SUCCESSFULLY ADDING DWI TO IMAGING FOR PROSTATE CANCER DIAGNOSIS AND STAGING

In oncologic MR imaging, diffusion weighted imaging (DWI) is becoming an important protocol for delivering a comprehensive exam that can lead to a confident diagnosis. At Dr. Jones & Partners Medical Imaging in Adelaide, South Australia, Kirsten Gormly, MD, has followed the increased use of DWI. “This is what we should be doing. The [majority of] large research departments are using DWI, and for the smaller hospitals and clinics, the literature indicates that we need to incorporate this into our protocols for prostate imaging.”

Dr. Gormly and her peers had been using high-resolution T2 imaging for diagnosis and staging of prostate
cancers. “We knew we were missing some T3 extensions and not seeing all the tumors. Adding DWI would add to our diagnostic confidence.”

Even though the sequence was on the center’s newly installed Optima MR450w, she wanted a better understanding of DWI and the physics behind it before implementing it. So Dr. Gormly set out to better understand its use in rectal, prostate, and pelvic oncologic imaging. She enhanced her knowledge of the sequence at the 2012 ISMRM meeting in Melbourne, and returned to Dr. Jones & Partners determined to add DWI to her oncology MRI protocols.

No time penalty, greater confidence

Tim King, Lead MRI Technologist, and Nigel Martin, Site Coordinator, at Dr. Jones & Partners worked with Dr. Gormly to implement GE’s enhanced DWI (eDWI) technique. “With the Optima MR450w, we obtain higher SNR with the new optical RF technology, so we can reduce the time of the entire exam from our previous generation scanner and incorporate eDWI without any time penalty,” King says. That was a key factor in convincing Dr. Gormly’s peers to add the sequence to pelvic oncology exams.

With the color maps, Dr. Gormly instantly found that her eyes were drawn to key areas of interest. “ADC maps are quite grainy, so being able to overlay the maps on the T2 images helps draw my eyes to these areas, especially the anterior tumors,” she says. “Even with the first case, my confidence increased.”

Anterior gland tumors can be difficult to diagnose—often the patient has a negative biopsy even though their PSA level is high. Tumors demonstrate restricted diffusion on the ADC maps and overlaying that onto the T2 images helps Dr. Gormly identify the precise location. In one particular case (Figure 1)

Figure 1. Patient history: PSA 11, Gleason 8 left apex. Previous TURP. Tumor sits in left anterior gland. T2 was difficult to interpret prospectively. DWI helped identify the tumor and gave confidence to call the T3 extension anterolaterally.
Prostate eDWI Protocol

The patient is positioned supine feet first with the 8-channel cardiac coil placed around the pelvis. The combined sequences protocol takes 22 min 52 secs.

**Sequences**

- T2 Axial whole pelvis
- T2 Sagittal high-resolution of the prostate
- T2 Axial high-resolution of the prostate
- T2 Coronal high-resolution of the prostate
- T1 Axial high-resolution of the prostate
- Diffusion (b-values 50, 400 and 800)

Following image acquisition, the data is transferred to the READY View workstation. The color ADC map is then fused with the T2 axial high-resolution scan to assist with diagnosis.

Dr. Gormly could see the supportive features of a potential tumor on a T2 image, but had much greater confidence in calling the tumor by adding eDWI.

Fusing the ADC with the T2 image is not only useful, but easy and quick to perform using the READY View application that resides on the Advantage Workstation, adds King. “A simple click and drag of the datasets and we can fuse the images together. The workstation has a wide range of tools that go from simple MR reformats to diffusion and spectroscopy. It simplifies the post processing of data sets.”

“The image fusion takes approximately two minutes to work up, and often within five minutes after completion it is available to the radiologists. It does not delay or interrupt our workflow,” adds Dr. Gormly.

