

Urgent Ultrasonography in Daily Clinical Practice

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SUMMARY

Emergency medicine is a clinical and academic discipline that does not deal with certain specific diseases or organic systems. This discipline is characterized with a comprehensive approach to the patients which is in a state of vital threat regardless of the nature and etiology of the disease which leads to such state. In the institutions of emergency medicine all patients arrives at any time of the days regardless of age and a range of symptoms so that emergency medicine applies clinical diagnostic and therapeutic methods of all other clinical disciplines in order that in the short period of time discover the cause of vital functions disturbance and apply emergency therapeutic procedures. All emergency states from all clinical disciplines belongs to the emergency medicine which leads practical management based on specific principles and approach to this kind of patients. Development of technology and application of new diagnostic procedures enabled doctors in emergency medicine to introduce effective diagnostic management during the first contact with the patient and to avoid costly and long hospital procedures. Ultrasonography examination is already for a long time important methods in all clinical disciplines, so it is inevitably applied in emergency medicine. Ultrasonography diagnosis has a high sensitiveness and specificity of most frequent illnesses at the departments and emergency wards, so the mobile ultrasonic device as an integral part of the equipment of family doctors may constitute "visual stethoscope", especially important and indispensable in emergencies. This method applies the ideal technology achievement for nearly all the emergency sates and which is proven based on the needs in practice, on the basis of scientific facts based medicine and the recommendations of the World Health Organization (WHO) for the obligatory of application of this method in centers for emergency medicine. Additional benefits are simple handling of the machine and the possibility of repeated examination and monitoring of the dynamic pathological changes. Necessary practical and theoretical knowledge can be gained during under and post-graduate education within the framework of existing programs.

Key words: Emergency medicine, Ultrasound.

1. WHAT IS ULTRASONOGRAPHY SCREENING OR URGENT ULTRASONOGRAPHY?

Urgent ultrasonography is urgent or immediate examination of patient in its bed in order to evaluate specific emergency stated. Advantages which this technique makes ultrasonography (US) the ideal diagnostic tool in emergency medicine services. (abdominal bleeding in case of trauma and perforation of organs, ectopic pregnancy, pericardiac taponade and aortal aneurism). High demand of the society for the rapid diagnostic and therapeutic treatment of the patients introduced US as the primary screening method in the urgent medicine stations (UMS). As the response to these demands World Health Organization (WHO) obliged physicians on education in different levels of skills, as in standard curriculum and residency in emergency medicine training is obligatory. Emergency medicine specialist sees US screening as necessary instrument, similar as stethoscope to the clinician. This US screening as its name states does not include the complete formal examination. More freely we can say that it is a highly focused and limited to certain goal which should answer on selected set of questions. At the critical moment US have high

benefit for the patient – life saving.

The answer to the following 10 questions is a critical moment in making important decision for preservation of patient's lives.

- Is there a pericardial free liquid?
- Is there a calcifications, acute inflammation or acute obstruction of the gall paths?
- Is there a kidney stones or hydronephrosis?
- Is there well defined intrauterine pregnancy?
- Is there a acute aortic aneurism?
- Is there some foreign object or free liquid?
- Is there a limited suppurated collection in the parenchyma organs?
- Is there a pleural free fluid?
- Is there some obstruction in the gastrointestinal system?
- Is there urine retention?

Specialist in emergency medicine which completed the courses in ultrasonography diagnostic can with high accuracy set the etiological diagnoses in urgent states. Urgent US screening can be applied as:

- Cardiology US,
- Abdominal ultrasonography,
- Pelvic ultrasonography,
- Ultrasonography in case of dull objects traumas,
- Ultrasonography of blood vessels,
- Ultrasonography of muscular and bole system.

2. SPECIFICITIES OF THE URGENT ULTRASONOGRAPHY OF THE ABDOMEN

Ultrasonography diagnostic process of the acute states in the stomach progressed significantly during last ten years mainly sues to the numerous technological innovations.

Illnesses of the liver, pancreas, biliar system and peritoneum with suppurated formations which often gives and clinical image of the acute abdomen can be sonographically evaluated up to final diagnosis. In case of acute abdominal pain, ultrasonography can successfully detect even ileus. In case of other acute abdomen conditions, caused by the illness of GI system

it is possible to diagnose acute appendicitis, peria-pendicular abscesses, tumors of the intestines, Crohn disease, which can be misdiagnosed as appendicitis, inguinal herniation and ulcer lesion.

