TRIDHA
Journal of Clinical Cases & Reports
Volume 2023, Issue S13, 10 pages
https://doi.org/10.46619/joccr.2023.6-S13.1003

CLINICAL RESEARCH

Value of Focused Assessment with Sonography for Trauma in Management of Hypotensive Polytrauma Patients: A Meta-Analysis

Philobater Bahgat Adly Awad* and Basma Hussein Abdelaziz Hassan

Department of Medicine, Ain Shams University, Egypt

Correspondence should be addressed to Philobater Bahgat Adly Awad, Department of Medicine, Ain Shams University, Egypt

Received: 27 January 2023; Accepted: 06 February 2023; Published: 13 February 2023

Copyright © Philobater Bahgat Adly Awad. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

BACKGROUND

Severe or major trauma is a worldwide pandemic and one of the leading causes of death and disability. Polytrauma always involves young, productive individuals and represents a substantial burden on the society Management of Trauma injuries generally emphasizes the importance of identifying and prioritizing the most serious life-threatening injuries and managing them. Management consists of a rapid primary survey, resuscitation of vital functions, a more detailed secondary survey, and, finally, the initiation of definitive care. Damage-control surgery has increasing role as it proves reliability in the most sensitive situations.

OBJECTIVE

To assess the Value of focused assessment with sonography for management of hypotensive polytrauma patients.

PATIENTS AND METHODS

All trials about the usage include participants who came to ER due to polytrauma with blunt or penetrating abdominal trauma or with undifferentiated shock, randomized controlled trials and prospective or retrospective cohort studies that assess the value of focused sonography in hypotensive polytrauma patients.

RESULTS

The value of an odds ratio like that of other measures of test performance for example sensitivity and specificity and likelihood ratios depends on prevalence. For example, a test with pooled diagnostic odds ratio of 10.00 is considered to be very good by current standards, therefore pooled diagnostic odds ratio of 77.46 which is considered to be very good. Spearman correlation coefficient:- 0.429 with p value 0.397 which is insignificant so, there was low threshold effect Positive and negative Likelihood ratio both are done on six studies with positive

likelihood ratio is 21.27 and negative likelihood ratio is 0.29 sensitivity and specificity are done on the six studies with pooled sensitivity is 0.73 and pooled specificity is 0.98.

DATA SOURCES

Medline databases (PubMed, Medscape, ScienceDirect. EMF-Portal) and all materials available in the internet till 2022.

CONCLUSION

FAST is significant in polytrauma patients especially in hypotensive patients with considerable accuracy rate 77.46 and good pooled sensitivity with 0.73 and pooled specificity with 0.98 and good ROC curve with are under the curve 0.70.

KEYWORDS

Acute coronary syndrome; Focused assessment with sonography in trauma

INTRODUCTION

Traumatic injury is the leading cause of death among individuals younger than 45 years old. Eighty percent of traumatic injury is blunt with the majority of deaths secondary to hypovolemic shock [1].

In fact, intraperitoneal bleeds occur in 12% of blunt trauma therefore, it is essential to identify trauma quickly. The optimal test should be rapid, accurate, and non-invasive [2].

Historically, providers performed diagnostic peritoneal lavage (DPL) to detect hemoperitoneum. While extremely sensitive (96% to 99%) and specific (98%), DPL is an invasive procedure with a complication rate of 1% [3].

The implementation of point of care ultrasound has significantly impacted the evaluation and treatment of patients [4].

The use of ultrasound to detect intraperitoneal fluid was first described in Europe during the 1970s. However, widespread adoption in the United States did not occur until the 1990s. The Focused Assessment with Sonography in Trauma (FAST) is an ultrasound protocol developed to assess for hemoperitoneum and hemopericardium. Numerous studies have demonstrated sensitivities between 85% to 96% and specificities exceeding 98% [5].

The FAST exam evaluates the pericardium and three potential spaces within the peritoneal cavity for pathologic fluid. The right upper quadrant (RUQ) visualizes the hepatorenal recess, also known as Morrison's pouch, the right paracolic gutter, the hepato-diaphragmatic area, and the caudal edge of the left liver lobe [6].

