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 belong 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 introduced us as the primary screening method in the urgent states. urgent US screening can be applied as:

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, pericardial 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 apsces, tumors of the intestines, Crohn
disease, which can be misdiagnosed as appendici-
tis, ingvinal hearniation and ulcus 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 predilec-
tive locations.
Urgent abdominal ultrasonography analysis be-
sides focused examination of the abdomen also in-
cludes evaluation of the distal parts of thorax be-
cause 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 ex-
ample: 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 de-
fined 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 emergen-
cy medicine.
Application of US in the emergency medicine
is differs in its approach to some extent from its ap-
lication 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 palpa-
tion or „visual stethoscope”. But, ultrasonography
obtaining of valid anatomic and functional informa-
tion'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 ab-
dominal ultrasonography (FAST)
• Evaluation of urgent conditions in gynecology.
• urgent echocardiography (in doubt on pericar-
dial effusion or tamponade),
• evaluation of aorta aneurism complications
(syncope, hypotension, signs of shock, abdomi-
nal 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 re-
nal lodges, abdominal pain with vomiting).
Obtaining even less precise pathological find-
ing 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 abdomi-
nal pain etiology, saving precious time in prehospi-
tal period, reduction of cost during presurgical di-
agnosis and duration of treatment, and lowering the
mortality rates.
Focused urgent abdominal ultrasonography be-
comes 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
biliar peritonitis, pancreatitis, and pericholecystic
apsces, gangrenous an emphysema cholecystitis and
hemorrhage in the abdominal cavity. Everyday prac-
tice prove big advantages of the ultrasonography
in making diagnosis of the acute cholecystitis, and
even in cases when there is no chleischtiai (Acal-
culus cholecystitis) or dilatation of the gull chan-
nels. Acute acalculus cholecystitis can occur also
in case of patients with the severe degree of mitral
stenosis and can be successfully diagnosed with ul-
trasonography. Perforation, as one of the most severe
complications of inflammation (multiple abscesses,
bil iar peritonitis, sepsis), also can be detected with
ultrasonography. Ultrasonic signs of the acute chole-
cystitis are numerous and include changes in the
wall, lumen, close and distant surrounding.
Ultrasonography examination of the abdomen
has diagnostic value in detection of illeus with pre-
sentation of the dilated 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 illeus (oppo-
site to RTG scan).
If there is a case of mechanic (dynamic) illeus
with ultrasonography we can find dilatated intesti-
nal curves, hyperchastration, peristaltic and an-
tiperistaltic waved. In case of paralytic illeus, in-
testinal curves are only dilatated, without visible
causations and with barely visible movement of the
content.
This method is especially valuable in detection
of invaginal illeus.

3. US IN EMERGENCY CARDIOVASCULAR
DISEASES
Screening cardiac US is especially useful in ur-
gent 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 activ-
ity. 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, dilatated 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 cardiocin-
tesis under US control after diagnosis has been set saves the patient’s life. AAA is the state which ful-
fills all criteria’s for the rapid diagnosis at the prima-
ry health care level in the emergency medicine cen-
ters. In order that patient survive in these cases im-
perative is diagnosis. This is the patients of top level of emergency which arrives with strong abdominal
pain, have hypotension with sincopal episodes and
pulsating abdomen mass so it definitely requires ur-
gent abdominal ultrasonography. Use of ultrasonog-
raphy 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 ar-
terial was which becomes divided. Blood besides
the right path also flows through the newly formed
lumenfalse, or paralumen).

This change is followed by the intensive pain
in the central abdomen regions with spreading low-
er into the back. A state of shock is developing; de-
crease 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 atheroscle-
rosis, hypertension, inflammatory, micotic and tra-
matic changes, and rarely spontaneous. Clinical im-
age is dominated with the intensive increasing pain
and symptoms of the hemorrhage shock.

4. URGEN T ULTRASONOGRAPHY IN CASE OF
URINARY SYSTEM DISEASES

One of the most often indications for the ur-
gent ultrasonography is occurrence of renal colic.
Although kidney stoned are not always seen oc-
currence of pyelon ectasy is easily seen by US ex-
amination. 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. Manage-
ment of these states is identical for all injured re-
gardless of age.

Injuries of the abdomen wall can cause occur-
rence of the acute abdominal pain especially cases
when it is accompanied lesions in some of the in-
ternal organs. Ultrasonography represents meth-
od of choice in evaluation of this condition use to
proven high sensitivity in detection of intra-abdom-
inal 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 trough the full bladder. This ultrasonic
evaluation is rather specific so a special algorithm
is formed called FAST (Focused abdominal sonog-
raphy examination in case of trauma) which is sys-
temic and focused on:

- right upper quadrant – hepatorenal space
  - Morison,
- left upper quadrant – perisplenic and paracolic
  region,
- left and right paracolic region and retro
  peritoneum,
- small pelvis – Douglas and vezicorectal 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 deter-
mine existence of itraperitoneal bleeding, pericar-
dial tamponade or haematothorax. Sensitivity of the
ultrasonography in detection of the posttraumatic
changes is increased with repeated evaluation and
close follow up o the patients condition.

Besides detection of fluid in predilection spac-
es in abdomen, posttraumatic focused abdominal ul-
trasonography recommends standards for detection
of lesions in parenchyma organs which sometimes
does not need to be accompanied with intra peritone-
al 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 hemoma or com-
plete destruction–convaxation of the organ. Focused
abdominal ultrasonography implies examination of
the caudal parts of the thorax in order to detect he-
matotherax, pneumothorax or pericardic 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.

Case 2. Acute necrotic alcohol induced pancreatitis

In case of this state ultrasonography signs are: a) diffuse heterogenic, mainly hypoechojenous 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 bend ed 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 hypoechojenous 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.

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 coastal 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 coastal 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 1. Ultrasound finding of free liquid in Morrison space](image1)

![Figure 2. Ultrasound finding of the acute pancreatitis](image2)

![Figure 3. Ultrasound finding of the acute cholecystitis](image3)
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.

**Case 5. Ileus.** Ultrasound criteria’s for intestinal occlusion are: a) dilated 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 caused by adherions from the previous surgery.

**Case 6.** Malignant stenosis of the stomach entrance.

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**

Ultrasound signs in this case are: tubular structure of the thickened irregular wall which is hypoechoigenic, 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.
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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 an 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.

REFERENCES


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