Diagnostics in Liver Diseases

8 Radiological diagnostics

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8 Radiological diagnostics

A definite diagnosis is often not obtained in liver disease despite the combined use of the **mainstays of diagnostics:** (*1.*) *clinical findings*, (*2.*) *laboratory examination data*, and (*3.*) *ultrasonography*. Possibly even (*4.*) *morphological analysis* has been unproductive or was not indicated at all. This raises the question of using special radiological and nuclear medical examination techniques. • Diagnostic problems may arise, especially with regard to the following **issues:**

- Identification of intrahepatic foci
- Clarification of the benignancy or malignancy of focal liver lesions
- Differentiation of vascular-related liver diseases
- Detection of alterations regarding the bile ducts
- Differential diagnosis of mechanical jaundice
- Assessment of portal hypertension
- Extent of collateral vessels
- Unclarified diffuse alterations of the liver parenchyma
- Control following liver trauma
- Staging of malignant tumours
- Checking indications for surgical intervention
- Examination before and follow-up after liver transplantation

Different **radiological procedures** are available for clarifying these diagnostic issues. (s. tab. 8.1)

1. Computer tomography (CT)
2. Magnetic resonance imaging (MRI)
3. Arteriography
4. Portography
5. Phlebography
6. Cholangiography

Tab. 8.1: Radiological procedures used in the diagnosis of hepatobiliary diseases

► These various imaging techniques (s. tab. 8.1) – as well as some nuclear medicine-based methods (*see chapter 9*) – enable key features of benign and malignant tumours to be recognized, including (*1.*) vascularity, (*2.*) internal structure, (*3.*) hepatocyte functions, (*4.*) biliary tract, (*5.*) bile secretion, (*6.*) calcification, and (*7.*) Kupffer cell activity.

1 Computer tomography

► Tomography was developed by A.E.M. Bocage and registered as a French patent in the same year. It was further developed in the form of transversal (and axial) tomography by H. Vieten (1936) and registered as a German patent. A research team headed by A. Gebauer presented a device for use in clinical practice in 1945. • The **introduction** of computer tomography (CT) into medicine by G.N. Hounsfield in 1971 (skull CT) and as computerized transverse axial scanning (tomography) in 1973 was a revolutionary event comparable with the discovery of X-rays by W.C. Röntgen in 1895. (15) • As early as 1975, the first normal CT scan of the upper abdomen was reported (R.J. Alfidi et al.) (1), and in the same year, the first pathological findings from abdominal diseases (relating to the liver) were also presented (D. Schellinger et al., 1975). (38)

1.1 Principle

In computer tomography, the attenuations of many finely focused X-rays are measured by detectors and converted to electrical signals. These values are transmitted to a computer. Subsequently, the absorption value of each image point is calculated and displayed in a complex digital image. The transmission of X-rays through the body occurs in the form of fan beams and is recorded by a rotating detector fan (3rd CT generation). The 4th CT generation is characterized by a static detector crown, spanning 360 degrees, around which the X-ray source continually rotates. (9) • More advanced spiral CT facilitates spiral scanning, permitting continuous imaging of the analyzed area while the patient holds his/her breath. This provides accurate anatomical data without respiratory artefacts and with optimum exploitation of the CM bolus. (3, 5, 6, 10, 12)

In contrast to ultrasonography, which is based on the recording and imaging of the reflection of sound waves between tissues with varying acoustic impedance, the radiological signal is produced by **differences in absorption.** • With the **radiation doses** used (100–140 kv), the absorbed dose of energy corresponds to 0.013 Gy (1.3 rad) per tomographical slice. By using many finely focused X-rays, the dose is largely restricted to the body layer to be imaged. Therefore, only a relatively low scatter of radiation has to be taken in consideration. The radiation exposure of a CT scan is comparable with that of a plain radiograph of the abdomen.

With consecutive tomograms, the thickness of each section of the body is 5-8-10 (–12) mm. In individual cases, additional thin-section tomograms of 1 mm can be obtained. Resolution is 1 × 2 mm in the hepatic area, with an accuracy in attenuation values of up to 0.5%. In this way, the values for a particular cross-section and their spatial distribution are visualized in a scan. This results in blur-free, anatomically precise imaging of a layer of the body in an axial plane. CT scans provide satisfactory information if an object diameter of 1.5 to 3 mm is resolved with a density gradient of 0.5% to the surrounding area at an integral dose of 10 mGy.

1.2 Hounsfield units

The attenuation values are given in Hounsfield units (HU), the density scale ranging from –1,000 (= air) through 0 (= water) to +1,000 (= bone). These 2,000 shades of brightness are recorded by the computer, but