Next, obtain subxiphoid (or subcostal) views to evaluate the pericardial space. Ultrasound detects as little as 20 cc of pericardial fluid [7].

Following the subxiphoid view, image the left upper quadrant (LUQ) to inspect the splenorenal recess, the subphrenic space, and the left paracolic gutter, as well as the left lower hemithorax when performing an Extended

FAST exam (eFAST). Finally, suprapubic images evaluate for free fluid in the rectovesical pouch in males and the rectouterine (Pouch of Douglas) and vesicouterine pouches in females [8].

In the subset of hypotensive trauma patients, the sensitivity of the FAST exam approaches 100%. Experienced providers perform the FAST exam in less than 5 minutes, and its use decreases time to surgical intervention, patient length of stay, and rates of CT and DPL [9].

During the past 20 years, multiple studies have reported on the sensitivity and specificity of FAST for detecting intra-abdominal injury. The majority of these have been done in hemodynamically stable patients with blunt trauma and have reported a high specificity and lower sensitivity, indicating that a positive FAST is highly predictive of the presence of an intra-abdominal injury, whereas a negative FAST does not exclude injury [10].

METHODOLOGY

Search Strategy

The PubMed, Web of science and Scopus were searched on February 15, 2022. The keywords were (Polytrauma) (Focused sonography) (Hypotensive), (FAST).

Relevant articles referenced in these primary studies were also searched to enroll additional cases, some articles were searched from the references of some studies.

Eligibility Criteria

All trials about the usage include participants who came to ER due to polytrauma with blunt or penetrating abdominal trauma or with undifferentiated shock, randomized controlled trials and prospective or retrospective cohort studies that assess the value of focused sonography in hypotensive polytrauma patients.

Patients who refused investigation, in addition to papers with other languages than English and reviews, case reports or studies regarding animals were excluded (figure 1).

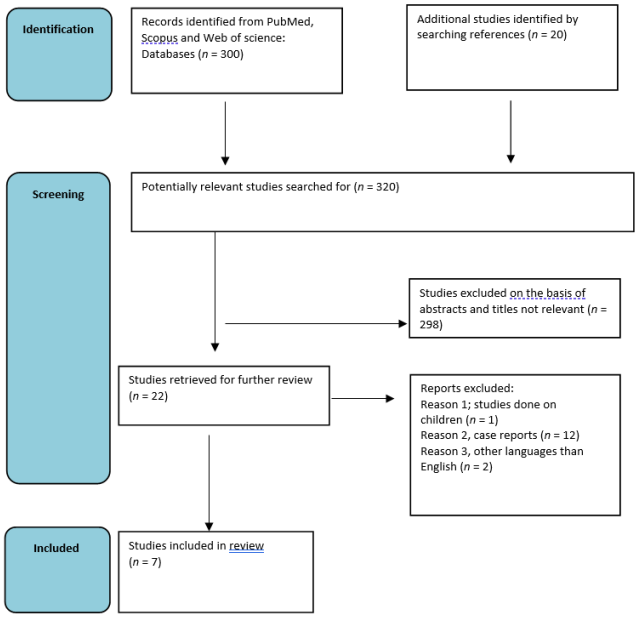

Figure 1: Prisma flowchart.

Outcomes

Outcomes of this study included sensitivity and specificity, in addition to, receiver operating characteristic curve (ROC curve), diagnostic odds ratio, negative and positive likelihood ratio and threshold effect of FAST in hypotensive polytrauma patients.

Quality Assessment

Each article was assessed by two independent researchers based on the Cochrane Handbook 5.0.2 and data were extracted separately by the two researchers. The included trials were evaluated with the following criteria: adequate sequence generation, allocation concealment, blinding of participants and outcome assessors, incomplete outcome data, free of selective reporting and free of other bias. Each type of bias was defined by an answer (Yes/No/Unclear). Yes, " Indicated low risk of bias, " No " Represented high risk and " Unclear " Represented unclear risk. In addition, the quality of evidence for each outcome was assessed by the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) system (33). Schünemann H, Brożek J, Guyatt G, et al. (2013) (Table 1) GRADE handbook for grading quality of evidence and strength of recommendations.

