Common medical imaging techniques

Ultrasonography uses high-frequency sound waves to produce images of internal organs and other tissues. A device called a transducer converts electrical current into sound waves, which are sent into the body's tissues. Sound waves bounce off structures in the body and are reflected back to the transducer, which converts the waves into electrical signals. A computer converts the pattern of electrical signals into an image, which is displayed on a monitor and recorded on film, on videotape, or as a digital computer image. No x-rays are used. Ultrasonography is painless, relatively inexpensive, and considered very safe, even during pregnancy. If the abdomen is being examined, people may be asked to refrain from eating and drinking for several hours before the test. Usually, the examiner places thick gel on the skin over the area to be examined to ensure good sound transmission. A handheld transducer is placed on the skin and moved over the area to be evaluated. To evaluate some body parts, the examiner inserts the transducer into the body—for example, into the vagina to better image the uterus and ovaries or into the anus to image the prostate gland. To evaluate the heart, the examiner sometimes attaches the transducer to a viewing tube called an endoscope and passes it down the throat into the esophagus. Ultrasound images are acquired rapidly enough to show the motion of organs and structures in the body in real time as in a movie. For example, the motion of the beating heart can be seen, even in a fetus. Ultrasonography is effectively used to check for growths and foreign objects that are close to the body's surface, such as those in the thyroid gland, breasts, and limbs, as well as some lymph nodes. Ultrasonography is effectively used to image internal organs in the abdomen, pelvis, and chest. However, because sound waves are blocked by gas (for example, in the lungs or intestine) and by bone, ultrasonography of internal organs requires special skills. People who have been specifically trained to do ultrasound examinations are called sonographers.

Magnetic Resonance Imaging systems use a powerful magnetic field and radiofrequency pulses to produce detailed images of the body's internal structures as cross-sectional images or slices. Without exposing the patient or staff to ionizing radiation (X-rays), MRI provides high quality images with excellent contrast detail of soft tissue and anatomic structures such as grey and white matter in the brain. It is used in a wide range of examinations from brain tumors and inflammation of the spine to slipped discs, assessing blood flow and functioning of the heart. MRI does not emit any ionizing radiation. MRI scanners can image a wide range of body parts including injuries of the joints, the blood vessels, the breast, as well as abdominal and pelvic organs such as the liver or reproductive organs. The MRI system consists of a very powerful superconducting magnet that creates a static magnetic field, smaller 'gradient' magnets that allow the magnetic field to be very precisely altered and designated coils for specific body parts that emit radiowaves. During the examination, the gradient coils are used to 'focus' the magnetic field on the part of the body to be scanned. The radio signal is turned on and off and the energy absorbed by different atoms is reflected back out of the body. The coil measures these radio waves and the computer then calculates the way they have been absorbed or reflected to compile the cross-sectional images. The tapping sound heard during the examination is caused when gradient magnets are switched on and off. MRI scanners can acquire direct views of the body in almost any orientation and without

exposing the patient or staff to ionizing radiation (X-rays). Care must be taken, however, in patients with implants, because they might be affected by the strong magnetic field. Patients with common pacemakers, for example, can generally not have an MRI scan. There is also a slight risk of allergic reaction by some patients to contrast agents, if used.

Elastography is a medical imaging technique that uses ultrasound or magnetic resonance imaging. It maps the elastic properties and stiffness of soft tissues. Elastography is used for the investigation of many disease conditions in many organs. It can be used to guide biopsies or replace them entirely. Biopsies are invasive and painful, presenting a risk of hemorrhage or infection, whereas elastography is completely non-invasive. Liver elastography is used to investigate disease in the liver. Liver stiffness is usually indicative of fibrosis or steatosis, which are in turn indicative of numerous disease conditions, including cirrhosis and hepatitis.

In **radiography**, a beam of X-rays, produced by an X-ray generator, is transmitted through an object, e.g. the part of the body to be scanned. The X-rays are absorbed by the material they pass through in differing amounts depending on the density and composition of the material. X-rays that are not absorbed pass through the object and are recorded on X-ray sensitive film. While bone absorbs X-rays particularly well, soft tissue such as muscle fibre, which has a lower density than bone, absorbs fewer X-rays. This results in the familiar contrast seen in X-ray images, with bones shown as clearly defined white areas and darker areas of tissue. This makes conventional X- rays very suitable for scans of bones and detection of bone fractures. Other uses of radiography include the study of the organs in the abdomen, such as the liver and bladder; chest radiography for diseases of the lung, such as pneumonia or lung cancer and mammography to screen for breast cancer. X - ray fluoroscopy is used to detect a number of diseases associated with the stomach and intestine, genitals and urinary tract.

