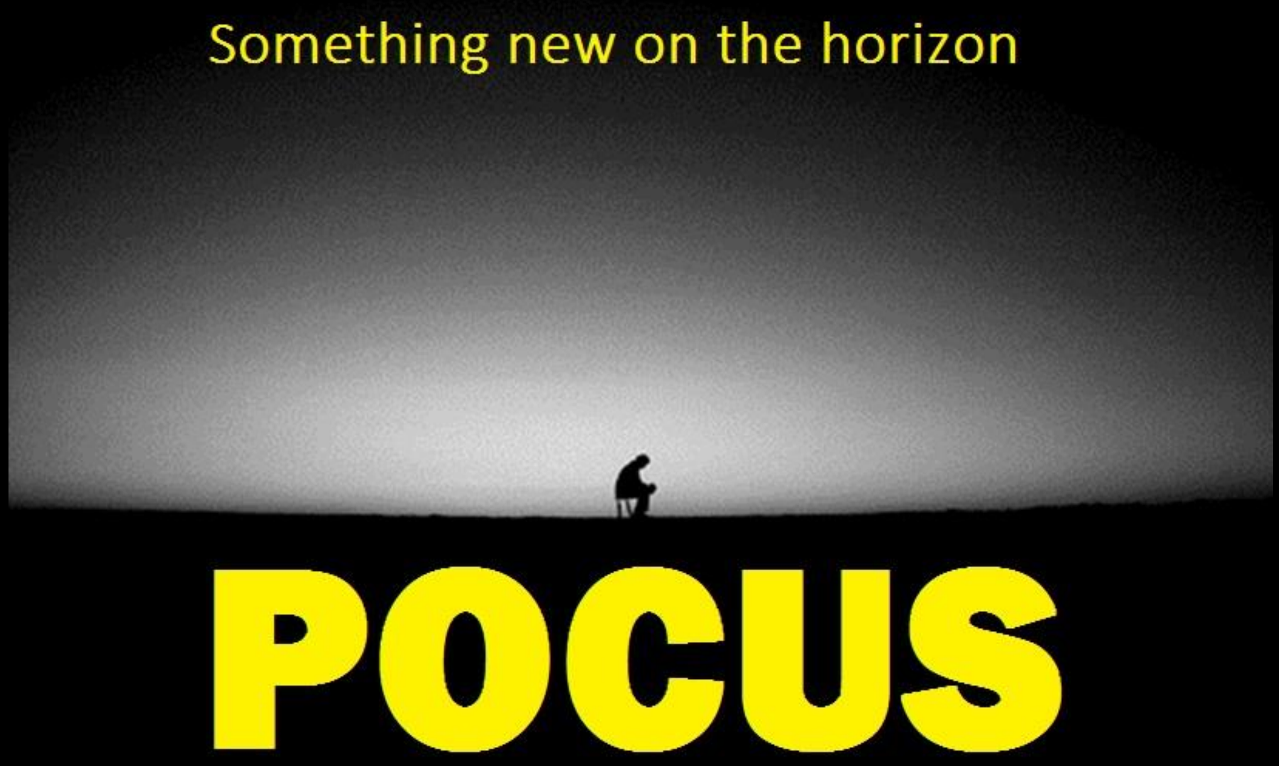
POCUS Journal

International POCUS Academy JULY 2023

Non-profit organization of national Point-Of-Care-UltraSound schools



Respected colleagues,

Here we are in the fifth year of existence of our organization, in which we have officially, after two meetings of the Board of Directors, been transformed into an Academy, a non-profit association of national POCUS schools. Our new website is now at **www.pocus.edu.rs** and all news about our activities are regularly updated and available there. We changed the name of this magazine from Newsletter to Journal because we have a sincere intention to improve the scientific and professional content and quality of it. I invite you to send your articles, case reports, reviews, etc., as many as possible by the end of this year, when we will publish the next edition of the Journal. Meanwhile, news from your national schools and academies can also be submitted for posting on the website. I hope that we will get new members soon and expand our national school.

All the best to everyone, have a long warm summer and success in your future work!

Dr. Ivica Zdravković, Editor
Secretary General of the IPA

Teachings for the Practicing Physician (TFPP)-April 2020 (1) Review article
Corresponding author: Gédéon GELIN MD gedeonghtgsd@rocketmail.com
Telephone: 01-509-36324433
A didactic Journal

Lung Ultrasonography for the Primary Care Physician

Gédéon GELIN MD - Founder and Chair CHRESS School of Ultrasound-Polyclinique Universitaire de Pernier, Haiti, Chief Physician-Ultrasound Department-Hospital L'Eau-de-Vie, Fonds-Parisien, Haiti
Barbara Pierre, MD - Hospital Espoir-Haiti
Sendia Gustave MD - First-Year Resident in Pulmonology-State University of Haiti
Levelt Jean MD - Pulmonologist-Polyclinique Universitaire de Pernier, Haiti

Abstract

Ultrasonography is a useful tool that can assist the primary care physician in diagnosing some common lung diseases. This paper presents the most common lung diseases a primary care physician can identify using a ultrasound probe in his daily practice.

Introduction

Ultrasound exams are becoming more and more popular among physicians all over the world for four main reasons. Number one, patients receive no radiations. Number two, the exam can be done with a laptop ultrasound at bedside. Number three, it costs lower than a Computed Tomography scanning. Number four, it may be as efficient as a CT scanning depending on level of expertise of the operator.

Ultrasonography is commonly used in many hospitals in Low-income Countries as one the first imaging tool for abdomen, obstetrics and gynecology. At CHRESS University Clinic of Pernier, Haiti, we use it as the first imaging modality not only for abdomen, obstetrics and gynecology but also for thyroid, testes, Heart, vessels, musculoskeletal and Lungs. Although evidences showed that this imaging modality can assist in diagnosing pulmonary diseases, physicians in many countries are not aware of its usefulness in pulmonology.

This review aims at seeing the current place lung ultrasonography should occupy in primary care medicine in Low-Income Countries. Basic lung ultrasound anatomy, ultrasound semiotics for lung diseases, examination techniques and common possible diagnosis will be discussed. We will conclude this didactic paper by explaining how practitioners can take the most of this cheap and useful imaging modality in primary care settings.

Lung Ultrasound Anatomy

Fig 1 shows a side to side correlation between lungs anatomy and normal ultrasound findings[1]. We can identify the following structures: skin, soft tissue, pectoralis muscles, ribs, intercostal muscles, pleura and lung.

Figure 1 from www.philips.com

Ultrasound semiotics for lung diseases

Ten basic signs have been identified to assist in the diagnosis of many lung diseases[2]. Fig 2 shows the first one: the "bat sign". A positive "Bat sign" means a normal lung. The illustration simulates a bat with its wings.

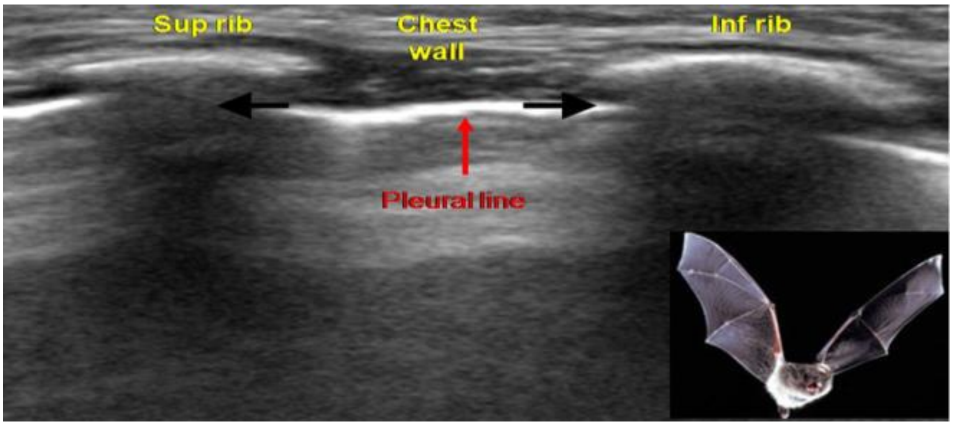


Figure 2-The Bat sign

Second come equidistant horizontal lines arising from the pleural line called "A lines" as shown in figure 3. They arise from air. A lines may suggest normal or abnormal presence of air in the lungs. They are hyperechoic.

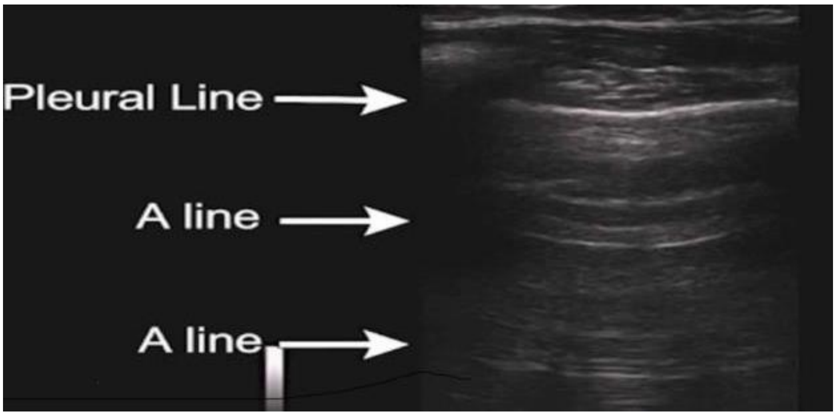


Figure 3: A line

When we look at the lungs under the probe, we see the pleural line moving from right to left and from left to right. This is called the "sliding lung" (third sign). When using M-Mode, the picture looks like a sea clearly separated from the shore by a border. This is the "seashore sign» (fourth sign).The "seashore sign» is shown at the right side of the below picture (Figure 4).The left picture confirms that the sea is above the border and the shore below. The "sliding lung" and the "seashore" signs are identical from a clinical point of view (5).

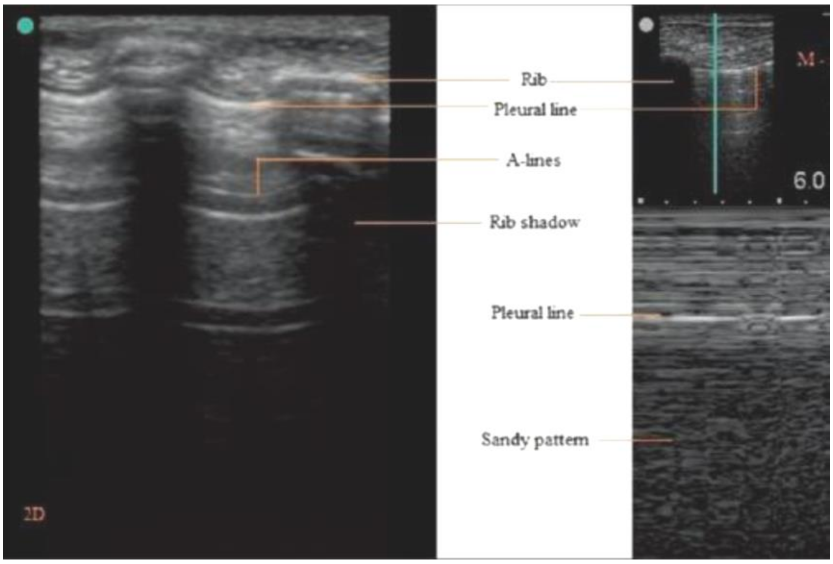


Figure 4: Seashore sign

The “Seashore sign” owns its name to the fact it looks like a beach. Figures 3 and 4 show equidistant parallel lines to the pleura called A lines.

The fifth sign is the “shred sign”[3]. It mimics consolidation. The lung has the same echogenicity as the liver. The shred sign pictures the irregular border between consolidated and normal aerated lung (4).

Figure 4: The shred sign

Lung consolidation shows the shred sign when it is translobar. Non translobar consolidation is illustrated trough the “lung sign” where a fluid disorder shows a liver or spleen like echogenicity (figure 5)(5).

Figure 5: Lung sign

Two other signs (Sixth and seventh) that have the same clinical meaning are the “Quad sign” and the “sinusoid sign”. Both mean pleural effusion. The quad sign consists of four lines: the pleura above, the lung below and the ribs on the sides. The black color inside them is the effusion. It is seen in B-Mode. We see the sinusoid sign in M-mode at the left (figure 6)[2]. The shred sign is also called “fractal sign”.

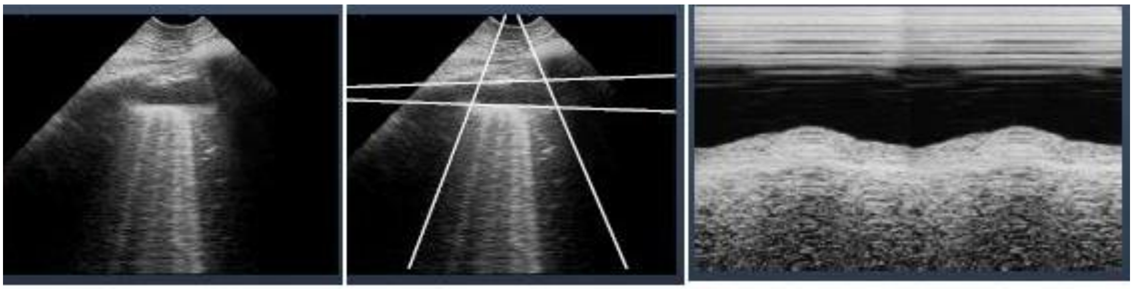


Figure 6: Quad sign and Sinusoid sign

A useful sign to identify interstitial syndrome is the B lines (Eight). We define them through seven features: they arise from the pleural line, are comet tail artifact and move with the pleural line when we have lung sliding. They usually do not fade until bottom of the screen, are well-defined laser-ray like, erase A-lines and are hyperechoic (figure 7)[2].

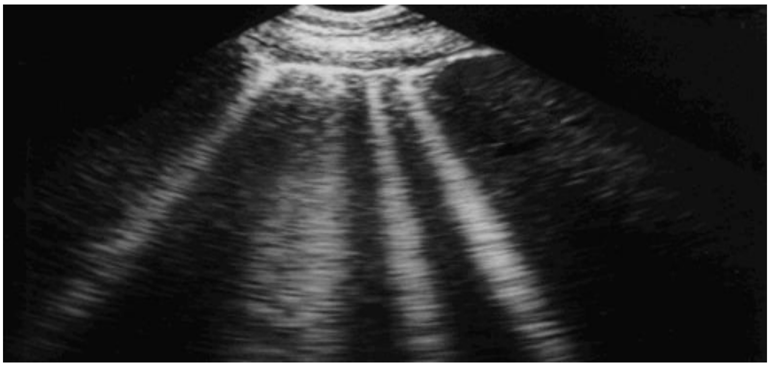


Figure 7: B lines

The last signs we will study are the “stratosphere” (Ninth) and the “Lung point”(Tenth) signs. The stratosphere sign means absence of lung sliding. M-mode illustrates it by showing a barcode. The lung point has the same clinical meaning. It is seen on B-Mode. Figure 8 compares the normal seashore sign and the stratosphere or barcode sign which can be seen in pneumothorax.

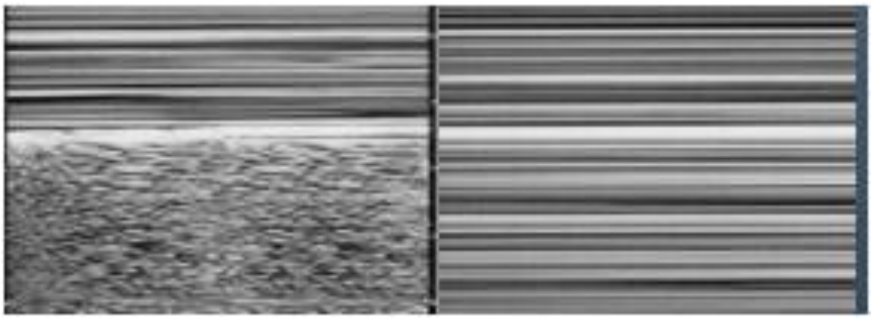


Figure 8: Seashore sign and Stratosphere sign

Lung sliding is easily seen: the horizontal pleural line is moving from left to right and from right to left (See figure 2).

Although this review is a basic introduction to lung ultrasonography, two other echogenic “lines” are worth mentioning: Lines C and Z. Lines C are parallel to lines A but they are not equidistant. Lines Z are vertical like lines B but they do not reach the bottom of the screen (7).

Examination techniques

Which probe should be used? The answer is simple: use a high-frequency probe for superficial structures and a low one for deeper ones.

Where should we place the probe? Lung ultrasonography can be performed on the whole chest longitudinally, perpendicular to the ribs, and obliquely, along the intercostal spaces. (Figure 8) (8,9). Suprasternal, supraclavicular and infraclavicular approaches can be used to study the apex of the lungs (9).

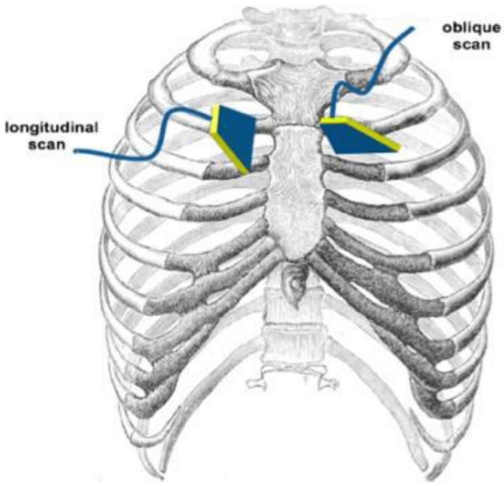


Figure 8: position of the probes.

Longitudinal and transverse scanning shows the following pictures:

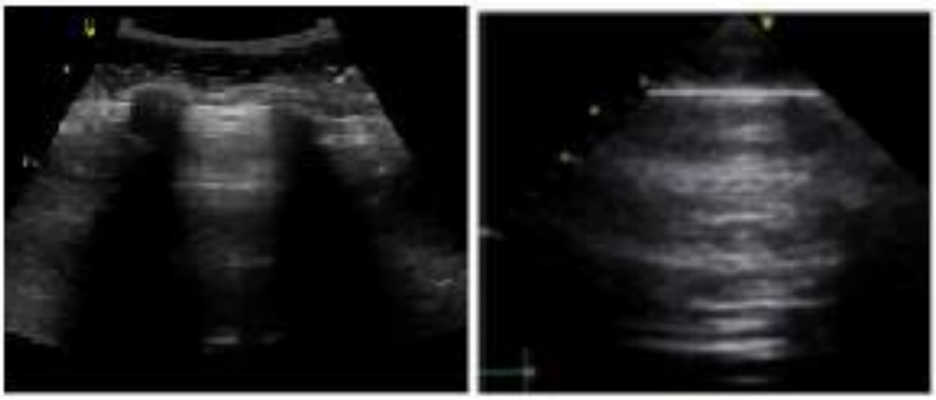


Figure 9: Longitudinal (left) and transverse scanning (right)

In contrast to longitudinal scanning, transverse scanning shows no costal shadows. The patient should be in a supine position at 30 to 45 degrees. The probe should image the 8 positions shown below (figure 10).

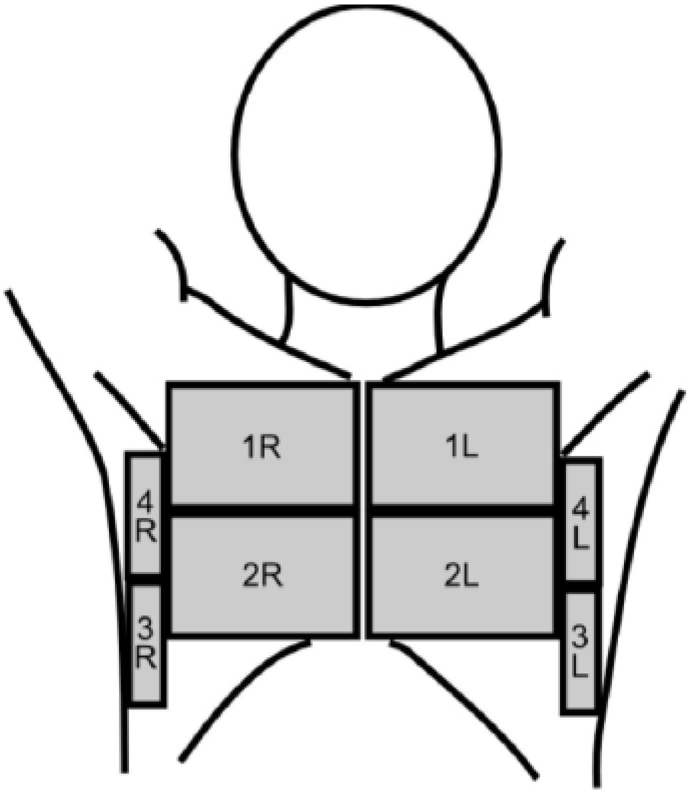


Figure 10: Positions of the probe

In this figure, R and L mean “right and left”. We can make a horizontal line at the level of the tip of the breast and two other ones parallel to the borders of the sternum. We also draw the anterior and posterior axillary lines. Number three (3) and four (4) are located between the anterior and posterior axillary lines.

