Sequence and Magnet Optimization, Post Processing & New Applications

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DWI has progressed from the brain to the body over the past 10 years with increasing demand in many clinical and research applications. Early stages of Body MRI using STIR and T1 were great at demonstrating pathology and degeneration however it was sometimes difficult to differentiate normal anatomy/vascular info from pathology. DWI has become a viable complimentary exam with high sensitivity to many pathological and disease processes and has advantage of high lesion/background contrast

When we moved from the brain to the body, there were higher susceptibility and physiological issues and we have learned many lessons in correcting for these. The innovation of parallel imaging (1999), multi-channel receiver coils and improved gradients have made significant contributions to these improvements.

Initially single region with accepted compromises, however effective tool in complimentary pathology assessment. Whole body (DWIBS 2004) has become a mainstream scan in today's clinical oncology so larger FOV/regions were needed to make practical. This has less room for compromise for seamless transitions in order to remove/limit false positive or negative findings. Improved software and hardware have helped WB DWI become robust and is becoming a powerful tool in oncology/disease assessment.

There are multiple uses currently in body DWI. Oncological screening/staging where it is used as a biomarker of oncological process such as Lymphoma, multiple myeloma, neurofibromatosis, Metastasis (bone, lymph node, lung…)

Observing treatment response to therapy looking for early (1-2 weeks) detection ADC changes to enable real time stop/increase or change drugs and prediction of response.

Non Oncological uses have a place in clinical imaging such as medium viscous fluids such as abscess, inflammatory pathology such as Ankylosing Spondylitis, myopathies and peripheral neurography.

The most used sequence has been traditional SE EPI which has known challenges. This presentation will address most and aim to optimization to reduce artefacts such as distortions, nyquist artefact and fat saturation failure.

Multiple parameters such as TR, TE, b values, receive bandwidth/water fat shift, parallel imaging and fat saturation technique can be optimized to make the best of each individual system. Unfortunately what works on one MRI system/manufacturer won't work on all so there are ways to assess and address many outcomes.

The ADC map manufactured by the dwi raw data creates spatial numeric values to assess the level of aggression of tumours. The choice of b values, how many and relative accuracy is addressed to try and make a practical solution for the application/question being asked.

Both sequence performance and ADC accuracy can be equipment and field dependent depending on the level of technology acquired.

There have been a number of evolutions in sequence design in dwi, particularly for difficult regions such as the spine and base of skull. Using a phase multi-shot approach, fast spins echo sing shot and other new options have created viable options to decrease known bone/tissue/air artefacts and increasing accuracy, however these also have their own challenges in SNR vs time as they can be significantly slower.

Whilst there have been many innovative ways to increase the accuracy sensitivity of body DWI, there are still many clinical diagnostic challenges with this technology which need to be recognised and are often specific to the region being scanned or the particular patient. Appearances of bone marrow and lymph nodes can be very challenging depending on the patient's age, sex and weather they are on a therapeutic drug. Specific contrast agents for lymph nodes are always being attempted. Unfortunately they are not all currently FDA approved, however work will continue.

This talk is for Radiographers/technologists, clinical physicists and Radiologists who are looking to improve on these challenging areas of body dwi.