US STUDY IN BLUNT ABDOMINAL TRAUMA AT VACHIRA PHUKET HOSPITAL

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ABSTRACT

Purpose: To evaluate the accuracy of abdominal ultrasonography (US) in patients having been injured by blunt abdominal trauma.

Material and methods: A retrospective reviews of medical record and imaging of 115 patients with blunt abdominal trauma who were sent to be investigated by abdominal ultrasonography at Vachira phuket hospital from 2000 to 2005. The abdomen and pelvis were scanned for free fluid while the visceral organs were assessed for heterogeneity. Empty bladder was filled with 200-300 ml of sterile saline through a Foley catheter. U/S findings were considered positive if free fluid was presented or if parenchymal abnormalities that could be consistent with trauma were detected. US results were compared with those of the diagnostic peritoneal lavage findings, repeated US, computed tomography (CT), cystography, surgery, and/or following of the clinical courses.

Results: Findings from 115 US examinations were evaluated with the results of being positive 82 of 90 patients regarding injuries (sensitivity 91 %). False negative findings were bowel injury, retroperitoneal injury, and intraperitoneal solid organ injury without hemoperitoneum. No patients with false-negative findings died from intraabdominal injury. Specificity of US was 68 % (17 of 25 patients). Positive predictive value was 91 % (82 of 90 patients), and negative predictive value was 68 % (17 of 25 patients)

Conclusion: Abdominal US is noninvasive procedure and useful in detection of damages in patients confronted with blunt abdominal trauma.

INTRODUCTION

Rapid diagnosis and treatment of abdominal injury is an important factor for decreasing preventable death in patients with blunt abdominal trauma. Physical examination is frequently unreliable in the early cases after the on set of acute trauma.[1] Since its description, diagnostic peritoneal lavage has successfully been used as a useful aid in both the diagnosis of abdominal injury and the determination of the need for laparatomy.[2]

More recently, computed tomography (CT) became an equally important diagnostic tool and made nonsurgical treatment possible in many patients who would have undergone laparotomy on the basis of diagnostic peritoneal lavage findings.[3-7]

Ultrasonographic (US) evaluation of patients with blunt abdominal trauma had been described more than 30 years ago,[8] and US is now the primary

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examination used in several trauma centers in Europe and Asia, as well as in selected centers in the United States.[9-17] Advantages of using US as diagnostic procedure are those for its fast, portable and easily to be integrated with other means of first aids and resuscitation of patients with trauma without a delay of therapeutic measures.

These features particularly facilitate its uses in the evaluation of patients who are hemodynamically unstable. Unlike diagnostic lavage, US is noninvasive and has no associated morbidity. The purpose of the present study was to evaluate the accuracy of abdominal US used in patients with blunt abdominal trauma.

MATERIAL AND METHODS

Reports of US performed and medical records for the evaluation of suspected blunt abdominal trauma from January 2000 through December 2005 were reviewed retrospectively.

Technique

All US examinations were performed by radiologists. The US trauma protocol consisted of evaluation of the right and left upper quadrants of the abdomen, epigastrium, paracolic gutter, retroperitoneal spaces, and pelvis. Empty bladders were filled with 200-300 ml of sterile saline through a Foley catheter if there was no contraindication to catheterization, such as suspected urethral injury.

Definitions

For statistical analysis US findings were considered positive if free fluid was present or if a parenchymal abnormality that could be consistent with trauma was identified. Free fluid in the presence of a known medical course was considered a positive US finding because hemoperitoneum could not be excluded, also the further investigation was necessary to rule out injury. Non-traumatic lesions, such as well visualized simple cysts, that allowed definite diagnosis at US were considered negative findings. For the purposes of the study, pleural and pericardial effusion was considered negative findings for abdominal injury.

A positive finding was considered true positive if CT, repeated US, cystography, laparotomy or clinical follow up also revealed evidence of abdominal injury. Positive US findings were considered false positive if injury was not confirmed at subsequent studies or good clinical outcome after follow up.

Negative US findings were considered true negative if all other findings were negative and/or if the patient had an uneventful clinical course. US findings were considered false negative if a subsequent study revealed free fluid, hemoperitoneum, or any visceral abdominal injury. Such the studies including laparotomy, CT, repeated US, or cystography that performed during the initial hospitalization or later on.

