Liver imaging takes a step forward with Ingenia

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Liver imaging takes a step forward with Ingenia

Lyon South Hospital strives to move from several studies – first CT, then MR or PET – to using just one comprehensive liver MRI exam for oncology cases

The Lyon South Hospital (Lyon, France) is part of the Lyon University Hospital Center. It has nearly 1000 beds, mostly dedicated to cancer care, including oncology, radiotherapy, interventional radiology and surgery. The hospital uses Ingenia 3.0T and Ingenia 1.5T to perform about 800 MR exams a month, about 200 of which are for abdominal conditions.

Prof. Pierre-Jean Valette, MD, is Chief of Radiology and Nuclear Medicine Service at Lyon South Hospital. “In oncology patients, liver MRI is performed in several situations: to help us characterize lesions, in follow-up after chemotherapy, and to assist in treatment planning in a concept of multidisciplinary care when a complete tumor removal appears to be feasible,” he says. “So, we need our imaging to provide a comprehensive visualization of the liver and all lesions, their size, volume and location relative to other critical anatomical structures – such as bile ducts and portal branches – that influence tumor resectability. This helps determine the treatment options; it may be resection or tumor ablation or maybe radiotherapy.”

Challenges and goals in liver MRI

“MRI of liver tumors offers more than CT in certain aspects,” says Prof. Valette, “as it provides visualization and characterization of lesions with combined T1, T2 and DWI sequences, in addition to good tumor contrast uptake resolution and anatomical biliary tree imaging. Therefore, we always perform MRI before surgery or interventional radiology in case of bile duct tumor and liver primary cancers (HCC) or metastases.”

“Liver tumor MRI is almost always associated with CT and contrast-US for imaging,” he adds. “However, we think that MRI could become the sole examination as soon as it can provide image quality robustness similar to CT, better control of its inherent artifacts and increased spatial resolution for vascular imaging.”

Ingenia’s high image quality helps to overcome challenges

Lyon South Hospital installed Ingenia 3.0T in 2011, and an Ingenia 1.5T
was recently added. Prof. Valette likes using the Ingenia’s dS Torso coil solution because it has a large coverage. “With this coil, whole abdomen acquisition is a single step for most patients. So, it is much faster to perform, for instance, bowel MRI for inflammatory diseases or tumors.”

With the most recent Ingenia software release installed, Prof. Valette has worked to improve reproducibility, image quality and acquisition time of the hospital’s liver sequences. “We were able to realize improvements thanks to high dS SENSE in RL direction and improved MultiVane T2-weighted imaging. We are now convinced that we are on the way to definitely overcome the challenges. We optimized for image quality and control of artifacts. The arterial phase detection of very small liver or pancreatic hypervascular tumors is also improved.”

**A robust high quality MRI exam**

Prof. Valette’s liver MRI includes some basic sequences and a set of optional sequences that may be used in special circumstances. “Our extended liver ExamCard includes a range of sequences for patients with limited capability to hold their breath, and also for obese patients,” he says. “If the patient is not able to maintain a breath hold we reduce the acquisition time by limiting the coverage to a selected region of interest and/or increase the voxel size, depending on the case.”

**Only one MRI exam instead of multiple studies**

“With all these improvements, I believe that resolution of vascular liver MR imaging is now approaching CT,” says Prof. Valette. “That’s important because we are moving from doing several studies - CT first, then MR or PET – to just one, and it’s saving us a lot of time.”

“With this coil, whole abdomen acquisition is a single step for most patients. So, it is much faster to perform, for instance, bowel MRI for inflammatory diseases or tumors.”

“For instance, when assessing bile duct tumors, we need to see the location and boundaries of the tumor, but also the bile ducts adjacent to the tumor, the vessels, the hepatic artery, the portal vein, because all these are needed to determine whether the tumor is resectable or not. When we get, for example, bile duct images from MR or CT and the tumor on PET and maybe the vessels from CT, it’s difficult to combine all these views. And it means two or maybe three examinations have to be performed. The idea is to do everything with just one multiparametric technique, and that is MRI.”