Table 1: Shows quality assessment in cohort studies selected.

	Selection				Comparability	Outcome			Results
Study	Is the Case Definition Adequate?	Selection of Controls	Representativeness of the Cases	Definition of Controls	Comparability of Cases and Controls on the Basis of the Design or Analysis	Assessment of Outcome	Was follow-up long enough for outcomes to occur	Adequacy of follow-up of cohorts	GOOD\Fair\Poor
Tsui 2008	*	___	*	___	*	*	*	*	(6*) Fair
Geraldo 2018	*	*	*	*	*	*	*	*	(8*) Good
Razi 2007	*	___	*	*	___	*	*	*	(6*) Fair
O'Brien 2015	*	___	*	___	___	*	*	*	(5*) Fair
Becker 2010	*	___	*	*	___	*	*	*	(6*) Fair
Carter 2014	*	___	*	___	___	*	*	*	(5*) Fair
Elbaih 2017	*	___	*	___	___	*	*	*	(5*) Fair

Statistical Analysis

Statistical analysis was performed by Meta disc version 5.3 software. The odds ratio (OR) with 95% confidence interval (95% CI) with ratio of 10 is considered to be very good test by current standards.

We test heterogeneity by threshold effect using spearman correlation coefficient more than 10 and P value less than 0.05 is significant.

Area under the curve was tested using ROC curve, Positive likelihood ratio tells how much to increase the probability of having the condition given a positive test result and negative likelihood ratio tells how much to decrease the probability of having the condition with 0.9 - 1.0 is excellent, 0.8 - 0.9 is very good, 0.7 - 0.8 is good, 0.6 - 0.7 is sufficient, 0.5 - 0.6 is bad and less than 0.5 is not a useful test.

RESULTS

Seven trials included Value of focused assessment with sonography for trauma in management of hypotensive polytrauma patients were selected from electronic databases [11-17].

The characteristic of studies collected is shown in Table 2.

Table 2: The characteristic of studies collected.

First Author, Year	Population, Type of Trauma	Methods	Type of Scan	Results of Accuracy
Tsui 2008	242 Blunt trauma patients	Retrospective cohort study	FAST	The sensitivity and specificity of the FAST scan were 86% and 99%, respectively, with the accuracy of 97%
Geraldo 2018	120 Blunt trauma	Observational prospective cohort	FAST	Sensitivity was 67.5%, specificity was 98.7%, the positive predictive value was 96.4% and accuracy was 88%
Razi 2008	102 With abdominal injuries	Retrospective study	bedside FAST	The sensitivity, specificity, and accuracy of FAST were 75%, 97.6%, and 93.1%, respectively
Kathleen M O'Brien 2015	100 Cases with blunt trauma	Retrospective cohort review	EFAST	Not mentioned
Becker 2010	3181 With blunt trauma	Retrospective cohort review	EFAST	Overall sensitivity and specificity were 75% and 98%, respectively, with overall accuracy 95%
Jeffrey W Carter 2014	1671 Blunt trauma	Retrospective cohort	EFAST	In 114 hemodynamically stable patients, FAST was positive in 25 patients, with a sensitivity of 22%. In 32 hemodynamically unstable patients, FAST was positive in 9 patients, with a sensitivity of 28%. In patients who underwent laparotomy, FAST exam was only positive in 10 out of 20 patients (50%) in the hemodynamically stable patients, and 9 out of 19 patients (47%) in the hemodynamically unstable patients. Specificity was 80 % and accuracy is 71.9%
Adel Hamed Elbaih 2017	150 Blunt patient	Cross-sectional study	EFAST	The sensitivity and specificity were 92.6% and 100%, respectively. The negative predictive value was 92%, while the positive predictive value of FAST was 100%. The accuracy of FAST was 96%

Diagnostic Odds Ratio

The value of an odds ratio like that of other measures of test performance for example sensitivity and specificity and likelihood ratios depends on prevalence.

