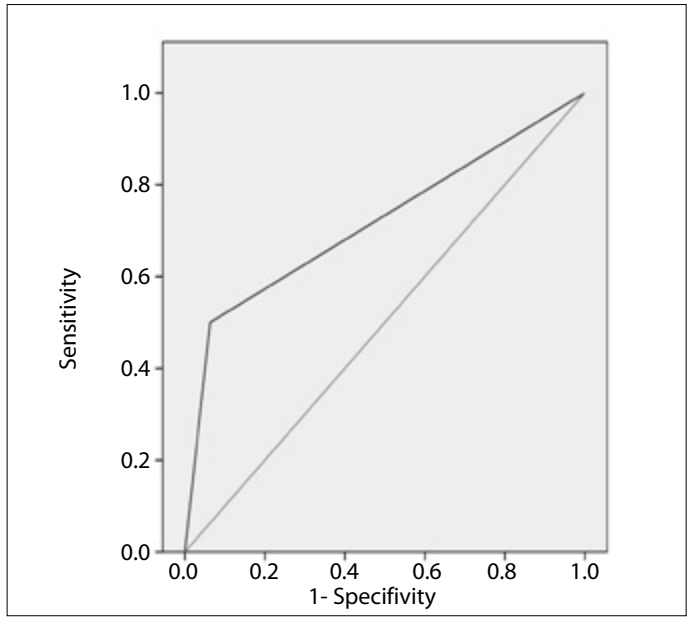

Figure 1. ROC curve of USG results according to CT results of patients

Table 1. Accompanying CT scan distribution of patients who underwent abdominal CT

	Abdominal CT								Total	
	Normal	Free abdominal fluid	Solid tissue damage	Visceral tissue damage	Retroperitonal injury	Free fluid + solid tissiue damage	Free fluid + visceral tissiue damage	Free fluid + retroperitoneal injury		
	n	n	n	n	n	n	n	n	n	%
Cranial CT	133	9	2	1	6	6	1	1	159	70.4
Cervical CT	105	6	1	0	3	5	1	1	122	54.0
Thorax CT	118	7	2	1	3	5	1	1	138	61.1
Lomber CT	14	1	0	0	1	0	0	0	16	7.1
Pelvic CT	12	2	0	0	1	0	0	0	15	6.6
Other	17	0	0	0	1	0	0	0	18	8.0
Total	190	10	3	1	8	11	2	1	226	100.0

CT: Computed tomography

We could not find a difference between groups (patients with Hb decrease-patients without Hb decrease) according to USG and abdominal CT positivity (p>0.05) (Table 2). Similarly, the WBC difference of the groups according to USG and abdominal CT positivity was not significantly different (p>0.05) (Table 3). Second Hb (p=0.027) values and first WBC (p=0.005) values of abdominal CT (+) patients were significantly different from abdominal CT (-) patients (Table 4).

Discussion

In our study, the most frequently accompanying CT scan in multitrauma patients with abdominal CT was cranial CT, followed by thorax CT. Although these investigations cause long stays in the emergency service, they are helpful for the diagnosis and treatment in multiple trauma patients.

Computed tomography is preferred more than USG in some centers because it gives more confident knowledge about the injury region and degree (4). Hemodynamically stable patients whose USG is unclear or positive should undergo CT scanning for further evaluation. Hemodynamically stable patients with negative FAST results should be observed a minimum of 6 hours in the emergency service; abdominal injury should be excluded with control USG. Hemodynamically stable patients with positive FAST results and patients who can be stabilized with fluid resuscitation should undergo CT scanning (5, 6). If the patient is unstable and requires emergency surgery and there is no time for abdominal CT, the tissues should be evaluated with FAST (6).

The presence of free fluid in three spaces directs clinicians to surgery. In general, while FAST is used for free fluid in abdominal trauma patients, the CT scan can easily show solid tissue damage and free fluid. DPL is usually preferred in patients whose stretcher transfer is unfavorable and unconscious patients with unclear physical examination. But, it is invasive, requires time, has complications, and is not suitable for obese and pregnant patients (7).

In some studies, high sensitivity and specificity values for FAST have been reported (8-10). In our study, we tried to evaluate the solid tissue damage of patients with USG, converse to other studies (11, 12). Because, free fluid intended FAST can not determine injuries those would not result with hemoperitoneum or late hemoperitoneum (diaphragm, visceral tissue damage) (11, 13). There are different studies in the literature about the sufficient effectivity of FAST in blunt traumas. Brown et al. reported that the sensitivity of USG was 96% and that it would be a useful evaluation for blunt abdominal trauma patients (14). Similarly, in Farahmand's study, the sensitivity was 97% and the specificity was 92% in blunt abdominal injury patients (4). Kuncir et al. compared USG and peritoneal aspiration, and the sensitivity was 50% and the specificity was 95% (15). This sensitivity value decreased to 46% in another study (16). Similar to the literature, in our study, the sensitivity of USG was 50% and specificity was 93.7%.

