

## Laboratory 3. Ultrasonography examination I i II

### 1. Introduction

Medical ultrasound (USG, also known as diagnostic sonography or ultrasonography) is a diagnostic imaging technique based on the application of ultrasound. It is used to see internal body structures such as tendons, muscles, joints, vessels and internal organs. Its aim is often to find a source of a disease or to exclude any pathology.

Ultrasound is sound waves with frequencies which are higher than those audible to humans ( $>20,000$  Hz). Ultrasonic images also known as sonograms are made by sending pulses of ultrasound into tissue using a probe. The sound echoes off the tissue; with different tissues reflecting varying degrees of sound. These echoes are recorded and displayed as an image to the operator.

Main applications of USG are:

1. cardiology (echocardiography) – imaging of the heart;
2. gastroenterology - imaging of organs such as liver, pancreas, kidney and colon;
3. gynecology - imaging of the fetus;
4. otolaryngology - the study of the thyroid, salivary glands and ears;
5. urology - in diagnostics, e.g. detection of kidney stones

### 2. Laboratory procedure

This exercise involves making measurements of internal organs: liver, kidney, aorta by ultrasound.

Used imaging system is a B-Ultrasound Diagnostic System CMS600P2 produced by Contec Medical Systems. Below is the starting procedure:

- connect the power supply to a laptop
- connect the convex probe
- start USG laptop by pressing the side button 0/1

Main function buttons:

clear – clears notes made on the screen

freeze – freezes the image frame

set – function like left Mouse button or Enter key

freq – changes the frequency of ultrasound wave

U/D – vertical image flip

LR – horizontal image flip

B/W – color inversion

gamma – gamma brightness correction

B – display 1 image of B type (brightness)

BB – display 2 B-type images

BBBB – display 4 B-type images

BM/M – display B-type and M-type images or only M-type images

In the table below you will find ultrasound wave frequencies used for various organ imaging.

Frequency [MHz]	Organ
2,5	heart, brain
3,5	liver, spleen
5,0	kidney, pancreas, skeleton
7,5	thyroid, blood vessels, endosonography
10	eye, breast, testicles, fingers
15	surface structures
>20	endovascular, skin

*Andrzej Nowicki: Wstęp do ultrasonografii. Podstawy fizyczne i instrumentacja. ISBN 83-919257-0-6.*

Keep the USG probe as if you were keeping a pen (Rys. 1). If the probe is positioned horizontally the marker should be on the right. For vertical position of the probe the marker should be directed towards the head. The marker on the screen should be positioned on the right (use L/R button).



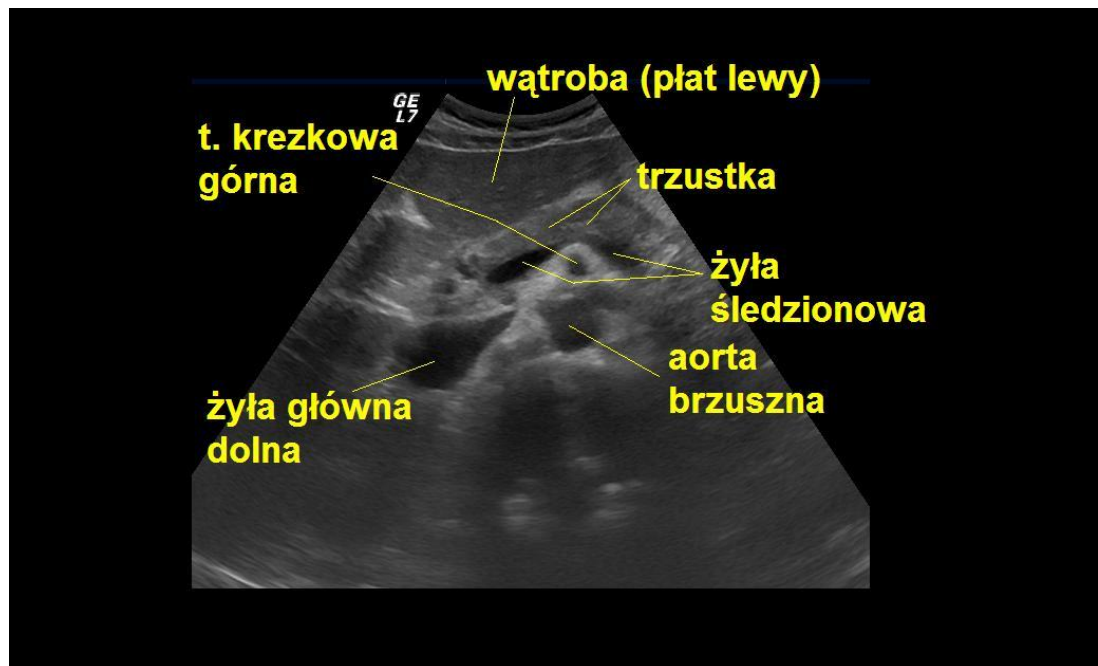
**Rysunek 1**

Examination procedure:

A. Pancreas

We begin the examination by positioning the USG probe horizontally on the midline, just below the sternum. The characteristic image is the image of the vein triad visible as three black areas. Above the triad we can observe pancreas.

