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For several years, radiologist Dr. Vincent Vandecaveye and his colleagues at the University Hospital Leuven (Belgium) have been assessing the value of 3.0T DWIBS in staging of suspicious lesions according to TNM (Tumor, Node, Metastasis) method in a single scan. Working with an Achieva 3.0T system, and more recently with a new Achieva 3.0T TX system with Philips’ MultiTransmit technology, the Leuven team is achieving very promising results.

Thanks to its exceptional contrast-to-noise ratio and the resulting improved lesion conspicuity, diffusion-weighted MR imaging (DWI) offers additional value to conventional MRI for lesion visualization. The benefits of the technique are even more apparent at 3.0T, which enables even higher contrast-to-noise ratios. This has encouraged clinicians at the University Hospital Leuven to explore the advantages of 3.0T DWIBS (whole body diffusion weighted imaging) in single-step cancer staging.

3.0T DWIBS can provide fast visualization of suspicious lesions

Currently, after an initial diagnosis of primary cancer, routine staging is performed on modalities such as CT, FDG-PET/(CT) and bone scintigraphy, while MRI is often performed for problem-solving or loco-regional staging. Diffusion weighted MRI (DWI) is currently not commonly used for whole body staging because of the relative immaturity of DWI applications and the time it takes to fully evaluate lesions using ADC mapping. “This is not the case with loco-regional DWI, where fewer lesions need to be evaluated, making ADC-calculation less time consuming, and multiple b-values can be used for ADC-calculation to assist in accurate lesion characterization. However, such a time investment should be avoided in whole body staging where finding suspicious lesions is really the aim,” says Dr. Vandecaveye. “For this purpose, we accept some loss in resolution and reduce the number of b-values to only b0 and b1000. We also try to reduce the number of lesions that require ADC calculation for characterization. Even though some resolution is lost when going from localized to whole-body DWI, we’re still able to see very small lesions down to 4 mm. The challenge is to be able to assess from a single whole body scan whether lesions need follow-up or not.”

Vincent Vandecaveye, MD, is radiologist at University Hospitals Leuven, Belgium. He is involved in different projects evaluating the use of diffusion- and perfusion-weighted MRI in oncology.
“Even though some resolution is lost when going to whole-body DWI, we are still able to detect very small lesions down to 4 mm.”

**MultiTransmit reduces imaging time**

The Leuven team used their experience in regional 3.0T DWI to develop their whole body staging protocol primarily based on DWIBS for quickly assessing the level of secondary lesions in patients with a primary tumor diagnosis. The examination, which takes only 20 minutes on the Achieva 3.0T TX with MultiTransmit comprises a fast whole-body anatomical scan (which serves for DWIBS planning) and a single free-breathing whole-body DWI scan at b-values of 0 and 1000, optimized for visualizing lymph node, liver and skeletal/soft-tissue lesions.

“I must say that we are impressed with the new Achieva TX system in this application. Thanks to the MultiTransmit technology, the anatomical sequences have really shortened, reducing their imaging time tremendously. So if we need immediate anatomical correlation for the imaging findings of DWIBS, the addition of co-registered whole body T1- or T2-sequences does not greatly increase total examination time,” points out Dr. Vandecaveye. “We also see advantages in image quality – in particular the B1 artifact which sometimes shows up as shading in 3.0T images appears to be much reduced in whole-body imaging, thanks to MultiTransmit.”
“With MultiTransmit, the anatomical sequences have really shortened, reducing their imaging time tremendously.”

Patient with recurrent cutaneous melanoma. FDG-PET shows a hypermetabolic focus in the right axilla, compatible with a metastatic adenopathy (arrowhead), as well as a subcutaneous metastasis in the right gluteal area (arrow). Co-registered CT in the lung window shows the presence of multiple lung metastases (circles). WB-DWI clearly shows the metastatic mass in the right axilla as a b1000 hyperintense area (arrowhead), corresponding to an ADC of 0.00073 mm²/s, two subcutaneous metastases as b1000 hyperintense nodules in the right gluteal muscle (arrows) and multiple lung metastases, also depicted as b1000 hyperintense lesions (circles). Images provided by Dr. Pans, UHL.

Suspected neuro-endocrine tumor

Patient presenting with increased chromogranine tumor marker, suspect of neuro-endocrine tumor (NET). DOTATOC PET and co-registered CT show a metastatic lesion in the left thoracic inlet (arrow) and a tumoral mass in the mesenterium (rectangle). Whole body diffusion-weighted MRI confirms the presence of the thoracic metastatic mass (arrow) and mesenterial mass (rectangle). Additional small peritoneal metastases are depicted as b1000 hyperintense lesions over the liver dome and right lateral hypochondriac area (arrowheads). Lesions were confirmed during imaging follow-up.
Although whole body DWIBS will not be a replacement for other techniques like FDG-PET or CT, we fully expect it to offer additional value.

Dr. Vandecaveye believes this relatively short examination protocol may be a valuable approach for imaging oncology patients. The Leuven center is currently studying this method in a group of patients that have common carcinogenic risk caused by the use of alcohol and tobacco, which is known to have an increased risk of head/neck, lung, esophageal and – to lesser extent – colorectal cancer. Additionally, they are investigating DWIBS for patients with lymphoma and neuro-endocrine tumors.

Image interpretation requires experience
Since interpreting the results requires considerable experience, Dr. Vandecaveye is developing a set of criteria for fast interpretation. “For hepatic metastases, our study currently looks at high signal intensities on the b1000 image and the ADC. Although we find that the b1000 image is often sufficient for diagnostic use, the ADC still offers additional value for exclusion of the T2-shine through effect in hemangiomas and cysts. As the improved signal on 3.0T field strength allows us to increase b-values to 2000, this may further help to differentiate liver metastases based on the high b-value. For skeletal and soft tissue lesions, it does not appear that the ADC map provides additional information to the b1000 image. However, for evaluating lymph nodes the ADC maps are important because signal intensity differences are small on the b1000 images.”

Apart from suspicious lesions, other anatomies also give high signal intensities on b1000 DWI images, including the brain, the spleen and kidneys, nerve roots from the lumbar and thoracic spine, and salivary and reproductive glands. It’s therefore important for radiologists to be aware of these areas and to know how they appear on diffusion weighted images to avoid pitfalls when interpreting the exam.

Further plans for using DWIBS
“What we plan to do next is to define in which patients DWIBS may be useful for staging. And most important, we must clearly identify the weaknesses of the technique including false positives and negatives. When we know these, we should be in a position to know when and how to use the protocol, not only for staging, but also for diagnosing and assessing early response to treatment. We can then establish how we can deploy it to complement FDG-PET or CT. Although whole body DWIBS will not be a replacement for these techniques, we fully expect it to offer additional value, both for diagnosis and treatment follow-up.”

Lymphoma treatment response
Patient with lymphoma localization in the right iliac wing. The CT-scan two weeks after start of chemotherapy shows no different volume of the mass. FDG-PET shows a significant decrease of FDG-uptake, while WB-DWI shows significant decrease of b1000 signal intensity, correlating to a significant increase in ADC. Both findings indicate good tumor response. Two year follow-up in the patient revealed no tumor recurrence.