**Finding the right b-value**

Perhaps the most challenging yet important aspect of the eDWI implementation at Dr. Jones & Partners was determining the best b-values. “The normal high T2 signal in the prostate needs to be suppressed at high b-levels. In the prostate, which has a natural high T2 signal, the ADC map is more useful than the b-image. This is a reversal of (what we’ve learned in) neuro imaging.”

A course at ISMRM on diffusion helped her better understand the importance of b-values. “The main question often is how many b-values we should use, and how high we can go,” she says. “At our center, we obtain three values and use all to create the ADC map.

King and Martin worked with Dr. Gormly to find the b-values that worked best in prostate imaging. “It was advised to try

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**Figure 2.** Patient history: PSA 15, Gleason 7 right apex and left mid gland biopsy. Several areas of abnormality noted. Peripheral zone complicated by post biopsy hemorrhage. Largest tumor nodule is located in the central gland, not seen on biopsy. With color map and ADC/DWI, tumor is well visualized with prominent restricted diffusion. Matching "erased charcoal" appearance seen on the T2.
Kirsten Gormly, MB, BS, FRANZCR, works with Dr. Jones & Partners in Adelaide and is clinic director of their rooms at the Tennyson Centre, a private oncology day hospital. She trained in South Australia and spent two-and-a-half years in London, sub-specializing in oncology imaging and pelvic MR. Dr. Gormly trained under Dr. Gina Brown in rectal MR at the Royal Marsden Hospital. She regularly reports oncology CT and pelvic MR for prostate, rectal, and gynecological cancers as well as benign gynecological conditions. She participates in multidisciplinary meetings and is involved in audit and research related to pelvic MR. She is an invited speaker at many national meetings and helps run a national pelvic MR training course.

Nigel Martin, is the Site Coordinator for Dr. Jones & Partners and St. Andrews Hospital MRI Department. He received his Bachelor of Medical Radiation at the University of South Australia and earned a Graduate Certificate for Health Science from the University of Sydney. Martin oversees two GE scanners—a Signa* HDxt 3.0T, which is the only 3.0T private magnet in the state, and the newly installed Optima MR450w 1.5T.

Timothy King is the MRI Chief of Modality and Lead MRI Technologist at Dr. Jones & Partners. His education includes a Bachelor of Medical Radiations (Diagnostic Radiography) and Graduate Certificate in MRI.

Dr. Jones & Partners Medical Imaging is a sub specialized practice offering a comprehensive range of imaging service to the patients and referrers of South Australia. With a proud tradition of MRI imaging including the first MRI in the state, first private 3.0T magnet and a 1.5T Optima MR450w wide bore system, they are delighted with the clinical value enhanced Diffusion Weighted Imaging has added (eDWI) to their comprehensive MRI service offering.

They then optimized the color maps on the workstation. “The ADC has to spread across the prostate region,” notes King. With the wide bore Optima MR450w, King finds the image quality is better as a result of less patient movement. “Patients are more comfortable and have less claustrophobia,” he says. This allows him to focus on the patient and also conduct the exam more efficiently. On the previous 60 cm bore, King would get one or two patients each day that would decline the exam due to size or claustrophobia. In just the first six months of using the new wide bore system, only one patient declined the MR exam.

Out different high level b-values on our machine and see how high we could go while still maintaining enough signal,” Dr. Gormly explains. “We found that at a b-value of 1,000, there was too much signal lost to define the prostate. With the 800 b-value we still had enough signal and could usually see the restricted diffusion on the DWI image.” King and Dr. Gormly settled on b-values of 50, 400, and 800 for prostate imaging. “You have to get to know your machine and what will work,” adds Dr. Gormly.

It’s the patients who win most at Dr. Jones & Partners Medical Imaging. Better image quality, advanced imaging sequences such as eDWI, and a more comfortable patient experience are all key benefits. Finding more aggressive tumors, such as those with prominent restricted diffusion, has been made easier with the implementation of eDWI at Dr. Jones & Partners. And with an implementation that was “surprisingly easy,” according to Dr. Gormly, more oncology centers will be able to offer their patients a comprehensive oncologic MR imaging exam that can help detect more tumors.