By the ultrasonography evaluation of the small pelvis organs we can obtain data about pathological changes in uterus, ovaries and surrounding organs: bladder, colon, large blood vessels, as well as about deposits of fluid, blood or suppuration at predilective locations.

Urgent abdominal ultrasonography analysis besides focused examination of the abdomen also includes evaluation of the distal parts of thorax because it provides rapid detection of pericardial and pleural effusions. This method provides dynamic information which is its great advantage compared to other, which evaluates only current state (for example: dynamic follow up of the changes in case of acute pancreatitis).

Positive clinical experiences lead to forming of criteria's and standards for its use. That primarily applies on cases of dull abdominal traumas, pains in certain topographic areas and patients with the defined standards with positive or negative findings.

American College of Emergency Physicians (ACEP) supported the concept and term of urgent sonography which is introduced into the practice, education and research. Curriculum of the urgent US become obligatory during residency in emergency medicine.

Application of US in the emergency medicine is differs in its approach to some extent from its application in other clinical disciplines. It is usually applied beside the patient's bed, at the same time with clinical evaluation of other procedures. This manner of application proves to be very efficient so it received synonym as extended arm for the palpation or „visual stethoscope“. But, ultrasonography obtaining of valid anatomic and functional information's gives it an advantage over the routine physical examination. In this manner we can obtain precise answers on focused questions.

This approach is necessary in case of following emergency states:

- in evaluation of trauma: urgent modified abdominal ultrasonography,(FAST)
- Evaluation of urgent conditions in gynecology.
- urgent echocardiography (in doubt on pericardial effusion or tamponade),
- evaluation of aorta aneurism complications (syncope, hypotension, signs of shock, abdominal pain, palpation pulsating resistance, back pain), emergency billiar ultrasonography (pain in the upper right quadrant, epigastric and back pain),
- Urgent renal ultrasonography (pain in the renal lodges, abdominal pain with vomiting).

Obtaining even less precise pathological finding in correlation with the clinical signs becomes an important feature in making the right conclusion.

Urgent ultrasonography prove its overall value by contribution n early detection of acute abdominal pain etiology, saving precious time in prehospital period, reduction of cost during presurgical diagnosis and duration of treatment, and lowering the mortality rates.

Focused urgent abdominal ultrasonography becomes the most important method in evaluation of acute stomach pain.

Ultrasound is a method of choice in diagnosis of the acute cholecystitis.

Most important complicating of this disease is: empiema of the bladder, perforation of the walls with billiar peritonitis, pancreatitis, and pericholecystic abscess, gangrenous an emphysema cholecystitis and hemorrhage in the abdominal cavity. Everyday practice prove big advantages of the ultrasonography in making diagnosis of the acute cholecystitis, and even in cases when there is no chleischtiais (Acalculosis cholecystitis) or dilatation of the gull channels. Acute acalculosis cholecystitis can occur also in case of patients with the severe degree of mitral stenosis and can be successfully diagnosed with ultrasonography. Perforation, as one of the most severe complications of inflammation (multiple abscesses, billiar peritonitis, sepsis), also can be detected with ultrasonography. Ultrasonic signs of the acute cholecystitis are numerous and include changes in the wall, lumen, close and distant surrounding.

Ultrasonography examination of the abdomen has diagnostic value in detection of ileus with presentation of the dilatated intestines curves filled with content. Sonography of the abdomen already at the beginning of illness can detect mentioned state and its cause, much earlier than RTG scan. This practically means, as soon as examination is done, there will be more ultrasonic signs of ileus (opposite to RTG scan).

If there is a case of mechanic (dynamic) ileus with ultrasonography we can find dilatated intestinal curves, hyperchaustration, peristaltic and antiperistaltic waved. In case of paralytic ileus, intestinal curves are only dilatated, without visible causations and with barely visible movement of the content.

This method is especially valuable in detection of invaginational ileus.

