

## **Metabolic MRI: is it useful or confusing?**

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The role of non-invasive imaging in managing cancer patients has increased beyond localization of solid tumour pathology and it now encompasses image guided therapy, monitoring treatment and identification of the tumour grade, allowing for more precise and effective management of cancer patients. Currently, in the standard of care, response assessment is performed by evaluating changes in linear tumour dimensions; however, it may take weeks to months before significant changes occurs, by which time the therapeutic window is often lost. Assessing tumour response early after the treatment enables to identify responders from non-responders and may allow for a change of treatment.

We suggest that saturation transfer MRI (ST-MR), a novel MRI technique, permits the robust evaluation of tumour micro-environment including regions with high metabolic activity and is capable of detecting early cell death (apoptosis) following treatment. We have recently applied these techniques in patients with brain metastasis undergoing stereotactic radiosurgery (SRS) and glioblastoma multiforme (GBM). To date we have scanned ~500 patients with High Grade Glioma (HGG) and brain metastases (BM).

1. In HGG, we observed that ST-MRI can identify which patients will progress as early as two weeks into their 6-week treatment.
2. Changes in tumour metabolism (CEST) allow for separation of responders from non-responders one-week post treatment of BM. qMRI can predict the amount of tumour shrinkage in BM at least one month before treatment.
3. CEST allows the assessment of treatment-induced side-effects of radiation treatment and permits distinguishing between tumour progression and radiation-induced necrosis
4. Even before treatment begins, several ST metrics can assess tumour aggressiveness and predict patient response.

We have also demonstrated a great potential in assessing tumour and NAWM environment in Low Grade Gliomas and its ability to predict further damage.

Similar techniques could be also used in detecting metabolic changes in the brain as a result of neurological disorders. ST-MRI has been successfully used in probing glucose metabolism in Alzheimer Disease and in modulation of GABA/Glutamate cycle in animal models of anxiety disorders using probiotics. It may be also possible to probe metabolites associated with serotonin pathway non-invasively.

In summary, metabolic MRI (such as ST-MRI) may serve as an non-invasive tool to monitor the effects of treatment for various disorders.