Soffer et al. studied penetrating injuries, and in their study, the sensitivity of USG was 48%. They reported that USG is not reliable for surgery decisions in penetrating abdominal injury patients (17).

It is clear that USG is an operator-dependent diagnostic tool, and this situation reflects the results. In a study, emergency FAST physicians and emergency non-senior residents were compared, and a 50% difference was determined in the results (8).

Table 2. Distribution of patients whose Hb decreased and did not according to USG and abdominal CT positivity

	Hb						
	Decreased		Not decreased		Total		
	n	%	n	%	n	%	p*
USG							
(+)	22	75.9	7	24.1	29	13.4	0.813
(-)	138	73.8	49	26.2	187	86.6	
Abdominal CT							
(+)	28	87.5	4	12.5	32	14.8	0.060
(-)	132	71.7	52	28.3	184	85.2	
Total	160	74.1	56	25.9	216	100.0	

**Chi-square test*
Hb: Hemoglobin, USG: Ultrasound, CT: Computed tomography

Table 3. USG and abdominal CT positivity distribution of patients according to WBC difference

1st and 2nd WBC difference (/mm³)	(+)		(-)		Total		
	n	%	n	%	n	%	p*
USG							
0-3.0	14	14.7	81	85.3	95	44.0	0.941
3.1-6.0	8	11.4	62	88.6	70	32.4	
6.1-10.0	3	9.4	29	90.6	32	14.8	
>10.0	4	21.1	15	78.9	19	8.8	
Total	29	13.4	187	86.6	216	100.0	
Abdominal CT							
0-3.0	15	15.8	80	84.2	95	44.0	0.797
3.1-6.0	8	11.4	62	88.6	70	32.4	
6.1-10.0	8	25.0	24	75.0	32	14.8	
>10.0	1	5.3	18	94.7	19	8.8	
Total	32	14.8	184	85.2	216	100.0	

**Chi-square test*
WBC: White blood cell, USG: Ultrasound, CT: Computed tomography

In our emergency service, FAST evaluation of trauma patients is performed by senior radiology residents. Patients undergo control USG or abdominal CT scanning according to their trauma degree and clinical observations.

Pelvic injuries probably can easily be overlooked and should be kept in mind in multitrauma patients. In a study, the USG reliability in pelvic ring injuries was insufficient (17). Similarly, visceral tissue damage and diaphragmatic and retroperitoneal injuries can not be determined easily with USG (17).

Study Limitations

Abdominal ultrasound is an operator-dependent procedure, and in our emergency service, USG is performed by a senior radiology resident. Emergency resident experiences could not be evaluated in this study.

Table 4. Mean 1st and 2nd Hb and WBC value distribution of patients according to USG and CT positivity

	(+)		(-)		Total		p*
	n	Mean±SD	n	Mean±SD	n	Mean±SD	
USG							
1.HGB	30	12.87±2.83	196	13.57±1.85	226	13.48±2.02	0.200
2.HGB	29	12.23±3.13	187	13.07±1.94	216	12.96±2.15	0.170
1.WBC	30	12.85±5.31	196	12.61±5.3	226	12.64±5.29	0.819
2.WBC	29	15.56±7.11	187	15.5±6.03	216	15.51±6.17	0.960
Abdominal CT							
1.HGB	36	12.88±2.59	190	13.59±1.87	226	13.48±2.02	0.053
2.HGB	32	11.93±2.88	184	13.14±1.95	216	12.96±2.15	0.027
1.WBC	36	14.92±5.54	190	12.21±5.15	226	12.64±5.29	0.005
2.WBC	32	16.55±6.07	184	15.33±6.18	216	15.51±6.17	0.302

**Independent sample t test*

USG: Ultrasound, HGB: Hemoglobine, WBC: White blood cell, CT: Computed tomography

Conclusion

Multiple trauma patients with positive USG findings according to their hemodynamic situations and multitrauma patients with suspicious USG findings should undergo abdominal CT scan in the emergency service.

Ethics Committee Approval: Ethical committee approval was obtained from Bozyaka Research and Education Hospital Education Committee.

Informed Consent: Informed consent was obtained from the patients.

Peer-review: Externally peer-reviewed.

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