3. US IN EMERGENCY CARDIOVASCULAR DISEASES

Screening cardiac US is especially useful in urgent states when there is lack of pulse and present electrical activity. These states occur in case of low hearth flow, hypovolemia, cardiac tamponade and ventilatory pneumotorax. Rapid visualization of the hearth wall enables doctor to detect cardiac activity. If the activity is detected fast evaluation saves the patient. Pericardiac tamponade besides trauma can be caused by the acute uremic state after car-

diovascular surgery. Clinically it can be manifested in silent tones, dilated neck veins, and rapid US diagnostics provides exact diagnosis of the effusion. This can be noticed by the collapse of the right atrium and ventricle wall in diastole. Rapid cardiocinesis under US control after diagnosis has been set saves the patient's life. AAA is the state which fulfills all criteria's for the rapid diagnosis at the primary health care level in the emergency medicine centers. In order that patient survive in these cases imperative is diagnosis. This is the patients of top level of emergency which arrives with strong abdominal pain, have hypotension with syncopal episodes and pulsating abdomen mass so it definitely requires urgent abdominal ultrasonography. Use of ultrasonography in these cases significantly reduces mortality. Advantage of this method is that it can be performed beside the patients bed and with the early diagnosis patients life can be saved.

Dissection represents brake in intimate layer and protrusion of blood into deeper layers of the arterial wall which becomes divided. Blood besides the right path also flows through the newly formed lumen)false, or paralumen).

This change is followed by the intensive pain in the central abdomen regions with spreading lower into the back. A state of shock is developing; decrease of peripheral blood pressure, pulse changes and CNS symptoms.

On ultrasonography, dissection is manifested with the waving of the intimate layer in the blood stream and presentation of the two lumens seen in transversal and sagittal plains.

Rupture occurs as a consequence of atherosclerosis, hypertension, inflammatory, mycotic and traumatic changes, and rarely spontaneous. Clinical image is dominated with the intensive increasing pain and symptoms of the hemorrhage shock.

4. URGENT ULTRASONOGRAPHY IN CASE OF URINARY SYSTEM DISEASES

One of the most often indications for the urgent ultrasonography is occurrence of renal colic. Although kidney stones are not always seen occurrence of pyelonephrosis is easily seen by US examination. Indications for this examination are the following:

- pain in renal loges and lower abdomen
- palpable mass in renal loges
- hematuria
- febrile states
- dull injuries
- disuria
- renal inefficiency
- secondary hypertension

5. BLUNT ABDOMEN TRAUMA

Blunt trauma of the abdomen is often seen in practice as a consequence of traffic accidents, inju-

ries at work place and physical violence. Management of these states is identical for all injured regardless of age.

Injuries of the abdomen wall can cause occurrence of the acute abdominal pain especially cases when it is accompanied lesions in some of the internal organs. Ultrasonography represents method of choice in evaluation of this condition use to proven high sensitivity in detection of intra-abdominal bleeding and follows up of the posttraumatic changes.

Because of the fact that ultrasonography can easily detect presence of even small quantity of free fluid in the abdomen main task of these traumatized patients evaluation is:

- detection of fluid in abdomen—blood,
- evaluation of contours and homogeneity of the parenchyma organs,

Detection of type of the lesions.

Intra-abdominal fluid is most easily found in the Morrison area (between liver and kidneys) around spleen and in small pelvis which needs to be analyzed through the full bladder. This ultrasonic evaluation is rather specific so a special algorithm is formed called FAST (Focused abdominal sonography examination in case of trauma) which is systemic and focused on:

- right upper quadrant – hepatorenal space - Morrison,
- left upper quadrant – perisplenic and paracolic region,
- left and right paracolic region and retro peritoneum,
- small pelvis – Douglas and vesicorectal space,
- epigastria region and periumbilical for thoracic air,
- Intercostal and sub diaphragm regions and parts of the thorax.

Goal of such detailed examination is to determine existence of intraperitoneal bleeding, pericardial tamponade or haemothorax. Sensitivity of the ultrasonography in detection of the posttraumatic changes is increased with repeated evaluation and close follow up of the patients condition.

Besides detection of fluid in predilection spaces in abdomen, posttraumatic focused abdominal ultrasonography recommends standards for detection of lesions in parenchyma organs which sometimes does not need to be accompanied with intra peritoneal bleeding. By following the continuity of the organ contour we can conclude about possible laceration, and according to depth of the fissure about rupture or complete organ fragmentation (fracture). During the evaluation we can detect existence of the local existence of the local posttraumatic changes in form of the post contusion edema, local hematoma or complete destruction—convexation of the organ. Focused abdominal ultrasonography implies examination of the caudal parts of the thorax in order to detect haemothorax, pneumothorax or pericardiac effusion.