Lung diseases diagnosed by ultrasound

In this section, we will review briefly some common lung diseases and will explain how ultrasound can assist in the diagnosis.

Pneumonia (Lung Consolidation)

When a patient presents to his physician with cough, fever and shortness of breath, chest radiography is often ordered. However, searching for pneumonia with chest radiography has low accuracy (11). Ultrasound imaging has proved superior to radiography in almost every setting ranging from intensive care units to emergency departments and outpatient clinics (11). The lung has the same echogenicity as the liver in case of pneumonia (figure 11).

Figure 11: hepatization of the lung

Lung ultrasound should be the primary imaging modality to assist the physician in diagnosing pneumonia in children. Ultrasound had 100% sensitivity and 91.2% specificity with accuracy 98.2% in diagnosis of pneumonia compared to CT (12). The sensitivity, specificity and accuracy of chest x-ray are 74.4%, 25% and 63.3% respectively (12). Chest radiography should therefore be the second choice to diagnose pneumonia when ultrasound is available. Beyond the parameters discussed above, ultrasound is safer than chest radiography.

Pleural effusion

Ultrasound is far superior to chest radiography in detecting pleural effusion. Diagnostic accuracy is 47% for x-ray against 93% for Ultrasound, thoracic computed tomography being the gold standard (14). Data confirmed that Chest X-ray can detect no less than 200 ml of pleural effusion (15) while ultrasound could catch as low as 20 ml (16).Figure 12 illustrates a case of pleural effusion.

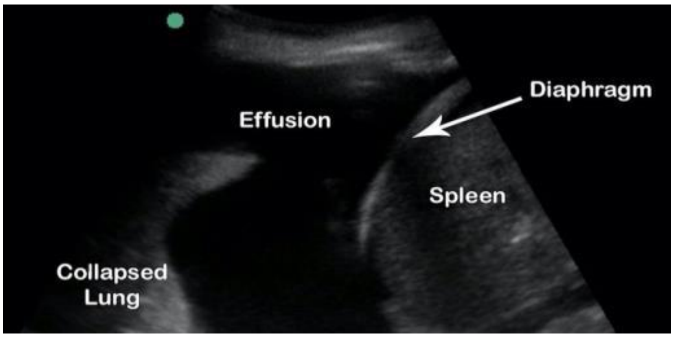


Figure 12: pleural effusion

Pneumothorax

Lung sliding or lung pulse all over the thorax rules out a large pneumothorax with a sensitivity of 95.3% and a negative predictive value of 100% (17). Does absence of lung sliding or lung pulse means pneumothorax? Not always (2). As the pleural line is represented only by the parietal pleura during a pneumothorax, the presence of B-lines rules out pneumothorax as these are generated by the visceral pleura (18).
A specific sign we should look for to confirm a pneumothorax is the presence of a lung point which is the interface between normal lung sliding and pneumothorax pattern (absence of lung sliding with exclusive A-lines) that is seen during M-mode. When A lines (see figure 4) combine with the stratosphere sign (Figure 8), the clinician should think about pneumothorax. Figure 13 shows the lung point (arrow) (2). The left side of the picture shows the seashore sign.

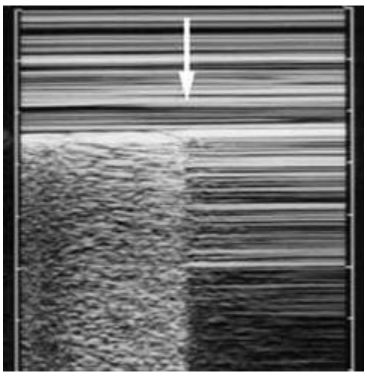


Figure 13: Lung point

Interstitial Syndrome

Interstitial tissues may be injured secondary to many diseases like pulmonary fibrosis, lung infections, acute respiratory distress syndrome or heart failure. A patient with interstitial lung disease has B lines originating from the pleural line and going all the way to the bottom of the screen (19). Figure 14 illustrates a case of lung interstitial syndrome (20).

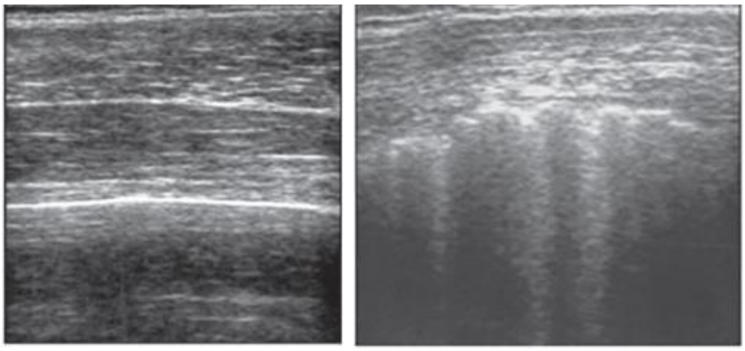


Figure 14 Normal and B-lines

Can ultrasound have a role in diagnosing tuberculosis? Lung ultrasound can show many pictures like consolidation, interstitial syndrome, pleural effusion or cavitation (21). It can mainly be useful for follow-up in a patient with pulmonary tuberculosis. Lung ultrasound can also assist in identifying abscesses or diseases like atelectasis or emphysema and even cancer (9). Abcesses (figure 15) show hypo-echoic focal lesions. Atelectasis (16) or lung collapse is easily seen with contrast ultrasound

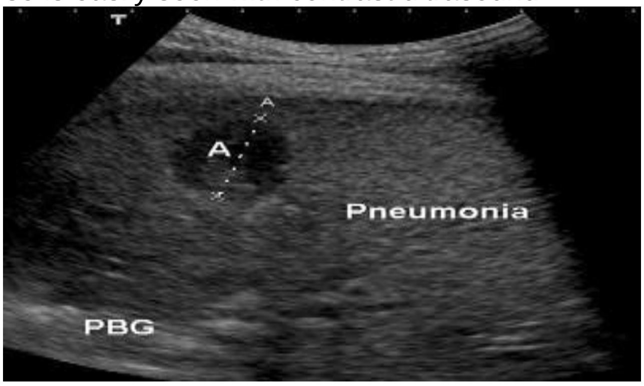


Figure 15 Abcess (A) showing hypoechoic lesion

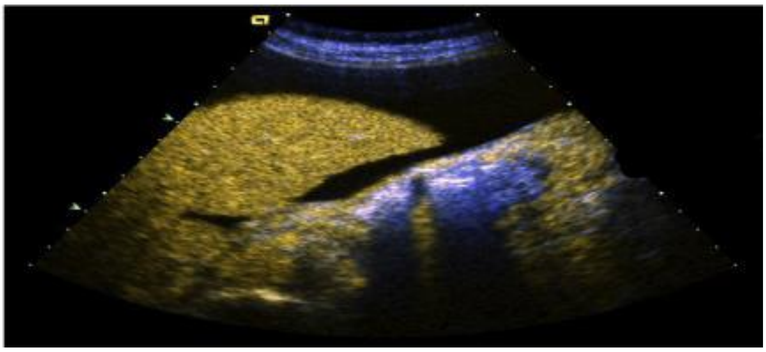


Figure 16 Lung collapse

Conclusion

To take the most of ultrasonography, we should see it as an extension of the clinical examination. In a patient with fever, cough, increased vocal vibrations at palpation and crackles during auscultation, if putting the probe on the thorax shows consolidation, do we

References

Really need additional information to think about pneumonia? The twentieth century physicians should use ultrasound probes as a stethoscope! In lung diseases, although it has limitations (Ex: for obese patients), it can assist in diagnosis many diseases. Ultrascope?

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POCUS Academy of Serbia

On May 21st 2023 we held the Founding assembly of the POCUS Academy of Serbia. This gathering was attended by colleagues from several cities in Serbia, specialists and instructors of POCUS ultrasound diagnostics, as well as prim. Dr. Željka Popović from Doboj (Bosnia and Herzegovina), associate professor of the Academy. This organization has existed informally for four years as a member of the International POCUS Academy and acts as a non-profit association of doctors. It was formed for purposes of continuous medical education in the field of clinical ultrasound diagnostics. Host of the event was Dr. Ivica Zdravkovic, Secretary general of IPA, Director of POCUS Academy of Serbia and associate professor.

A small workshop on three ultrasound machines was organized in the "ID MEDICA" clinic. The Council of the Academy was elected and the titles of scientific associates - assistants and associate professors were awarded.

The participants of the meeting stated that they hope work and activities of the Academy will be followed with more attention from medical organizations in Serbia, including Medical Chamber of Serbia. The Academy, in cooperation with educators from Republika Srpska, conducted training for several hundred doctors at various courses over the past 6 years in Belgrade, Požarevac, Bijeljina, Doboj, Prnjavor and Prijedor. The second edition of the POCUS ultrasound diagnostics textbook, written by the Academy's lecturers, is in printing procedure and it was also agreed to lounchSerbian POCUS Journal in the future.

Variety of new activities is announcend, including internationl symposium in Doboj, Bosnia and Herzegovina, hosted by Prof. Željka Popovic and her colleagues in september this year.

POCUS Academy of Serbia is a small organization, but full of enthusiasm and good energy. POCUS has brought many of the doctors back to the time when they entered vigorously the world of medicine. With this renewed strength, members of the Academy joyfully welcome the days and years ahead.

POCUS AKADEMIJA
SRBIJE

Journal of International POCUS Academy, July 2023

Clinical cases with the use of POCUS at the pre-hospital stage

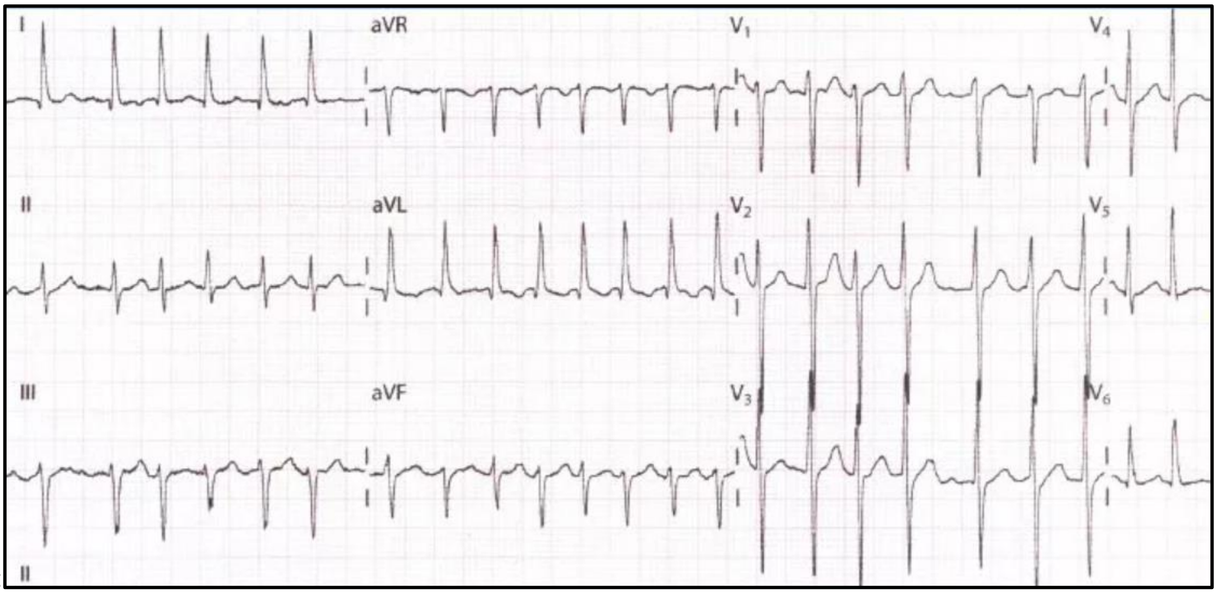
Dr. Roman Mikhei, Dr. Roman Filyavin

Moscow ambulance crews are equipped with modern medical equipment that allows a wide range of diagnostic and therapeutic measures, up to advanced resuscitation measures during transport to the clinical hospital using LUCAS 2, under continuous monitoring of patient vital parameters and visual control of portable ultrasound systems with Wi-Fi sensors (SONON 300C\300L).

Clinical Case #1

Call with hypotension of unclear etiology to a 75-year-old man. History of hypertension, CHD, a constant form of atrial fibrillation, atherosclerotic lesion of cerebral vessels, periodic pulsating pains in the abdomen. He takes hypotensive and rhythm-relieving drugs, oral anticoagulants. On objective examination, BP 100/60 mmHg, HR 105 per min, BP 19 per min, SpO2 95%, body temperature 36.3°C. On palpation of the abdomen, a pulsatile mass in the mesogaster region.

EKG:



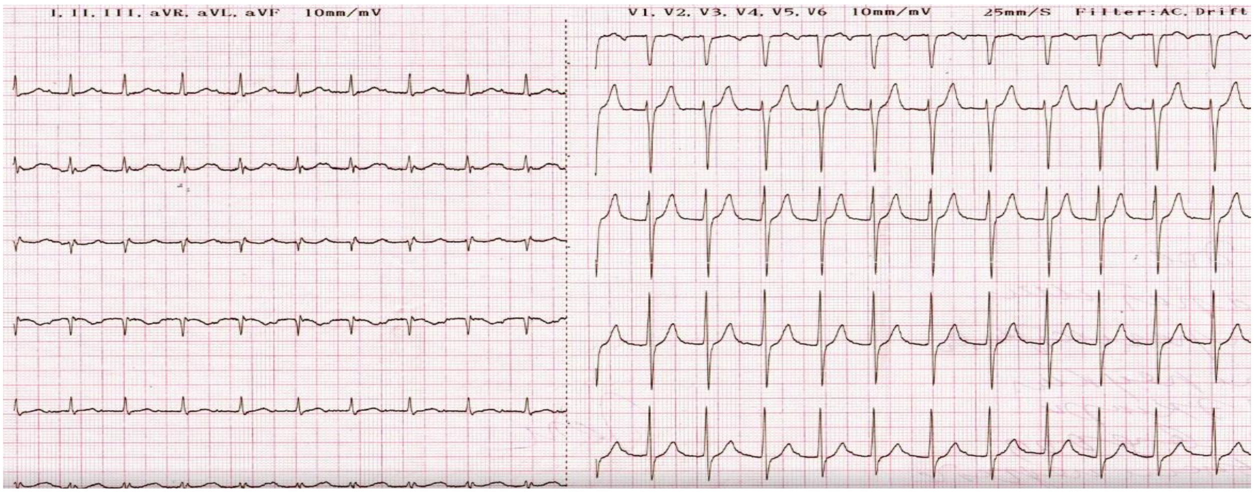
Screening study by EFAST protocol did not reveal abdominal, pleural and pericardial cavity fluid in the patient, no pneumothorax. But there was pronounced cardiac hyperdynamic, decreased size of NPV up to 12 mm with more than 50% collapsing.

Additional investigation of the abdominal aorta revealed a spindle-shaped aneurysm up to 55 mm in diameter without signs of rupture. The patient underwent correction of the water balance with infusion therapy and received treatment recommendations with referral to a vascular surgeon.

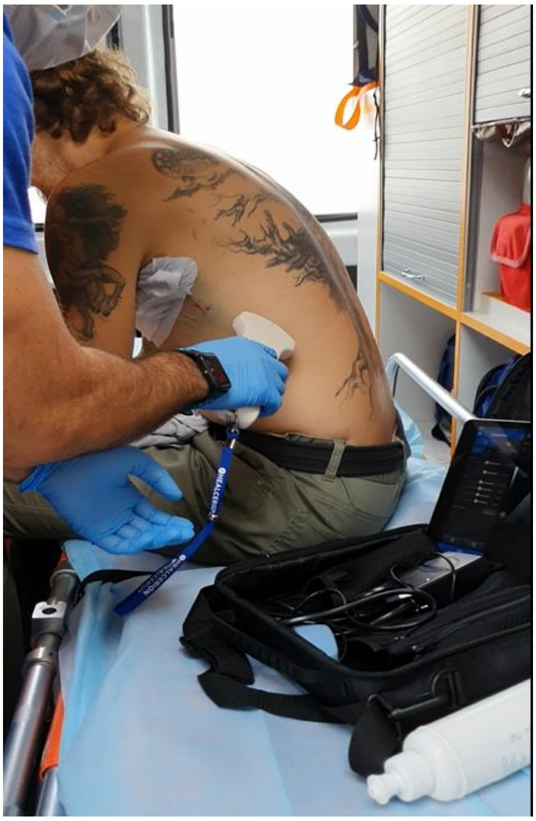
Clinical Case #2

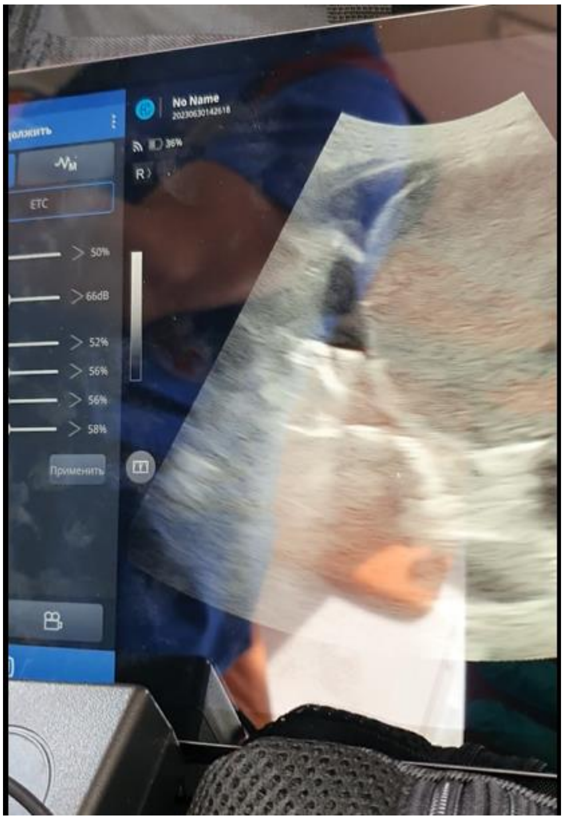
A 55-year-old man was called with the cause of dyspnea, heavy breathing. Past medical history includes chronic lung disease, chronic heart failure, venous insufficiency of the lower extremities veins, atherosclerotic lesion of the cerebral vessels. Dynamic deterioration within 14 days is known. On objective examination, BP 110/70 mmHg, HR 95 per min, BP 22 per min, SpO2 88%, body temperature 37.9°C. Decreased respiratory murmurs were noted on both sides.

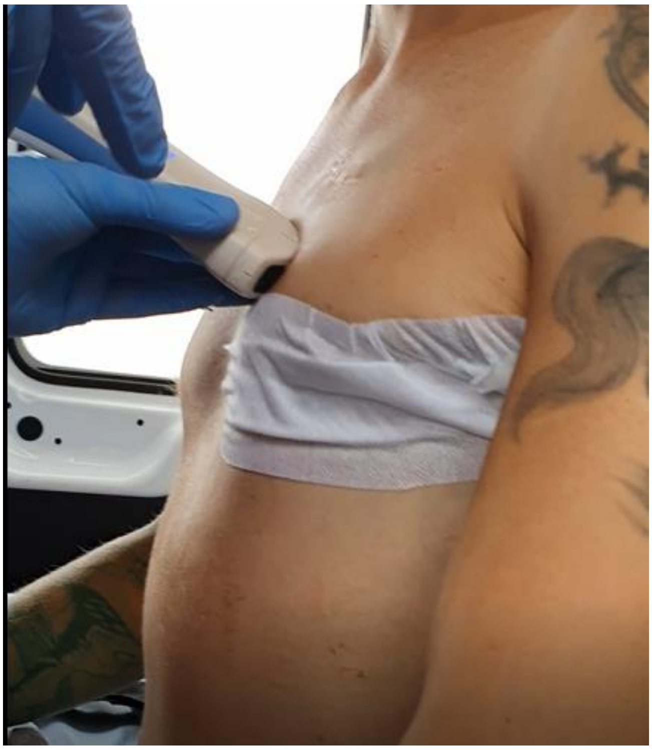
EKG:



A BLUE-protocol was performed: compression atelectasis of the right lung with large fluid accumulation in the pleural cavity (more than 1 liter) was revealed. And hydropericardium.



