Liver tumors and Portal Hypertension
Radiological and Surgical Aspects
A. Steudel and M. Reiser
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The ESDIR-meeting on “Liver Tumors and Portal Hypertension” was attended by 78 young radiologists from 12 different European countries, including seven Eastern countries. Two hundred and thirty-seven senior radiologists and abdominal surgeons took part in the meeting. The teaching programme was created in close cooperation with the radiological departments of the universities of Leuven, L’Aquila, Boston, Berlin and Bonn.

The symposium was supported by the German Research Community (DFG) and the European Association of Radiology (EAR) and was part of the annual European Seminars in Diagnostic and Interventional Radiology (ESDIR).

The scientific programme included four parts concerning diagnostic and interventional radiology as well as surgery: (1) diagnostic imaging – lesion detection and tissue characterization; (2) liver transplantation; (3) therapeutic intervention; (4) portal hypertension. Even though the presentation of new results in radiological and surgical research was the main aim of the meeting, state-of-the-art papers and reflections on the cooperation of radiology and surgery were emphasized by both the speakers and the moderators.

The first session on diagnostic imaging was opened by a state-of-the-art lecture on liver contrast agents in MRI presented by D. D. Stark (Boston). Lesion detection and tissue characterization can be improved using both paramagnetic and supermagnetic agents. Iron oxide particles exhibit a highly tissue-specific biodistribution, whilst their pharmacokinetics are less complex than Gd-DTPA and hepatobiliary chelates such as Mn-DPDP. Dr. Stark is convinced that problems concerning particle size and safety aspects will be overcome and that routine clinical use of this type of contrast agent with superior tumor-liver contrast will be possible in the 1990s.

M. Luning (Berlin) pointed out the value of various imaging modalities for tissue characterization of benign vs. malignant liver tumors. In the differential diagnosis of liver tumors, MRI was superior to ultrasound and computed tomography in all but one diagnostic criterion. Criteria evaluated in this trial included tumor inhomogeneity, pre- and post-contrast signal intensity, the detection of scars and rim signs, kinetics of the particular contrast agents, and peritumoral vessels. Ultrasound was superior to MRI and CT in detecting the rim sign and in the differential diagnosis of metastases and hepatocellular carcinoma.

G. Onik (Pittsburgh) reported on his results with intraoperative ultrasound (IOUS) of the liver. Four groups of patients were identified. 1) In 55%, no new information was found and no changes in planned surgery were required. 2) Fourteen percent had additional findings which had no effect on the planned surgery. 3) Twelve percent had no change in diagnosis and no additional lesions were detected, but superior accuracy of IOUS resulted in an alteration to the planned procedure. 4) Nineteen percent had findings which altered the planned surgery.

The analysis of results revealed superior sensitivity and specificity of IOUS compared with other imaging methods.

For detection of tumors within diffusely diseased liver using MRI, B. Kreft and D. D. Stark (Bonn, Boston) emphasized the value of call-specific contrast agents. In experimental animals with liver tumors, tumor-liver contrast (CNR) in fatty liver was increased on T1-weighted images and decreased on T2-weighted images compared with normal controls. CNR was greatest (60-80% higher than on the phase contrast images) after administration of either MnDPDP or Gd-BOPTA/Dimeg. No difference was noted between the enhancement in controls and in animals with fatty liver, indicating that the uptake and enhancement of these contrast agents is not affected by fatty infiltration of the liver. Similar results were obtained for MnDPDP in an experimental tumor study associated with chemically induced hepatitis.

Liver cancer is often associated with diffuse liver disease such as fatty liver, hepatitis, hemochromatosis and cirrhosis. Each of these disorders result in characteristic changes of the relaxation times of liver tissue, and can affect detection of tumors by MRI. Kreft and Stark concluded from their experiments that chemical shift imaging
using T2-weighted, opposed-phase images improved the detection of tumors in the presence of fatty infiltration of the liver and that cell-specific contrast agents were equally effective for tumor detection in normal liver and in the presence of fatty infiltration and/or hepatitis.

Interesting results about studies of hepatobiliary contrast agents were reported by T. Vogl (Munich). MnDPDP significantly increased the signal-to-noise ratios of the liver parenchyma in all T1-weighted sequences because of specific enhancement of liver tissue. All focal liver lesions could be significantly better visualized after MnDPDP application. Within the group of metastases, 25–120 % more lesions could be delineated after MnDPDP. In five patients, particular liver lesions (cirrhotic nodules, HCC, FNH) showed significant enhancement with MnDPDP. In these studies, the hepatobiliary contrast agent MnDPDP proved to be a safe and specific drug for MR imaging. The diagnostic results of liver MRI were improved by superior delineation of tumor extension and increased sensitivity of tumor detection.

