

Ultrasonography in the Diagnosis of Traumatic Haemothorax

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INTRODUCTION

The use of ultrasonography (US) for accurately identifying of free pleural fluid in the emergency patients sustaining blunt and penetrating trauma has been well established over the past 30 years [1,2]. This result may be available before the standard trauma supine chest radiography and could potentially be more accurate permitting early and precise definition of the location of bleeding in the unstable trauma patient. Many reports point out the advantage of ultrasonography in the detection, diagnosis, follow-up and planning initial therapy of the hemothorax in major trauma patients [3,4,5]. Percutaneous diagnostic interventions under US or CT (computer tomography) control of free pleural collections are widely accepted as useful procedure with high diagnostic efficacy and low complication rate [6,7,8].

AIM

To present our experience concerning the place of ultrasonography in the diagnosis, follow-up and therapy of free and encapsulated haemorrhagic collections in polytrauma patients.

MATERIAL AND METHODS

Thoracic US, supine chest radiography, and CT were performed to assess for haemothorax in 107 patients (35 female and 72 male) who sustained acute trauma of the chest. US examination were performed in detecting a relatively small amount of pleural fluid in a supine patient who, for trauma reasons, cannot be moved.

The radiologist was the part of the trauma team. The right and left intercostals oblique views as posteriorly as possible were used to examine the chest. The standard two thoracic views were performed in a few (3-8) minutes. US findings were compared with CT findings- the reference standard for haemothorax detection. For the purpose of this study, the sonographers were blinded to the radiographic and CT findings. Interventional procedures under imaging (US and CT) control were performed in 35(32.71%) of all 107 patients in the conditions of emergency to decide whether it should be treated conservatively or with a drain or thoracoscope. All examinations and invasive manipulations were performed with the informed consent of patients.

The following method and materials were used:

- Ultrasonic equipment with 3.5 and 7 MHz linear, convex and biopsical transducers for guidance of the interventional procedures.
- CT investigations and guidance were done with a 16-slice scanner.

- The “Chiba” needles 18, 20, 22, 23G (Figure 1.) catheters pig-tail 7,8F and angiographic guide wires. A modified “Chiba” needle with hole 5mm distant from the tip of the needle which allow better highlighting and quicker evacuation of the liquid collections was used in some cases.
- Methods of guiding the interventional procedures:
 - a/ “Free-hand” puncture method under US control.
 - b/ US guiding method using biopsical transducer.
 - c/ “Free-hand” method for puncture and drainage under CT control.

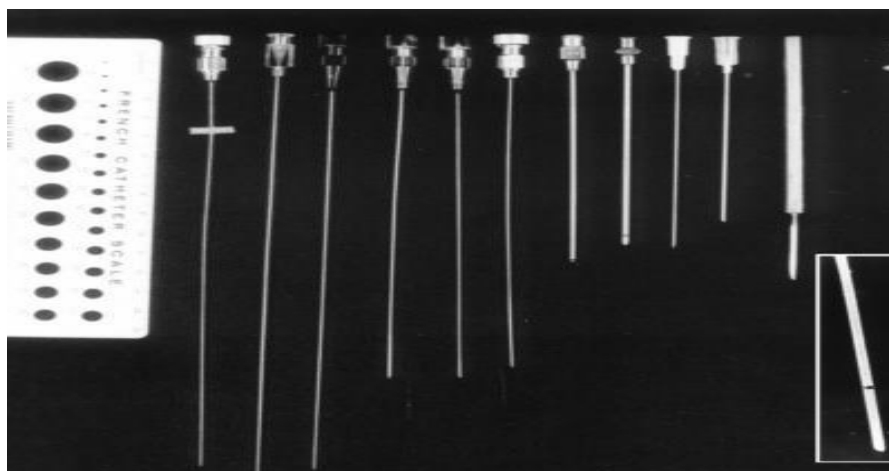


Figure 1. System for interventional procedures- “Chiba” needles 18, 20, 22, 23G, and modified “Chiba” needle with hole 5mm distant from the tip of the needle

RESULTS

In 107(35 female and 72 male) thoracic trauma patients in the conditions of emergency from August 2007 to September 2009 year, were performed conventional examinations and interventional procedures under US and CT control. All of the conventional ultrasound examinations were performed immediately after the primary clinical survey in the emergency department with the patient supine.