RESULTS

Of 115 patients included in this study, 25 underwent ultrasound abdominal study with findings interpreted as negative, while 90 underwent ultrasound abdominal study, were interpreted as positive. In the minority of ultrasound examination 22 % (25 of 115 patients), the findings were interpreted as negative. Of those, being followed up, 16 were performed with serial physical examinations and determination of hematocrit levels without further abdominal imaging. All of these patients had an uneventful course without clinical evidence of a delayed complication from a missed diagnosis of injury. One of the cases, the finding was interpreted as negative, developed hypovolumic shock from massive hemothorax and found to be death at the end, then abdominal tapping was performed but showed no hemoperitoneum. Two patients with negative US findings underwent CT and US studies performed for having clinical indications. One patient,

a second US study was repeated and a minimal free fluid at the lelf lower quadrant on the 2nd day, underwent laparotomy and found to have a minimal tear of the descending and sigmoid colon. A repair was done and followed up with a good clinical outcome. Another patient, having a repeated CT study, was found to have free air in the abdominal cavity. An operation was done and found to have a tear off the small bowel.(Fig.1) A repair was done with also a followed up of good clinical outcome. Six patients underwent laparotomy due to various clinical suspicious clinical signs of abdominal organs injuries (e.g. seatbelt sign), transient hypotension, unexplained decrease in the hematocrit level, or persistent abdominal pain. Four patients had small bowel injury, one patient had blunt liver injury and ruptured diaphragm, one patient had retroperitoneal hematoma.

Of 90 patients with positive US findings, 77 directly underwent laparotomy. Injuries were found in 76 (Fig.2,3,4) whereas the remaining 1, no intraabdominal injury was found. Two patients died from nonabdominal injury and DPL were performed, and found to be positive for hemoperitoneum. One patient underwent subsequent CT study and found to have rectal sheath hematoma without other intraabdominal organ injury. Six patients were observed clinically and conservative treatment with good clinical outcome. The remaining four patients underwent CT, repeated US, and IVP were found to have positive abdominal organ injury but conservative treatment were given with good clinical outcome.

DPL = Direct Peritoneal Larvage

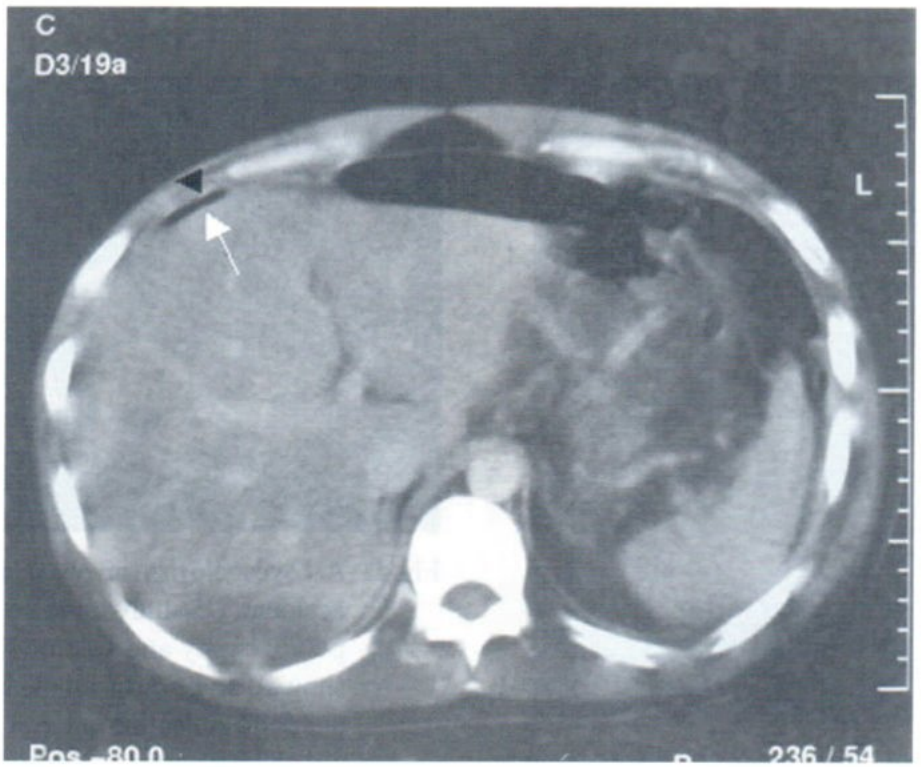
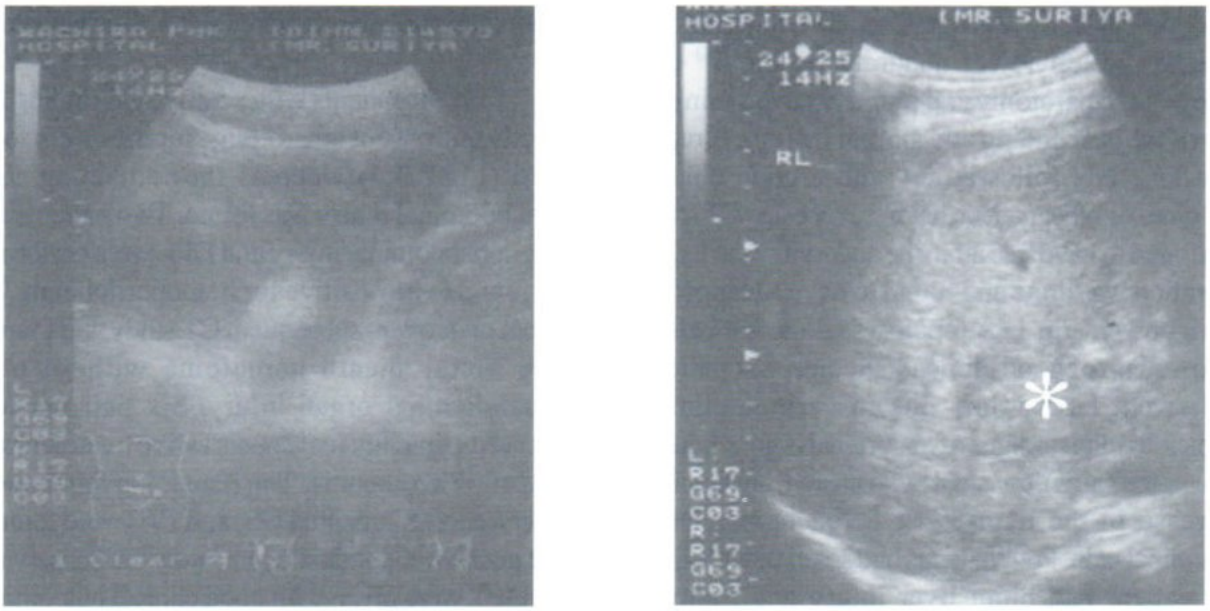