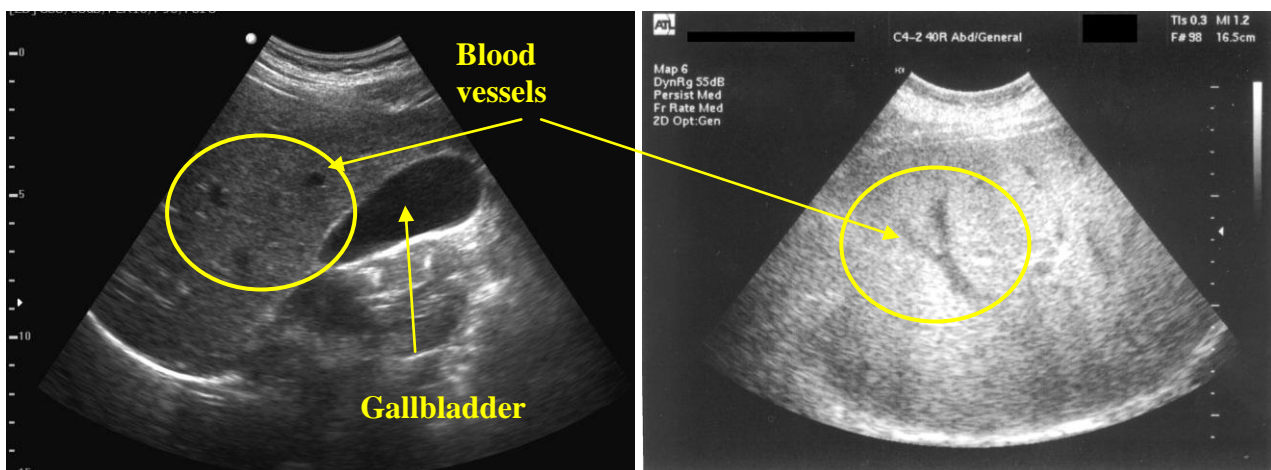
Zaczynamy badanie od ustawienia głowicy poprzecznie na linii pośrodkowej, nieco poniżej mostka. Charakterystycznym obrazem jest obraz triady żył widocznych jako trzy czarne obszary. Powyżej triady można zaobserwować trzustkę (Rys. 2).



Rysunek 2 (wątroba płat lewy – left lobe of the liver, trzustka – pancreas, tętnica kręzkowa górna - superior mesenteric artery, żyła śledzionowa - splenic vein, aorta brzuszna - abdominal aorta, żyła główna dolna – lower vena)

B. Liver

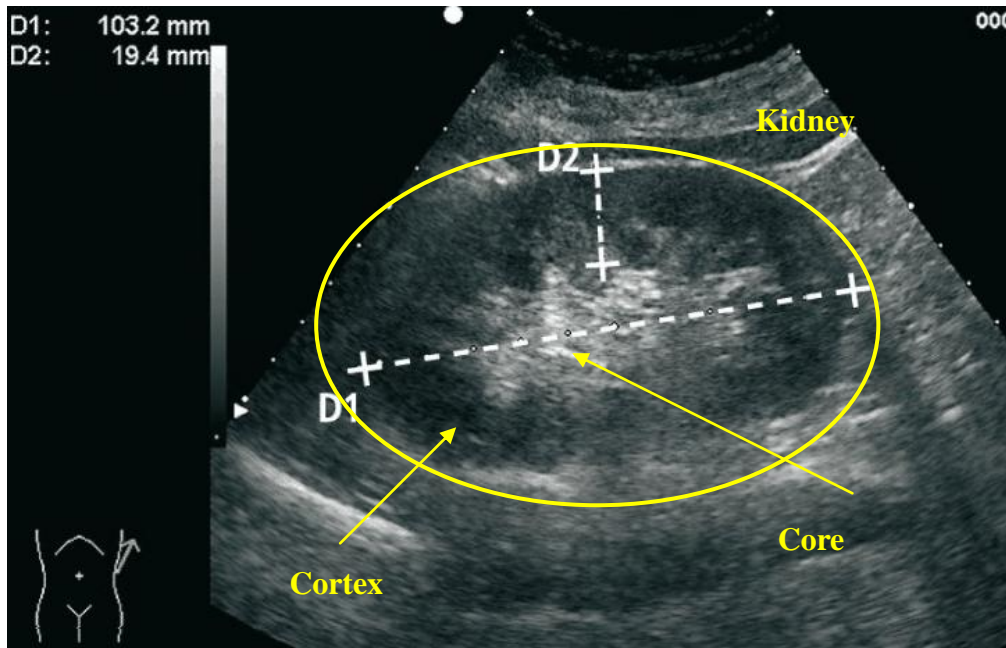
Moving the probe to the right of the patient we can observe the two lobes of the liver (in gray-silver) with a lot of blood vessels (Rys. 3) in the form of dark spots or irregular branching lines (due to the dichotomous nature in the liver), depending on the position of the probe.



