

## Research Article

# Emergency Ultrasound in Critical Patients: The “Bedside Ultrasonography” as the “Third Hand” of Emergency Surgeon

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## Abstract

**Introduction:** Ultrasound (US) is a safe and useful diagnostic tool for the detection and the study of several organs. Absence of radiations and collateral effects make it be a repeatable test with low costs, feasible and quickly. Ultrasound scan can be performed to patient's bedside avoiding losing precious time for diagnostic and therapeutic decision making in transferring him in radiologic room or department.

**Aim:** To illustrate and support the precious aid of emergency ultrasound in emergency surgeon's hands.

**Materials and Methods:** we selected 45 patients admitted to our department of general and emergency surgery for abdominal and thoracic acute problems. A retrospective cohort study was made on a period of six month.

**Result:** US were performed as soon as possible to avoid delay in diagnosis. In all cases, the contribution of ultrasonography was precious influencing the decision making process. The only echographic evaluation has been sufficient to establish that was necessary immediate surgery (in 30 cases - 66.7%), or monitoring and non-operative management or transfer the patient to other specialists' care (in 9 cases - 20%) or endoscopic management (in 6 cases - 13.3%). Only in two cases was necessary a CT scan to integrate ultrasound evaluation.

**Conclusion:** Bedside ultrasonography in critical patients is safe and feasible; it could be the “third hand” of emergency surgeon integrating the bounds of clinical examination.

We stand that all emergency surgeon or physician should be trained in bedside emergency ultrasound.

**Keywords:** Ultrasound; Critical; Ultrasonography; Surgeon; Bedside

## Introduction

Ultrasound is a safe and useful diagnostic tool used for the detection and the study of several organs and their diseases. Because of absence of radiations and collateral effects it is a repeatable test with low costs, feasible and quickly. One of the great advantages of the ultrasound scan is the possibility to perform the exam to patient's bedside avoiding transferring him in radiologic room or department and losing precious time for diagnostic and therapeutic decision making [1]. In recent time not only radiologist appreciate the potentiality of ultrasound, but overall emergency physicians and surgeons start to perform ultrasonography scans both as Focused Assessment Sonography for Trauma (FAST) and monitoring hemodynamic conditions specially in critically ill patients. Increasingly, the ultrasound scans integrates the clinical examination giving precious dates on areas closed to physical exploration [2]. Ultrasound power makes the “bedside ultrasonography” often the first diagnostic instrumental approach to several both abdominal and lung pathologies and not only but also in the neurological evaluation because of the advances in technology that allow to penetrate the

skull [3-4]. Often the bedside ultrasound is the “third hand” of the emergency physician or surgeon. In this cases series we report our daily experience in a small centre illustrating the precious aid of this fantastic diagnostic tool [5].

## Materials and Methods

For this retrospective cohort study, we collect the data, from October 2014 to April 2015 from the emergency department of general and emergency surgery of “M. Chiello” hospital in Piazza Armerina. In a period of six month we selected 45 patients, as heterogeneous population, admitted to our department for abdominal and thoracic acute problems. They were divided in four groups: Abdominal acute problems (Group 1), Blunt trauma (Group 2), Post-operative complication (Group 3), and Thoracic acute problems (Group 4). The main age was 63 years old with a range between 8 and 92 years old. 7 patients were admitted for thoracic pain and evolving dyspnea: 3 had pleural effusion. 2 patients developed pneumothorax, one had spontaneous pathogenesis and one iatrogenic due to central vein catheterization; 2 patients developed pulmonary edema and lung

