Perfusion magnetic resonance imaging

Perfusion is a fundamental biological function that refers to the delivery of oxygen and nutrients to tissue by means of blood flow. Perfusion MRI is sensitive to microvasculature and has been applied in a wide variety of clinical applications, including the classification of tumors, identification of stroke regions, and characterization of other diseases. Perfusion MRI techniques are classified with or without using an exogenous contrast agent. Bolus methods, with injections of a contrast agent, provide better sensitivity with higher spatial resolution, and are therefore more widely used in clinical applications. However, arterial spin-labeling methods provide a unique opportunity to measure cerebral blood flow without requiring an exogenous contrast agent and have better accuracy for quantification. Importantly, MRI-based perfusion measurements are minimally invasive overall, and do not use any radiation and radioisotopes. In this review, we describe the principles and techniques of perfusion MRI. This review summarizes comprehensive updated knowledge on the physical principles and techniques of perfusion MRI [1)]

Perfusion weighted imaging is a term used to denote a variety of MRI techniques able to give insights into the perfusion of tissues by blood.

In perfusion MR imaging, the term ‘perfusion’ comprises several tissue hemodynamic parameters (cerebral blood volume – CBV, cerebral blood flow – CBF, and mean transit time - MTT) that can be derived from the acquired data. In the evaluation of intracranial mass lesions, however, CBV appears to be the most useful parameter.

Indications

see Magnetic resonance perfusion imaging in glioblastoma.

Types

There are three techniques in wide use to derive one or more perfusion values:

Dynamic Susceptibility Weighted Contrast-Enhanced Perfusion Imaging

Dynamic contrast enhanced MRI (DCE)

Arterial spin labelled imaging (ASL)

Derived values

time to peak (TTP)

mean transit time (MTT)

cerebral blood volume (CBV)

cerebral blood flow (CBF)

negative enhancement integral (NEI)

k-trans

The main role of perfusion imaging is in evaluation of ischaemic conditions (e.g. acute cerebral infarction to determine ischaemic penumbra, moya-moya disease to identify vascular reserve) and neoplasms (e.g. identify highest grade component of diffuse astrocytomas, help distinguish glioblastomas form cerebral metastases).

1)
Jahng GH, Li KL, Ostergaard L, Calamante F. Perfusion magnetic resonance imaging: a comprehensive update on principles and techniques. Korean J Radiol. 2014 Sep-Oct;15(5):554-77. doi: 10.3348/kjr.2014.15.5.554. Epub 2014 Sep 12. PMID: 25246817; PMCID: PMC4170157.