**Focal nodular hyperplasia in liver**

In a 45-year-old woman recently operated for a breast cancer, ultrasound revealed a right hepatic nodular lesion. T1-weighted images at arterial and late phase demonstrate a small mass, markedly hypervascular at the arterial phase, isointense to the liver at the late phase except persistent enhancement of fibrous septa, making a characteristic aspect of FNH. On the T2-weighted image the nodule is moderately hyperintense. The 3D image demonstrates the spatial arrangement of the hepatic artery, the portal vein and hepatic veins showing the anatomical relationship of the hepatic nodule with the vascular liver structures. Ingenia 3.0T with dS Torso coil solution, patient feet first, arms up.

“We are moving from doing several studies – CT first, then MR or PET – to just one, and it’s saving us a lot of time.”
User experiences

“The use of high dS SENSE in RL direction provides shorter breath hold times, higher resolution and sharper images.”

Liver exam at Lyon South Hospital

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<td>• T2 MultiVane</td>
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<td>• mDIXON FFE with all image types reconstructed</td>
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<tr>
<td>• mDIXON FFE water only, arterial/portal (2)/venous, breath hold ca. 18 sec.</td>
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<td>• DWI b1200</td>
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<th>Optional sequences</th>
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<td>• T2 single shot: if respiratory motion artifacts in T2 MultiVane</td>
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<td>• 3D respiratory gated T2 MRCP: for bile ducts tumor. Axial acquisition if hilar tumor +++</td>
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<td>• single shot T2: if artifacts in 3D T2 MRCP</td>
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<tr>
<td>• mDIXON FFE early arterial and portal if vascular anatomy is needed</td>
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Large centro-hepatic cholangiocarcinoma

A 54-year-old male is admitted for jaundice. CT revealed a large centro-hepatic mass but the local extension to hilar structures could not be determined precisely. The T2-weighted image shows a large well-defined mass in segment IV. T1-weighted images at arterial and portal phase show late heterogeneous enhancement of the lesion suggesting a fibrous component and possibly mucinous content or central necrosis. DWI demonstrates restriction predominantly at the peripheral part of the mass. No evidence of adjacent lesions into the liver. The MIP and VRT MRCP views confirm the hilar bile duct invasion, of which details are clarified on reformatted views in an axial plane. There is no associated compression of portal branches. Ingenia 3.0T with dS Torso coil solution, patient feet first, arms up. Final diagnosis is hepatic cholangiocarcinoma invading the convergence of the bile ducts with prominent extension of the right side. Resectability may be considered in the absence of portal damage, but was not attempted because of insufficient left lobe volume.
New way of patient positioning benefits image resolution

“Thanks to Ingenia’s wide 70 cm bore,” says Prof. Valette, “we have been able to improve our imaging strategy by implementing the high dS SENSE speedup in RL direction with arms-up patient positioning. This allows using a narrowed acquisition volume without the patient’s arms causing artifacts. This provides shorter breath hold times, higher resolution and sharper images because of reduced blurring in TSE and less distortion in DWI. This positioning is accepted by almost every patient, but requires an examination time not exceeding 20 to 25 minutes.”

“The use of high RL dS SENSE factors in combination with arms-up provides a real advantage. So often with MR, when you change something, you lose something somewhere else. In this case, I see just advantages,” he concludes.

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Multifocal liver hepatocellular carcinoma

A 57-year-old male with decompensated cirrhosis is referred to MRI to visualize the hepatocellular carcinoma (HCC) and the lesion extension and to help assess the feasibility of an Yttrium radioembolization. CT shows a heterogeneous liver without obvious nodule. The left portal branch is the site of a suspended thrombus. T2-weighted MRI demonstrates large effusion ascites, heterogeneous liver with the presence of multiple slightly hyperintense nodules. On DWI a multi-nodular lesion is seen in the liver with marked diffusion restriction. The portal vein nodule is also hyperintense suggesting a tumor thrombus.

On T1-weighted mDIXON the lesion shows arterial enhancement and portal phase wash-out. MRI supports the diagnosis of decompensated liver cirrhosis with multinodular HCC. Early opacification of the left portal vein at arterial phase suggesting the presence of arteriportal fistulas, by which radioembolization would not appear to be safe. Ingenia 3.0T with dS Torso coil solution, patient feet first, arms up. dS SENSE in LR direction, T2W SP with MultiVane. DWI with b0-b1200, free breathing.

“Our extended liver ExamCard includes a range of sequences for patients with limited capability to hold breath, and also for obese patients.”