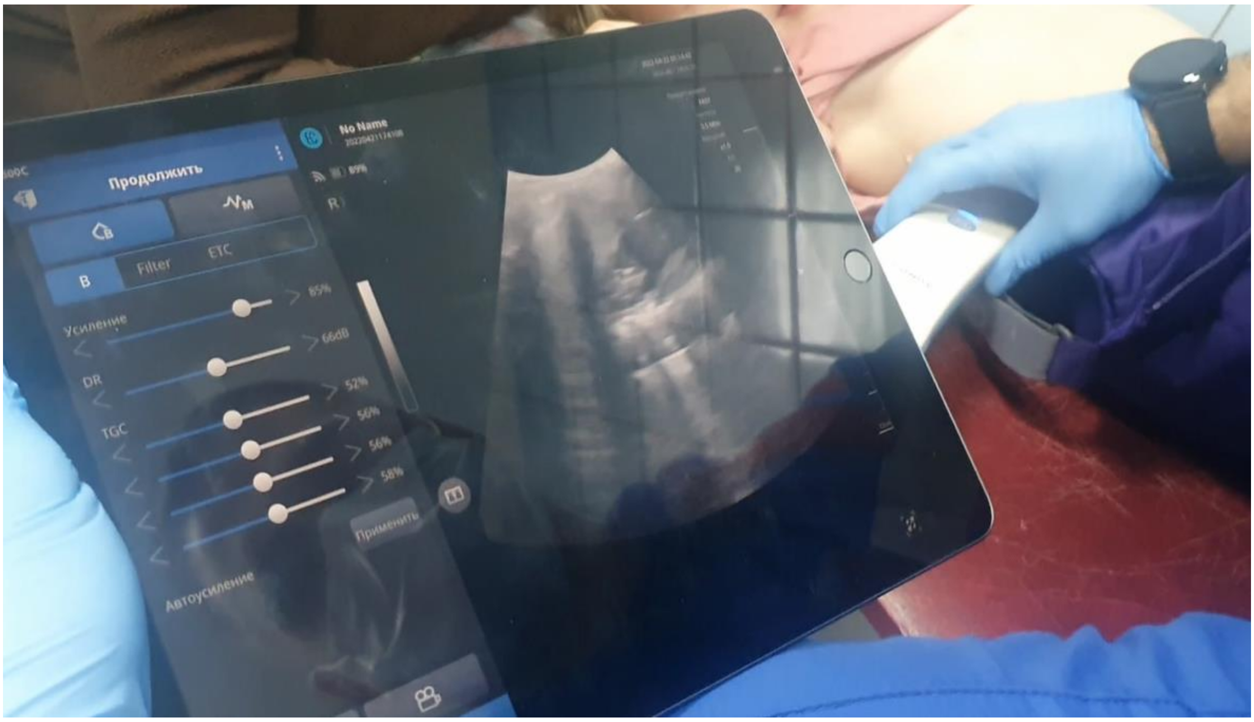




Assisted oxygen support was administered, the patient was admitted to a specialized hospital.

Clinical Case #3.

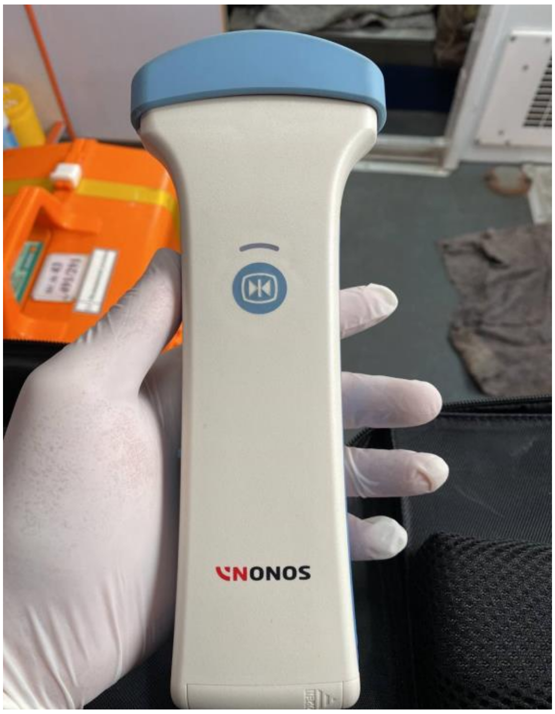
Call to the children's trauma center for a 10-year-old child with suspected closed abdominal injury after a fall from a slide. No history of disease. It is known that 2.5 hours passed after the injury, the child did not lose consciousness, he moves independently. On objective examination, BP 90/50 mm Hg, HR 105 per min, BP 22 per min, SpO2 98%, body temperature 36.4°C. Painfulness on palpation of the anterior abdominal wall.

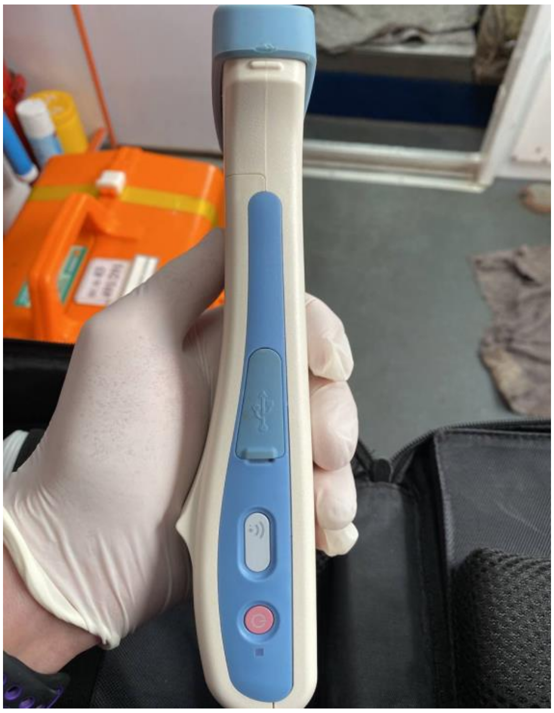


There is no free fluid in abdominal and pleural cavities during EFAST-protocol ultrasound examination. There was no fluid in the pericardium. No signs of pneumothorax were found. No hospitalization was required, he was treated on an outpatient basis.

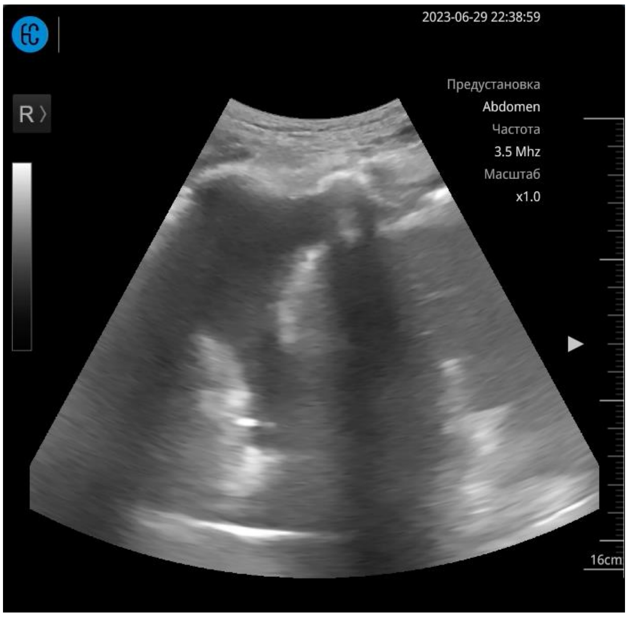
Clinical Case #4.

An ambulance team was called to patient P., 64 years old, with the reason for the call "gasping for breath, became lethargic". On arrival at the scene of the call, the A&R team found the patient lying on the bed with his head elevated. On physical examination, BP 90/50 mmHg (patient adapted to 100/60 mmHg), HR 58 per minute, SpO2 94% when breathing atmospheric air, body temperature 36.6°C, glucometry: 4.9 mmol/l. The patient is accessible to contact, lethargic, apathetic, no active complaints at the time of examination. According to relatives, the patient's condition has been progressively worsening for several days. Over the past two days, episodes of hypoglycemia (up to 2.3 mmol/l) were noted several times, which were stopped by the ambulance crews, and the patient refused further hospitalization. Today, the relatives thought that the patient stopped responding to treatment, and an ambulance team was called. According to EMIAS: Stage III hypertension, CHD, PICS (of unknown age), coronary cardiomyopathy, type 2. According to the submitted medical records, the patient was discharged from Chazov Cardiology Center on June 23, 2023, where he was treated for CHF, septic shock, ARF (repeated sessions of renal replacement therapy). The patient has a history of CABG, PCI (2009), coronary artery stenting (2008). The patient regularly takes Torasemide, Digoxin, Diuver, Bisoprolol, Glucofage. According to the relatives, there is a decrease of diuresis rate (about 1000 ml per day). He denies allergy to medications. Covid 19 was ill, vaccinated, denies contact with infectious patients. An ultrasound scanner was used for diagnostic purposes during the examination.





According to the findings, the patient was found to have bilateral hydrothorax, decreased LV contractility. The patient was admitted to the cardiac intensive care unit for further treatment.



Conclusions:

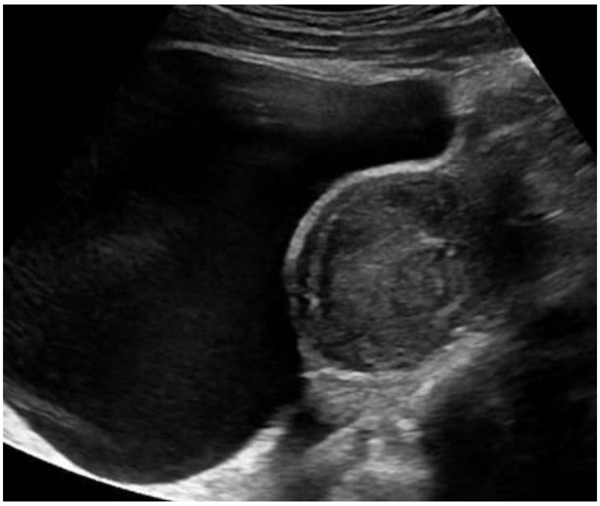
The use of ultrasound-assisted examination of patients in the prehospital phase allows to understand the cause of clinical deterioration of patients and to carry out timely therapeutic measures at the place of medical care. The eFAST and BLUE protocols are used in practice at the pre-hospital stage in Moscow by medical teams in patients with trauma, arterial hypotension, respiratory failure and decreased SpO2, in shock and in extended resuscitation measures, which proved to reduce time of differential diagnosis in urgent practice and significantly increase survival prognosis in the large metropolitan area of the world.

POCUS CASE REPORTS

Contrubuted by
Dr. Danijel Oderković, POCUS specialist,
POCUS Academy of Serbia instructor & scientific assistant

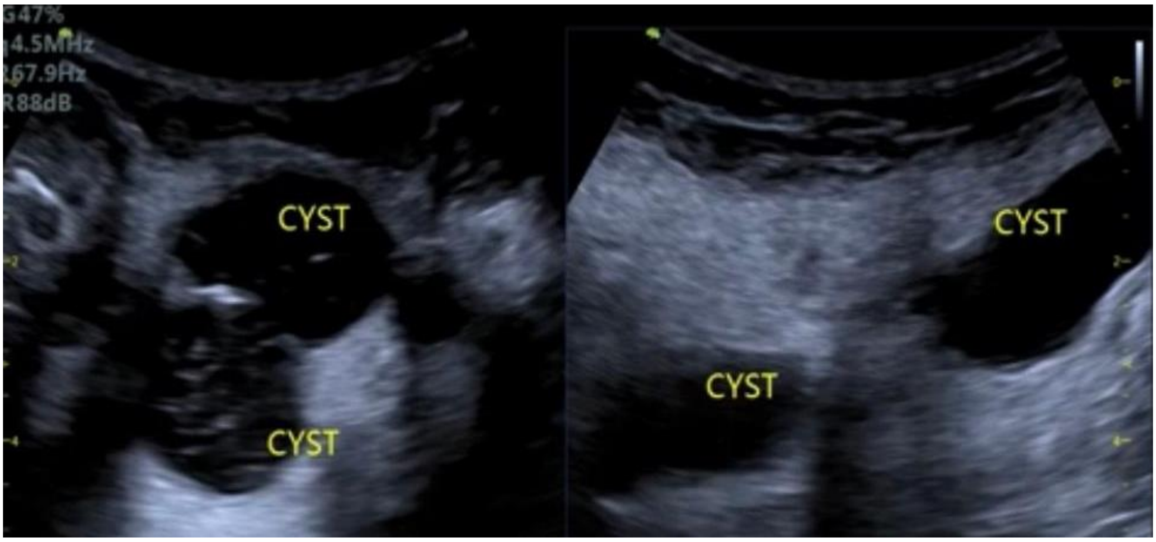
Bleeding fybroid

A 49-year-old female patient, intellectually disabled, comes accompanied by a nurse, who complains of pain in the lower abdomen, frequent urination and traces of blood. She cannot determine with certainty whether the blood originates from the urine or the vagina. Physical examination shows a painful palpation. POCUSUS examination shows an intramural myoma measuring 55x58 mm with a small amount of free fluid in the Douglas pouch. The patient was referred to a gynecologist who confirmed the findings. In the received lab analysis, the drop in hemoglobin to 82 g/L is highlighted, and the urine examination is normal.



PASH

A 43-year-old female patient comes to the examination because she felt a lump in her left breast. She also mentions pain in both breasts during the cycle. In addition to the physical examination, a breast ultrasound was performed, which showed multiple cysts of various sizes in both breasts, with poorly preserved glandular tissue, a dominant fibrous component and one fibroadenoma in the left breast. Certain changes in both breasts suggest PASH (Pseudoangiomatous stromal hyperplasia).Both axillae are without enlarged lymh nodes. Estimated BI-RADS of both breasts is 3. I proposed mammography and examination by a surgeon.



Contrubuted by
Prim. dr. Željka Popović, FM &POCUS specialist,
POCUS Academy of Serbia associate professor

POCUS AND URINATION PROBLEMS

Diseases of the urinary tract are among the most common causes for which patients turn to their family doctor. Very often, the diagnosis can be made based on the sole symptoms that the patient reports, and the treatment ends with empirical priscription of antibiotics. However, relying on the characteristical clinical forms and applyiong "easy solutions" sometimes may cause malpractice. The following two cases illustrate this danger.

A 60-year-old patient complained of frequent urination over the last few months. At the same time, she had no urinaring discomfort. Lately she has been feeling tired and weak. I noticed that she had already consulted a doctor several times for the same complaints. She took antibiotics, but without much improvement. Laboratory findings were in favor of mild anemia and external contamination of urine. However, the patient provided very important anamnestic information: she had a gynecological operation few years ago for which she underwent radiotherapy several times. An ultrasound image of the right kidney showed a third-degree hydronephrosis,with severely thinned cortex. Considering the anamnestic information about radiotherapy, I suspected that it was a stricture of the right ureter, which resulted in hydronephrosis. The patient was urgently admitted to the urology department, where further imiging confirmed the diagnosis.

The second case tells of a female patient in her late 50's who also came because of frequent urination and a feeling of pressure in the lower abdomen, and an occasional pain that spread to the lower part of the spine. She was visibly upset because the previous treatment did not show any results. POCUS of both kidneys and bladder revealed no disease. However, I noticed a large myoma of the uterus, that was the size of a child's head. She was immediately referred to a gynecologist who soon got her operated.

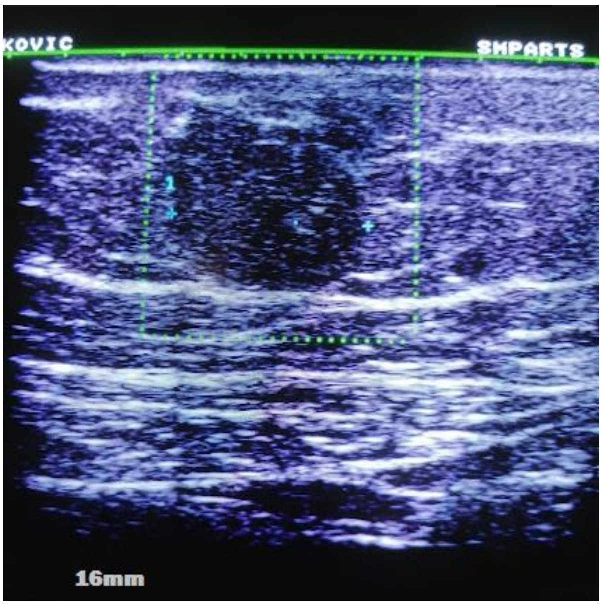
It is interesting that the patient attributed her "pregnant figure" to genetics and that she was gaining weight "only in the stomach". She was quite surprised after hearing the diagnosis. Needles to say, she was not seeing gynecologysts ever since she lost her periods years ago.

Both cases demonstrated the importance of POCUS in cases where the laboratory was not pathognomonic. The ultrasound should be in the first line of diagostical procedures when complications of other diseases are suspected and frequent urination is the single isolated symptom.

Contrubuted by
Prim. dr. Ivica Zdravković, GP &POCUS specialist,
POCUS Academy of Serbia associate professor

ABDOMINAL WALL ENDOMETRIOSIS

A 25-year-old female patient comes because of occasional pain in the right inguinal region. Denies pregnancy, denies urinary complaints. Her appendix was operated in childhood. She has not given birth until now, and a few months ago she had a laparoscopic gynecological operation - she does not know for what reasons, but it is related to infertility. The pains are not in correlation with physical effort, they are mild, almost on a daily basis, but they intensify a little during the period. On the abdomen there is a small palpable mass, similar to a hernia or lypoma, but high above the inguinal ligament and a few centimeters away from the small scar after laparoscopy. Her laboratory analyzes are normal. POCUS shows a subcutaneous hypoechoic change 16mm in size, that is avascular, located in the subcutaneous fat tissue and resembles a hematoma. After a control examination by the gynecologist, it was confirmed that it is endometriosis, which arose as a result of the previous operation.



"SAFE-R+" ultrasound protocol in the practice of the NICU intensive care doctor

Krushelnitsky A.A., Yudenkov D.I., Kondratev M.V., Petrova A.S., Serova O.F.

Abstract

Rapid diagnosis of sudden and life-threatening conditions in the neonatal intensive care unit (NICU) is essential for the timely initiation of therapy. Recently, the use of ultrasound as a tool for implementing a program of timely verification of pathological conditions in newborns isgaining wide scale in clinical practice. Various Point-of-Care Ultrasound (POCUS) protocols used in adult patients, such as BLUE, FAST, RUSH, etc., are well described in the current literature. However, the selection of specialised protocols designed specifically for neonates issmall (SAFE, SAFE-R).

*The author's team has supplemented existing emergency diagnostic protocols for newborns, resulting in a domestic ultrasound protocol (**SAFE-R+**). The new diagnostic scheme isspecifically designed for use by NICU specialists and visiting resuscitation and consultativeteams. The main features of SAFE-R+ are the use of standardized ultrasound positions with asingle transducer, and the effectiveness of diagnosing neonatal emergencies by a physician witheven minimal training in ultrasound diagnosis.*

Keywords:

POCUS, SAFE, SAFE-R, SAFE-R+, emergency ultrasound, neonatal resuscitation.

Rapid diagnosis of sudden and life-threatening conditions in the neonatal intensive care unit (NICU) is important for the timely initiation of therapy. Recently, the use of ultrasound as atool for the implementation of a program for the timely verification of pathological conditionsof newborns has become widespread in clinical practice. In the modern literature, various protocols of bedside ultrasound diagnostics (ultrasound diagnostics) - Point-of-Care Ultrasound (POCUS) - used in adult patients, in particular BLUE, FAST, RUSH, etc. are well described. At the same time, the choice of specialized protocols developed specifically for newborns is small (SAFE, SAFE-R).

The team of authors supplemented the existing protocols of emergency diagnostics of thecondition of newborns, as a result of which a domestic ultrasound protocol (**SAFE-R+**) was created. The new diagnostic scheme is specially designed for use by specialists of the NICUand field resuscitation and advisory teams.

The main features of SAFE-R+ are represented by the use of standardized ultrasound positions, a single sensor, as well as the effectiveness ofdiagnosing emergency conditions of newborns by a doctor who has even a minimal amount oftraining in ultrasound diagnostics.

In recent years, there has been increasing interest in the use of Point-of-Care Ultrasound (POCUS) in practice; this is particularly relevant to emergency department physicians andanaesthetists, resuscitation and intensive care units. Clinical guidelines and ultrasound protocolshave been published for the use of the technique in older patients, with wide coverage of clinical situations, including dyspnoea [1], shock [2], and trauma [3]. The POCUS algorithm came into paediatric and neonatal practice somewhat later, but the international clinical guidelines for the use of ultrasound in the diagnosis of infant critical conditions published by the European society of paediatric and neonatal intensive care (ESPNIC) working group in2020 [4] provide grounds for active implementation of the technology in paediatric and neonatal intensive care units. Rapid diagnosis of acute and potentially life-threatening conditions in the NICU is essential for a rapid response to the clinical situation. POCUS is a simple, safe and accessible examination method with low training costs. According to G. Escourrou et al. (5), the introduction of bedside ultrasound in the NICU has approximately halved the need for chest radiography and significantly reduced the average radiation dose to patients. In the absence of formal, scientifically proven, validated diagnostic clinical ultrasound algorithms adapted to the neonatal period, the development of a simple and convenient protocol for using ultrasound not only to verify the causes of sudden deterioration in children in NICU, but also as an additional diagnostic tool to make decisions about patient transportability by visiting intensive care andconsultation teams, as well as to identify the most common SAFE protocol: current model.

SAFE protocol: current model

Given the growing need for an emergency ultrasound algorithm for critically ill patients, F.Raimondi et al. in 2018 proposed the SAFE (Sonographic Assessment of liFE-threatening emergencies) protocol, which incorporates lung ultrasound techniques as well as emergency focal echocardiography, which can be performed by a doctor who is not specialised in ultrasound diagnostics [6]. The experts point to the occurrence of unexpected and severe decompensation (bradycardia or severe desaturation requiring resuscitation, a significant increase in respiratory support parameters or cardiac therapy) in previously stable or relatively stable neonates as the main provision for the use of SAFE.