**Table 1:** Summary of echographic findings driving decision making.

Indications to admission	N° pz	Echographic findings	Diagnosis	Decision making
<p><b>Group 1</b> <i>Abdominal acute problems</i> Upper pain, fever, vomiting, biliary colic pain</p>	11	<ul style="list-style-type: none"> <li>-Gallbladder distension and wall thickening &gt; 6 mm</li> <li>-pericholecystic fluid and peri-intrahepatic free gasses</li> <li>-stagnant or purulent gallbladder contents</li> </ul>	<ul style="list-style-type: none"> <li>Acute lithiasic cholecystitis</li> <li>- associated pericholecystic abscesses</li> <li>-gangrenous cholecystic perforation</li> </ul>	<ul style="list-style-type: none"> <li>-Cholecystectomy</li> <li>-Perihepatic drainage</li> </ul>
<p>Lower right or left abdominal-pelvic pain, fever, vomiting, missed evacuation dehydrations</p>	17	<ul style="list-style-type: none"> <li>-Free intrabdominal fluid</li> <li>-pelvic abscesses</li> <li>-thickening appendicular wall</li> <li>-intestinal dilatations and bowel immobility</li> <li>-Colonic wall thickening</li> <li>-per colic free fluid</li> <li>-“Pseudo kidney” images</li> </ul>	<ul style="list-style-type: none"> <li>-Acute appendicitis</li> <li>-Ovarian rotation and pelvic diseases</li> <li>-Intestinal occlusion</li> <li>-Acute diverticulitis</li> <li>-Per colic abscesses</li> </ul>	<ul style="list-style-type: none"> <li>-Appendectomy pelvic lavage and drainage</li> <li>-Gynaecologic counselling and transfer</li> <li>-Intestinal resection</li> <li>-Bowel viability monitoring and discharging</li> <li>-Colic resection</li> </ul>
<p>Jaundice</p>	6	<ul style="list-style-type: none"> <li>-Biliary tree dilatations</li> <li>-Obstructive iperechogenic images</li> <li>-intrahepatic masses</li> </ul>	<ul style="list-style-type: none"> <li>-Choledocholithiasis</li> <li>-Liver tumours</li> </ul>	<p>ERCP</p>
<p><b>Group 2</b> <i>Blunt trauma</i></p>	2	<ul style="list-style-type: none"> <li>-Non homogenous spleen aspect</li> <li>-per splenic free fluid</li> <li>-Psoas disomogeneous aspect</li> </ul>	<ul style="list-style-type: none"> <li>-Evolving spleen rupture</li> <li>-Psoas hematoma</li> </ul>	<ul style="list-style-type: none"> <li>-Splenectomy</li> <li>- Monitoring</li> </ul>
<p><b>Group 3</b> <i>Post-operative complications</i></p>	2	<ul style="list-style-type: none"> <li>-Disomogeneous wall collection</li> </ul>	<ul style="list-style-type: none"> <li>-Hematoma of rectum muscle</li> <li>-Seroma mesh related</li> </ul>	<p>Non Operative Management</p>
<p><b>Group 4</b> <i>Thoracic acute problems</i> Chest pain, dyspnea, blunt chest trauma</p>	7	<ul style="list-style-type: none"> <li>-Lung point</li> <li>-A Lines</li> <li>-B Lines</li> <li>-Pleural free fluid</li> </ul>	<ul style="list-style-type: none"> <li>-Pneumothorax (2)</li> <li>-Pleural effusion (3)</li> <li>-Lung diseases (2)</li> </ul>	<ul style="list-style-type: none"> <li>-Thoracentesis (3)</li> <li>-Chest drainage (2)</li> <li>-Medical management (2)</li> </ul>
<p>Total</p>	45			

disease. 11 patients, suffered from upper abdominal pain, vomiting and fever, had biliary colic pain; 17 patients were admitted for lower right or left abdominal-pelvic pain, sub-continuous fever and vomiting, 2 of these had missed evacuation of gasses or feces, dehydrations and other occlusive clinical signs. 2 patients were admitted for left colic pain with associated resistance to abdominal palpatory examination. 6 patients were recovered for jaundice; 2 had blunt abdominal trauma and 2 were reported for postoperative surgical complications. All these patients underwent first of all to ultrasonography evaluation (Table 1). In our experience all these patients were primary valued in emergency rooms and often underwent to a summary radiologic evaluation in emergency setting; often the primary examination was superficial and too fast so all the patients admitted to our department were be retested to ultrasound evaluations. Only expert surgeon with advanced echographic technique skills carried out all the exams. Where use always the same echographic instrument. All the exams were carried out using Convex probe 3-5 MHz and linear probe 7-9 MHz for both abdomen and thorax. Patient's position was chosen in agreement with general clinical conditions, patient's degrees of collaborations, previous surgical procedures if present and however to patient's bedside. Few times patients were prepared the day before with fasting diet and medicine to reduce abdominal meteorism; according to the age and the collaboration of the patients, we use standard scansions to detect abdomen and thorax; in some cases, patients were studied in sitting or prone position. In all cases, we do not use contrast enhancement. Median time elapsed between admission and echographic evaluation was about  $1.3 \pm 8.5$  hours. Mean operative time was  $10 \pm 30$  min. Mean ASA (American Society of Anaesthesiologists) score was III.

**Results**

In 11 patient of Group 1 were found gallbladder enlargement, with wall thickening and free fluid or perihepatic collection and in

all cases was made diagnosis of acute cholecystitis, associated in two cases to hepatic abscesses and gangrenous cholecystic perforation in other two patients (Figure 1-2). In all these patients were performed cholecystectomy and perihepatic lavage and drainage [6]. In 17 patients, admitted for lower abdominal pain, the echographic findings were: intra abdominal fluid, pelvic collection, thickening small bowel or colonic wall or distention and was made diagnosis of acute appendicitis in 11 cases whom underwent to appendectomy



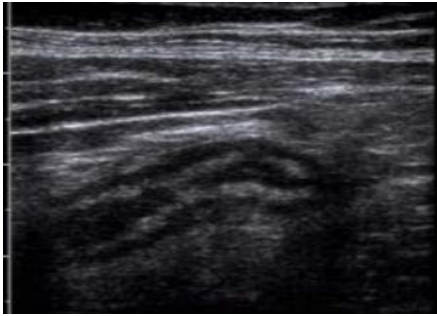


Figure 3: Acute appendicitis.

