23 The case for MRI

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23.1
Introduction

MR imaging (MRI) was used in the early phase mostly for applications in neuroradiology and musculoskeletal radiology. In the 1980s and early 1990s a large number of papers were published on the potential use of MRI in the upper abdomen, including the pancreas. However, no true outcome study was generated: in fact, pancreatic MRI was considered mostly useless, and CT remained the procedure of choice for evaluation of diseases of this organ. Furthermore, no potential application concerning the biliary tree was identified, and that field was considered outside the scope of MRI.

Things have changed completely in the past 5 years, owing to new technical advances. Nowadays we can image the pancreas with a spatial resolution rivaling that of spiral CT and with a definitely higher contrast resolution. Newer contrast media are being produced that are able to improve the contrast resolution of MRI in the detection of small lesions within the pancreas and the liver. Moreover, the biliary tree and the pancreatic duct can be imaged with magnetic resonance cholangiopancreatography (MRCP), the only noninvasive technique that can compete with ERCP.

In this brief overview we will summarize the technical achievements that have allowed these improvements, enabling MRI to be considered as an efficient imaging modality for the diagnosis of pancreato-biliary diseases. We will outline the areas in which, in our opinion, MRI can already be proposed as a valid substitute for spiral CT.

23.2
Technical Improvements in MRI

23.2.1
Fast Imaging

The pancreas is an abdominal organ and, as such, is subject to respiratory movement. With older MRI equipment, respiratory gating procedures were used to optimize image quality. However, this resulted in blurring of anatomical contours due to signal averaging.

Currently, with high-field MRI equipment (field strength over 1 T) optimized sequences are available that allow coverage of the whole upper abdomen in a few seconds, so that imaging in one breath-hold is feasible. The spatial resolution of these images is comparable to that of spiral CT.

Moreover, one of the major advantages of MRI is its very high contrast resolution. In the pancreas even small neoplastic lesions can thus be detected because of the strong differences in signal intensity compared with the normal surrounding parenchyma. In particular, the T1 relaxation time is much longer in neoplastic tissue than in normal pancreas, so that tumors are usually well seen as hypointense lesions on T1-weighted images.
23.2.2
Contrast Agents

Despite the high intrinsic contrast, much research has been devoted to the evaluation of contrast media that are able to improve conspicuity of pancreatic tumors. Gadolinium chelates influence signal intensity in areas where the contrast medium is distributed through vascular diffusion. Carcinomas of the exocrine pancreas can be better visualized in dynamic studies, using images acquired immediately after the injection of contrast medium. They appear hypovascular compared with the normal pancreas.

Another approach is to use specific contrast media with a special tropism toward the pancreatic cells. In particular, a manganese compound (Mn-DPDP, Teslascan Nycomed), initially proposed as a hepato-biliary contrast medium, has been observed to provide high enhancement of normal pancreatic parenchyma. Further studies are needed to show that this agent really improves the diagnosis of pancreatic tumors. However, this approach seems very promising.

23.2.3
Magnetic Resonance Cholangiopancreatography

MRCP is a major breakthrough in upper abdominal MRI. This technique makes it possible to image the biliary tree and the pancreatic duct noninvasively and without the need for a contrast medium.

MRCP has become possible only recently, thanks to major advances in gradient technology. Thus, using gradient higher than 15 mT/m (versus 3–10 mT/m with earlier equipment), it has been possible to develop turbo-spin echo (consisting in a rapid repetition of 180° pulses), with very long echo times and without signal degradation. Thus, it is possible to register the high signal of fluids with prolonged T2 values (specifically bile and pancreatic juice) while completely canceling the signals from solid organs.

Using this technique, images in the upper abdomen can be obtained which demonstrate only the biliary tree and the pancreatic duct. The more the ducts are dilated, the higher is the signal obtained, leading to images of very high quality.

23.3
Clinical Indications for MRI (Present and Future)

Despite the recent technical improvements, MRI has yet to confirm its position against spiral CT. In fact, in most centers MR systems are overwhelmed by neurological and musculoskeletal examinations. The awareness of newer MR techniques takes time to reach the referring clinicians, leading to limited requests for MR examination of the biliary tree and the pancreas. Furthermore, the advantages over spiral CT are not always obvious, and radiologists prefer to stay with a technique that they feel more confident with.

The indications we propose in this chapter reflect the results of studies that have been carried out personally in our department or have been published in the literature.

23.3.1
Biliary System

Spiral CT has a relevant role in the evaluation of the biliary tree only for the diagnosis and staging of neoplastic diseases, whether intrinsic or extrinsic. MRI may substitute spiral CT in this indication, but it can also be proposed in a number of other indications in which ERCP, but not spiral CT, is of value. Thus, MRI also rivals ERCP in usefulness.

The largest area of possible indications for MRCP of the biliary tract includes benign biliary diseases. Most common benign biliary diseases are usually accompanied by mild symptoms, and the use of an invasive imaging modality such as ERCP is problematic. The first, and probably most frequent, reason for which patients are referred is evaluation for suspected stones in the common bile duct. Biliary stones are not detected on US in over 50% of cases, and the diagnosis is mostly made by ERCP. We have studied a series of patients presenting with symptoms suggestive of choledocholithiasis in whom US was negative and who were considered as candidates for ERCP. In these patients MRCP had an accuracy of over 90%, but the most important aspect of this is that there was a prevalence of disease in only 28%. It means that only in 28% was the clinical diagnosis correct and the patient really had a bile duct stone. In the other patients there was either some other disease or no biliary involvement at all. The routine use of MRCP in this group of patients would lead to a reduction in the frequency of diagnostic ERCPs and