For example, a test with pooled diagnostic odds ratio of 10.00 is considered to be very good by current standards, therefore pooled diagnostic odds ratio of 77.46 which is considered to be very good.

Spearman correlation coefficient: - 0.429 with p value 0.397 which is insignificant so, there was low threshold effect as shown in Figure 2.

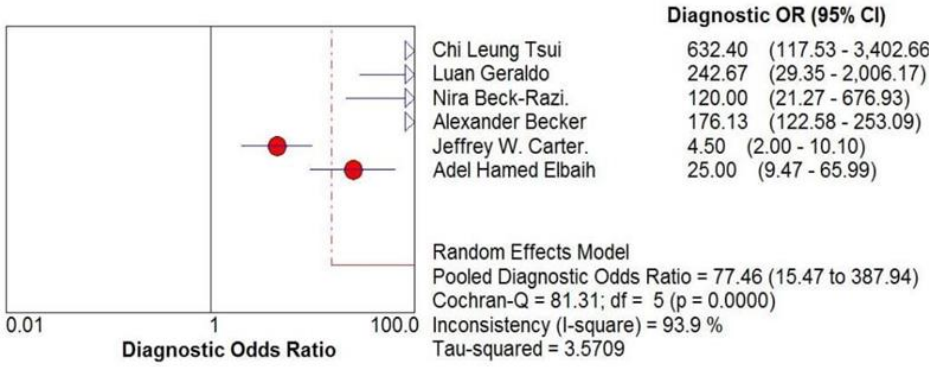

Figure 2: Shows diagnostic odds ratio.

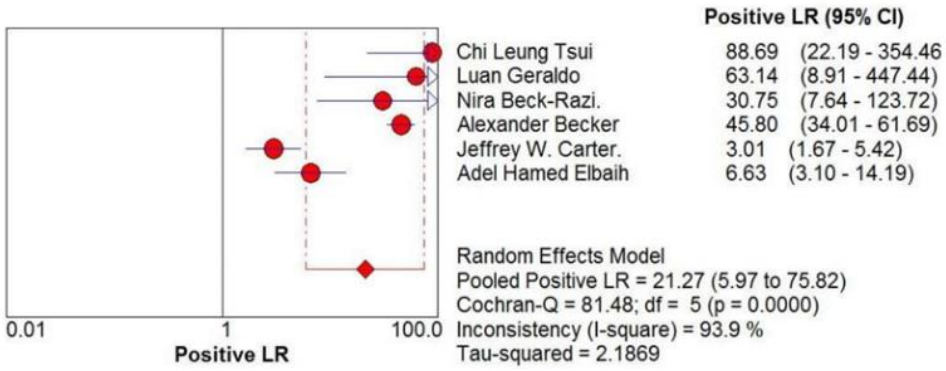

Figure 3: Shows positive likelihood ratio.

Positive and Negative Likelihood Ratio

Both are done on six studies with positive likelihood ratio is 21.27 and negative likelihood ratio is 0.29 (Figure 3 and Figure 4).

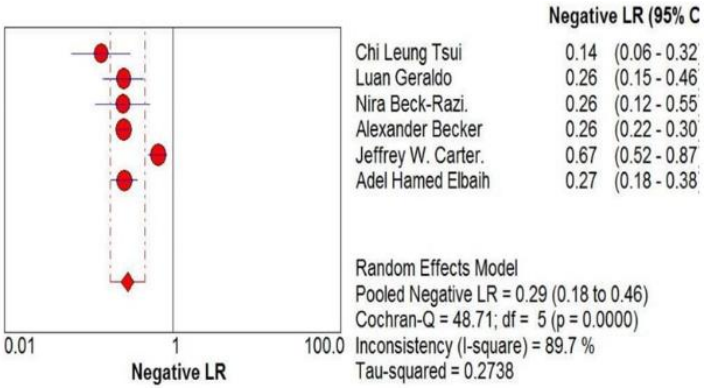

Figure 4: Shows negative likelihood ratio.