An important distinguishing feature of this protocol is that it can be used by neonatologists, anaesthesia resuscitators with minimal ultrasound diagnostic skills and experience, and will require an ultrasound transducer with afrequency of 5-13 MHz, (e.g. linear, microconvex or phased), with overlapping at specific standardised ultrasound points.

The SAFE protocol begins with a simple subjective assessment of left ventricular myocardialcontractility by EYEBALL; this technique allows left ventricular ejection fraction to be determined by visual assessment. The results of its clinical use suggest that it is comparable with other diagnostic procedures, which have been found to be more accurate but are unsuitable for use in paediatrics because of the time required to measure and assess the parameters (7,8). Significant highlights of the practical application of SAFE are the uncomplicated system of short answer (yes/no) to diagnostic search questions. The algorithm is ordered by the urgency of the condition. Thus, the first step is to rule out cardiac tamponade: it is considered a rare complication, but can be fatal in the absence of surgical intervention.

The next steps are to rule out tension pneumothorax and pleural effusion. The latter is also quite rare in clinical practice and is mainly due to the placement and operation of central venous lines or catheters, which are often used in the NICU. Current guidelines for intensive care in adults and children postulate the use of ultrasound in the diagnosis of pneumothorax and pleural effusion, as this technique is superior to chest radiography (4, 9).

SAFE-R protocol: review of positions

In 2021, N. Yousef et al. published an article [10] in which they proposed to revise the existing SAFE protocol, extending it to the verification of extra-thoracic causes of acute decompensation in previously stable patients in NICU. The authors recommended calling the document SAFE-R (Sonographic Assessment of liFE-threatening emergencies Revised), including critical aortic stenosis, acute abdominal complications and massive intraventricular hemorrhage in the diagnostic search. The SAFE-R protocol is similar to its predecessor, i.e. the specialist does not take any additional measurements but makes a qualitative assessment of the patient's condition. This approach significantly saves time for the clinician to identify life-threatening conditions in patients. In addition, like its predecessor, SAFE-R is intended for neonatologists, anaesthetists and resuscitators who have minimal training in ultrasound diagnostics.

In the initial phase of SAFE-R, the physician fully follows the steps outlined in the SAFE protocol. Correctable causes of decompensation are prioritised in the diagnostic search and therefore the ultrasound transducer positions have been chosen to allow logical and easymovement of the working instrument from the thorax to the abdominal aorta, the iliac regionsand then to the head (Figure 1).

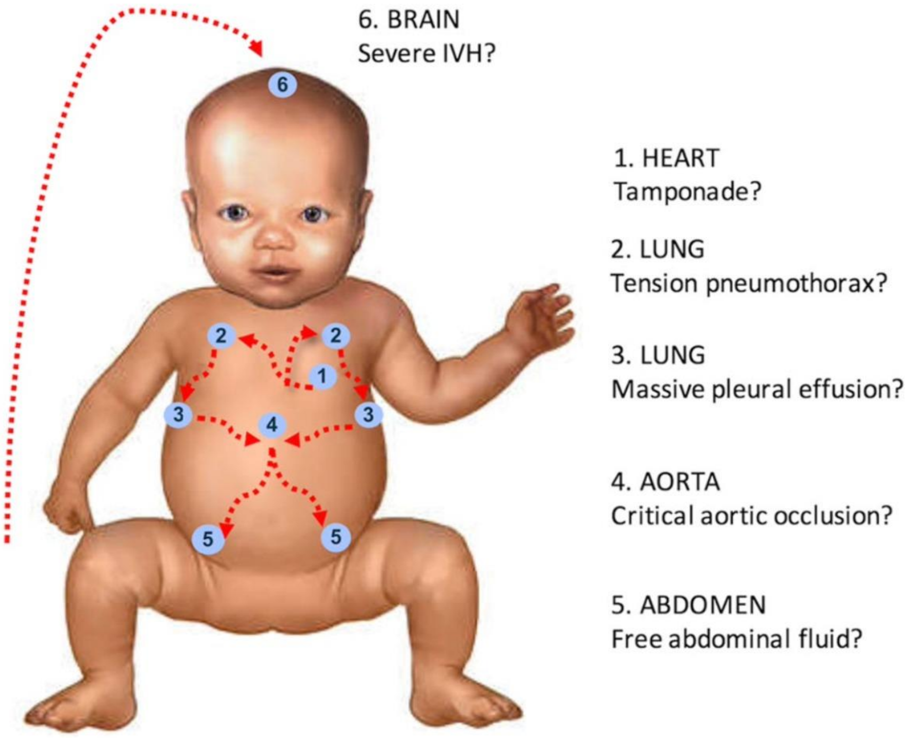


Figure 1: Ultrasound transducer positions for examination: 1 - heart (tamponade?); 2 - lungs (tension pneumothorax?); 3 - lungs (massive pleural effusion?); 4 - aorta (critical aortic stenosis?); 5 - abdomen (free fluid in abdomen?); 6 - fontanelle (severe intraventricular haemorrhage?)

The clinician then performs a diagnostic search for extra-thoracic causes of patient destabilisation. The authors of the new protocol suggest assessing the pulsation of the abdominal aorta by moving the sensor of the device to the sub-costal position. If there is nopulsation, one should assume critical aortic stenosis and urgently consult an ultrasound diagnostic specialist to rule out this congenital heart defect. The next step involves placing the transducer in the iliac region where signs of free fluid indicating acute abdominal surgicalpathology (e.g. perforation in necrotising enterocolitis or others) can be detected. In the finalstep of the protocol, the probe is placed in the projection of the great fontanelle, where severe intraventricular haemorrhage (IVH) can be verified.

SAFE-R+ protocol: Russian version

In 2021, two leading Russian clinics - the Moscow Regional Perinatal Centre and the Shchelkovo Perinatal Centre - established a new protocol, which aimed not only to assess the causes of sudden infant deterioration in the NICU, but also to improve the quality of medical care provided by the outreach teams of the regional intensive care and consultation centre. The already existing and well-established SAFE and SAFE-R protocols were taken as the basis for the domestic protocol. The new diagnostic algorithm is called SAFE-R+ (Figure 2).

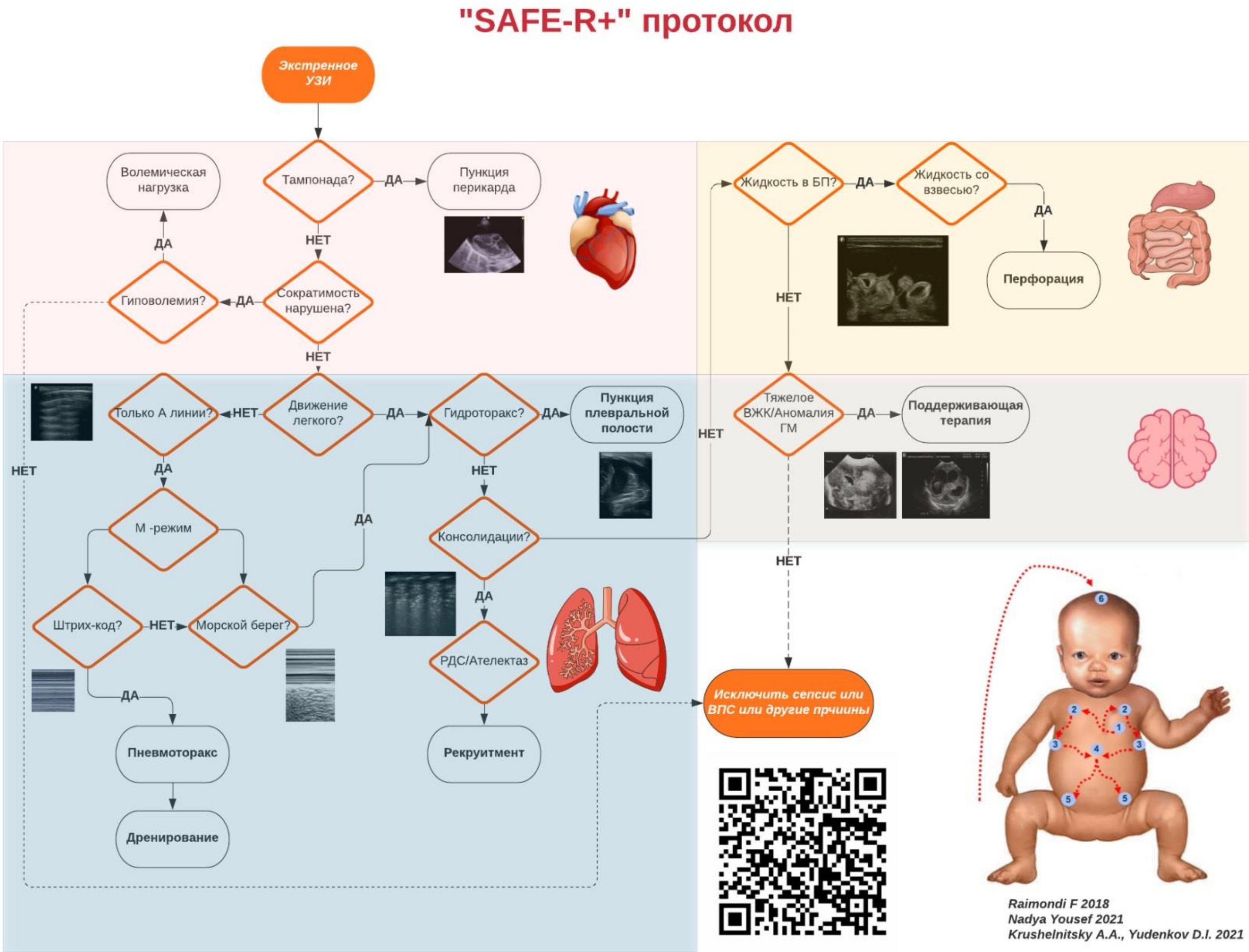


Figure 2: SAFE-R+ protocol

In the first stage of diagnosis the doctor visually assesses the contractility of the left ventricleand also rules out cardiac tamponade. Left ventricular contractility can be judged by placing the scanning device sensors in several positions: apical 4-chamber, parasternal long axis, parasternal short axis, and via sub-costal position (11,12). The latter option can be used to obtain better image quality in clinical situations where imaging of the chamber cavities through the parasternal or apical positions is not possible or not optimal.

One of the innovations of the SAFE-R+ protocol has been the detection of severe hypovolemia, not included in previous versions of the diagnostic algorithms. The development of hypovolemia is indirectly judged by visual assessment of cardiac chamber filling as well aschanges in inferior vena cava (IVC) size during the cardiorespiratory cycle. However, it shouldbe taken into account that with the use of artificial lung ventilation, including high mean airway pressure, as well as changes in heart rate, venous return function may be impaired and the evaluation of IVC response will be of low information [11,13,14].

After excluding cardiac tamponade, left ventricular contractility disorder and hypovolemia, according to the new SAFE-R+ protocol, the physician proceeds to the diagnosis of lung diseases, in particular tension pneumothorax, hydrothorax, and pulmonary atelectasis. This nosology has also been overlooked in previously published protocols. Atelectasis is a fairly common complication of various lung diseases among neonates, especially premature infants, and often accompanies the patient's transition from artificial ventilation to independent breathing (15). To date, chest radiography is used as a diagnostic tool for this pathological condition in global clinical practice. However, this manipulation has many disadvantages, e.g., difficulties in moving critically ill neonates, controlling the patient's body position and risks associated with radiation exposure [16]. In the current literature, there is ample evidence that ultrasound is an effective diagnostic tool for detecting pulmonary atelectasis, with sensitivity and specificity superior to chest radiography (17, 18, 19).

Following the exclusion of intrathoracic pathological conditions, the SAFE-R+ protocol allows the transition to the diagnosis of extrathoracic complications, which include pathological fluid effusion into the abdomen as well as intraventricular haemorrhages and cerebral anomalies (e.g., aneurysm of the Galena vein, etc.). The appearance of an abdominal effusion may indicate perforation or active bleeding. Emergency ultrasonography can diagnose these conditions with a high degree of certainty (Fig. 3).

Figure 3: QR code for detailed information on the SAFE-R+ protocol

Another difference between the previously proposed SAFE-R protocol and SAFE-R+ is that the latter did not include the assessment of abdominal aortic pulsation as an indication of critical coarctation of this vessel. It is important to note that the SAFE-R+ is not designed to detect congenital heart disease. In newborns there is a risk of undiagnosed critical congenital heartdisease and therefore after excluding all the above nosologies, the physician, with the necessary competence, proceeds to a 'targeted' Echo-CG using specialised transducers or performs symptomatic therapy while waiting for an ultrasound diagnostic specialist.

Conclusion

Newborns in NICUs are potentially vulnerable to complications associated with their underlying disease and the invasive procedures used in these units, in particular the placement of central venous lines and catheters, drains, and artificial ventilation. The current methods of diagnosing emergencies and complications are mostly limited to chest and abdominal X-rays, which is in no small part due to the skill of almost every physician working in the NICU in interpreting X-rays (albeit with a certain margin of error). Full-blown ultrasonography is not always available due to the lack of round-the-clock availability of such specialists in some institutions.

Never the less, in recent years it has become increasingly common for NICU physicians to use bedside emergency ultrasound to diagnose emergencies. The most important practical advantages of the technique include the ability to perform it quickly in the couch or open ICU, reproducibility, noninvasiveness and high diagnostic efficiency compared to chest and abdominal radiography. The emergency ultrasound technique involves the use of a single high-frequency transducer (5-13 MHz), which allows significantly faster verification of the diagnosis. A physician does not need to be specialised in ultrasound diagnostics to learn and apply the protocol in practice, and training takes a shortperiod of time.

However, it is worth noting that the problem of introducing the method into broad clinical practice lies in the equipment of NICU departments with modern portable ultrasound equipment and its availability to department staff, as well as the need for mandatorytraining of practical skills in applying the method by a neonatology resuscitator either in simulation and training centres or in the workplace.

The protocol developed and proposed by the SAFE-R+ author team is adapted for use by NICU and resuscitation and consultant teams. It is intended for use in acute decompensation and patient destabilisation in the intensive care unit in previously stable neonates after excluding the most common technical causes (e.g. endotracheal tube occlusion or displacement, ventilator failure, etc.). SAFE-R+ provides rapid screening for emergencies, including acute left ventricular failure, hypovolemia, cardiac tamponade, hydrothorax, pneumothorax, and pulmonary atelectasis.

Emergency abdominal ultrasound helps in the diagnosis of acute surgical pathological conditions - necrotising enterocolitis, intestinal perforation if free fluid is found in the abdominal cavity, bleeding, malformations of the lymphatic duct. Emergency neurosonography allows the detection of DVT and gross malformations, which may affect the clinical condition of the patient. Based on the SAFE-R+ protocol, the MOOC has developed a checklist for visiting resuscitation and consultative teams, which is used in the comprehensive assessment of patient transportability.

The protocol developed and proposed by the SAFE-R+ team has been implemented by the NICU and RCCN since June 2021. After training at the Simulation and Training Centre, it isactively used in the workplace. The introduction of the SAFE-R+ protocol has optimised the management of critical patients, reducing the time taken to decide on therapeutic options for acute deterioration. A 23% reduction in the number of radiological investigations performed for lung ultrasound.

The use of functional EchoCG in the development of shock of various etiologies led to the prescription of target inotropic and vasopressor therapy, which reduced the number of fatal cases. Thus, the introduction of SAFE-R+, reduced the development of critical conditions and thereby improved the outcome. The promise of the technique suggests continued work on the accumulation of evidence-based data to support the feasibility of introducing the protocol into broad clinical practice.

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POCUS (Point-Of-Care-Ultrasound) in the diagnosis of testicular torsion in pediatric patients

Dr. Vekoslav Zajić, specialist of emergency medicine and POCUS, POCUS Academy of Serbia instructor & scientific assistant

Torsion of the testicle is a twisting of the testicle around its longitudinal axis by 180, 360 or more degrees, with consequent interruption of venous and arterial circulation. It occurs in the case of abnormal mobility of the testes within the scrotum (congenital anomaly, often bilateral), by twisting above or below the junction of the membranes (extravaginal/intravaginal).

Torsion can occur at any age, but is most common in infants and adolescents.

- Neonatal torsion: occurs due to the twisting of the testicles together with the sheaths in the loose subcutaneous fat tissue. It can also occur "in utero".
- Extravaginal torsion: it is rarer and is characteristic of newborns or undescended testicles of older children.
- Intravaginal torsion: more common and characteristic of adolescence (12-18 years).

Apart from morphological predispositions (weaker fixation of the testes due to a highly attached tunica vaginalis or some paratesticular anomaly), additional conditions such as trauma, hyperactivity (sports, lifting weights, cycling...) are also necessary. There are theories about hormone-dependent torsion due to sudden temperature differences. They occur more often on the left side due to the longer funicular route.

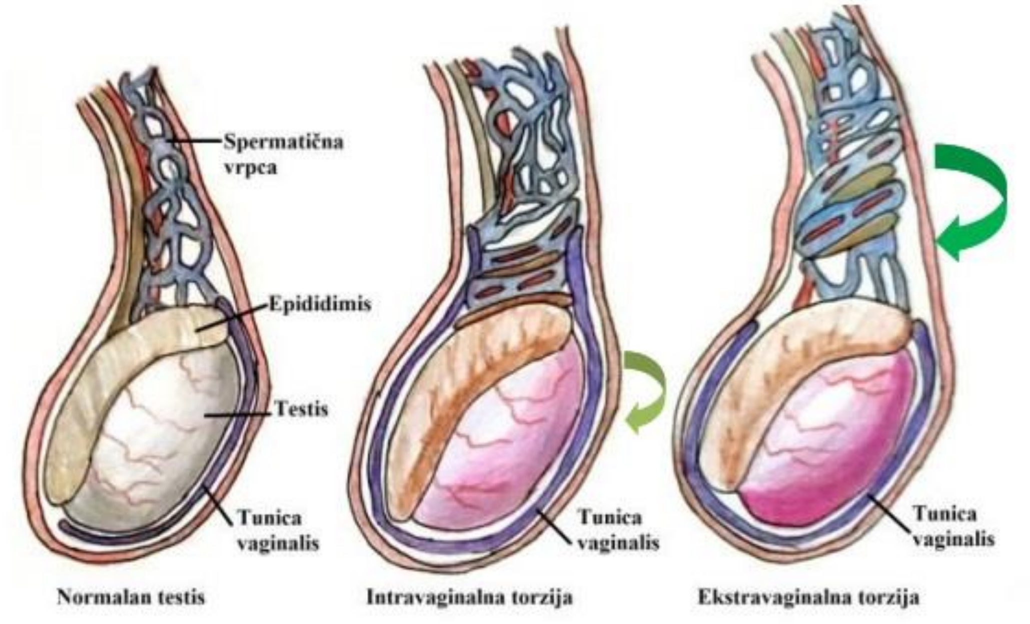

Figure 1 Anatomical types of testicular torsion

It is an urgent condition that requires treatment within the first six hours, because the sperm cells, after the interruption of circulation, perish very quickly. There is no reliable data on the maximum time for which a twisted testicle can preserve its vitality. Cases were described when complete necrosis occurred after only 2 hours from torsion, as well as preserved testicular vitality after 24 hours from the onset of the disease.

Symptoms and signs are manifested by severe pain in the hemiscrotum with irradiation towards the kidney, and soon swelling of the testicle that becomes sensitive to touch, tense, round, usually high. This condition lasts for 2-5 days, and then the swelling subsides and everything ends with atrophy of the testicles.

Figure 2. Acute scrotum - horizontal position of the right testicle

The diagnosis is made based on the clinical picture, local findings and ultrasound examination. Severe pain and edema can make physical examination unreliable, and for this reason POCUS diagnostics is considered highly specific and sensitive.

During the first few hours, testicular torsion cannot be diagnosed with an ordinary ultrasound examination, but if there is an option to use Doppler, we can prove that the affected testicle has no blood flow.

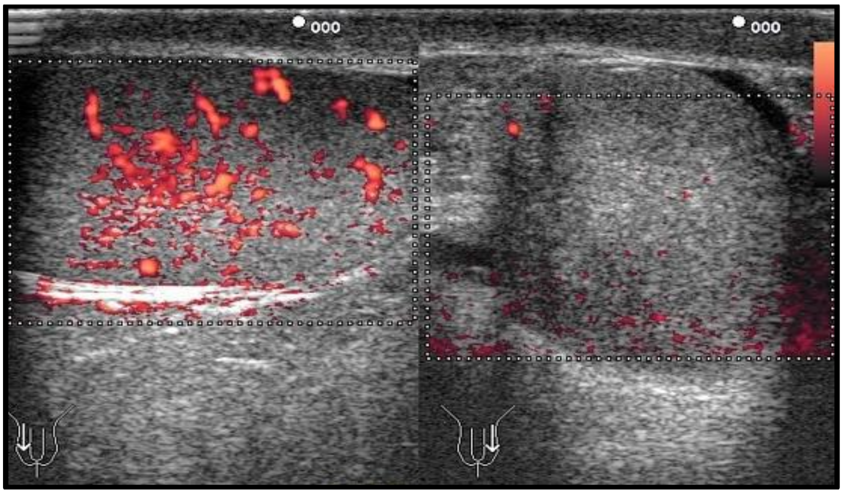

Figure 3. Left testicular cyst: malrotated, avascular, with enlarged epididymis and small hydrocele

Torsion that lasted a short time is characterized by mixed echogenicity. After several hours, edema begins to develop and signs of focal ischemia of the testis appear - such as hypoechoicity compared to the opposite side of the scrotum. We can also notice enlargement of the epididymis, reactive hydrocele and thickening of the scrotal wall.

