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The place of US for the diagnosis of clinically suspected abdominal bleeding in trauma patients

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Abstract

Aims and Objectives: The detection of liquid collections remains a challenge for the trauma team, especially when there is multiple trauma. We present our experience in the diagnosis, follow-up and planning therapy of free and encapsulated abdominal liquid collections by performing ultrasound examination.

Methods: 143 emergency trauma patients /116 male and 27 female/ were examined using ultrasound for a period of 2 years. The right and left oblique and propositioning view was used for US examination to identify free and bounded liquid collections in the abdominal cavity. The examination was performed immediately after the initial clinical survey with patients supine. Positive findings of liquid collections on US were compared with those provided by CT, punctures under US control or surgery. US machine supplied with 3.5 and 7 MHz linear and convex transducers, MDCT device, needles and catheters were used.

Results: One hundred and fifteen /80.41%/ of all 143 US examined trauma patients had free and encapsulated liquid collections, confirmed by CT scan, surgery, or clinical course. In 59 /51.30%/ patients we performed fine needle puncture under US control. There were 95 true-positives, 14 true-negatives, 2 false-positives and fore false-negative results. Overall this demonstrated that ultrasonography had a sensitivity of 95.95%, specificity of 87.50% and accuracy of 94.78%. The PPV is 97.93% and the NPV – 77.77%.

Conclusion: Our experience and literature reports support the opinion that US examination should be used as a primary method for diagnosis and follow-up of abdominal liquid collections in emergency patients.

Keywords: US examination; Abdominal bleeding; Emergency patient; Invasive procedures.

1. Introduction

1.1. Purpose

The detection of closed abdominal injury remains a challenge for the trauma team, especially when there is multiple trauma. Both false-positive and false-negative findings bear the risk of severe complications. The clinical problem is the poor reliability of the physical signs and symptoms that indicate the presence of visceral lesions and subsequent abdominal distension, especially in intubated or comatose patients. Clinical evaluation allows the detection of external hemorrhage and antero-posterior chest x-ray and tube thoracostomy are sufficient to rule out significant hemothorax [1,2]. Emergency room abdominal ultrasound (US) may be inconclusive in quantitation of intraperitoneal free fluid and false positive studies may result from retroperitoneal hematoma that leaks blood into peritoneal cavity. Contrast enhanced spiral computed tomography (CESCT) offers a complete imaging assessment of the abdomen and pelvis with

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the best sensitivity and specificity, including injuries of intra- and retroperitoneal organs, soft tissues and bones [3,4,5], but may be harmful in unstable hemodynamic conditions.

The use of ultrasonography for precise identification of free and localized intraperitoneal or retroperitoneal fluid in patients with blunt and penetrating trauma has been well established over the past 25 years [6,7,8,9].

The aim of this report is to present our experience in the diagnosis, follow-up and initial planning therapy of free and localized abdominal collections in trauma patients using conventional and interventional ultrasound.

2. Material and methods

One hundred forty-three patients /116 male and 27 female/ were examined using ultrasound for a period of 2 years. All US examinations followed primary clinical examination and were done in the Emergency room or in the Department of Radiology with the patient on a supine position. Right and left oblique, transversal and multilocational views were used to detect free and localized fluid collection in the peritoneal cavity and retroperitoneal space. Positive findings of the US examination were compared with those provided by computed tomography /CT/, punctures under US control, laparoscopy or surgery.

The following materials and methods were used:

- Ultrasonic equipment with 3.5 and 7 MHz linear, convex, and biosocial transducers for guidance the interventional procedures.
- CT investigations and guidance were acquired using a 16 slice scanner.
- The “Chiba “needles 18,20,22,23 G catheters pigtail 7,8F and angiographic guide wires (Fig. 1a, b).

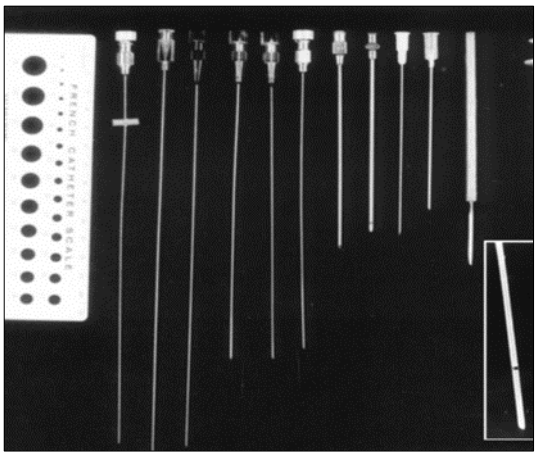

Figure 1a “Chiba “needles 18,20,22,23G used for invasive procedures

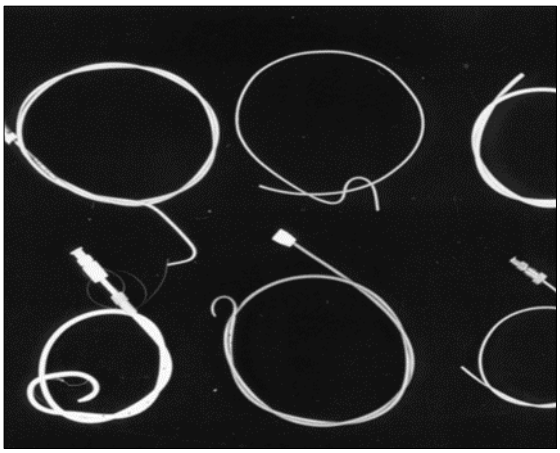

Figure 1b Catheters pigtail 7,8F and angiographic guide wires

- Methods of guiding the interventional procedures:
  - a/ “Free hand” biopsy and puncture method under US control.
  - b/ US guiding method using biosocial transducer.
  - c/ “Free hand” method for biopsy, puncture, and drainage under CT control.

