Dynamic glucose enhanced MRI

Dynamic glucose enhanced (DGE) MRI is used to study the signal intensity time course (tissue response curve) after D-glucose injection.

T1ρ-weighted DGE MR imaging in healthy volunteers and patients with newly diagnosed, untreated glioblastoma enabled visualization of brain glucose physiology and pathophysiologically increased glucose uptake and may have the potential to provide information about glucose metabolism in tumor tissue [1].

D-glucose has potential as a biodegradable alternative or complement to gadolinium-based contrast agents, with DGE being comparable to dynamic contrast enhanced MRI. However, the tissue uptake kinetics as well as the detection methods of DGE differ from DCE, and it is relevant to compare these techniques in terms of spatiotemporal enhancement patterns.

Seidemo et al aimed to develop a DGE analysis method based on tissue response curve shapes, and to investigate whether DGE MRI provides similar or complementary information to DCE MRI. Eleven patients with suspected gliomas were studied. Tissue response curves were measured for DGE and DCE MRI at 7 tesla and the area under curve (AUC) was assessed. Seven types of response curve shapes were postulated and subsequently identified by deep learning to create color-coded “curve maps” showing the spatial distribution of different curve types. DGE AUC values were significantly higher in lesions than in normal tissue ($p<0.007$). Furthermore, the distribution of curve types differed between lesions and normal tissue for both DGE and DCE. The DGE and DCE response curves in a 6-minute post-injection time interval were classified as the same curve type in 20% of the lesion voxels, which increased to 29% when a 12-minute DGE time interval was considered. While both DGE and DCE tissue response curve shape analysis enabled differentiation of lesions from normal brain tissue in humans, their enhancements were not temporally identical and not confined entirely to the same regions. Curve maps can provide accessible and intuitive information about the shape of DGE response curves, which is expected to be useful in the continued work towards interpretation of DGE uptake curves in terms of D-glucose delivery, transport, and metabolism [2].

1)
Paech D, Schuenke P, Koehler C, Windschuh J, Mundiyanapurath S, Bickelhaupt S, Bonekamp D, Bäumer P, Bachert P, Ladd ME, Bendszus M, Wick W, Unterberg A, Schlemmer HP, Zaiss M, Radbruch A. T1ρ-weighted Dynamic Glucose-enhanced MR Imaging in the Human Brain. Radiology. 2017 Dec;285(3):914-922. doi: 10.1148/radiol.2017162351. Epub 2017 Jun 16. PMID: 28628422.
2)
Seidemo A, Wirestam R, Helms G, Markenroth Bloch K, Xu X, Bengzon J, Sundgren PC, van Zijl PCM, Knutsson L. Tissue response curve shape analysis of dynamic glucose enhanced (DGE) and dynamic contrast enhanced (DCE) MRI in patients with brain tumor. NMR Biomed. 2022 Oct 30:e4863. doi: 10.1002/nbm.4863. Epub ahead of print. PMID: 36310022.