The definitive way to treat testicular torsion is surgery, after possible manual detorquation. The procedure of manual detorquation of the testicles provides pain relief, if successful, after which the restoration of blood flow must be confirmed. Other signs that indicate a successful manual detorquation are: a change in the position of the testes from a transverse to a longitudinal orientation, the lower position of the testes in the scrotum and the return of normal arterial pulsations on Doppler ultrasonography.

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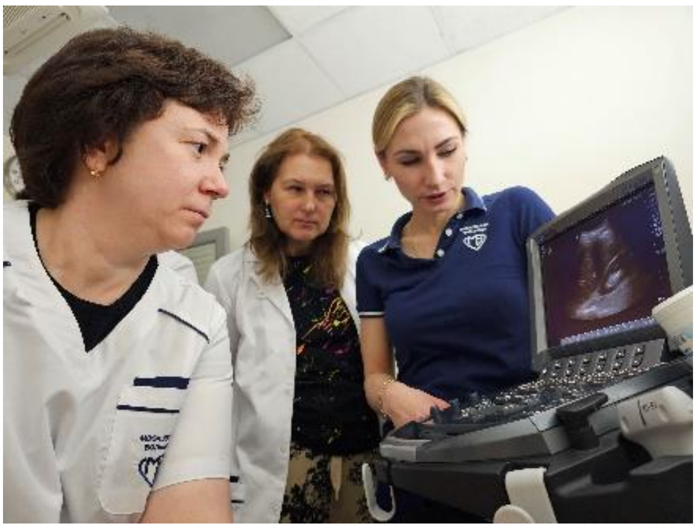
POCUS MOSCOW
Activities for the first 6 months of 2023

This year our group got off to a power start in the form of permanent POCUS courses at the Botkin Hospital Medical Simulation Center. Beginning in mid-January, we held regularly 3 2-day courses each week. The idea is to develop active training of new trainers through regular educational activities. This kind of activity sets a high tempo and allows us to keep the whole POCUS MOSCOW team in a high tone.

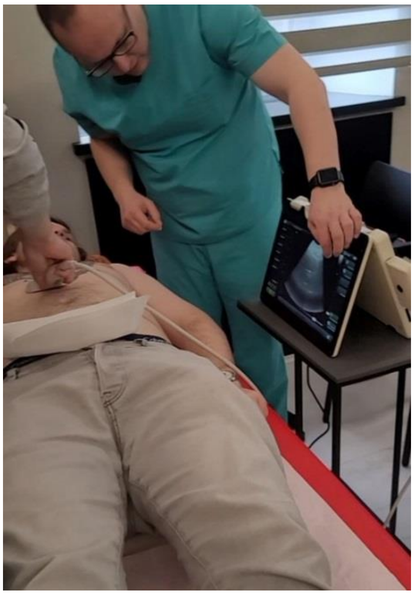
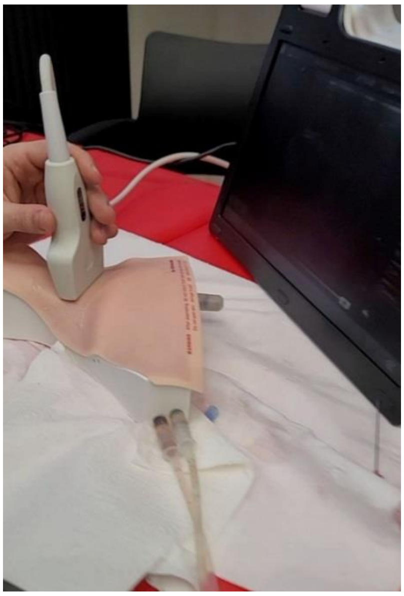
Here are some pictures from the courses at Botkin Hospital.




On average, with an intensive workload our team is ready to train up to 1500 people in POCUS direction every year. I'll describe in detail my participation in a number of events that are significant in the world of POCUS.

In February, a master class was held at the manufacturer of Russian ultrasound equipment; students and residents of St. Petersburg educational institutions took part in the training.




We continue to develop the POCUS course in veterinary medicine and the courses on regional anesthesia in cats and dogs arouse a great interest. Several groups of veterinary anesthesiologists have passed our joint cadaver courses. At the end of July, a course is planned in the direction of POCUS diagnostic A-FAST & T-FAST protocols. Cadaver course was held at the Innovation Veterinary Center of the International Veterinary Academy in Moscow.

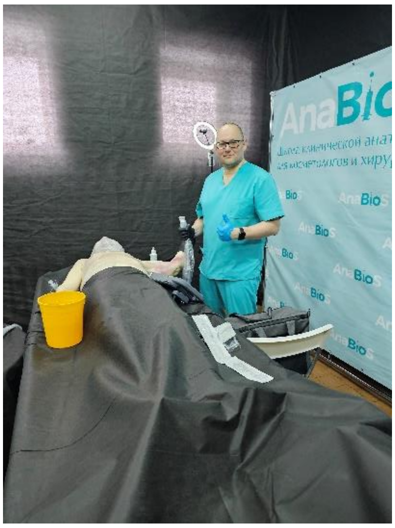



In March, our on-site on-the-job training program was actively developed. The peculiarity of these programs is that the doctors are not disconnected from their work and get new skills and knowledge on their equipment and in familiar conditions. Different clinics in different locations.

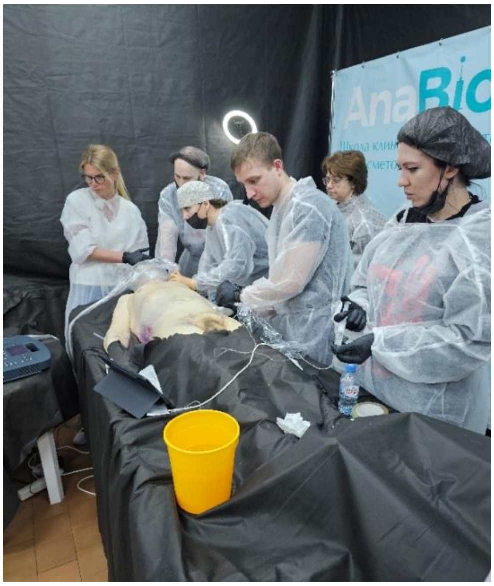




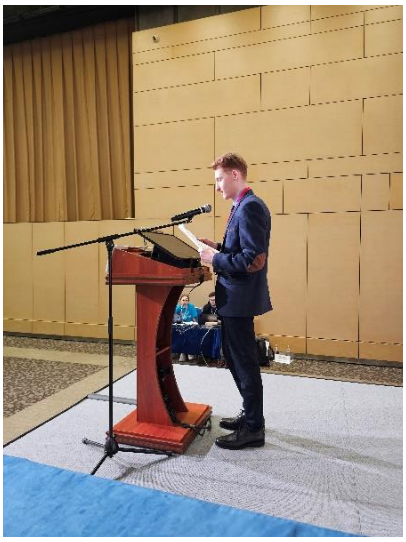
In April and June our regular cadaver courses took place in St. Petersburg. This kind of training is very popular, it is a unique opportunity to practice skills of regional anesthesia on the cadaver material under real conditions. The course is very intense, 90% of it consists of practice and preliminary online training.

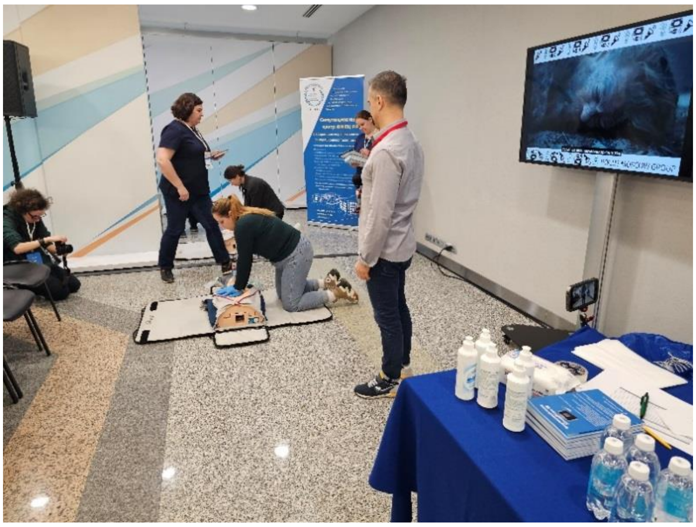



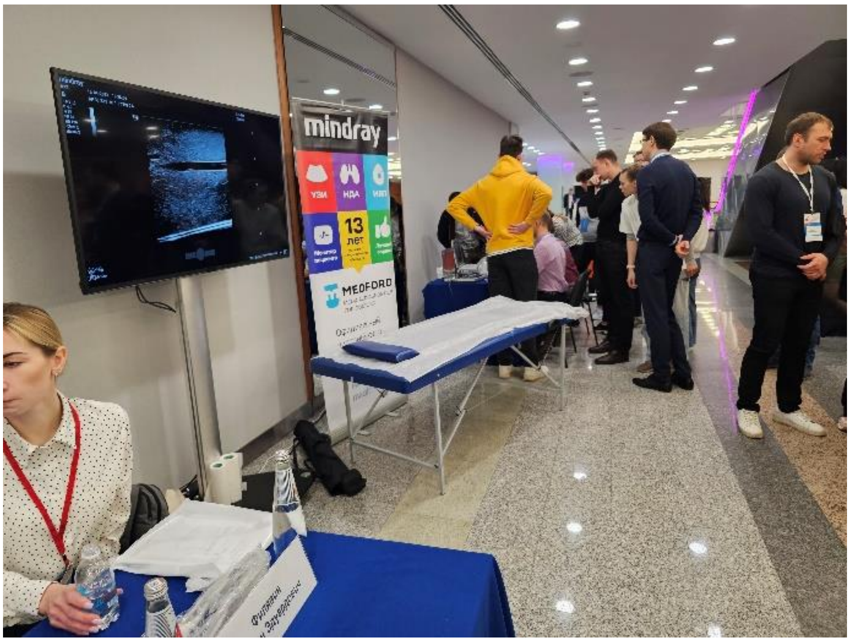




Every year in April there is the Moscow city congress of anesthesiologists and intensive care specialists in the capital. This time we took an active part. Within the framework of the congress there was a section POCUS MOSCOW where members of the group and interested colleagues made several interesting and important reports. The second day of the conference was traditionally dedicated to POCUS competitions which this time were combined with CPR skills. More than 20 teams of physicians, students, and residents competed for the top prizes.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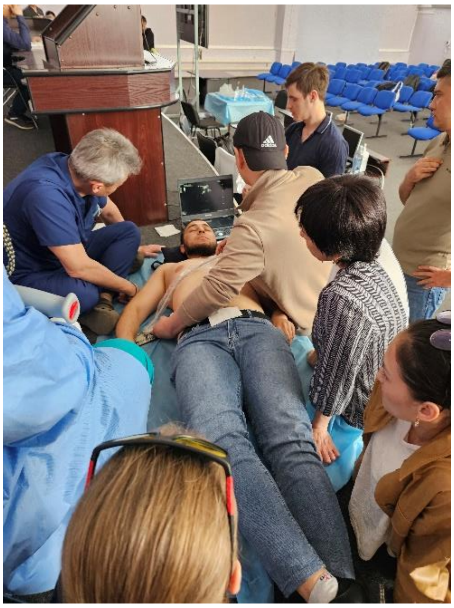
The last week of April was devoted to a course in Karaganda, Republic of Kazakhstan. This was the second visit of the School of Practical Ultrasound. The school was organized with the support of the Multidisciplinary Hospital named after Professor H. J. Makazhanov. Special thanks to the chief freelance anesthesiologist-resuscitator of Karaganda Kim S. I. The second visit showed a significant progress in skills and knowledge in the direction of POCUS, which significantly influenced the development of anesthesiology-resuscitation service.

As part of this visit, in agreement with the IPA Board, an IPA School was established in Kazakhstan, with Sergei Kim as head of the school. Several active POCUS teachers were immediately registered. The first new IPA certificates were issued.



We have continued our POCUS school spreading program. The next time, our goal was the Republic of Kyrgyzstan, Bishkek, and the Republic of Uzbekistan, Tashkent.

In Bishkek, we had a 2-day master class on Regional Anesthesia under ultrasound control at the Kyrgyz State Medical Academy. We are very grateful to the management of the Academy for their assistance in organizing this event. More than 80 people participated in this course, colleagues from different regions of Kyrgyzstan. During the event, there was a broadcast from the operating rooms, where several regional blockages were performed for orthopedic interventions. Our friendship with colleagues from Kyrgyzstan has a long history and this time, the IPA School in the Republic of Kyrgyzstan was formed, with Isakov Manas as the head of the school.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The next point of our POCUS journey was Tashkent. A wonderful city, where the Nano Medical Clinic hosted a 2-day master class dedicated to the treatment of acute and chronic pain with the use of ultrasound navigation in interventions. We hope for further cooperation with our colleagues and will form IPA School of the Republic of Uzbekistan in the future.

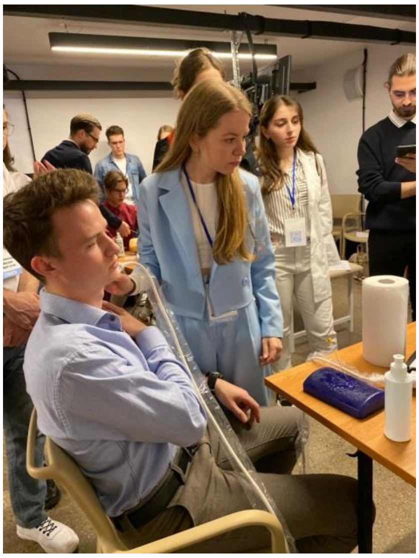



(Report from POCUS MOSCOW Group, IPA national Scool in Russia, contributed by prof. dr. Vsevolod Lykhin, Board member of IPA)

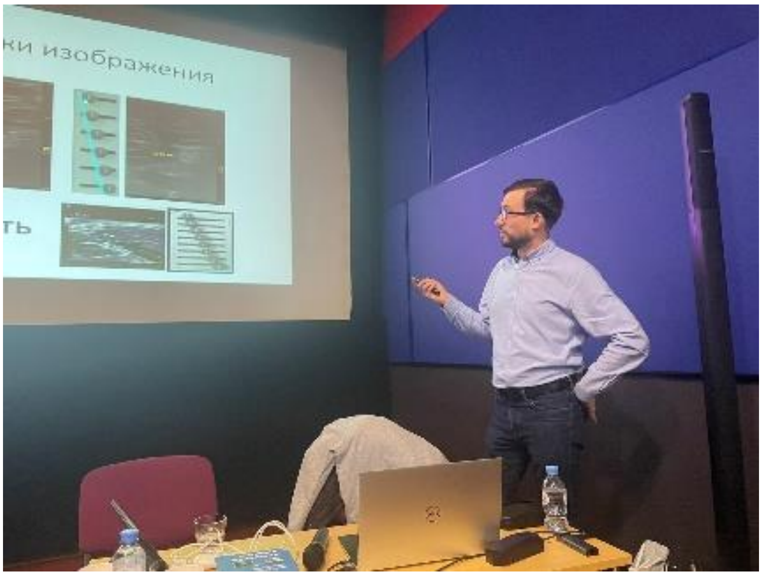
POCUS MOSCOW Group pays special attention to medical students and our participation in the largest medical student conference in St. Petersburg, based at the V.A. Almazov National Medical Center, allowed us to see on a small platform the interest of future medics in the POCUS direction. We discussed and demonstrated eFAST and BLUE protocols, methods of regional anesthesia.





In June, our cadaver course on regional anesthesia in St. Petersburg included the participation of our colleague from Turkey, Tolga Ergonenc. Over 2 active practical days, the colleagues gained skills in safe regional anesthesia under ultrasound control. And also, an excellent opportunity to exchange experiences and receive advice from our experts.



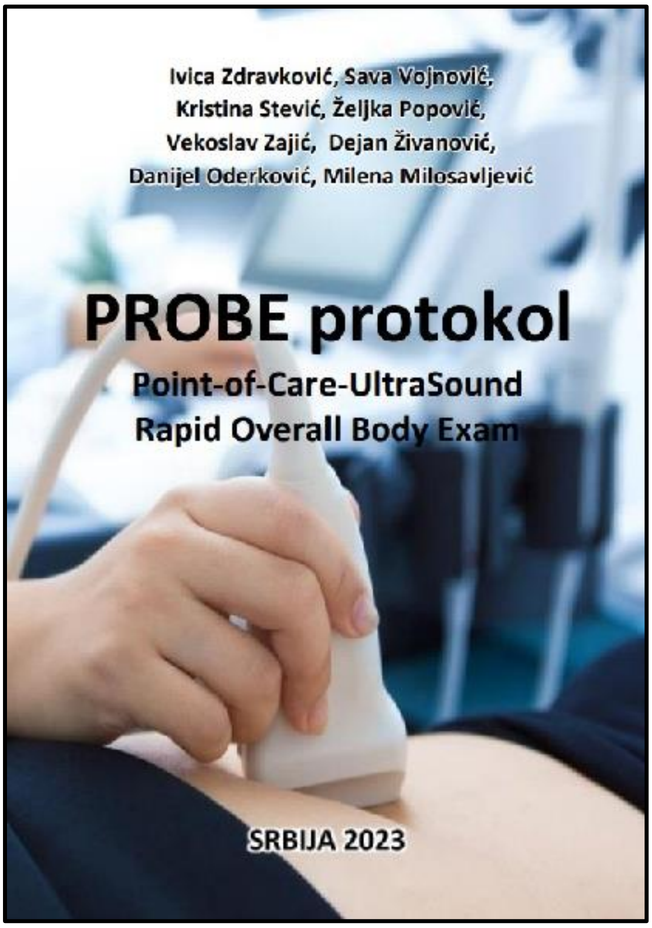
All in all, the first half of the year 2023 has seen a rapid increase in the educational events held by our POCUS MOSCOW group. We hope to work actively in the second half of this year, a number of events have already been scheduled. And we have also started planning educational events for 2024 under the aegis of IPA and POCUS MOSCOW. See you soon friends!

TWENTY-FIVE, STAY ALIVE!

By Dr. Ivica Zdravković, Serbia

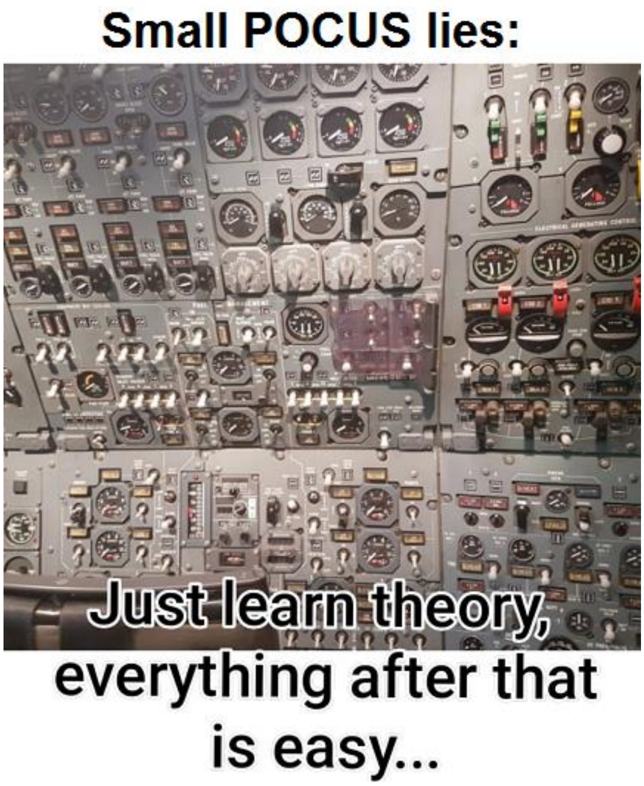
I remember how some 5 or 6 years ago, at the American POCUS Certification Academy, we set out to create a POCUS Generalist course, and within it something we then called POCUS 25: twenty-five basic things (core skills) that every POCUS practitioner should know. I started thinking and writing then, but soon I left that organization (or rather: it left me, all the people I worked with there mysteriously changed their jobs and dissapeared).