3. Results and discussion

All US examinations were performed immediately after primary clinical examination with the patients on a supine position.

One hundred and fifteen of all 143 US examined trauma patients had free or localized fluid collection, which was verified by CT scan, tube laparoscopy, surgery or clinical course.

Furthermore, the US examinations of the emergency patients were classified as:

3.1. Diagnostic US examinations

Performed in all 143 patients. Ten of the patients were excluded from the study because tube laparoscopy had been performed prior to US examination. Altogether one hundred and fifteen patients had free or localized fluid collection.

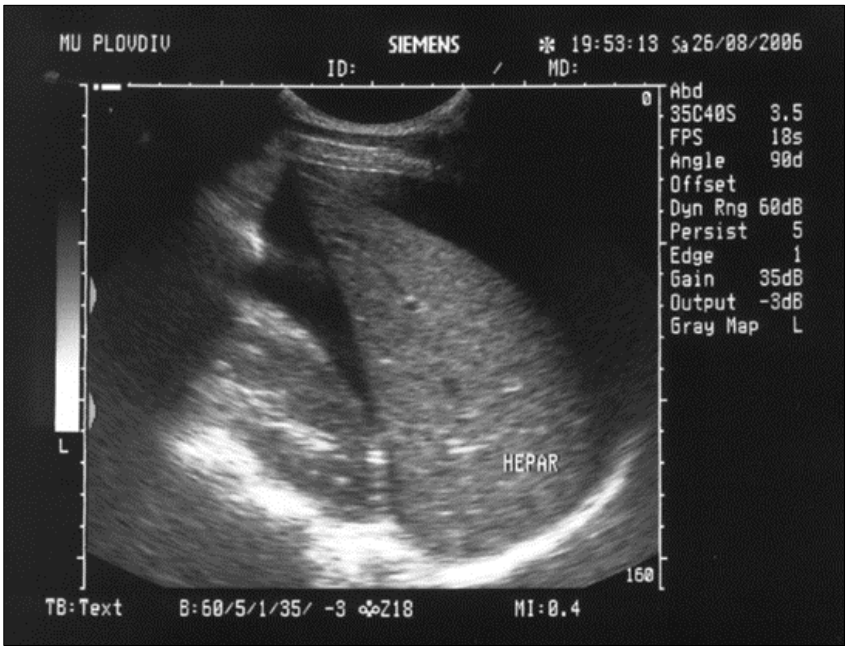

Figure 2 US image. The free liquid in the abdomen /hemoperitoneum/

The US images of hemoperitoneum, localized hematoma and subcapsular bleeding are presented on Fig. 2, 3 and 4.

Figure 3 US image. Localized liquid collections/haematoma/.

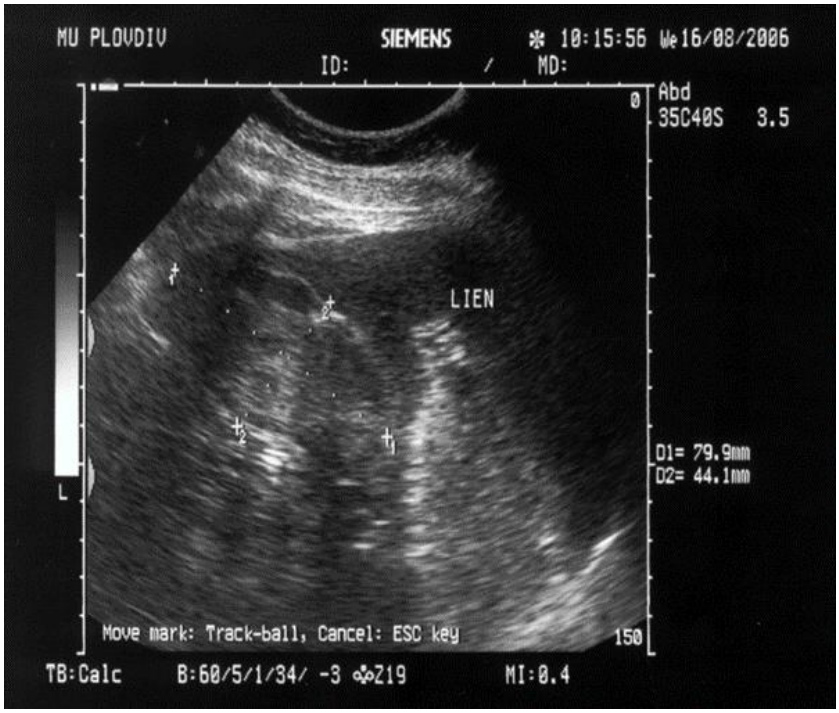

Figure 4 US image of the patient with subcapsular haematoma of the spleen.