6. PRACTICAL CASE PRESENTATIONS

Case 1. Perforated peptic ulcers have following clinical signs: a) presence of air in stomach cavity; b) presence of liquid in stomach and c) wall discontinuity at the perforated location. Male patient, 28 years, physical labor, come to the hospital as an emergency case due to sudden strong pain in epigastria followed with general weakness. He does not mention any other problems. In personal history he presented data that occasionally he used antacid medication and h₂ blockers due to heartburn, smoker. During admission expressed severe pain sensitivity in epigastric region with local muscular defense. RR 30/80, pulse ratios 90. Immediate native X-ray of the abdomen without pathological changes. Immediate urgent ultrasound of the abdomen indicated presence of free liquid in the Morrison space and perihepatically, as shown on Figure 1.

With suspicion on perforated ulcer patient was referred to the urgent surgery. Surgery verified perforated duodenal ulcer. Surgery completed with sutura.



FIGURE 1. *Ultrasound finding of free liquid in Morrison space*

Case 2. Acute necrotic alcohol induced pancreatitis

In case of this state ultrasonography signs are: a) diffuse heterogenic, mainly hypoechogenous tissue structure with increased pancreas head and body, and with signs of necrosis and liquid collections.

Patient M.A. male 48 years comes to the emergency ward due to diffuse pain in stomach, nausea and vomiting. Problems started day before with constant increase in pain intensity located at epigastric area and spreading in both costal arches. Patient was previously treated due to arterial hypertension and alcoholism. During examination in forced bended position, skin was cold and wet, dyspnoic. Physical finding: unheard breathing bilaterally basal. RR 180/95, P 120/min. abdominal wall is diffusely pain sensitive with muscular defense in epigastric region. Urgent ultrasound of the abdomen verified increased hypoechogenic pancreas with necrosis signs, and set diagnosis of acute necrotic pancreatitis. Diagnosis is confirmed with biochemical analysis and CT scan. During hospital treatment drainage

of the necrotic parts was performed with catheter introduced with ultrasound control.



FIGURE 2. *Ultrasound finding of the acute pancreatitis*

Case 3. Acute purulent cholecystitis. Ultrasonic examination in case of acute purulent cholecystitis can show:

a) wall thickening; b) wall layering; c) irregular flow; d) subserotic edema; e) changes in shape and f) internal echoes. Female patient RM 48 years, comes during night at the Emergency ward with suspicion on „acute abdomen“. In anamnesis she give data that illness started 3 days ago with spastic occasional pain below right costal arc, and that since this morning she have fever with shivers, and permanent intensive pain within whole right part of the abdomen. During admission in physical finding besides intensive pain sensitiveness of the stomach wall paraumbilical right and under right costal arc palpation timorous egg shape mass pain sensitive. Urgent ultrasound of the abdomen showed signs of the acute cholecystitis with positive ultrasonic Murphy sign, and completely dilatated cholecyst with irregular shape, with thicken and layered wall which also have irregular flow and continuity break with present subserotic edema. Lumen is filled



FIGURE 3. *Ultrasound finding of the acute cholecystitis*

with heterogeneous liquid with internal echoes.

With suspicion on acute purulent cholecystitis with possible perforation of cholecyst patient was referred to urgent surgery. Surgery confirmed ultrasound finding.

Case 4. Acute appendicitis. Ultrasound signs of appendicitis are: a) clear visualization of tubular aperistaltic appendix structure; b) transversal diameter larger than 6mm; c) thickening of the muscular layer; d) appendicolyte, air (gangrenous type) and hydro gases level (empiema) within lumen, e) periappendicular liquid formation. Female patient IT 16 years are coming to the examination due to occasional spastic pain in epigastric area and peri-umbilical, followed by fever, distaste and vomiting. During examination there is pain sensitiveness in epigastric region and ileocecaly. Urgent ultrasonography showed appendix with increased diameter and wall thickness. Clinical course of illness implies non complicated appendicitis, so the patient is referred to the surgery ward. Surgery confirms the diagnosis of acute appendicitis.