Anyway, this idea of small number of basic POKUS skills lived in me all these years. A few weeks ago, in cooperation with friends from the POCUS Academy of Serbia, I published my tenth medical book, the "PROBE protocol", a protocol that represents my small contribution to POCUS diagnostics. It is a way to examine the patient as quickly, simply and completely as possible, intended for doctors of general medicine, family medicine, emergency medicine, internists, surgeons, doctors in the ICU, anesthesiologists, etc. The book has already started to live its own life, we are applying the PROBE protocol extensively, and after everything, I have finally crystallized a list of 25 things that, in my opinion, make the core of POCUS. I call it "POCUS 25" and I strongly believe it should become a part of the mandatory propaedeutics (art of examination) that is taught at all medical faculties. Without further elaborating why, how and where exactly this "unusual list" came from, I will share it here, with hope that students and POCUS educators will keep it in mind in the future.



POCUS 25
(PROBE protocol in short)

1. Is the thyroid gland enlarged, normal or reduced in size?
2. Is the structure of the thyroid gland homogeneous, or patchy, fibrous, typical of Hashimoto?
3. Is the vascularity normal, or increased?
4. Are there any significant nodules in the thyroid gland (more than 1cm that are "burning", or more than 2cm, even if vascularly normal)?
5. Are there large or numerous plaques in ACC?
6. Is there a stenosis of at least 50%, or subocclusion and occlusion in the ACC bulbs or in the initial portion of the ACI?
7. Is the AV flow verified at all?
8. Are there B-lines in the lung fields?
9. Is there water in the recesses?
10. Is there ascites in Morrison's, Koler's and perivesical space as well as fluid in pouch of Douglas or Proust?
11. FATE 1, Subx: thickness of septum and width of RA and LV. Contractility (eyebulbing) of LV.
12. FATE 2, A4c: estimation of MAPSE and TAPSE
13. FATE 3, PLAX: aortic root, MACS, width of LA, what is E/A and EPSS, measurement of septum thickness and EDD.
14. FATE 4, PSAX: eyebulbing for EF, segmental contractility of LV walls, pericardium, signs of PE.
15. Is there hydronephrosis, with or without stones?
16. Are there gallstones or cholecystitis and cysts?
17. Are there liver lesions?
18. Choledochus and pancreas suspicious or not?
19. Is there AAA?
20. Bladder walls, volume, prostate volume?
21. Pregnancy, TU of pelvis?
22. Is there DVT?
23. Flow curves through peripheral arteries monophasic or not?
24. Are there pathologically enlarged lymph nodes on the neck, axillae, groin, in the retroperitoneum?
25. Are there clear ruptures or fractures in MSK?



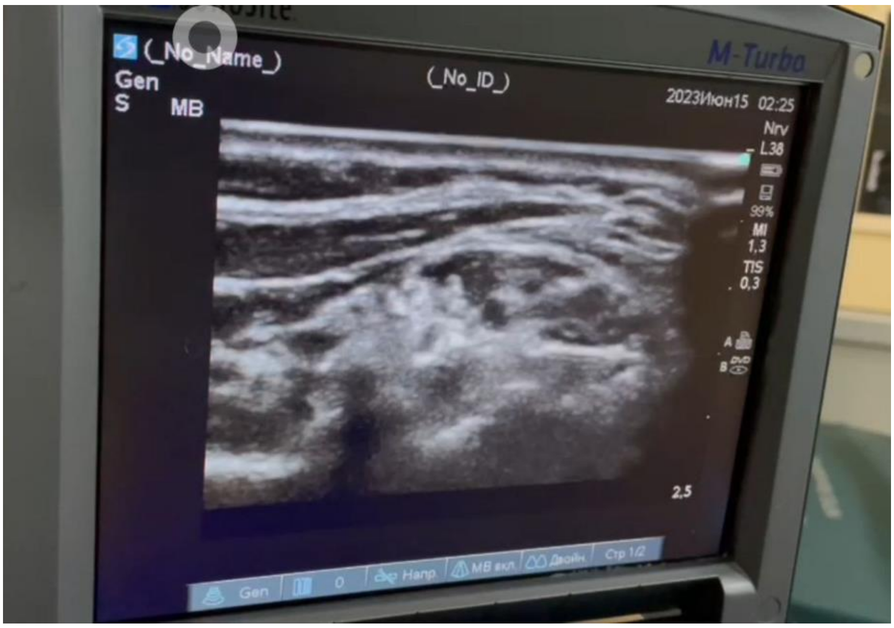
Interscalene block in clavicle surgery

Contributed by
Dr. Kim Sergey, Dr. Mustaphin Ruslan
(Karaganda, Republic of Kazakhstan)

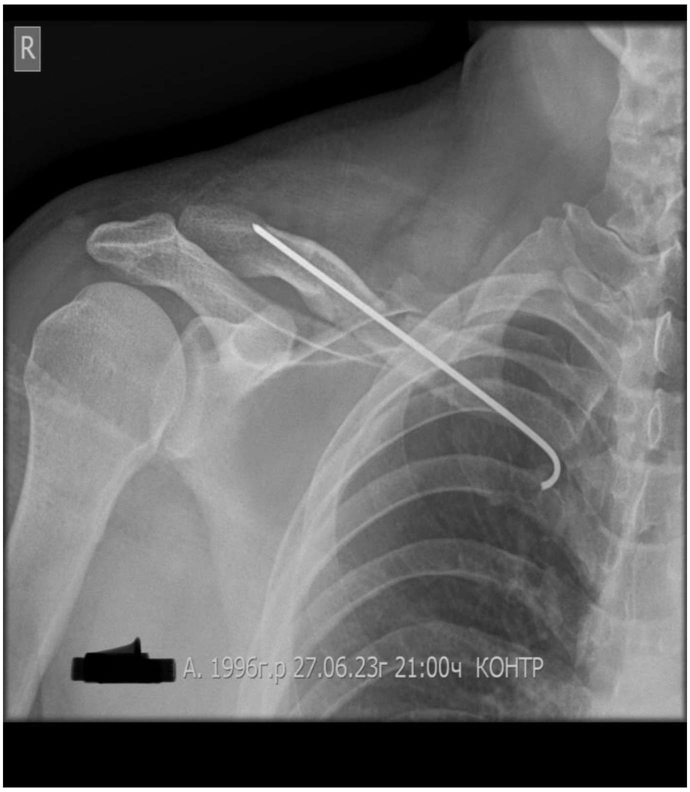
Patient A., 27 years old, was admitted with the diagnosis of a traffic accident. Closed comminuted fracture of the right clavicle with dislocation. Contusion abrasion of the right knee joint. Abrasion in the outer ear on the right side. After performing laboratory and instrumental examinations with the purpose of early activation, stable fixation of bone fragments, early restoration of limb function, prevention of secondary displacement of fragments, given the nature of the fracture, fracture area, surgical treatment is planned in surgical treatment: Open repositioning of the right clavicle MOS.

Preoperative X-ray:

Pain score according to the HACS scale - 5-6 points
Anesthesiologic aid - interscalene block using ultrasound navigation.
There are no absolute contraindications.
In the operating room after insertion of an 18G peripheral venous catheter, BP was monitored - 130/80 mm Hg, heart rate 110 bpm, SpO2-99%. On connected ECG monitoring - sinus rhythm - minus tachycardia. In the supine position with the head turned to the left, after treatment with antiseptic solutions three times, the brachial plexus was visualized, perineurally, with a G22 needle was injected with Ropivin 150 m + Dexamethasone 4 mg.



The effect of the blockade was satisfactory. Subjectively, the patient noted relief on the VAS scale - 0 points. BP - 110/70 mmHg, HR - 75 bpm, SpO2 - 98%. No additional anesthesia was required intraoperatively. In the postoperative period the patient was additionally administered non-narcotic analgesics after 12 hours from the end of the operation.



Conclusion:

Regional anesthesia under ultrasound control allows you to significantly improve the quality of the blockade. It also ensures the safety of patients and physicians when performing invasive manipulations. Ultrasound navigation is the gold standard for regional anesthesia in the 21st century.

Efficacy of sulodexide in patients with chronic venous insufficiency (CVI) and atherosclerosis of the lower extremities

Dr. Dejan Živanović, specialist of general medicine and POCUS,
POCUS Academy of Serbia instructor & scientific assistant

The topic of the study is the investigation of effectiveness of sulodexide in patients with chronic venous insufficiency (CVI) and the presence of atherosclerosis confirmed by ultrasound (POCUS linear prove echosonography of distant veinsa dn arteries). Sulodexide (sold under trade names as Vessel and Aterina), is mixture of glycosaminoglycans composed of low.molwcular heparan sulfate (80%) and dermatan sulfate (20%). Clinically, sulodexide is used for the prophylaxis and treatment of thromboembolic diseases, mainly CVI. Goal of this study was to examine potential use od sulodexide in arteriosclerotic ishaemia of legs.

The results of the study were interpreted according to the patient's subjective symptoms and objective examination (control POCUS, as wall as inspection and palpation of peripherial pulses).

The study included participants 60-82 years old. There werw 20 participants: 12 female and 8 male of them. The incusion criteria for participation in this study was presence of chronic venous insufficiency in lower extremities (CVI) visible as swelling and/or venous varices and ulcers, plus atherosclerosis of peripherial arteries: monophasic waveforms detected in distal arteries, in particular in arteria tibialis anterior (ATA), arteria tibialis posterior (ATP), arteria dorsalis pedis (ADP) and arteria retromalleolaris (ARM).

Other co-morbidity causing circulation pathology was also notified.

Diabetes mellitus type II (insulin dependent and insulin independent) was present in 9 patients.
Long-term or former nicotin smoking was present in 13 patients
High blood pressure was marked in 14 patients
Elevated cholesterol (LDL) wqs present in 12 patients

The main symptoms taken into consideration were:

1. Tingling of the toes and feet in one or both extremities
2. Feeling cold feet
3. Claudication with significantly reduced distance under 100-200m
4. Visible oedema and/or trophical changes of the skin
5. POCUS finding of dilatation and insufficiency of surface and deep veins and/or perforant veins
6. POCUS finding of at least one of the peripherial arteries (ATA, ATP, ADM, ARM) with monophasic waveform in any leg.

All patients have received therapy according to the prescribed instructions for the use of sulodexide: fifteen days 1 ampoule of sulodexide 600LSU. via infusion, then thirty days oral use of sulodexide 250 LSU capsules, bid.

There were no significant side-effects reported by the patients.

The positive therapeutical were present in in majority of patients (17 out of 20):

1. Cessation or significant reduction of the tingling sensation in the lower extremities
2. Sensation of heat in the lower extremities
3. Claudication distance increased over 200m
4. Disappearance or signifiant reduction of lower limb swelling
5. Appearance of biphasic waveform in all observed peripherial arteries on POCUS exam.

Conclusion:

Soludexide proved to be an excellent solution for patients with signs and symptoms of chronic venous insufficiency, with or without additional arterial wall changes / atherosclerosis. Patients with atherosclerosis and ishaemic arterial flow also had an improvement in their condition. POCUS used in this study helped confirming subjective improvements with objective finding of better arterial blood floow, depicted through altered biphasic pulse wave Doppler waveforms.

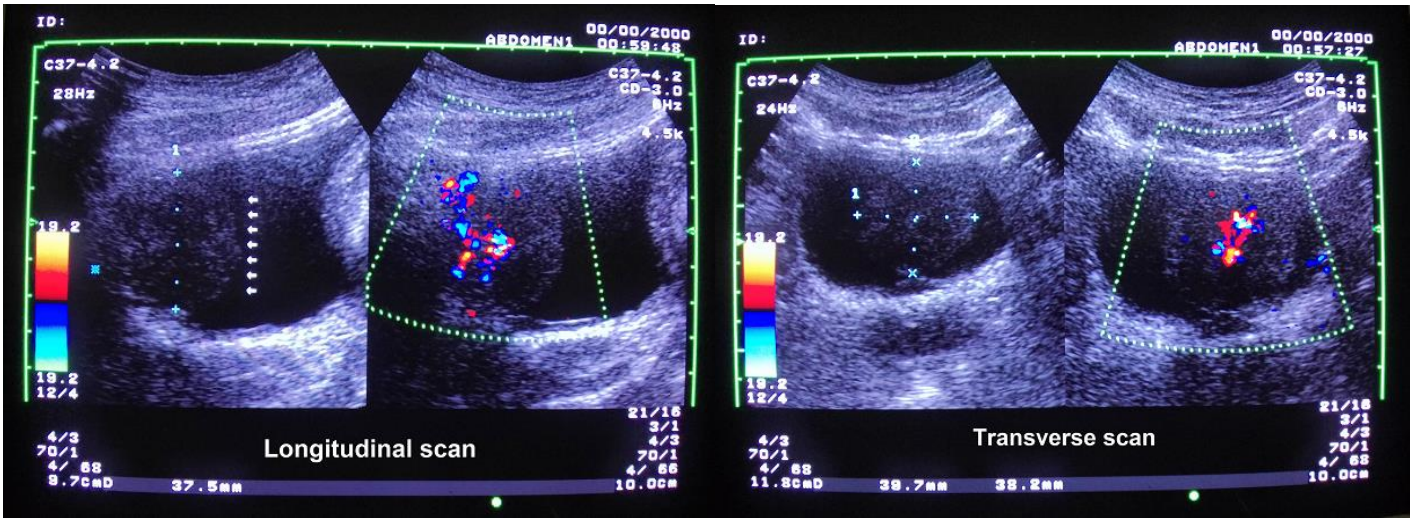
From Facebook group

International POCUS Academy

POCUS in GPs' office - Case of the day

A 54-year-old patient has had occasional painless hematuria for a few months. He brings lab analyzes in which there are no pathognomonic changes, except for 5-10 fresh erythrocytes, 10-15 leukocytes and few bacteria in the urine sediment. In the anamnesis there are no identifiable risk factors for bladder tumor, as well as convincing symptoms of urinary tract infection and prostatic complaints.

POCUS examination reveals papillomatous change on the front-lower wall of the bladder, spherical and isoechoic with the bladder mucosa. Beneath the bladder is a prostate of homogeneous structure, discretely enlarged in volume, without protruding into the lumen of the bladder.



Most often, patients with such changes in the urinary bladder are first observed, with the suspicion that the change is a hematoma after hematuria due to hemorrhagic cystitis. We give antibiotics (fosfomycin, nitroxolin, hinolones) and schedule a control ultrasound after seven days - and we often find that the clot has been evacuated, so we conclude that it actually was a hemorrhagic cystitis.

In this case, however, the change in the bladder wall has clear central **vascular activity**, which is not typical for clots. It is most likely transitional cell carcinoma of the bladder (TCC). The patient was sent to urologist for cystoscopy and, most likely, transurethral resection (TUR).

by Dr. Ivica, Serbia

Bedside ultrasound examination in heart failure (ConCOrD - CONgestion, Cardiac and multiorgan Dysfunction).

Kochmareva E. [1,2,3] ORCID: 0000-0002-6614-6251, e-mail: Sangrija27@yandex.ru
Mikhey R. [4,3], ORCID: 0000-0003-1317-8740, e-mail: DrMikhey@yandex.ru
Lykhin V. [3,6], ORCID: 0000-0003-3129-2037, e-mail: pro-zerno@yandex.ru, tel: +79175962464 (corresponding autor)
Filyavin R. [3,7], ORCID: 0000-0002-9421-504X, e-mail: filyavin@mail.ru
Soloviev V. [3,5], ORCID: 0000-0002-4845-3610

Abstract

The purpose of this article is to discuss an algorithm for bedside ultrasound examination in patients with heart failure, which consists of three blocks: assessment of morphofunctional cardiac pathology, detection of hypertension in the heart chambers, and the presence of congestion. This protocol is based on the point-of-care ultrasound methodology and is designed for medical practice by doctors of clinical non-ultrasound specialties. The protocol is presented in two variations: extended (for expert cardiological assessment) and short for emergency examination. The article provides brief information about the diagnosis, terminology, and classification of heart failure according to clinical guidelines.
Keywords: heart failure, systolic dysfunction, heart failure with preserved ejection fraction, pulmonary hypertension, lung oedema, congestion, hypervolemia.

Introduction

Heart failure (HF) is a clinical syndrome characterized by the presence of typical symptoms and signs caused by morphofunctional disorders of the heart, resulting in decreased cardiac output and/or increased cardiac filling pressure (clinical guidelines of the European Society of Cardiology, 2021). [2]. In half of cases heart failure complicates such diseases as arterial hypertension and coronary heart disease, less often - myocarditis, cardiomyopathies, valvular heart diseases etc. Thus, the prevalence of heart failure as a complication of most cardiovascular diseases remains rather high - over 70% among elderly patients and about 7% among 30-year-old patients [2].

Ultrasound examination occupies a central place in algorithms of HF diagnosis and treatment. According to European Society of Cardiology classification [2] there are left ventricular (systolic and diastolic) and right ventricular heart failure (systolic dysfunction is the most studied). In the terminal stage, patients have biventricular heart failure. Patients with left ventricular failure include those with preserved left ventricular (LV) ejection fraction (>50%, diastolic dysfunction predominates), those with intermediate LV ejection fraction (40-50%), and those with reduced LV ejection fraction (<40%) (Table 1). Echocardiography has different objectives for each category of patients.

Table 1. Classification of heart failure according to the European Society of Cardiology Clinical Guidelines 2021.

Type of HF		HFrEF	HFmrEF	HFpEF
CRITERIA	**1**	Symptoms ± Signs	Symptoms ± Signs	Symptoms ± Signs
	2	LVEF ≤40%	LVEF 41–49%	LVEF ≥50%
	3	–	–	Objective evidence of cardiac structural and/or functional abnormalities consistent with the presence of LV diastolic dysfunction/raised LV filling pressures, including raised natriuretic peptides

HFmrEF = heart failure with mildly reduced ejection fraction; HFpEF = heart failure with preserved ejection fraction; HFrEF = heart failure with reduced ejection fraction; LV = left ventricle; LVEF = left ventricular ejection fraction.

For patients with systolic dysfunction the starting point of management tactics is an accurate determination of left ventricle ejection fraction (LV EF), as the diagnosis of HF syndrome is not difficult and is based on the clinical signs and echocardiography. The fundamental question for such patients is implantation of intracardiac devices of ICD and CRT type, improving quality and/or life expectancy. Besides, the prognosis of such patients is considerably aggravated by the presence of severe valve pathology (mitral and aortic defects), the appearance of valve regurgitation with fibrous ring distension, gradual decrease of LV systolic function, the main method of detection of which is alsoechocardiography.

Another important point is the dynamics of clinical condition during therapy. Sensitivity of ultrasound examination with regard to interstitial lung syndrome (B-lines) and hydrothorax is high and allows to detect a tendency of extravascular fluid accumulation before the clinical signs appear. In addition, ultrasound examination helps to assess the volemic status. It is known that the main point in diuretic dosage is the presents of hyperhydration and increased filling pressure of the heart chambers. When HF compensation is achieved and intravascular and interstitial fluid volume is resolved, the dose of diuretics can be significantly reduced. The simplest technique to determine the volemic status is VExUS protocol [3]. Current ESC clinical guidelines suggest using ultrasound assessment of the inferior vena cava (IVC) and lungs for this purpose, with further therapy adjustment (class of evidence IIB) [2].

For patients with preserved and mildly reduced EF, the association of symptoms with cardiac dysfunction is ambiguous. Ultrasound signs of interstitial syndrome in the lungs may be a consequence of such conditions as noncardiogenic pulmonary edema, covid-associated lesion and interstitial lung disease. In this case, in addition to the clinical picture, it is necessary to consider the levels of natriuretic peptides and ultrasound criteria, which include the detection of increased LV filling pressure, left atrial dilatation (LA), structural changes of myocardium (hypertrophy, accumulation disease, etc.) and other indicators of LV diastolic dysfunction. In subclinical stage detection of these signs will allow to change treatment tactics with the purpose of prevention of disease progression and prevention of the developed heart failure.

Summary, the objectives of ultrasound protocol for patients with heart failure are:

1. confirmation of congestion (detection of signs of congestion in the pulmonary circulation, systemic oedema);

2. identification of structural pathology in the heart that is a substrate for the development of heart failure (systolic dysfunction, severe valve lesion, significant thickening of the myocardium);

3. detection of increased LV filling pressure, postcapillary and precapillary pulmonary hypertension, hypertension in the vena cava and hepatic veins of the systemic circulation.

4. dynamic of organ dysfunction, hypertension in the heart chambers, volemic status.

We proposed an ultrasound algorithm for investigation of patients with signs/suspicion of CH - ConCOrD (Congestion protocol Cardiac and multiorgan Dysfunction), which is descriptive, consists of three independent blocks, each of which can be added or excluded at the discretion of the investigator. At the same time, the protocol is compiled on the basis of European Echocardiography recommendations and includes all indices necessary for making the most complete view of intracardiac hemodynamics. The study sequence takes into account stages of cardiac insufficiency progression, at the same time, in urgent situations and dynamic studies the protocol can be modified (the short version is also described below).

