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The power of MR phase: Technical developments and clinical applications of susceptibility weighted imaging and quantitative susceptibility mapping

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Susceptibility Weighted Imaging (SWI) has been widely used in clinical applications such as imaging stroke, traumatic brain injury and neurodegenerative diseases. Its exquisite sensitivity to susceptibility effects is attributed to the use of MR phase images which contain valuable information of in vivo tissue properties. Despite its success in visualizing cerebral vasculature and differentiating calcium from iron content, SWI only provides qualitative measure and is dependent on imaging parameters such as field strength, echo time and orientation. This problem is solved by the quantitative version of SWI, Quantitative Susceptibility Mapping (QSM). In QSM, an inverse problem is solved to extract the susceptibility distribution from the magnetic phase images. The potential of QSM in quantifying iron content in grey matter structures has been demonstrated in various studies. Furthermore, QSM can be combined with SWI to provide true susceptibility weighted imaging (tSWI) which solves the orientation dependence problem in conventional SWI. SWI and QSM have also been extended to body imaging, such as quantifying liver iron concentration and imaging the spine. In this presentation, the recent technical developments in SWI and QSM are introduced, with examples of clinical applications of SWI and QSM in the brain and the liver. In addition, a new imaging protocol named Strategically Acquired Gradient Echo (STAGE) is presented, which enables rapidly imaging of the entire brain in less than 10 minutes and yet provides information for a comprehensive diagnosis of neurovascular and neurodegenerative diseases, based on the recent technical developments in SWI and QSM.

Biography

Saifeng Liu has completed his PhD in 2014 from McMaster University. He is now a Research Scientist in the MRI Institute for Biomedical Research, directed by Dr. E. Mark Haacke. He has published 14 papers on Susceptibility Weighted Imaging (SWI) and Quantitative Susceptibility Mapping (QSM) in top journals on MRI. He has developed several data processing algorithms and software packages for SWI and QSM, which are being widely used by researchers in this field.

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