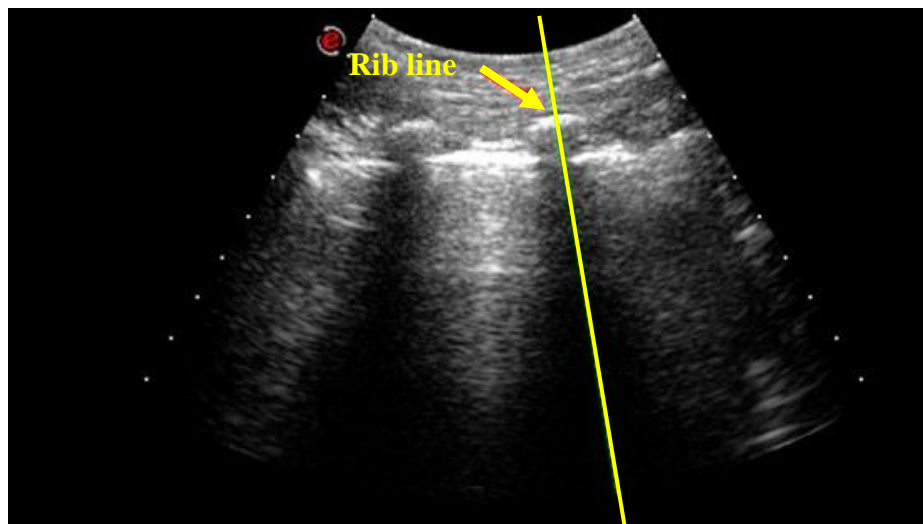
Rysunek 3

### C. Right kidney

By moving the probe toward the right side of the patient we can find a kidney that can be observed as a "two-tone" structure (Rys. 4), in which we can distinguish core (the brighter area inside) and the cortex (the darker area outside). If you set a probe on the side of the patient the kidney is visible in the intercostal spaces, and the ribs are visible as dark stripes (Fig. 5). Measure the size of the kidney (dimension D1 and D2 as shown in Figure 4).