ROC curve is shown in figure with area under the curve 0.7 which is good (Figure 5).

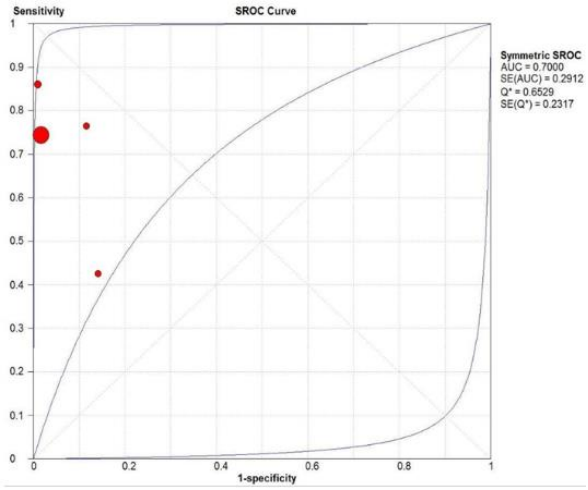

Figure 5: Shows ROC curve.

Sensitivity and specificity are done on the six studies with pooled sensitivity is 0.73 and pooled specificity is 0.98 as shown in Figure 6 and Figure 7.

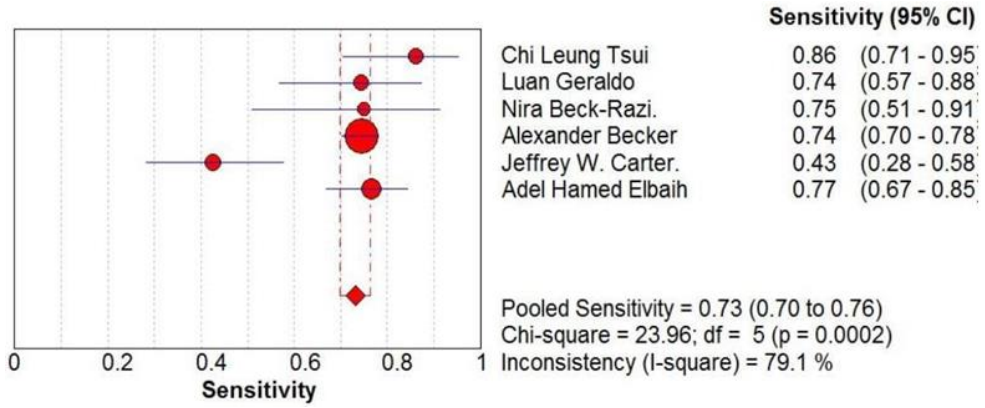

Figure 6: Shows sensitivity.

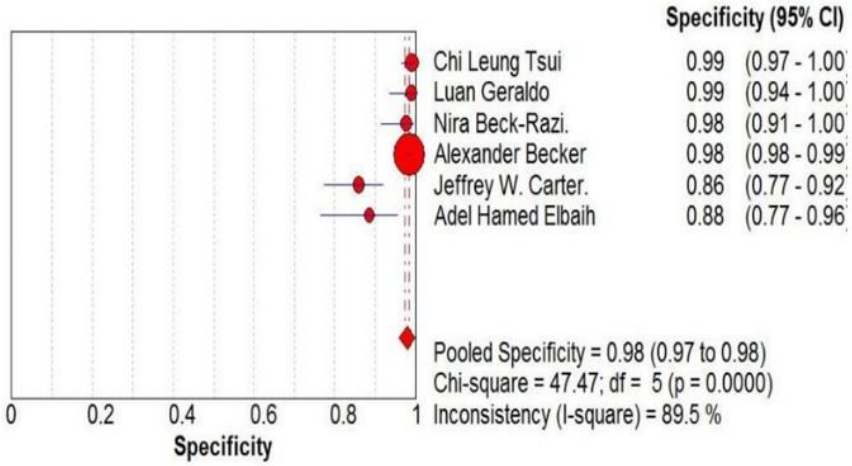

Figure 7: Shows specificity.