I. Choose all correct answers:

1. Ultrasonography uses

a) high-frequency sound waves

b) X-rays

c) is painless

d) is safe even during pregnancy

2. Ultrasonography is commonly used to evaluate:

a) fetal development

b) blood flow in the heart

c) thyroid gland tumor

d) bone fractures

3. Magnetic Resonance Imaging examination

a) uses a powerful magnetic field

b) does not use ionizing radiation

c) is safe for patients with cardiac pacemakers

d) is safe for patients with implants

4. Computed tomography

a) uses two- dimensional X-rays

b) creates cross-sectional images of the body

c) uses a fixed X-ray tube

d) is a useful screening tool for detecting possible tumors or lesions within the abdomen

5. The sources of excessive and risky radiation are:

a) nuclear medicine

b) computed tomography

c) fluoroscopy

d) elastography

6. Elastography is a medical imaging technique which:

a) maps elastic properties and stiffness of soft tissues

b) uses ultrasounds

c) uses X-rays

d) is an invasive and painful examination

7. Liver diseases which can be detected by elastography examination are:

a) emphysema

b) cirrhosis

c) hepatitis

d) appendicitis

II. Chose one answer a, b or c.

1. Which of the following in NOT an advanced medical imaging technique?
   a) USG
   b) MRI
   c) X-ray
2. Which of these examination techniques uses high-frequency sound waves and a transducer?
   a) MRI
   b) USG
   c) CT
3. Which of these examination techniques does not use X-rays?
   a) Mammography
   b) CT
   c) MRI
4. Which of these examination techniques is very suitable for the detection of bone fractures?
   a) Elastograph
   b) MRI
   c) X-ray
5. Which of these examination techniques uses radio waves and a magnetic field?
   a) ECG
   b) USG
   c) MRI
6. Which of these examination techniques is invasive:
   a) Biopsy
   b) Mammography
   c) Elastography
7. Which of these examination techniques is NOT suitable for diagnosing diseases of lungs, intestines and bones:
   a) X-ray
   b) USG
   c) CT

III. Match the words on the left (1-10) with the words on the right (a-j) to form collocations and translate them into Polish.

1. brain	a. agent
2. gradient	b. vessels/flow
3. electrical	c. waves
4. contrast	d. radiation
5. blood	e. field
6. soft	f. images
7. magnetic	g. coils
8. ionizing	h. tissue
9. sound	i. tumor
10. cross-sectional	j. current

IV. Match the words (1-10) with their definitions (a-j).

1. capillary
2. esophagus
3. reflex
4. secrete
5. fetus
6. tissue
7. lesion
8. hemorrhage
9. hypothalamus
10. overdose

a) the part of the brain that connects the nervous system with the endocrine system
b) a group of connected cells that have similar function or structure
c) the smallest kind of blood vessel in the body
d) more than the normal or recommended amount
e) a muscular tube connecting the mouth to the stomach
f) a profuse discharge of blood, bleeding
g) an involuntary and immediate movement in response to a stimulus
h) a prenatal human between its embryonic stage and its birth
i) to emit a substance in order to perform some bodily function
j) an abnormal structural change of an organ or part due to injury or disease

V. Write Polish translations of the words:

1. urinary bladder
2. esophagus
3. lungs
4. small intestine
5. large intestine
6. lymph nodes
7. thyroid gland
8. pelvis
9. chest
10. stomach
11. uterus
12. throat

VI. What are the functions of the following parts in the MRI system?

1. superconducting magnet
2. gradient magnets
3. gradient coils
4. computer

VII. Change the sentences into the passive voice.

1. A transducer converts electrical current into sound waves.
   Electrical current…… .
2. A sonographer is examining the thyroid gland.
   …… .
3. Ultrasonography does not use any X-rays.
   No X-rays……in ultrasonography .
4. You can see the motion of the beating heart on a screen.
   The motion..... .
5. Your doctor may ask you to refrain from eating and drinking for several hours before the ultrasound examination.
   You…… .

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