‘Not Just a Button Pusher’: The Role of a Research Radiographer in Applying Advanced Neuroimaging MR Techniques

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Introduction

Modern medical research involves the work of an integrated network of personnel. Imaging forms a primary activity of this research and the gathering of high quality Magnetic Resonance Images (MRI) is essential. The research radiographer is a highly qualified individual with translational skills to help make the research process a smooth one.

As a research radiographer, contrary to popular opinion, I do not ‘only push the button’. My role is to:

- Facilitate the set up of research projects with protocol & sequence development and collation of necessary paperwork
- Ensure the patient/volunteer has an understanding of their role in the project and consents to take part. Carry out the MR procedure to the highest degree of professionalism
- Use advanced applications skills to acquire high quality MR images
- Carry out image manipulation and data analysis for research projects
- Actively take a role in research project management and present the findings of research at a local and international level.

Background

The University of Aberdeen operate a Philips Achieva 3T, GE 1.5T & Fonar 0.6T Positional MR systems . The Aberdeen Biomedical Imaging Centre’s core focus is imaging. This includes: Neurological, oncology and the musculoskeletal imaging. The MRI team consists of a diverse mix of clinical scientists, radiologists, medical physicists, radiographers and PhD students.

Advanced Imaging

It is part of the research radiographer’s role to learn new techniques and apply them to imaging in order to acquire high quality imaging data from the MR system.

Use of a high field 3 Tesla system has brought several new techniques to the fore. The enhanced Signal to Noise Ratio and faster imaging techniques such as SENSE allows acquisition of excellent image quality. The majority of these techniques can be applied to neuro imaging. These include:

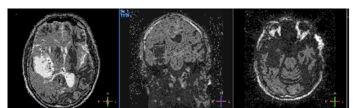
- Diffusion Tensor Imaging (DTI) and fibre tracking
- $_1$H proton spectroscopy and chemical shift imaging
- Multinuclear spectroscopy
- Functional MRI (fMRI)
- First pass perfusion imaging

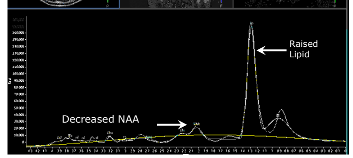
Some of these techniques are illustrated in the following case studies:

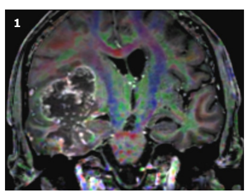
High Grade Glioma

The patient was examined using a combination of High resolution T1 and T2 weighed imaging pre and post gadolinium administration. DTI and single voxel 1H proton spectroscopy were performed.

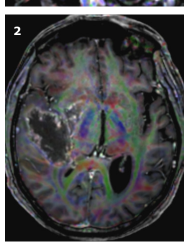
$_1$H Single Volume spectroscopy (TE=35ms)demonstrates a decreased NAA (N-acetylaspartate) peak and increased Lipid peak. NAA is a known neuronal marker and lipid is a cellular and myelin breakdown product. This type of spectrum is in keeping with the characteristics of a high grade necrotic glioma.

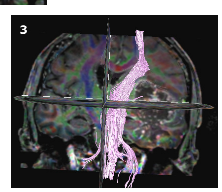


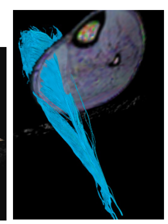


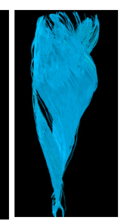


DTI (15 diffusion directions) with fibre tracking demonstrates midline shift of the tumour with extension into the posterior limb of the right internal capsule. The tumour is in contact with the right posterior putamen and lateral margin of the right thalamus. DTI fractional anisotropy overlay in images 1 & 2 help to differentiate the white matter tracts from the tumour. Blue signifies superoinferior diffusion direction, green anteroposterior. A 3D reconstruction of the fibre tracts demonstrate the tumour’s intimate relations with the internal capsule (reverse angle image 3)









The technique of fibre tracking can also be applied to muscle fibres, as illustrated with fibres of the soleus muscle in the calf.

Stroke

Stroke MR imaging is now an advanced field and new techniques are being added to routine imaging protocols.

This case illustrates the use of standard imaging protocol but with superior image quality using a modern 3 Tesla system. The patient has a large recent infarct in the left posterior temporal parietal region as illustrated in the T2 weighted FLAIR and Diffusion weighted b=1000 images. The use of the parallel imaging technique SENSE has reduced susceptibility artefact from the sinuses in the DWI sequence as well as reducing imaging time in a restless patient. Excellent in-flow effect, reduced T1, short TR for background suppression and SENSE, enabling a high resolution matrix is demonstrated on the Time of Flight Angiogram of the Circle of Willis. MRA was normal in this patient.