In 102(95.32%) of all 107 patients during the initial study two anatomic areas were examined by the rapid trauma US for detecting free fluid - the right and left intercostals oblique view as posteriorly as possible. In the ultrasound examination haemorrhagic fluid in the pleural cavity was viewed as an anechoic space cranially to the hyperechoic line that represents the diaphragm (Figure 2). Thirty-five fine-needle aspirations (FNA) under US control were performed for diagnostic reasons. We divided the performed diagnostic imaging examinations of the emergency patients as:

Diagnostic Noninvasive

In all 107 patients were performed US examination during the initial study in a supine patient who, for trauma reasons, cannot be moved. Altogether 85(79.43%) of all 107 polytrauma patients included in the study has haemothorax. When comparing the trauma US examination to the criterion standard definition, there were 64 true positives, 9 true negatives, 4 false positive and 8 false negative results.

Overall, this demonstrated that ultrasonography had a sensitivity-88.88%, specificity-69.23%, accuracy – 85.88% and the PPV-94.11% and the NPV-52.94%.



Figure 2. US images of traumatic haemothorax: free fluid in the pleural cavity-inter and subcostal view - an anechoic space cranially to the hyperechoic line that represents the diaphragm

Diagnostic Invasive Procedures

FNA were performed in 35(32.71%/) of all 107 trauma patients with detected pleural liquid collections in the aim to specify the nature of fluid and to decide whether it should be treated conservatively or with a drain or thoracoscope. In 32(91.42%) of them a sufficient amount of liquid collections was obtained, favoring the diagnosis and planning following therapy. A haemothorax during puncture is shown at Figure 3. Only in 3(8.57%) cases of 35 patients with performed invasive manipulations we failed to obtaine pleural fluid due to thickened pleura. All FNAs were continued with evacuation of liquid collection as much as is possible concerning individual status of the patients.



Figure 3. US image of haemothorax during puncture with Hyperechoic shadow from the tip of the needle.

In 3 patients (8.57%) of all 35 punctured patients with big amount of haemorrhagic fluid we extended the procedures with drainage by inserting catheters under imaging control. The drainage was kept for approximately 5 days. US control were used to follow-up these patients because of usefulness in detecting organisation of haematoma, presentation of septae etc (Figure 4).



Figure 4. US control were used to follow-up and to detect organisation of haematoma, presentation of septae etc.

In 2(3.7%) cases the haemorrhagic fluid restored after the invasive manipulations and the thoracostomy were performed followed by surgical interventions. In 5(14.28%) cases with insufficient evaluation of haemorrhagic collection and control of the needle we used CT control for better visualization of the interventional procedures (Figure 5).

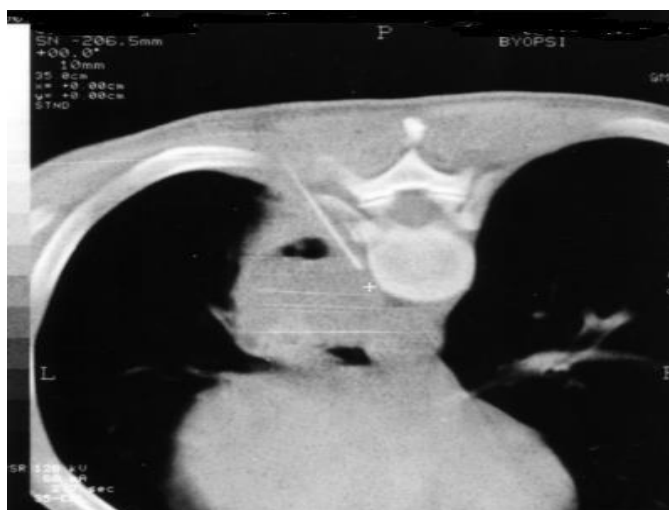


Figure 5. Punctured haemothorax under CT control.

DISCUSSION

Focused assessment with sonography for trauma by trained radiologists has been shown to provide an accurate and rapid evaluation of haemothorax therefore augmenting clinical decision making [9,10,11].

This may be available before the standard trauma supine chest radiography and could potentially be more accurate permitting early and precise definition of the location of bleeding in trauma patient who cannot be moved. In our series most of the ultrasound results were available considerably earlier than the chest radiograph.

Furthermore, interrogation of the standard two thoracic views can be performed in a mean time of four minutes, improving the time to the diagnosis of bleeding in either of the two main body cavities.

Our study demonstrated that the ultrasound examination can serve as a sensitive, specific and accurate diagnostic tools in detecting traumatic haemothorax in major trauma patients.

The speed and accuracy of US examination with the possibilities to detect smaller quantities of pleural fluid than the chest radiograph may be of benefit in the diagnosis and treatment of trauma patients. It is estimated that the supine chest radiograph can detect a minimum of 175ml of pleural fluid by contrast of US– minimum of 20ml [12,13].

CONCLUSION

Our experience and literature reports support the opinion that US should be used as a primary method in diagnosis and monitoring of haemothorax in major trauma patients. We supports the opinion that the fine-needle aspiration (FNA) under US or CT control should be applied as a method of choice in difficult to differentiate cases.

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