Fig.1 A 24- year man involved in an automobile accident was sent to be investigated by US study and found no free fluid or parenchymal abnormality. CT study revealed free air at anterior surface of liver (arrow). Operative note found a small bowel injury.



2A 2B

Fig.2 Transverse ultrasound image in a 32-year man involved in a motor vehicle accident. (a) US image shows free fluid in pelvic cavity (b) US image of right upper quadrant shows heterogeneity of the liver (*). Operative note found to have a rupture of the liver.

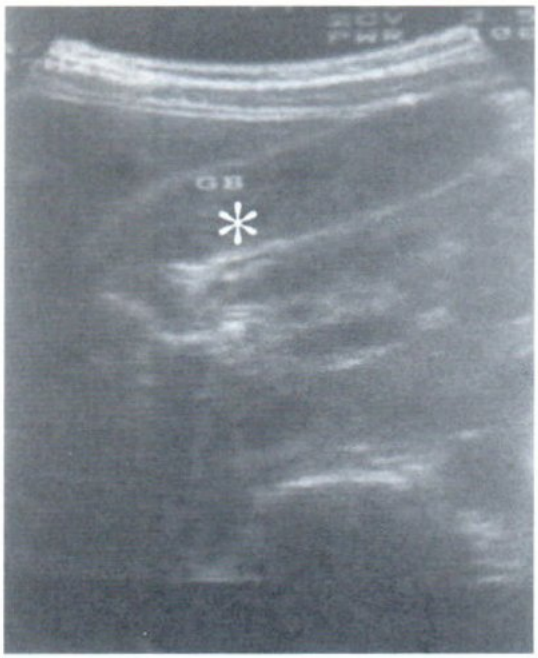


Fig.3 A 13 years old girl involved in a motor vehicle accident. US image of left upper quadrant shows hyperechoic lesion filled in GB (*) and free fluid. Operative note found to have rupture GB.

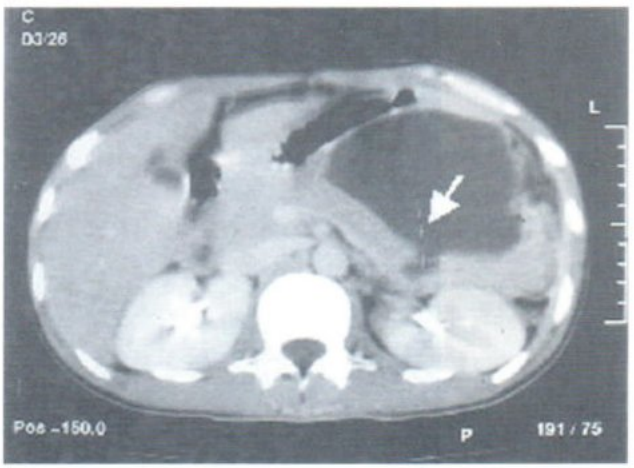


Fig.4 A 32 year old man involved in a motor vehicle accident, US study revealed free fluid at the pelvic cavity and splenic fossa. CT study shows disruption at tail of pancreas (arrow) and fluid collection anterior to the body and tail of the pancreas. Operative note found to have a laceration of the pancreatic tail.

