Achieva 3.0T throws doors open to spectrum of abdominal studies

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The abdominal MRI practice of Indraprastha Apollo Hospital (New Delhi, India) underwent a rapid evolution and growth – from a few simple, anecdotal cases to 20% of the entire patient volume – in their Achieva 3.0T system’s first seven months of operation. With fast, advanced techniques such as THRIVE, SENSE and DWIBS and the extra SNR that 3.0T affords, Indraprastha Apollo’s abdominal MRI options greatly expanded to include both straightforward body examinations such as MRCP, as well as more sophisticated studies, such as evaluation of liver and pancreas tumors, renal donors, atherosclerotic disease, aortic aneurysms and pelvic diseases. Applications also include follow-up studies of post-intervention patients, according to Indraprastha radiologist/interventionist Dr. Harsh Rastogi.

Liver imaging after tumor embolization
Multiphase THRIVE images of the liver acquired 3 days after embolization of the right hepatic artery. Intra-tumoral necrosis can be recognized as non-enhancing mass in the right lobe of the liver. Viable tumor fed by the left hepatic artery shows enhancement.

Equipped with a 64-slice CT scanner and limited to a 0.5T MRI system, Indraprastha Apollo Hospital radiologists had little motivation to perform many abdominal MRI studies before November 2005 – when they began operating the Achieva 3.0T system.

“The 0.5T system was the workhorse for neuro and musculoskeletal cases for 10 years, but in abdominal imaging, we were limited to studies of the biliary tree by MRCP or doing a few simple pelvic examinations,” recalls Harsh Rastogi, M.D., senior consultant in radiology and intervention at Indraprastha Apollo Hospital, a 700-bed, multi-specialty, tertiary care medical center in India’s capital, New Delhi.

By June 2006, Indraprastha’s new Achieva 3.0T had supercharged the medical center’s abdominal MRI service, making it a 20% share of the total MRI volume. Today,
Indraprastha radiologists perform three to four body MRI examinations per day, encompassing routine MRCP studies and advanced CE-MRI and CE-MRA cases to survey for tumors and other pathology in the abdomen and pelvis. A key to Indraprastha’s present success in upper abdominal imaging – beyond the obvious benefit of doubled SNR at 3.0T – is the THRIVE sequence, Dr. Rastogi notes.

**Efficient liver coverage**

“THRIVE is fast and provides great contrast enhancement and superb high resolution,” he says. THRIVE (T1 High Resolution Isotropic Volume Examination) combines a 3D T1-weighted TFE sequence with SPAIR fat suppression and SENSE, enabling fast, high-resolution imaging with large FOV coverage and excellent fat suppression – in a single 17-20-second breath hold. For liver, spleen, pancreas and kidney studies at Indraprastha, clinicians use the SENSE Torso coil and a SENSE factor of 4, a 39.5 cm FOV, two millimeter slices with two parallel REST slabs and 2 x 2 x 2 mm³ isotropic voxels.

“THRIVE helps us pick up small mets or evaluate the dynamics of contrast enhancement per unit of time,” Dr. Rastogi observes.

He cites the case of a 75-year-old man who presented with a hepatic adenocarcinoma metastasized from an unknown primary, for which clinicians were attempting to determine the optimal treatment. The patient had undergone previous RF ablation for this malignant lesion, so the Indraprastha surgeon indicated that the mass was inoperable. Consequently, Dr. Rastogi suggested palliative transarterial chemoembolization (TACE) of the tumor. Baseline and post-interventional THRIVE studies were able to show that TACE had completely cut off the tumor’s blood supply, evidenced by a non-enhancing tumor central core in a post-therapy scan.

“We were surprised and thrilled to see and be able to document via MRI that embolization had definitively caused the infarction of the tumor and that the therapy had worked for this patient,” he says. “Now, we can follow-up with these

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**Sciatic Nerve Neurofibroma**

CT showed a spindle-shaped mass in the popliteal fossa. MRI was done to pre-operatively assess the relationship of the mass to the neuro-vascular bundle. Coronal and sagittal post-contrast THRIVE images of the popliteal fossa show multiple heterogenously enhancing nerve sheath tumors on the sciatic nerve and its branches. The DWIBS image shows restricted diffusion along the sciatic nerve and multiple tumors. The 3D volume rendered images show the “snow man” sign of multiple nerve sheath tumors.
"For visualizing neurofibromas, DWIBS is excellent."

patients every three to six months with MRI to monitor the outcome.”

THRIVE in the pancreas
In an acute chronic pancreatitis case, upper and lower GI endoscopies were unsuccessful in helping determine the cause of blood in the stool, upon which the patient was referred to Indraprastha Apollo.

“We did a THRIVE study of the upper abdomen and to our surprise we found a 4 cm diameter pseudoaneurysm in region of the pancreatic tail,” Dr. Rastogi relates.