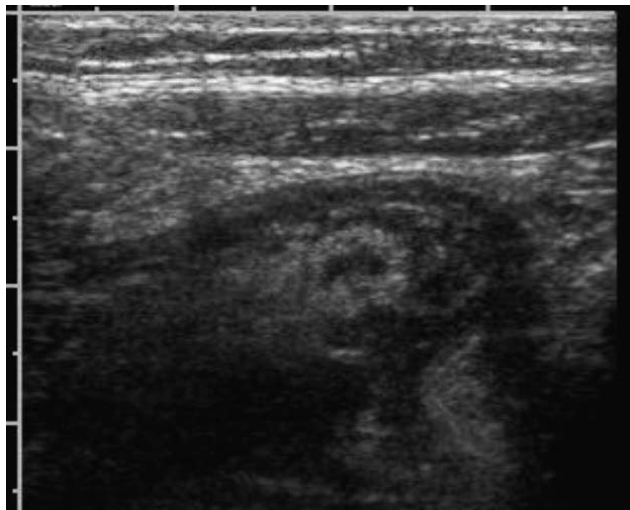


FIGURE 4. Ultrasound finding of acute appendicitis

Case 5. Ileus. Ultrasonography criteria's for intestinal occlusion are: a) dilatated curves, b) wall edema; c) motility-peristaltic; d) sedimentation of the intestinal content; e) air bulbs above liquid.

Male patient 68 years arriving to the emergency ward due to the diffuse stomach pain followed by swelling and vomiting. Within personal anamnesis gives data that 2 years ago he underwent surgery due to inguinal and umbilical herniation, and 10 years ago due to the perforated duodenal ulcer. Physical examination showed diffuse meteorism. Urgent ultrasonography indicates possible occlusion of the intestine due to present dilatation with stasis in content passing and its sedimentation with wall thickening. Course of illness and control ultrasound examination as well as x-ray indicates ileus of the intestines. Surgery discovered ileus caused by adhesions from the previous surgery.

Case 6. Malignant stenosis of the stomach entrance.



FIGURE 5A and 5b. Ultrasound finding of the intestines occlusion

Ultrasonic indicators of this state are: thicker, hypoechogenous stomach wall with lumen decrease.

Male patient 58 years arrives as emergency case due to persistent vomiting and pain in epigastric region. Within anamnesis gives data that for the last 3 months he have permanent pain in epigastric region and loss of appetite. Emergency ultrasound detects thickened wall of the pyloric stomach region with narrowing of the lumen and retention of content. Gastroscopy evaluation is done next day in order to confirm the diagnosis of the tumor stenosis of the stomach entry region.

Case 7 Malignant tumor of the colon

Ultrasonography signs in this case are: tubular structure of the thickened irregular wall which is hypoechogenic, without peristaltics.

Patient MS, male 70 years comes to the clinic as an emergency case due to the intensive pain below right coastal arc and constipation. Within personal anamnesis mentioned long term constipation and pains like spasms in epigastric region with stomach swelling.



FIGURE 6. US finding of the wall thickening at the entry stomach region



FIGURE 7. Pseudo renal colon formation: hypoechoic irregular thickening of the colon wall

Emergency ultrasound showed pseudo renal formation within hepatic colon flexus. Colonoscopy confirmed this diagnosis of the stenotic colon cancer.

7. CONCLUSION

Ultrasound (US) has been recognized as a powerful tool for use in the diagnosis and evaluation of many diseases in clinical practice. The possibility of immediate bedside US examinations in the evaluation of specific emergent complaints makes it an ideal tool for the emergency specialist.

Correct diagnosis of potential life-threatening emergencies such as hemoperitoneum following blunt trauma, abdominal emergencies, ectopic pregnancy, pericardial tamponade, and aortic aneurysms with US evaluation can be easily made

Emergency physicians now view screening ultrasonography as highly focused and limited to answer on select set of questions. These questions include: Is there a pericardial effusion present? Are there gallstones present? Is there hydronephrosis

evident? Is there free peritoneal fluid? Is there intrauterine pregnancy? Is there an abdominal aortic aneurysm (AAA) present? Is there a foreign body?

It is clear that emergency screening ultrasound is now accepted tool for the rapid evaluation of the emergency patient. Using this effective diagnostic and therapeutic tool in emergency units our patients will have efficient, safe, and accurate health care.

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