Quantitative Susceptibility Mapping in Identification of Intracranial Hemorrhage: A Case Report

M. Sait Dundar[1], Gonca Koc, MD[2], Kazim Gumus, PhD[3], Yusuf Caner, PhD[3]

[1]Biomedical Engineering, Graduate School of Natural and Applied Sciences, Erciyes University, Kayseri, Turkey

[2]Pediatric Radiology, Faculty of Medicine, Erciyes University, Kayseri, Turkey

[3]Biophysics, Faculty of Medicine, Erciyes University, Kayseri, Turkey

Introduction

Differentiation of intracranial hemorrhage and calcification on conventional MR images is often challenging. Both pathologies show varying signal intensities on T1- and T2-weighted images, making them difficult to separate. Computed tomography (CT) is considered the gold standard in confirmation of calcification. However it uses ionizing radiation. Phase images obtained in Susceptibility Weighted Imaging (SWI) [1] and Quantitative Susceptibility Mapping (QSM) [2] have been reported to be useful in identification of hemorrhage and calcification. This study explores the benefits of QSM on a case of 10-year old patient with diagnosis of hemorrhage and several microhemorrhages and compare its findings with SWI phase images.

Materials and Methods

Quantitative Susceptibility Mapping (QSM) provides a map of tissue magnetic susceptibility. QSM is a novel contrast mechanism in MRI compared to traditional hypointensity contrast in SWI or T2* weighted images that only allow detection of the presence of tissue susceptibility. QSM overcomes this problem by utilizing both magnitude and phase data and performing a dipole deconvolution. QSM images were reconstructed from multi-echo GE images [3]. Reconstruction process begins with creating mask according to the voxel size and erase the image beside the tissue or in this case, brain. Then the noise level is adjusted to normalize the signal intensity and get SNR. Next step is unwrapping the spatial phase from matrix size to create field mapping and the final part is dipole inversion that makes a map of quantitative susceptibility. QSM is very useful for chemical identification and quantification of specific biomarkers including iron, calcium, gadolinium, and super paramagnetic iron oxide (SPIO) nano-particles.

Discussion

Microhemorrhage and hemorrhages have been examined in this study and compared between QSM, SWI phase, MPRAGE and FLAIR images for all three sections.

In Figure 1, both QSM and SWI phase images distinctly show a paramagnetic lesion (white arrow), which corresponds to microhemorrhage, but both MPRAGE and FLAIR images fail to determine it.

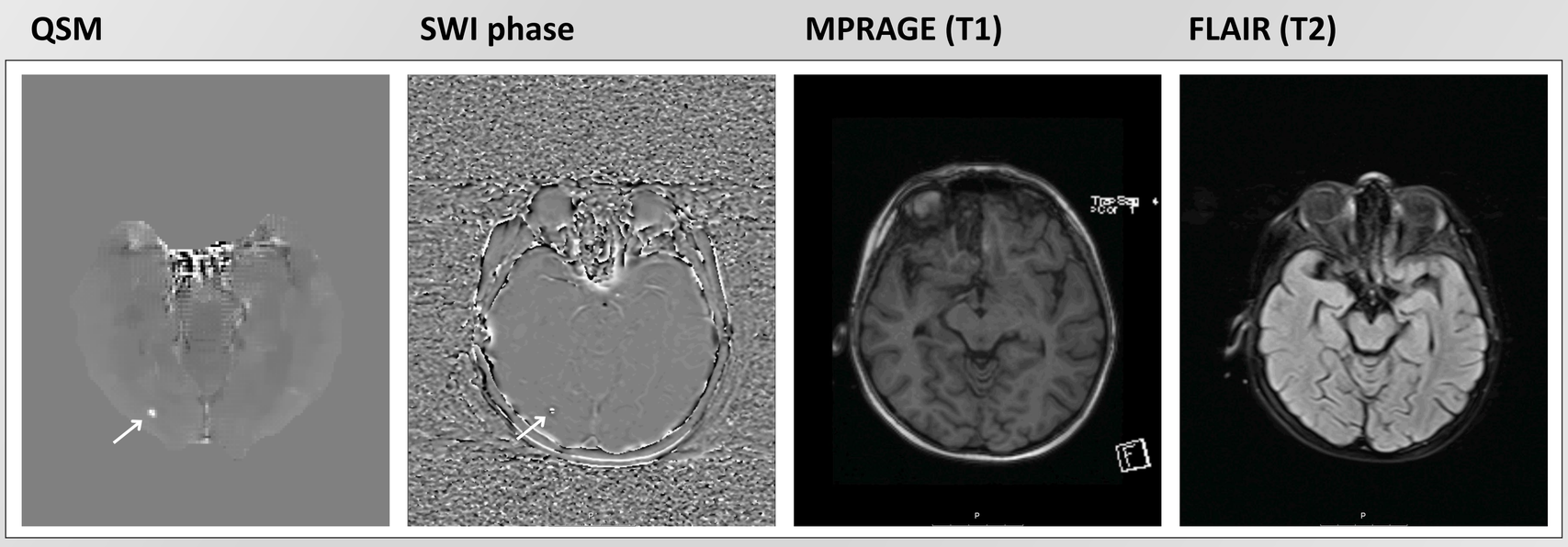


Figure 1

In Figure 2, QSM image shows a paramagnetic lesion (white arrow), which corresponds to hemorrhage but SWI phase image shows heterogeneous appearance (white arrow) which causes misclassification of the pathology. A small lesion (white arrow) is observed in both MPRAGE and FLAIR images but both fails to explicitly identify whether it is hemorrhage or calcification.