“The patient’s CT scan three weeks previous was absolutely normal. The bleeding was caused by the pseudoaneurysm, which I occluded by infusing liquid embolic agent. The follow-up THRIVE examination four days pre-discharge showed that the aneurysm had thrombosed. Another follow-up THRIVE study showed us that the aneurysm had completely disappeared. It is just amazing how much we can do with the THRIVE sequence alone.”

Renal applications
THRIVE has proven invaluable in renal MRA examinations of Indraprastha’s kidney donor patients – helping doctors account for renal arteries pre-transplant – and those suffering from kidney diseases.

An elderly patient suffering from acute renal failure had a THRIVE study instead of standard angiogram due to her kidneys’ condition as well as an allergy to iodinated contrast. The THRIVE study enabled doctors to detect multiple renal infarcts and occlusion of the superior mesenteric artery.

“The diagnosis was a thrombus in the thoracic aorta that was embolizing into the organs of the abdomen, including the bowel, kidneys and superior mesenteric artery,” he reports.

Dynamic examinations
For the youngest patients, Dr. Rastogi has discovered that he is able to forego breath holds and scan dynamically with Achieva 3.0T. A benchmark case was an eight-month-old boy who presented with biliary atresia at another hospital and who had surgery to correct the disorder with no complications five months post-surgically. Subsequently, the patient began experiencing melena. Clinicians at the aforementioned medical center prescribed a number of tests, including upper and lower endoscopies and nuclear medicine studies to identify the site of the bleeding, but all were inconclusive.

“This patient was specifically referred to our hospital, where our primary care physicians indicated they wanted an MR angiogram done on his abdomen,” Dr. Rastogi recalls. “Instead of an MR angiogram I suggested a dynamic contrast-enhanced MRI of his abdomen – as breath holding wouldn’t be possible. With MRI, we visualized venous congestion and ectopic varices of the small intestine arising due to portal hypertension. This finding completely changed the management from surgery to a more conservative medical approach.”

Versatile THRIVE works just about everywhere
Dr. Rastogi stresses that while THRIVE’s value is most readily appreciated in the abdomen, Apollo clinicians have demonstrated the technique’s utility in other regions as well, including the neck, limbs and even the tongue. “THRIVE is such a robust technique. It seems to work well under all circumstances,” he says.

DWIBS provides large-FOV survey
Advanced, innovative techniques such as DWIBS (diffusion-weighted whole-body imaging with background body signal suppression) are now available at Indraprastha on its Philips MRI platform.

“For visualizing neurofibromas, DWIBS is excellent,” Dr. Rastogi says. “This technique also is quite valuable for nerve imaging in examinations for possible lymphomas and for imaging the brachial plexus as a whole.”

In a recent case, a patient presented with a CT-confirmed neurofibroma in the popliteal fossa. Dr. Rastogi wanted to clarify the relationship of this nerve sheath tumor with the popliteal arteries and veins. A whole-body DWIBS study revealed that the patient had not just one tumor, but many of them “scattered all over,” he remarks.
“This finding completely changed the perspective of the treating surgeon – there were far too many to treat surgically,” he says. “Moreover, surgery would have risked damage to one of the major leg veins and the patient was not suffering from any neurological or functional limitations, anyway.

“It’s interesting that on CT, we were able to pick up just one neurofibroma, whereas DWIBS enabled us to visualize many,” he adds. “In brachial plexus imaging for the detection of neurofibromatosis, DWIBS also helps visualize the nerve root entry zone in the neck and assists us in identifying the nerve roots, per se, which can be difficult in conventional imaging due to the brachial plexus’s oblique angulation. DWIBS images can be post-processed into other planes, so precise slice positioning is less relevant.”

Prostate spectroscopy helps zero in on target
A burgeoning pelvic application for Indraprastha Hospital’s Achieva 3.0T is prostate spectroscopy for pre-biopsy characterization of prostate tumors. The technique is valuable for patients with a large prostate (e.g., 70-80 g), for which a more accurate identification of the optimal biopsy region is desired. “In these cases, prostate spectroscopy has helped show us where the high citrate peaks – indicating a neoplastic process – are located in the prostate,” he says.

The 3.0T revolution in abdominal imaging
Dr. Rastogi’s opinions about 3.0T for abdominal imaging may be colored by the hospital’s dramatic – and perhaps uncommon – vault from 0.5T imaging to 3.0T imaging, but it is equally true that 3.0T clinical utility has increased tremendously in recent years.

“My understanding is that the global radiologist community is trying to revolutionize abdominal imaging with 3.0T – and the applications are immense,” Dr. Rastogi says. “There is no radiation to the patient and the use of THRIVE imaging and similar rapid imaging sequences is significantly reducing scan time while simultaneously decreasing artifacts. The use of 3.0T can only become more popular as time goes on – and it will present a big challenge to high resolution CT in the years to come.”

Tongue AVM with bleeding
The top row images show the AVM nidus in the left half of the tongue. Numerous branches of the lingual artery feed the AVM. The median raphae is displaced to the right. MPR images of the THRIVE scan show the dilated left lingual artery, the draining vein, and two segments of a well-defined nidus along the lateral border of the tongue. The SENSE NeuroVascular coil was used.