False negative findings

Injuries were missed at US studies in 8 patients (shown in Table1)

Table 1 False negative US findings.

Site of injury	No. of missed	Total
Enteric	6	30
Liver or spleen	1	42
Isolated extraperitoneal	1	9
Total	8	81

Eight patients underwent laparotomy while seven patients underwent surgical repair of injuries. Six patients with false negative US findings underwent laparotomy for bowel injury, one patient underwent laparotomy for liver repair, and one underwent laparotomy, found to have an unexplained retroperitoneal hematoma with no action taken. All those 8 patients included other six patients from thirty patients who had bowel or mesenteric injuries. US finding was also negative in only one of 42 patients with injuries involving liver or spleen. In addition, one of 9 patients was found to have retroperitoneal hematoma. No patient with false negative screening US findings, died from abdominal injury.

False-positive findings

There were 8 false positive findings (shown in Table2). The most common false positive US was physiologic pelvic fluid (Fig 5). At US, many women had fluid in the pelvis, in which it was ultimately believed to be physiologic. Free pelvic fluid in reproductive women was thought to represent a positive US finding because a traumatic cause could not entirely be excluded on the basis of US findings alone. If subsequent CT findings or the clinical course were otherwise unremarkable, US findings were considered to be false positive. This findings accounted for 4 of 8 false positive findings. One patient had false positive US findings and resulted in nontherapeutic laparotomy.

Fig.5 Transverse image in a 22- year woman involved in a motor vehicle accident found anechoic lesion in pelvic cavity suggestive of free fluid. Follow up clinical course were otherwise unremarkable with no surgery.

Table 2 False positive findings.

CT finding or clinical follow up	No. of findings.
Normal (fluid suspected at US)	3
Physiologic pelvic fluid	4
Rectal sheath hematoma	1
Total	8

DISCUSSION

In several recent articles[12-17, 18-24] in the trauma literatures, the benefits and limitations of US following blunt abdominal trauma have been cited. Techniques and methods vary among studies, and in many, US were performed by surgeons. The examination may consist of a brief survey for free fluid[25] or a more complete abdominal study including assessment of organ parenchyma.[12,24] A brief four-quadrant survey for fluid conducted by surgeon has been called focused abdominal sonography for trauma[21] or focused assessment for the sonographic examination of the traumatic patient,[16,17] or FAST. Published studies also differ as to the degree of bladder distension and criteria what constitutes a positive finding. Many authors[13-17, 18-22] use free fluid as the only criterion for a positive study finding. Others[11,12,24] consider any suspected finding, such as free fluid, free air, or parenchymal abnormality, to represent a positive screening US finding.

FAST = Focus Abdominal Sonogram for Trauma

There is also variability as to the standard against which US is measured. When available, surgery or autopsy is used. In other clinical follow up, non of which have perfect sensitivity. Because of cost and practicality prohibit the performance of routine CT in all patients undergoing US at most institutions, the standard can not always be consistent among patients.

In this study, US studies were totally performed by radiologists and there are only three radiologists in our hospital. Furthermore, ER room was covered by rotating staffs who are specialized in different specialties such as EYE, ENT,GP, then can not performed the screening of all cases of blunt abdominal trauma using US. Suspected blunt abdominal trauma cases were sent for US, would be determined by surgeon or physician at ER room. Thus, there were more positive US findings than negative US findings. The most common cause of false positive finding is physiologic, which may be assumed that the woman with isolated pelvic fluid did not require further evaluation in the appropriate clinical situation.[25] The false positive criteria described previously served to maximize the number of false positive findings, which decreased the specificity and positive predictive value.

Initial US images did not depict injuries in 8 patients in our series. Six of these patients had bowel injuries, which had been known as diagnostically challenging with US or CT.[26] Another limitation of US lies in the depiction of the retroperitoneal space.[27,28] One isolated retroperitoneal injury was missed at US. In one patient with false negative findings, US demonstrated without free fluid. Clinical follow up, the patient was still having abdominal pain in the area of right upper quadrant and a serial hematocrit drop. Exploratory laparotomy found to have a blunt liver injury grade IV and also a rupture

of diaphragm. Screening ultrasound study to detect abdominal injury in patients with blunt abdominal trauma is highly useful. With the limitation of a number of radiologists who can not covered totally in 24 hours and no emergency physician in the ER room, thus training of sonographers for screening US at Vachira Phuket hospital is a challenging to be organized to perform this useful job in the future.

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