DISCUSSION

The current meta-analysis is to analyze Value of focused assessment with sonography for trauma in management of hypotensive polytrauma patients. We have comprehensively searched and assessed the published literature regarding this topic.

In this study an overview of the current evidence was created regarding the use of FAST and EFAST in trauma patients especially hypo-tensive patients.

Ultrasound is a useful diagnostic tool in hospitals; with recent improvements in technology, it has shown great importance in emergency contexts, assisting physicians in critical decision-making [11].

Ultrasound represents an important tool for managing polytrauma patients when they experience shock, hypotension, and hemodynamic instability after trauma or its complications, and when their unstable conditions do not allow their movement to other departments (i.e., the radiology department) or hospitals [12].

In our experience, ultrasound contributed to the immediate clinical and diagnostic management of the patients during the initial evaluation and subsequent monitoring of their condition. In fact, in the beginning, ultrasound was useful for rapid diagnosis with FAST, for indicating negative results when the patient became hemodynamically stable. Later, was fundamental in monitoring the patient when presented with abdominal effusion, heart hypovolemia and during recovery and associated regaining of normal hemodynamic conditions [13].

Therefore, FAST played a key role in abdominal effusion, the monitoring and the staging of liver and lung lesions. Positive interpretations assessment significantly increased the likelihood of injury and could include triage to the appropriate hospital, improved hospital preparation and expedited lifesaving interventions. Negative interpretations were not sufficient for factoring into decision making [14].

Evidence based recommendations regarding the appropriate use of bedside ultrasound are a step forward in critical care practice, improving patient outcomes [15].

Bedside ultrasound is a real-time imaging, non-invasive, indolent, and non-ionizing radiation method that offers valuable diagnostic information, which is useful for supporting, refuting, or changing a clinical diagnostic hypothesis [16].

Farahmand et al. [17] performed a retrospective analysis of FAST in 129 hypotensive injured patients at a single center for a 9-years period and reported that ultrasonographic examination had a sensitivity of 85% for detecting any injury and 97% for detecting injuries requiring operation.

On controversy other studies showed that in hypotensive patients with a negative FAST, clinicians should still maintain a high index of suspicion for significant abdominal hemorrhage and that it had a sensitivity of 62% and specificity of 83% [18].

In summary, the accuracy rate was considered to be adequate 77.46 in six studies with good sensitivity 0.73 and specificity 0.98 and good ROC curve with area under the curve 0.70.

Some factors influence the use of ultrasound and should therefore be taken into consideration. First of all, insufficient time, difficult visualization of the screen in daylight and motion of aircraft.

Furthermore, the assessment of the ultrasound performed was complicated in patients with e.g. obesity, subcutaneous emphysema, patient packaging such as haemostatic dressings, making one or more views inaccessible. Secondly, the diversity consisted of both the patients and type of trauma undergoing ultrasound, and the ultrasound operator.

The included patients had either chest trauma, abdominal trauma or both; penetrating injuries, blunt injuries or both. A more homogeneous result could be presented when all patients included had sustained comparable injuries.

Thirdly, the accuracy of ultrasound differs strongly with the level of practice and experience of the operator.

LIMITATIONS

This meta- analysis is limited by the level of evidence and qualities of the studies analyzed. Although most studies did report similar objective criteria to measure treatment outcomes, many studies employed different grading systems. Only small number of studies performed power analyses. Moreover, it was difficult to reach a greater sample size and we did not have complete homogeneity with the method of scintigraphy because the studies were done in different institutions. Selection bias was also present, as many of these studies were retrospective reviews.

CONCLUSION

FAST is significant in polytrauma patients especially in hypotensive patients with considerable accuracy rate 77.46 and good pooled sensitivity with 0.73 and pooled specificity with 0.98 and good ROC curve with area under the curve 0.70.

