A Primer on Perfusion MRI

At Pharmascan, we have brought together a large panel of imaging specialists for consultations and central reading in clinical trials. Our experts are often world leaders in their field and are available for all types of trial work. In this update, we have asked our experts to compile a short primer on the basics of perfusion MRI in oncology.

1. Introduction:

Perfusion MRI is a form of molecular imaging that assesses tumor angiogenesis and capillary permeability, both of which are biologic correlates of malignancy, grading, and prognosis. Tumors with lower blood volume (BV) have a better RECIST response than those with higher BV and have improved 2 year survival by almost 59%. Perfusion MRI can also be used to differentiate radiation changes from active disease.
There are three perfusion methods: dynamic susceptibility contrast imaging (DSC); Dynamic contrast enhancement (DCE); and arterial spin labeling (ASL). DSC sequences are commercially available on most modern MRI scanners and has FDA approved post processing software readily available. DSC is most widely used in the brain. DCE is more widely used in the rest of the body though experimental and research use in the brain is increasing. ASL is an experimental methodology that is not in yet in widespread use and is the only technique that does not require intravenous contrast administration. For DSC and DCE, selection of contrast material is important as protein bound contrast materials may influence perfusion metrics and are therefore not recommended for use.

2. Dynamic Susceptibility Contrast Imaging (DSC)

DSC relies on the T2 signal drop caused by the passage of a gadolinium-containing contrast agent through the tissues. The drop in signal is proportional to the concentration of the contrast agent and the tissue vascularity. This perfusion methodology has gained widest use in neuro-oncology and stroke evaluation due to its ease of use, short scan times and the largest body of published literature.
Recent large scale studies on glioma grading using DSC confirm the findings of a lower BV in lower grades and high BV in higher grades. DSC MRI is degraded significantly by artifact arising from hemorrhagic products or foreign bodies within the surgical bed. This can materially affect the BV measurements.

3. Dynamic Contrast Enhancement (DCE)

DCE MR imaging consists of repeated imaging with a rapid T1-weighted sequence to measure changes in signal intensity as a bolus of contrast diffuses into the tumor. The scanner plots the contrast agent concentration curve in plasma (the arterial input function), and a time course of accumulation of contrast in tissue. Compared to DSC technique, DCE offers better resolution, is more resistant to artifact, and allows studying the microcirculation of tumors. There are recommendations that DCE MR imaging be used as a primary imaging method to assess anti-angiogenic and anti-vascular therapeutic agents.\

The most widely used DCE MR imaging quantitative parameter is the transfer constant K_{trans}. K_{trans} describes the relationship between the arterial input function and increasing contrast concentration in tissue. Put simply, K_{trans} provides a quantitative measurement of enhancement. It is limited by either the vascular blood flow or permeability. In tumors, the blood flow to the tumor tissue is often hampered by an abnormal tumor vasculature, so the uptake of contrast by tumor tissue is mainly limited by blood flow, not by permeability. With increasing grade, there is higher likelihood of T1-weighted contrast enhancement of the tumor and increasing Ktrans correlates strongly with tumor grade. K_{trans} is altered by anti-angiogenesis drugs and the effects on Ktrans after such drugs are administered are rapid.

Our experts at Pharmascan can provide insight and analysis, putting their international expertise at your disposal for protocol design and central readings.

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