(Figure 3); ovarian torsion and pelvic pathologies were found in two cases whom underwent to gynaecologic evaluation avoiding useless surgical procedures (Figure 2). In two patients were demonstrated echographic signs of mechanical occlusion and in one cases was necessary the surgery but in one due to adhesion we preferred Non Operative Management and echographic monitoring of bowel viability [7-8] (Figure 3). One of two patients with colonic wall thickening developed the “pseudo-kidney” signs after few days as expression of paracolic abscesses and was performed a colonic resection after TAC evaluation. 6 patients had jaundice and were studied to detect the obstructive cause, that in 5 cases was a biliary stones, but in one case was an intrahepatic mass: all these underwent to Endoscopic-Retrograde-Cholangiopancreatography [9-11] (Figure 4).

In Group 2 one patients with finding of free increasing perisplenic fluid, anaemia and haemodynamic instability, after blunt abdominal trauma underwent to splenectomy; the other one to Non Operative management and monitoring of psoas muscle hematoma [12]. In Group 3 two patients developed post-operative complication and echographic detection showed dishomogeneous wall collection due to hematoma of rectum muscle and seroma mesh related, no surgical procedure were carried out (Figure 5). In Group 4 were collected patients with chest pain, dyspnea or chest blunt trauma; in these cases we performed ultrasounds evaluation finding pleural effusion, treated by thoracentesis, “lung point” as expression of pneumothorax treated by chest drainage [13-15].

The only echographic evaluation has been sufficient to establish that in 30 cases (66.7%) was necessary immediate surgery, in 9 cases (20%) was sufficient monitoring and non-operative management or transfer the patient to other specialists' care and in 6 cases (13.3%) endoscopic management was required (Table 2).

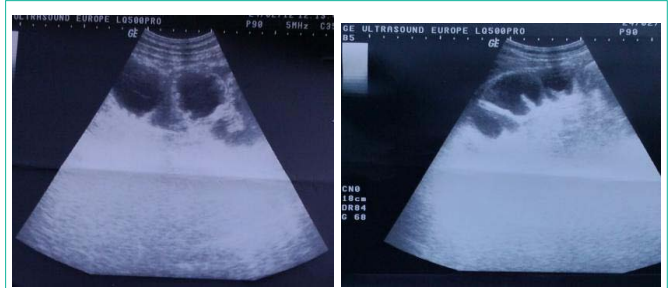


Figure 5: Bowel obstruction.



Figure 6: Choledocholithiasis.



Figure 7: Abdominal wall hematoma.

## Discussion

Ultrasound evaluation was performed as soon as possible to assure the best medical or surgical management, avoiding delay in diagnosis. In some cases ultrasound data were integrated with a second level diagnostic step, but we report the echographic findings that ride and drive the decision making process. In all cases, the contribution of ultrasonography was precious both too led to a certain diagnosis and to drive toward the correct decision. The only echographic evaluation has been sufficient to establish if it was necessary immediate surgery, monitoring and non-operative management or transfer the patient



Figure 4: Pelvic disease.



**Table 2:** Management and procedure performed.

Decision Making	Procedures	Cases	%
Surgical Management	Cholecystectomy and peritoneal drainage	11	66.7
	Appendectomy	11	
	Splenectomy	1	
	Bowel resections	2	
	Thoracentesis	3	
	Chest drainage	2	
Endoscopic Management (ERCP)	Biliary stent	1	13.3
	Common bile duct "toilette"	5	
Non Operative Management (NOM)	Monitoring (hematoma-seroma-bowel motility)	5	20
	Medical menagement	2	
	Transfer to other specialists	2	
Total		45	100

to other specialists' care. Only in two cases was necessary a CT scan to integrate ultrasound evaluation. In these way with a non-invasive diagnostic tool is possible in few minutes integrate with a great number of data the information of clinical evaluation with the advantage to expand the areas where the human sense are less sensitive. One of the most important aspects consists in the possibility to perform the echographyc evaluation when you want, how much time is necessary and overall where you want without moving the patient just to his bedside [16].

## Conclusion

Beside ultrasound evaluation in critical care patients with blunt chest/abdominal trauma, biliary, splenic, bowel problems is a useful tool for the emergency physician and surgeon. Often critical patient may be not able to collaborate giving the essential clinical history and in this case the ability to survey specific organs is lifesaving; however in greater cases US can guide the decision making process and even if it is not infallible could avoid diagnostic mistakes and delay [17-18]. As a "handily" technique requires a good instrument but overall a serious operator's trained skill and eye. However bedside ultrasonography evaluation of critical patients is safe and feasible, representing a powerful weapon in emergency department: it could be the "third hand" of emergency surgeon, so we stand that all emergency surgeon or physician should be trained in bedside ultrasound evaluation [19-20].

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