

MRI sequences and how they are used in cancer imaging

Prof. Anwar R Padhani. Mount Vernon Cancer Centre, London, England
anwar.padhani@stricklandscanner.org.uk

MRI is integral part in management of cancer patients with distinct decision making roles in the clinic and for drug development. Close interaction between oncologists and radiologists and physicists allows optimal use of MRI in the clinic. Oncologists need to define specific questions in order for radiologist to choose appropriate sequences to answer specific question. Both morphologic and generated function biomarkers have transformed the way that patients are managed in the clinic. MRI sequences are continuously being developed and refined with validation and adoption into the clinical and for drug development at different rates which makes standardisation and validation problematic.

Clinical questions in cancer patients are dependent on point on the patient journey

- Screen for abnormalities - early cancer detection
- Diagnose disease - suspected cancer
- Characterise abnormalities
- Evaluate extent of disease in cancer patients – Tumour, Nodes Metastases (TNM)
- Therapy planning – local vs systemic; curative/palliative
- Monitoring response to therapy
- Assess residual abnormalities
- Detect relapse of disease

Cancer hallmarks are key anti-cancer targets; MRI has the ability to depict these to various extents

- Sustained proliferative signaling
- Evading growth suppressors
- Avoiding immune destruction
- Enabling replicative immortality
- Tumor promoting inflammation
- Activating invasion & metastasis
- Inducing angiogenesis
- Genome instability & mutation
- Resisting cell death

- Deregulating cellular energetics

Drugs trials research – MRI sequence requirement are dependent on phase of drug development and what question is being addressed

- Exploratory marker of drug efficacy in very early clinical studies - phase 1 trials
- End-point for selecting new anticancer drugs for future efficacy studies - phase 2 trials
- Prospective end-point to estimate the benefit of treatment in a specified group of patients – phase 3 clinical trials

Professional challenges for multi-functional MR sequences in patient evaluations include

- Integration of multiple individual tests all of which can be done at a single patient visit (new bioinformatics challenge)
- Dealing with heterogeneity that exists between patients, between lesions (in the same patients) and within lesions (at baseline and in response to therapy)
- Understanding the biology behind the image (gene expression profiles, proteomics, serum & urinary biomarkers) & therapeutic efficacy biomarkers
- Need to develop common measurements and analysis methods, uniform data displays, standardization, reproducibility, multicentre methodologies
- Developing roadmaps for BM qualification fit for drug development and personalized medicine