Description of the protocol

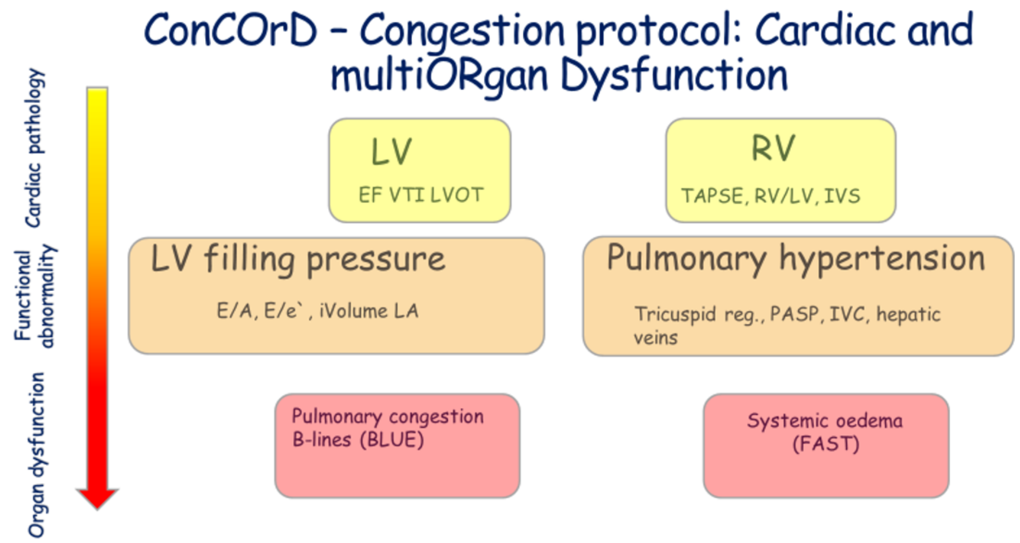


Figure 1. Schematic of the full version of ConCorD protocol

LV - left ventricle, RV - right ventricle, EF - ejection fraction, VTI - velocity-time integral, TAPSE - systolic fibrous ring of tricuspid valve, IVS - interventricular septum, iVLA - indexed left atrial volume, Vtr - peak rate of tricuspidal regurgitation, PASP -pulmonary artery systolic pressure, S>D - predominance of systolic flow in hepatic veins.

Block I - Detection of severe morpho-functional cardiac pathology.

1. assessment of LV systolic function.

Visual screening assessment of LV EF is performed in parasternal position along short axis of LV and in four-chamber view (PSAX and 4CH) according to the following gradations: severe decrease (EF <30%), moderate decrease (PV 30-50%), normokinesia (PV 50-70%), hyperkinesia (PV>70%).

Quantitative assessment of stroke volume is performed by measuring Velocity Time Integral (VTI) of left ventricular outflow tract (LVOT). For this purpose, the pulsed Doppler beam is placed in the direction of transaortic flow in the five-chamber position (5CH), the control volume is over the aortic valve leaflets (Fig. 2). Systolic flow is traced, and VTI is automatically determined. Normal VTI value of LVOT > 18 cm (which at LVOT diameter values >2 cm corresponds to a stroke volume > 60 ml).

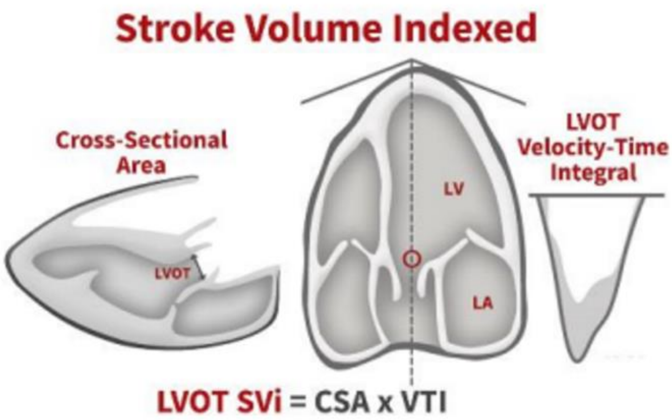


Figure 2: Calculation of left ventricular stroke volume
SV - stroke volume, LVOT - left ventricular outflow tract, LV - left ventricle,
VTI - velocity time integral.

2. Assessment of systolic function of the right ventricle (RV).

Visual assessment of RV function is performed in PSAX and 4CH positions according to the following criteria: flattening/shift of interventricular septum (IVS) (Fig. 3), RV/LV≥1, forming of the heart apex by the RV.

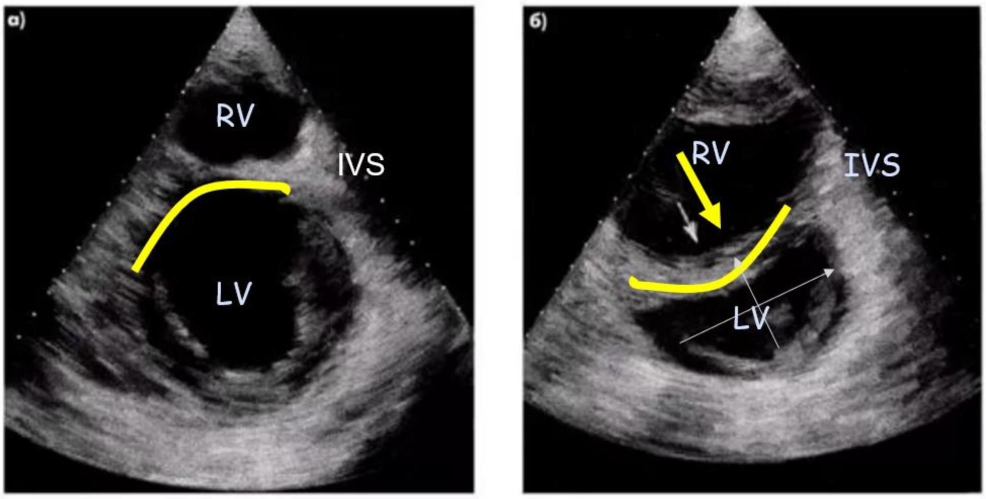


Figure 3: Parasternal short axis view (PSAX).
In the presented figure: on the left - normal, on the right - RV dysfunction
RV - right ventricle, LV - left ventricle, IVS - interventricular septum

Quantitative assessment of RV systolic function is performed by the systolic excursion of tricuspid annular plane systolic excursion, TAPSE. To perform the measurement, it is necessary to place ultrasound beam in M-mode through the lateral edge of the fibrous ring of the TC, measure the amplitude in the obtained image (Fig. 4). Hypokinesia of the free wall of the RV is defined as a decrease in TAPSE amplitude <17 mm.

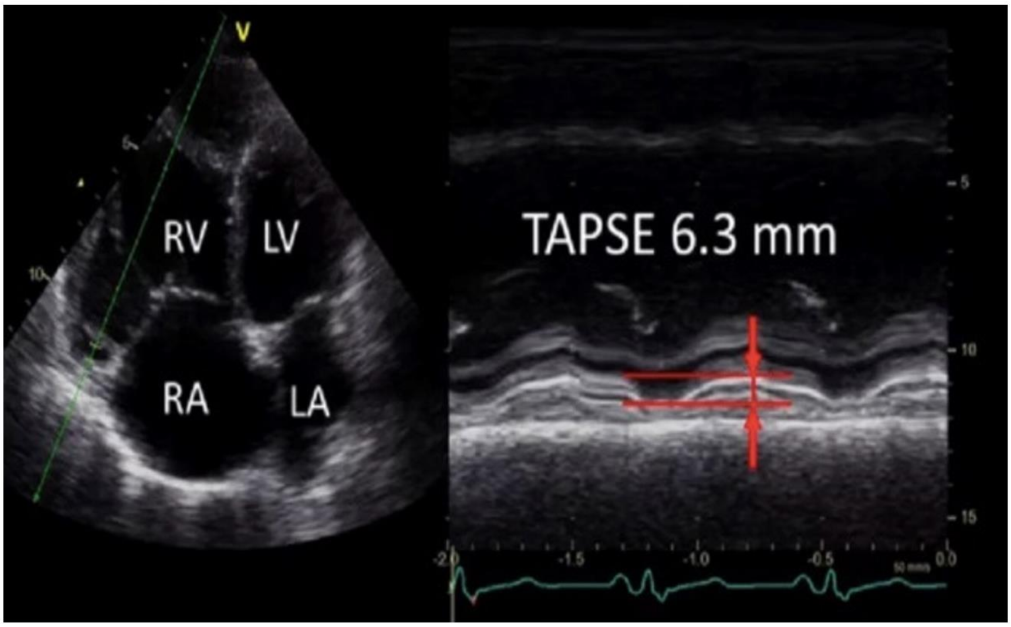


Figure 4: Four-chamber view, TAPSE amplitude measurement
The four-chamber view (left) shows signs of RV dysfunction (RV is involved in the formation of the apex of the heart, RV/LV>1, the correct placing of the ultrasound beam in M-mode for TAPSE measurement. The M Mode (right) shows the TAPSE measurement. RV- right ventricle, LV – left ventricle, RA – right atrium, LA – left atrium, TAPSE – tricuspid annular place systolic excursion

3. Detection of severe valve pathology.

To detect severe valve pathology, the color Doppler frame should be directed alternately to all valve structures and septum of the heart.

Criteria for severe valve lesions.
Severe atrioventricular valve regurgitation (mitral/tricuspidal regurgitation) - wide central jet or eccentric jet reaching the posterior atrial wall (Figure 5).
Aortic regurgitation - the ratio of regurgitation flow width to LVOT diameter ≥65% (Figure 5).
Mitral stenosis - turbulent high velocity transmitral jet (Figure 5).

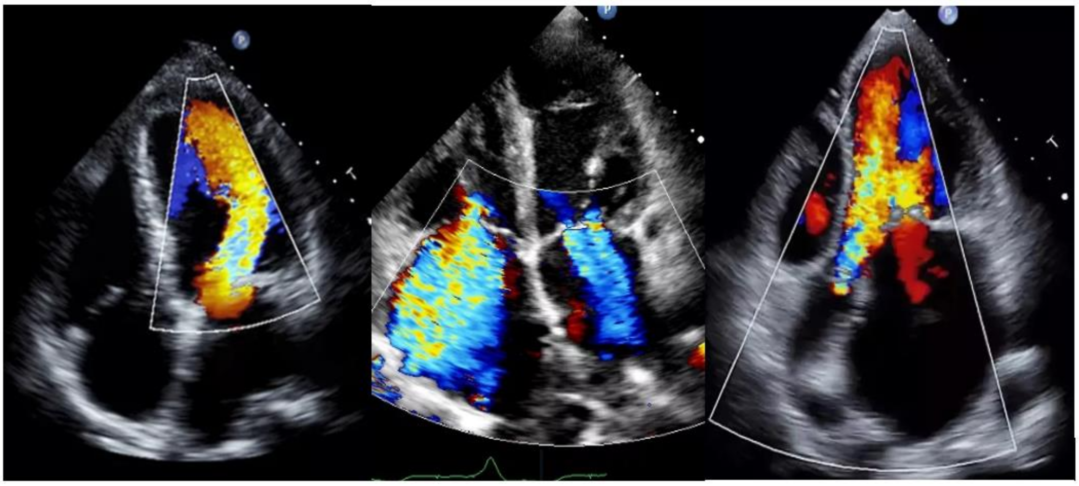


Figure 5. Valve pathology in color Doppler mode.
I - Mitral stenosis in color Doppler mode. II - Moderate mitral and severe tricuspidal regurgitation. III - Mitral stenosis, severe aortic regurgitation.

Quantification of mitral stenosis is performed using pulsed Doppler in the 4CH position by placing a control volume just above the tips of mitral valve leaflets. The resulting diastolic flow is traced. Mean Pgr >10 mmHg. - criterion for severe mitral stenosis (Figure 6).

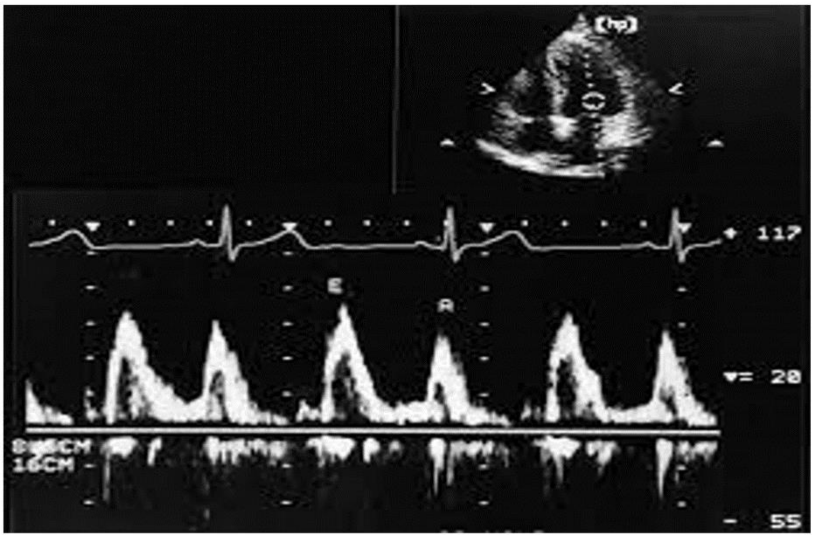


Figure 6. Transmitral gradient measurement to assess the severity of mitral stenosis.

Aortic stenosis is turbulent high velocity systolic transaortic flow.

Quantification is performed using constant-wave Doppler in the 5CH view by placing the ultrasound beam into the transaortic flow (under color Doppler control). The resulting systolic flow is traced. Mean Pgr >40 mmHg, Vmax >4 m\c are criteria of severe aortic stenosis.

Normal Vmax <1.5 m\c, 1.5-2.5 m\c - aortic sclerosis, >2.5 m\c - aortic stenosis (Figure 7).

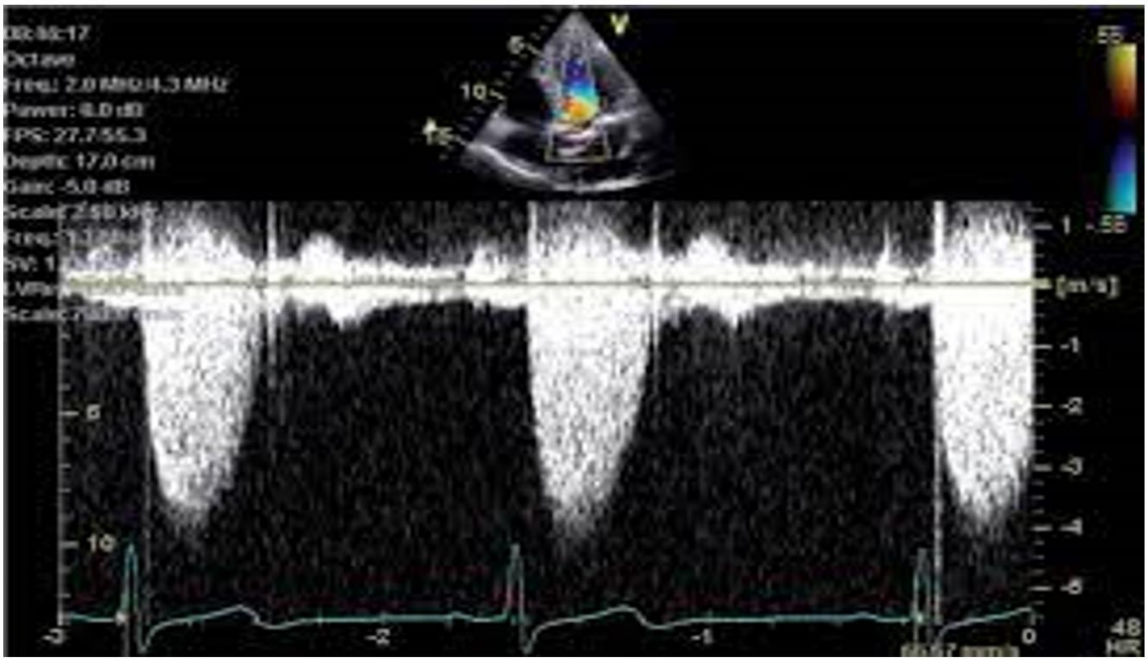


Figure 7. Doppler study of aortic stenosis. Five-chamber position, continuous-wave Doppler. Systolic transaortic flow.

Block II- Identification of signs of hypertension in the pulmonary and systemic circulation.

This stage consists of several independent parts, each of which performs its own tasks.

1. pulmonary postcapillary hypertension

(increased end-diastolic LV pressure (EDP), increased pressure in LA and pulmonary veins).

A. Determination of the transmitral flow profile

For this purpose, a pulsed Doppler control volume is placed over the mitral valve leaflet tips in the 4CH position.

The limitation is if the patient has atrial fibrillation/tripping (no peak A - atrial systole) and has severe mitral regurgitation (restrictive type of diastolic dysfunction) (Fig. 8).

2A > E> 0.8A - normal type (A)/pseudonormal type (C)
E ≤ 0.8A – impaired relaxation (B)
E > 2A – restriction (D)

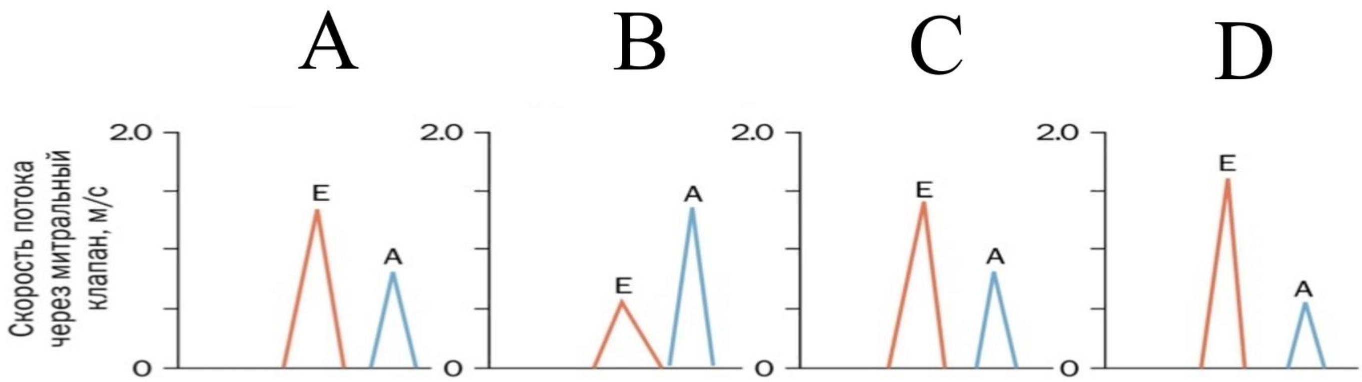


Figure 8. Diastolic dysfunction types

The E>2A profile indicates increased pressure in the pulmonary circulation. All other variants require further investigation.

Stage 2 - detection of at least 2 signs out of three:

E/e>14 (Figure 9C), Vmax of tricuspid regurgitation >2.8 m\c (Figure 9B), indexed LA volume >34ml\m2 (Figure 9A). This step belongs to the expert ECHO study, since the measurement of these indices requires experience.

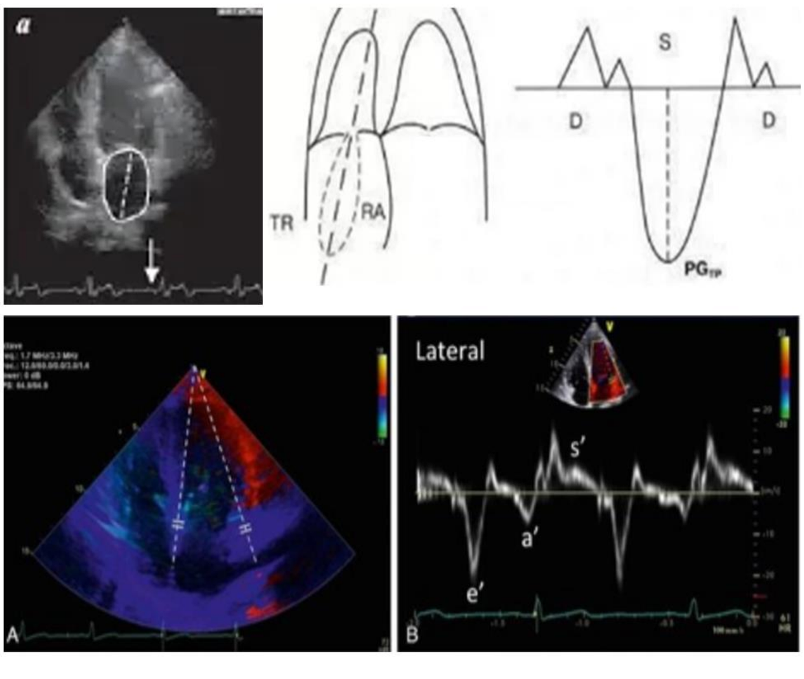


Figure 9. A - measurement of LV volume by area-length method (for simplicity, this protocol allows deviation from measurement standards), B - measurement of regurgitation flow rate and peak gradient on tricuspidal valve, C - measurement of e` in tissue Doppler mode.

e` is determined in tissue Doppler by placing a control volume on the lateral mitral valve annulus, the Vmax of the first negative peak is marked on the obtained image (Fig. 9C).