3.2. Diagnostic interventional procedures –

FNP /fine needle punctures/ under US control were performed in 89 of all patients with detected fluid collections in the peritoneal cavity and retroperitoneal space. In 86 of them sufficient amount of liquid collection was obtained that favored diagnosis and allowed planning of the following therapy. Hemoperitoneum during puncture under US control is shown on Fig. 5.

Figure 5 Hemoperitoneum during the puncture under US control.

FNP /fine needle punctures/ under CT control was used only in 5 cases with insufficient evaluation of small amount of fluid and to define a safe percutaneous window allowing access to the collection avoiding vascular structures and bowel loop. A punctured hematoma under CT control is shown on Fig. 6.

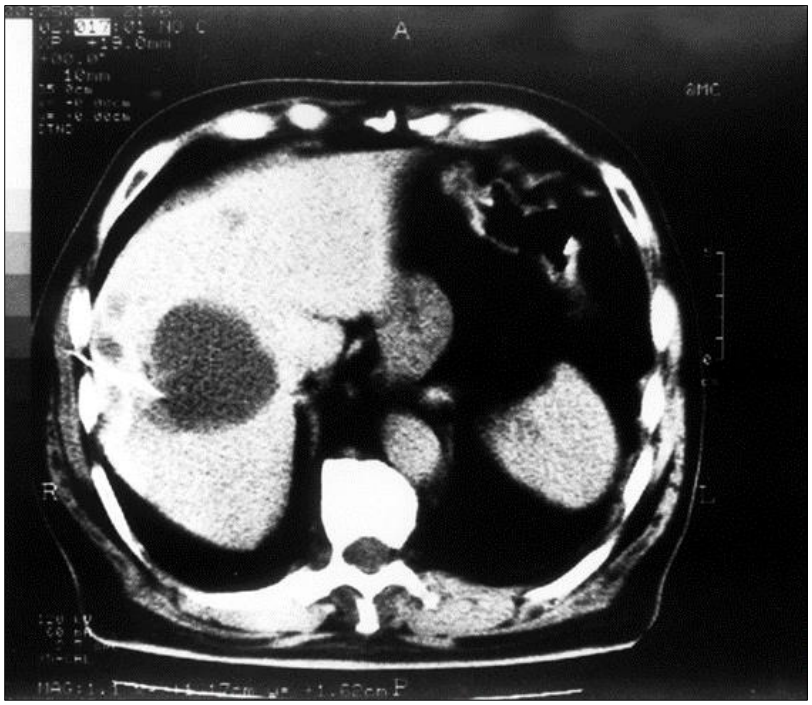

Figure 6 Patient with haematoma punctured under CT control.

Using noninvasive US examination and FNP under US or CT control of the patients with suspected abdominal liquid collections we obtained the following results: there were 95 true-positives, 14 true-negatives, 2 false-positives and fore false-negative results. Overall this demonstrated that ultrasonography had a sensitivity of 95.95%, specificity of 87.50% and accuracy of 94.78%. The PPV is 97.93% and the NPV – 77.77%.

These results demonstrated that ultrasonography can be used as a sensitive, specific and accurate diagnostic tool for detecting hemoperitoneum in clinically suspected abdominal bleeding in major trauma patients. The speed and accuracy of US examinations with the possibilities to detect smaller amounts of peritoneal fluid collections than the other imaging methods may be of benefit in early planning the treatment of trauma patients. It is estimated that ultrasonography can detect a minimum of 15-20ml of liquid collections in the peritoneal cavity.

4. Conclusion

The choice of clinical strategy is often decisive for outcome. The most crucial early decision in a bleeding patient with abdominal trauma is to found and to treat primarily the predominant source of hemorrhage. Our protocol emphasizes abdominal US to determine the need of laparotomy. Laparotomy was mandatory when US showed more than 1 cm of fluid strip or expanding or fluid in two or more spaces. This approach has been validated in prospective clinical series [10, 11] and no patient of our series required emergency operative intervention for hemorrhage after a negative US.

Ultrasonography has high diagnostic performance in the screening of patients with suspected abdominal liquid collections. Abdominal US is a useful and valuable diagnostic tool after clinical evaluation in these patients. Because of its high negative predictive value, we recommend that clinical follow up is adequate for patients whose US results are negative for intrabdominal free and incapsulated liquid collections.

Our experience and literature reports support the opinion that US tomography should be used as a first method for diagnosis, follow-up and planning therapy of patients with abdominal liquid collections, as well as a control of the invasive diagnostic procedures.

Compliance with ethical standards

Disclosure of conflict of interest

All authors have contributed in the manuscript, and none of them haven't the conflict of interest.

Statement of ethical approval

The present research work does not contain any studies performed from authors, without permission of any of the patients.

Statement of informed consent

Informed consent obtained from all individual participants included in the study.

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