Rysunek 4



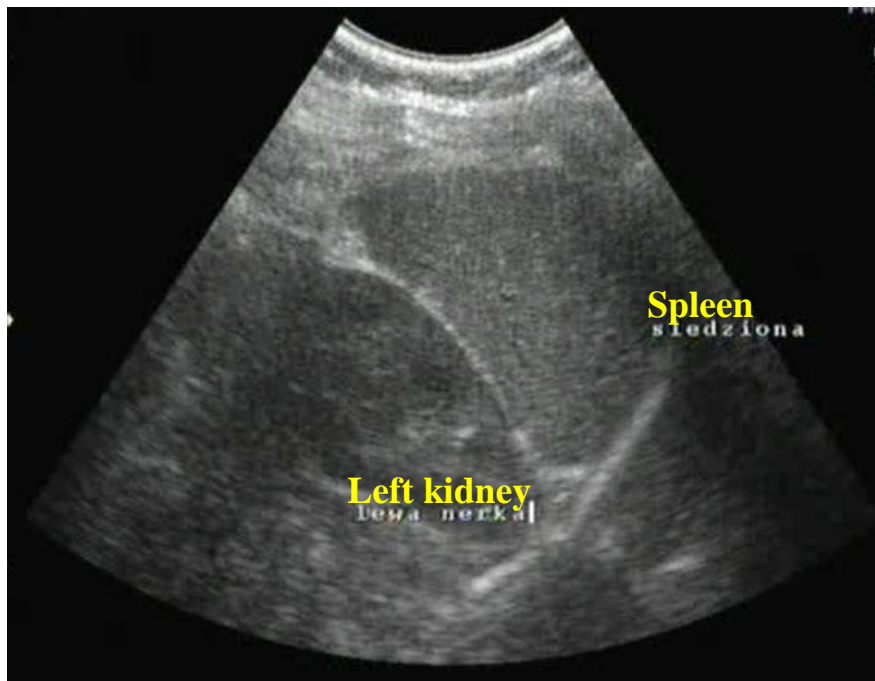
Rysunek 5

### D. Left kidney

Move the USG probe symmetrically to the left side of the patient and find the left kidney, which should be positioned slightly higher than the right kidney. Measure the left kidney, as in the case of the right.

### E. Spleen

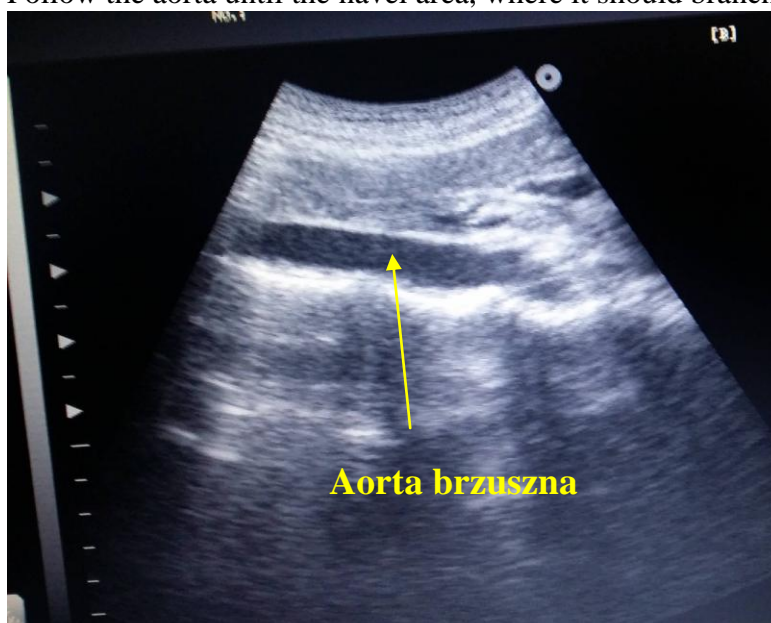
Slightly above the left kidney, in the ventral direction you can locate the spleen (Fig. 6). In case when it is difficult to see the organ you can ask the patient to inhale the air and hold the breath so the organ is "pushed out".



Rysunek 6

### F. Abdominal aorta

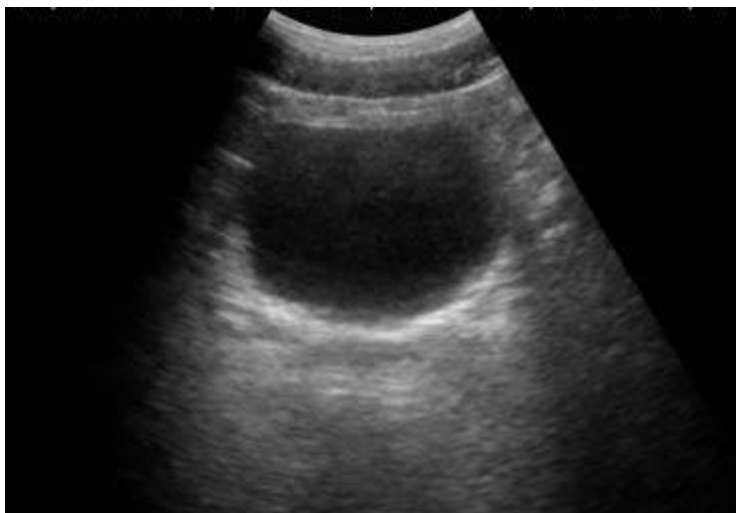
The last part of the examination involves finding the abdominal aorta. Put the USG probe to a vertical position, approximately at the level of the stomach, on the center line of the body. The marker should be directed towards the patient's head. You will see the abdominal aorta as a pulsating elongated dark "tube" with clearly outlined bright borders (Fig. 7). Observe the aorta and measure its diameter (the correct value is approx. 2 cm). Follow the aorta until the navel area, where it should branch out to the left and right.



Rysunek 7

G. Bladder (not obligatory)

At the end of the examination you can find the patient's bladder, which is located below the navel, usually slightly to the right. The bladder is visible as a dark area (Fig. 8).



**Rysunek 8**