Vmax of tricuspid regurgitation is determined in continuous Doppler in 4CH view by placing the ultrasound beam in the flow of tricuspid regurgitation (under color Doppler navigation), Vmax is marked on the obtained image, the machine automatically calculates the peak pressure gradient Pgr (needed for calculation of pulmonary artery systolic pressure) (Figure 9B).

Left atrial volume* is determined by area-length method, it requires tracing the LA from the fibrous ring at the 4CH position at the end of systole, the indexed value is obtained by the ratio of the obtained volume to the patient's body surface area (Fig. 9A).

**It is accepted to measure LA volume in two positions - four-chamber and two-chamber vews by biplane method, however, for simplicity of performance of the protocol and avoiding derivation of more positions, a deviation from standards of measurement is admitted. If you have experience in deriving the 2CH position and enough time to conduct the study, it is more correct to use the biplane method.*

2. Assessment of the pulmonary artery systolic pressure (PASP) (pulmonary arterial hypertension)

The calculation is performed by assuming that the PASP corresponds to the systolic pressure in the RV, which corresponds to the right atrial pressure (RAP) + peak pressure gradient on the tricuspid valve (TV).

PASP= Pressure RV = RAP+ PGr TV

PgrTV was calculated in point 1 of the block II of the current algorithm.

The RA pressure was determined according to the scheme, depending on the degree of inspiratory collapse and IVC diameter. This requires visualization of the IVC from subcostal access, the long axis (marker pointed toward the patient's head, longitudinal scan) (Table 2, Fig. 10). The criteria for pulmonary arterial hypertension is PASP>40 mmHg.

Table 2. Correlation of inferior vena cava diameter and its degree of collapse on inspiration and right atrial pressure

IVC DIAMETER	IVC COLAPSES	RA PRESSURE
>2.1 cm	<50%	15 mm Hg
<1.5 cm	>50%	3 mm Hg
1,5–2,1 cm	NO CHANGES	8 mmHg

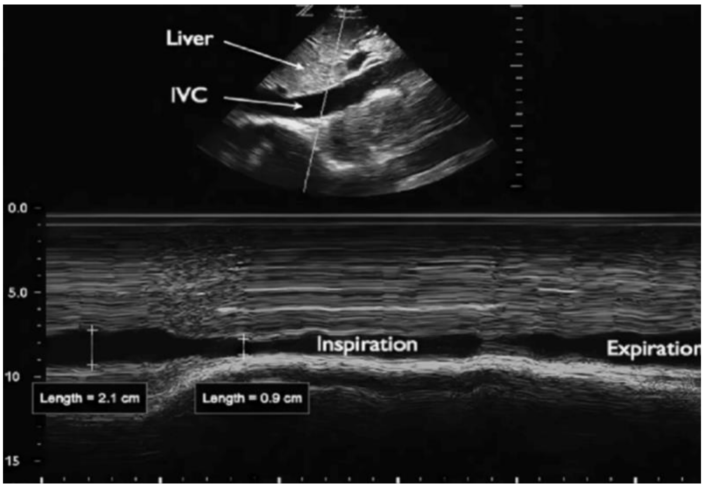


Figure 10. Collapse of inferior vena cava during breathing. Longitudinal scan in the subcostal position. IVC - inferior vena cava.

3. Evaluation of right atrial pressure and systemic venous hypertension.

It is performed using three indices: right atrial area, IVC diameter, hepatic vein flow profile.

Right atrial area is measured by tracing at the end of systole in 4CH position. The sign of increased pressure in RA is dilatation of RA >18 cm^2 (Fig. 11).

Figure 11: Measurement of right atrial area.

Dilation of the IVC >2.1 cm is an indirect sign of hypervolemia (Figure 10).

A flow evaluation is performed in the hepatic veins in pulsed Doppler mode (the beam should be parallel to the flow). The ratio of S/D peaks indicates the presence of hypervolemia (Figure 12).

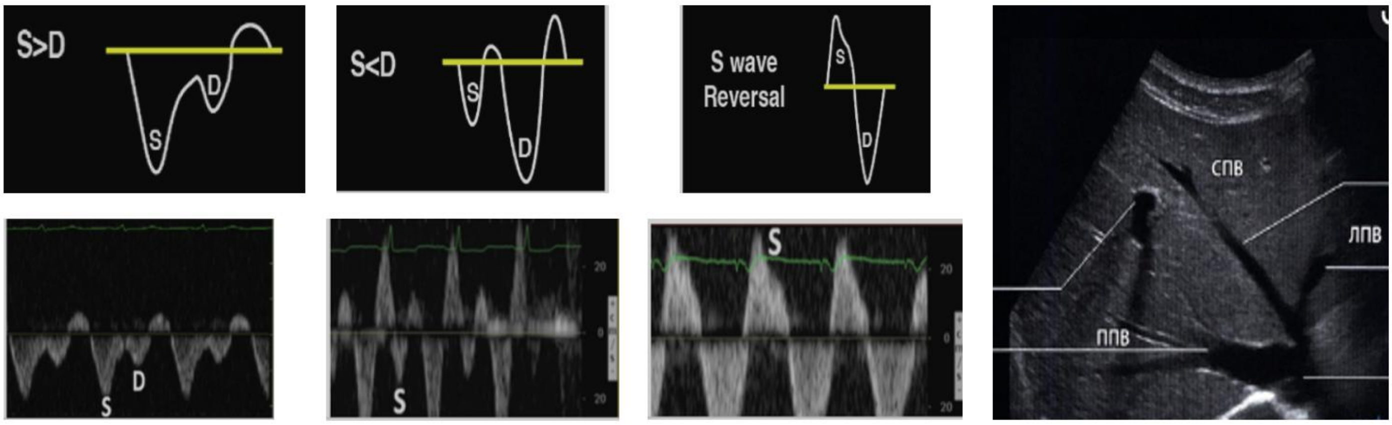


Figure12. Types of curves in Doppler study of blood flow in hepatic veins. MHV - middle hepatic vein, RHV - right hepatic vein, LHV - left hepatic vein.

S - ventricular systole, D - ventricular diastole.

Limitation: in severe tricuspidal regurgitation the flow profile will correspond to severe hypervolemia (S inversion).

S>D - normal flow profile/euvolemia

S<D, S inversion towards the transducer (above the isoline) – hypervolemia.

III block - detection of organ signs of congestive heart failure.

It consists of two parts:

- detection of free fluid in pleural cavities, pericardium and ascites.

-detection of interstitial lung syndrome

Part 1 - detection of free fluid in abdominal and pleural cavities is performed according to FAST protocol technique [4].

For this purpose a longitudinal scan with a marker directed to the patient's head is performed with a convex sensor along the middle axillary line from the right subcostal region and visualization of the kidney to the lower parts of the lungs (Fig. 13).

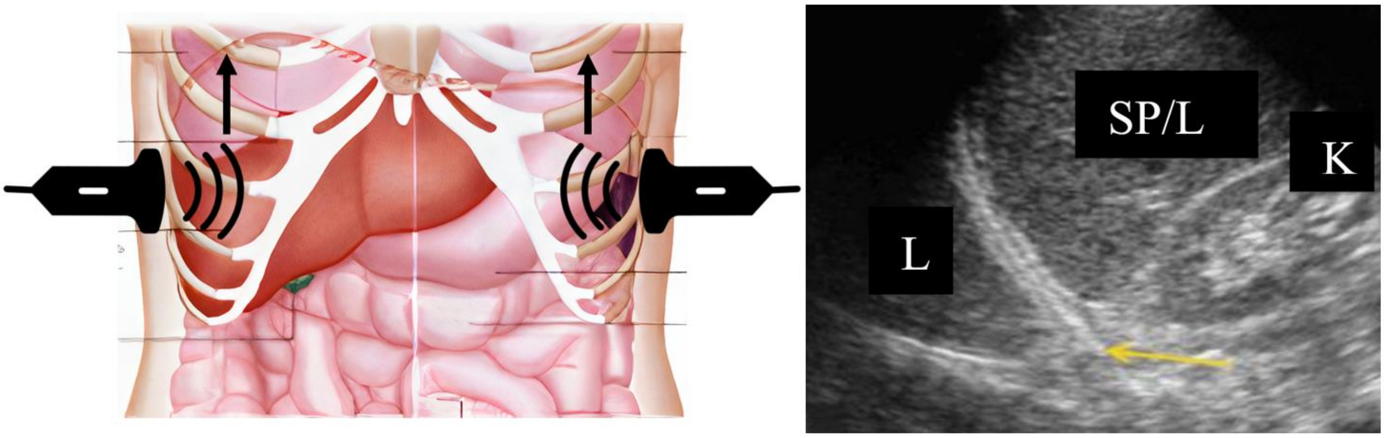


Figure 13. Schematic location of the transducer and marker for right and left quadrant abdominal/pleural cavity studies. In the resulting scan, L is the pleural sinus, SP/L is the spleen or liver, and K is the kidney.

The presence of fluid is found:

-in the hepatorenal pouch
-in the right subdiaphragmatic space
-in the right pleural cavity

Besides, the lower parts of lungs are scanned for interstitial syndrome using BLUE protocol technique (presence of B-lines) [5].

Similarly, the left quadrant of the abdomen is examined with a longitudinal scan along the posterior axillary line.

Examined for fluid:

-splenorenal pouch
-left subdiaphragmatic space
-left pleural cavity

The examination in this area is completed by evaluation of the lung profile in the lower left parts - B/A - pattern (Fig. 14).

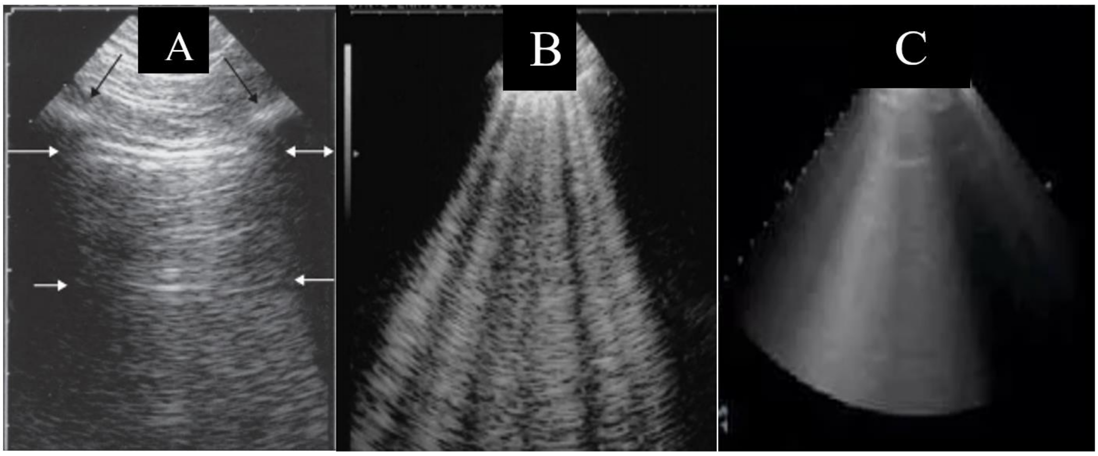


Figure 14. Lung profiles: A - presence of A-lines (transverse hyperechogenic lines being "reflection" of pleura and soft tissues (sign of "dry" lung). B - presence of B-lines - hyperechogenic artifacts like "comet's tail", starting from the pleura and passing through the entire scan, more than 2 in one intercostal space - a sign of interstitial syndrome. Extreme severity of interstitial syndrome - confluent, wide B-lines completely covering the A-lines - "white lung" or “waterfall” (C).

Part 2 - evaluation of anterior and upper-lateral parts of lungs.

For this purpose, the anterior-upper regions (2-3 intercostal spaces along the midclavicular line) and the upper-lateral regions (4 intercostal spaces along the mid-axillary line, marker directed toward the patient's head) are sequentially scanned bilaterally (Fig. 15).

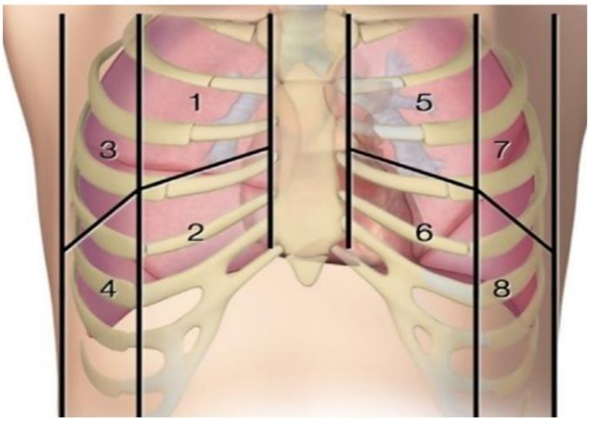


Figure 15. Sensor and marker location for anterior - upper and upper-lateral lung areas examination.

The result of the study is the detection of B-lines in the examined areas (B-lines are defined as hyperechogenic artifacts like "comet`s tail" originating from the pleural line and passing through the whole scan (Fig. 14.) (Normal - up to 3 B-lines in one intercostal space).

Presence of confluent wide B-lines and diffuse interstitial syndrome over the whole surface of the lungs is a sign of pronounced congestion in the small circle of circulation. Absence of B-lines in the upper and middle parts of lungs was suggested to be regarded as unexpressed congestion.

Simplified version of the protocol.

In urgent situations, as well as in dynamic examinations, the following scheme is suggested as a simplified version of the protocol.

1. Assessment of organ dysfunction and congession (right and left quadrants of abdominal cavity and corresponding right and left lower lungs + pleural cavities).
2. Assessment of the volemic status by measuring the diameter of the inferior vena cava.
3. Measurement of PASP as an indicator of pulmonary hypertension.
4. Focused assessment of ventricular contractility and detection of severe valve dysfunction.

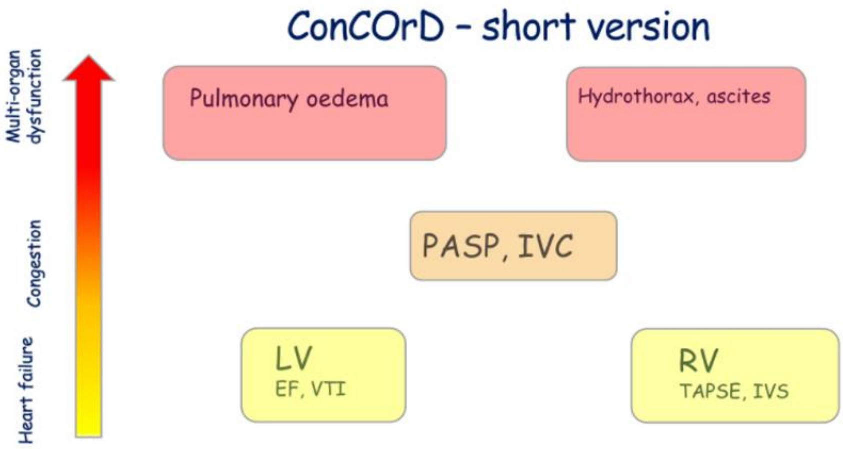


Figure 16. Short version of the ConCOrD protocol for urgent assessment or monitoring.

Conclusion

It should be noted that many parameters used in the protocol have their own assumptions and measurement conditions.

1. Assessment of global LV contractility

Visual assessment of EF requires good visualization, operator experience. Indices such as fractional shortening cannot be used in LV geometry abnormality, and the Simpson measurement of LV EF is operator-dependent, and not suitable for use as a screening method. VTI measurement is the standard of noninvasive hemodynamic monitoring. However, the second important component of stroke volume measurement is the cross-sectional area of LVOT. Thus, it is possible to judge the value of stroke volume using only VTI parameter in the absence of LV basal IVS hypertrophy.

2. Assessment of RV systolic function

The TAPSE score is standard in the study of RV function. However, it reflects, in fact, longitudinal contractility - systolic excursion of the fibrous ring. The analogue of the ejection fraction for the RV can be the fractional area change (FAC), but due to the irregular shape of the RV, in different variations of the 4-dimensional position (for example, the RV-focused four-chamber position) its size can vary greatly, leading to false calculations. In addition, there are other indicators - MPI, IVA, measurement of which is more complicated and is not included in the focused Echo-protocols. Extended Echo assessment of right heart chambers is covered in detail in the guidelines [6].

3. Assessment of pulmonary hypertension.

Noninvasive assessment of postcapillary hypertension is difficult. Catheterization uses pulmonary artery wedge pressure (PAWP) for this purpose, but there are no ultrasound analogues for it. These indices are taken from the algorithm presented in clinical guidelines on the diagnosis and treatment of pulmonary hypertension [7]. Transmitral blood flow and diastolic mitral annulus velocity (E/A, E/e`) are used to estimate indirectly the filling pressure in LV that correlates with PAWP, with E\e` >15 approximately corresponding to PAWP >20 mm Hg. [8-9]. This index is an independent predictor of death in any LV EF [10-11]. Recommendations on ultrasound diagnostics of diastolic function present an algorithm for increased LV pressure detection, which is an indirect sign of postcapillary venous hypertension [12], in a shortened version the above algorithm is included in block II of the current protocol.

It should be noted that E/A measurement is incorrect in severe mitral regurgitation, as in this case pronounced prevalence of E can be caused by LV preload due to regurgitation, but not by high pulmonary vein hypertension.

4. Assessment of systemic hypervolemia.

The protocol includes assessment of hypertension in the IVC and hepatic veins, as well as in RA. It should be noted that inversion of S peak in the hepatic vein can also be observed in severe TP and not be a sign of severe hypervolemia. Since hypertension and hypervolemia are often links of the same pathophysiological chain, evaluation of IVC diameter and flow profile in the hepatic vein is also part of the algorithm for detection of hypervolemia, as demonstrated in the short version of the protocol. The full VExUS protocol can be consulted separately and applied at the operator's discretion [3].

Organ congestion in the decompensation stage may be present in varying degrees. Their detection helps to establish the diagnosis and determine the cause of clinical symptomatology, so must be included in the screening ultrasound protocol. The technique is well known and is a simplified version of FAST and BLUE protocols [4-5].

Typically, lung congestion develops faster and is more clinically severe in the form of moist wheezing/B lines on ultrasound. In contrast, systemic hypervolemia elevates slowly, less common (as diseases affecting right heart function are less common) and resolve also slowly, reaching sometimes such large volumes that they require cavity punctions.

Currently, lung ultrasound assessment is a mandatory component of the management of patients with HF, which positively affects the duration of inpatient treatment period [13].

Initially, B-line scanning and imaging were performed in 28 zones during lung ultrasonography. However, this technique seems to be relatively time-consuming. Today in the description of lung ultrasound technique we can increasingly see the recommendation to perform the study with 8 and 4 zones scanning [14-16]. The current protocol suggests 3 zones on the right side and 3 zones on the left side, which corresponds to symmetrical spread of the process from bottom to top.

In addition to the location, another important parameter is the number of B-lines. There are a sufficient number of papers that reflect the correlation between the number of B-lines, the severity of heart failure and clinical outcomes. Various threshold numbers of B-lines have been proposed by the authors: >30 [17], >15 [18], as independent predictors of rehospitalization. Since the exact determination of B-lines is operator-dependent, the present protocol proposes a semi-quantitative assessment of interstitial syndrome considering its localization and the nature of B-lines.

It should be also noted the similarity of ultrasound picture in congestive phenomena of the small circulatory system and Covid-19-associated lung lesion. In favor of infectious genesis of interstitial syndrome there is an atypical spread of the process (left-sided, upper lung involvement, failure to observe the rule of process intensity increase from right to left, from bottom to top) subpleural consolidations, pleural thickening.

Block II- in-depth assessment of intracardiac hemodynamics with elements of expert examination. It is of particular value in patients with cardiac insufficiency with preserved ejection fraction. In this case the aim of the study is to detect functional abnormalities in the absence of cardiac contractility decrease.

Conclusion

Thus, the present algorithm is a versatile ultrasound examination of the cardiovascular system in patients with various forms of heart failure, which allows modifying it depending on the situation and using it both as an expert protocol and in urgent situations. The proposed algorithm ConCOrD is based on clinical recommendations of the world leading experts in ultrasound and clinical diagnostics, and its application will help to improve the efficiency of treatment of patients with heart failure.

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CONTENT:

Lung Ultrasonography for the Primary Care Physician, Gedeon Gelin 1
POCUS Academy of Serbia, Ivica Zdravkovic 9
Clinical cases with the use of POCUS at the pre-hospital stage, Roman Mikhei, Roman Filyavin 12
POCUS Case Report, Danijel Oderković 18
POCUS Case Report, Željka Popović 19
POCUS Case Report, Ivica Zdravković 20
"SAFE-R+" ultrasound protocol (...), Krushelnitsky A.A., Yudenkov D.I. et al... 21
POCUS in the diagnosis of testicular torsion in pediatric patients, Vekoslav Zajić 28
POCUS MOSCOW Activities for the first 6 months of 2023, Vsevolod Lykhin 30
TWENTY-FIVE, STAY ALIVE!, Ivica Zdravkovic 42
Interscalene block in clavicle surgery, Kim Sergey, Mustaphin Ruslan 44
Efficacy of sulodexide (...), Dejan Živanović 46
Bedside ultrasound examination in heart failure, CONCORD Protocol, Moscow POCUS group 49

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