Whole Body MRI; Improve Lesion Detection and Characterization with Diffusion Weighted Techniques

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Purpose:

Diffusion weighted imaging (DWI) is a powerful imaging technique which provides unique functional information of water movement within tissue. An overview of the theory, scanning techniques and applications as well as pitfalls will be provided. This technique when combined with conventional clinical sequences improves lesion detection and characterization throughout the whole body.

Outline of Content:

DWI sequences are fat suppressed sequences based on motion probing gradients which sensitize water at two separate points in time. The signal generated from the water movement is proportional to the mean free path of intracellular water (thus nuclear cytoplasmic ratio) and the extracellar space (thus tissue cellularity). Using different gradient field strengths (b-values), the quantifiable, and machine independent apparent diffusion coefficient (ADC [mm2/s]) can be calculated. In many malignancies, reviewed here, tissue hypercellularity is increased, and thus DWI with ADC can aid in lesion detection, characterization, and quantification.

Technical advances with MRI equipment such as EPI, parallel imaging, multichannel coils, increased gradient strength and continuous moving scan table enables whole body DWI. This MRI hardware interfaced with vector based DICOM PACS equipment, which allows multisequence multiplanar co-localization, enables routine high spatial resolution sequences (ie T1, T2, STIR etc.) to be coregistered with high contrast resolution and thus, sensitive DWI sequences.

DWI coregistered to conventional sequences in the chest can discriminate between benign and malignant lesions, separate mass from atelectasis, and localize lymph nodes for characterization. In the abdomen and pelvis, DWI can characterize lesions within the organs, enabling greater specificity between benign and malignant conditions, while limiting the need for gadolinium. DWI can also be used to discriminate between ascites/pleural effusions, and peritoneal carcinomatosis/empyemas.

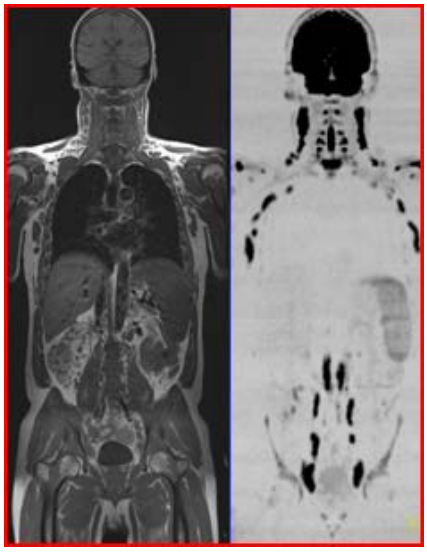

Figure 1. Lymphoma

Non hypercellular tissue that also demonstrates increased signal on DWI techniques include: mucinous lesions, abscesses, hemorrhage, and distortion at fat/water/air interfaces. With image coregistration to conventional sequences, these occurrences can easily be identified.

Summary:

MRI technology has evolved to a level where diffusion weighted imaging in the body can easily be performed, improving lesion detection and characterization. This is accomplished by using the unique capability of MRI to exquisitely allow visualization of tissue anatomic form as well as provide insight into function at the cellular level.