In another paper, T. Vogl and co-workers (Munich) reported on the efficacy of a new hepatobiliary contrast medium, Gd-BOPTA. This agent exhibited low acute and neuronal toxicity, and may be useful in obtaining prolonged enhancement of the liver and a high rate of biliary excretion.

Human liver regeneration as an important factor relevant to liver resection was studied by R. Maas (Hamburg) and U. Kania (Bonn). Both scientists agreed that the volume of liver tissue resected for both benign and malignant liver tumors can regenerate up to 100 %. These results may greatly influence decisions concerning tumor resectability.

B. Hamm (Berlin) addressed the detection of malignant liver lesions using various imaging modalities. The choice of an adequate imaging procedure depends on both the technique and the risks of the method employed. The clinical circumstances of the individual must also be taken into account. Ultrasound is sensitive for the detection of focal liver lesions. It is, moreover, non-invasive, inexpensive and widely available. MRI, on the other hand, has a superior sensitivity, but is expensive and not so widely available. Angiography no longer plays a significant role in the detection of liver lesions and its use is limited to the evaluation of vascular anatomy prior to surgery and interventional procedures.

It is now widely accepted that computed tomography following an intravenous bolus injection of contrast agent is more accurate in the detection of liver metastases than ultrasound. The detection rate for a lesion size of 15 mm or more is 80.5 % and 92 % for ultrasound and CT, respectively. The superior sensitivity of MR imaging is observed especially in small lesions.

The best results in tumor detection are obtained with CT portography (injection of contrast material into the superior mesenteric or splenic artery). As an invasive technique, it should be applied only for surgical planning in selected patients.

Due to major technical advances, MR imaging has now reached a sensitivity comparable to contrast-enhanced CT in the assessment of liver metastases. Some studies have found an even higher accuracy for MR imaging. Among all imaging modalities, portal enhanced CT yielded the best results (81 %) followed by MR imaging (57 %) and contrast-enhanced CT (38 %). Intra-arterial CT portography is however an expensive, and invasive procedure, and it should be used only in patients who will definitely undergo liver resection.

Results with portal enhanced MRI using Gd-DTPA were reported by P. Pavone (L'Aquila). Superior liver-to-lesion contrast was found in 12 patients with hepatic malignancies. A definite increase of signal intensity was found within the liver, whereas the lesions remained hypointense, enabling a better delineation of pathology. Portal enhancement utilizing ultrafast imaging techniques was recommended for the sensitive assessment of liver tumors in candidates for resection therapy.

G. Layer and co-workers (Bonn) presented a new fast imaging MRI protocol for the evaluation of focal liver lesions. Using breath-hold FFE sequences and a dynamic study following the IV injection of Gd-DTPA, good temporal resolution and adequate image quality together with sensitive detection and specific characterization of focal liver lesions can be achieved on a mid-field whole-body MRI scanner. An imaging protocol with T1- and T2-weighted pre-contrast, breath-hold FFE sequences and a dynamic study after bolus injection of 0.1 mmol Gd-DTPA per kg body weight with an ultrafast gradient-echo sequence (time resolution less than 5 s) was applied. No lesions detected on conventional SE images were missed with this protocol. The characteristic increase in signal intensity and – even more importantly – the characteristic time-related liver parenchyma/lesion contrast after bolus injection allowed precise differentiation between malignant tumors, focal nodular hyperplasias, and hemangiomas.

In an important “state-of-the-art” paper, radiological diagnoses before and after liver transplantation were discussed by M. Galanski (Hannover). Guidelines for the rational use of various imaging modalities in complications were presented: (1) Initial non-function or dysfunction diagnosed clinically and biochemically. In these circumstances, apart from the demonstration of hepatic artery patency, no further investigations are required. (2) Duplex and colour Doppler ultrasound are the primary modalities for the exclusion of vascular complications. Localization and the extent of parenchymal necrosis are readily assessed using CT, ultrasound or angiography. (3) The diagnostic modality of choice for the demonstration of early biliary complications is T-tube cholangiography. (4) Ultrasound and/or CT are the mainstays for the diagnosis of suspected infections. In ambiguous lesions, fine-needle biopsy and/or aspiration should be performed. (5) The diagnosis of rejection is dependent on histological examination; which cannot be replaced by diagnostic imaging. The possible contribution of MR spectroscopy has not yet been evaluated.

B. Marinecek and co-workers (Zurich) reported a retrospective trial analyzing early and late post-operative CT and MRI findings in 25 patients with liver transplantation. Perihepatic fluid collections, perihepatic hematoma, subcapsular liver hematoma, right suprarenal hematoma, and liver infarction were evaluated. Many of the complication-