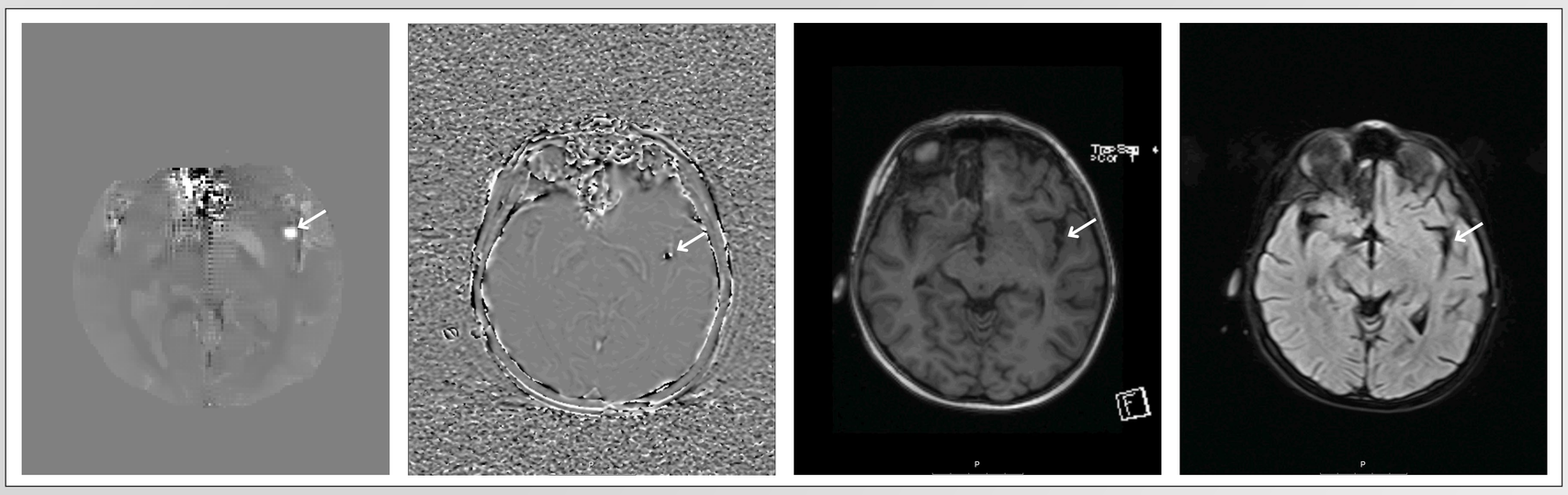


Figure 2

In Figure 3, QSM image shows a paramagnetic lesion, hemorrhage (white arrow) but SWI phase image shows varied signal and make it impossible to identify the hemorrhage. MPRAGE and FLAIR images show hypointense appearances (white arrow).

Of note, heterogeneous region shown by the black arrow on QSM images is an artifact.

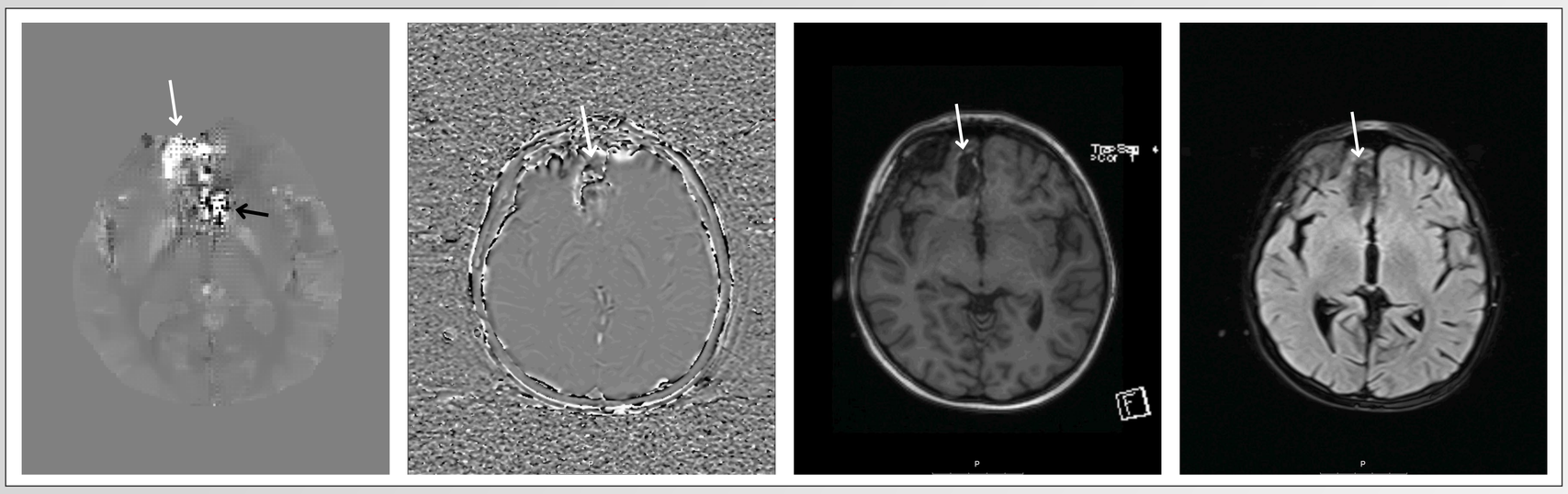


Figure 3

Conclusion

Both QSM images and SWI phase images were found successful in identifying microhemorrhages. The large hemorrhage was observed to have heterogeneous appearance on SWI phase images whereas QSM images showed hyperintensity indicating that it is a hemorrhage not a calcification. MPRAGE and FLAIR images showed hemorrhages with hypointense appearance similar to calcifications. As a result, QSM was useful in identification of hemorrhage and microhemorrhages in our case.

References

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