Hardware, software advances give fMRI a place in abdominal imaging

By Frances Rylands-Monk [3]

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Inflammatory, metabolic, and tumorous diseases of the abdomen can appear on a functional, microstructural, or molecular basis, not just anatomically. Information acquired through new MR approaches such as perfusion, diffusion, spectroscopy, or elastography — which relate to vascular permeability, thermal motion, chemical composition, and parenchymal microstructure — will become increasingly important in clinical practice, said Dr. Luis Marti-Bonmati, head of the MRI unit at Dr Peset Hospital in Valencia, Spain.

Marti-Bonmati moderated a special focus session on Tuesday. Many vascular, microstructural, and molecular pathologic changes may not have associated symptomatic changes in the patient. MRI tools such as perfusion allow for earlier detection and follow-up, as well as quantifiable and reproducible results. They also allow radiologists to easily establish a disease's severity, prognosis, and treatment response, Marti-Bonmati said.

Diffuse conditions of the liver such as steatosis, fibrosis, and iron overload, which could not previously be staged noninvasively, can now be subject to accurate evaluation with functional and quantitative MRI, according to Dr. Bernard Van Beers, a professor of radiology and head of medical imaging at the Université Catholique de Louvain in Brussels.

Radiologists can assess abdominal tumors more precisely with perfusion and diffusion MRI, and they can evaluate tumor response to chemotherapy, radiotherapy, and antiangiogenic treatments with increased sensitivity.

"Approaches such as perfusion, diffusion, spectroscopy, and elastography complement the assessment of diffuse and focal diseases with anatomic MR images and can obviate the need for invasive procedures such as biopsy," Van Beers said.

Dr. Thomas Lauenstein, an assistant professor of radiology at Emory University Hospital in Atlanta focused on optimal MRI sequences to evaluate the gastrointestinal tract. In a patient with inflammatory bowel disease, the gastroenterologist needs to know whether disease is active or chronic. Active disease is treated with immunosuppressive medication such as cortisol, while chronic disease is treated mainly with surgery.

T2-weighted fat-suppressed imaging is a key sequence to assess inflammation activity, Lauenstein said. After a T1-weighted sequence to detect the presence of disease, T2-weighted fat-suppressed imaging sequences allow depiction of edema adjacent to the bowel wall. Edema in this location is nearly always considered an indication of active disease, while absence of edema means that the disease can be diagnosed in most cases as chronic.

"Before this two-step technique, the decision to choose the right treatment was more difficult. Even three years ago, it is possible that patients were not followed up as effectively as they can be now because treatment depended on scoring other features such as number of lymph nodes and bowel wall thickness to decide on its progress. This cumbersome process has been replaced by a very easy T2-weighted sequence," he said.

Lauenstein also recommends MRI as the first-line imaging modality in Crohn's disease. Crohn's disease affects a large number of otherwise healthy young adults of between 15 and 35 years of age, and they most likely undergo long-term therapeutic monitoring. The accumulation of radiation...
exposure in a young person is a concern, he said. 
"MR is a good indication in such patients. CT should not be the first choice modality, especially in 
young people with inflammatory bowel disease," he said.
Many functional imaging techniques would not be as effective or productive without the latest 
generation of MR scanners for real-time intervention under imaging guidance, according to Dr. 
Jean-Paul Vallée, a professor of radiology at Geneva University Hospital. Vallée listed improvements 
in hardware and software, as well as contrast agents, particularly hepatospecific media. All create 
new opportunities for the exploration of abdominal pathologies.
Improved depiction of lesions not seen by ultrasound or CT can now lead to treatment by 
image-guided therapy that would not be possible otherwise. Patients who cannot be treated by 
surgery, for example, can still have metastases removed by thermal ablation under MRI guidance 
using an interventional system, for an improved prognosis.
"In thermal ablation therapy, too much heat kills good liver parenchyma around the tumor, while too 
little leaves some of the tumor. With MRI, one can now monitor in real-time the heat deposition using 
the temperature dependency of the MR signal phase," Vallée said.

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