CONFLICT OF INTERESTS

No.

REFERENCES

1. Teixeira PG, Inaba K, Hadjizacharia P et al. (2007) Preventable or potentially preventable mortality at a mature trauma center. Journal of Trauma and Acute Care Surgery 63(6): 1338-1347.
2. Poletti PA, Mirvis SE, Shanmuganathan K et al. (2004) Blunt abdominal trauma patients: Can organ injury be excluded without performing computed tomography?. Journal of Trauma and Acute Care Surgery 57(5): 1072-1081.
3. Griffin XL and Pullinger R (2007) Are diagnostic peritoneal lavage or focused abdominal sonography for trauma safe screening investigations for hemodynamically stable patients after blunt abdominal trauma? A review of the literature. Journal of Trauma and Acute Care Surgery 62(3): 779-784.
4. Richards JR and McGahan JP (2017) Focused assessment with sonography in trauma (FAST) in 2017: What radiologists can learn. Radiology 283(1): 30-48.
5. Boulanger BR, McLellan BA, Brenneman FD et al. (1996) Emergent abdominal sonography as a screening test in a new diagnostic algorithm for blunt trauma. Journal of Trauma and Acute Care Surgery 40(6): 867-874.
6. Rozycki GS, Ochsner MG, Feliciano DV et al. (1998) Early detection of hemoperitoneum by ultrasound examination of the right upper quadrant: A multicenter study. Journal of Trauma and Acute Care Surgery 45(5): 878-883.
7. Mandavia DP, Hoffner RJ, Mahaney K et al. (2001) Bedside echocardiography by emergency physicians. Annals of Emergency Medicine 38(4): 377-382.
8. Brooks A, Davies B, Smethhurst M et al. (2004) Emergency ultrasound in the acute assessment of haemothorax. Emergency Medicine Journal 21(1): 44-46.
9. Lobo V, Hunter-Behrend M, Cullnan E et al. (2017) Caudal edge of the liver in the right upper quadrant (RUQ) view is the most sensitive area for free fluid on the FAST exam. Western Journal of Emergency Medicine 18(2): 270-280.
10. Patel NY and Riherd JM (2011) Focused assessment with sonography for trauma: Methods, accuracy, and indications. Surgical Clinics 91(1): 195-207.
11. Malaguarnera G, Catania VE, Francaviglia A et al. (2017) Lipoprotein (a) in patients with hepatocellular carcinoma and portal vein thrombosis. Aging Clinical and Experimental Research 29: 185-190.
12. Marconi S, Pugliese L, Botti M et al. (2017) Value of 3D printing for the comprehension of surgical anatomy. Surgical Endoscopy 31: 4102-4110.
13. Blanco P and Volpicelli G (2016) Common pitfalls in point-of-care ultrasound: A practical guide for emergency and critical care physicians. Critical Ultrasound Journal 8: 1-12.
14. Ha YR and Toh HC (2016) Clinically integrated multi-organ point-of-care ultrasound for undifferentiated respiratory difficulty, chest pain, or shock: A critical analytic review. Journal of Intensive Care 4(1): 1-19.
15. Ranga U, Kalra N, Saxena AK et al. (2016) Focal hepatic lesions characterisation by different sonographic techniques: A prospective analysis. Journal of Ultrasound 19: 15-23.
16. Testa A, Giannuzzi R, De Biasio V (2016) Case report: Role of bedside ultrasonography in early diagnosis of myonecrosis rapidly developed in deep soft tissue infections. Journal of Ultrasound 19(3): 217-221.
17. Farahmand N, Sirlin CB, Brown MA et al. (2005) Hypotensive patients with blunt abdominal trauma: Performance of screening US. Radiology 235(2): 436-443.
18. Roberts I, Shakur H, Coats T et al. (2013) The CRASH-2 trial: A randomised controlled trial and economic evaluation of the effects of tranexamic acid on death, vascular occlusive events and transfusion requirement in bleeding trauma patients. Health Technology Assessment 17(10): 1-79.