

ROLE OF SUSCEPTIBILITY WEIGHTED IMAGING IN GLIAL TUMORS GRADING

Tarek Mohamed Rashad Saleh, Amal Shawky Ismail, Basma Abdel-Azim Kamel Ahmed
Department of Radiodiagnosis and Intervention, Faculty of Medicine, Alexandria University

INTRODUCTION

SWI is very effective at detecting neovascularity (which includes venous blood and deoxygenated hemoglobin), hemorrhage, and calcification, making it a crucial modality for evaluating the internal composition of gliomas. The intra-tumoral susceptibility signal (ITSS) acts as a non-invasive imaging marker for neovascularity. Research indicates that ITSS is positively correlated with increased cerebral blood volume (CBV) seen on MR perfusion imaging and is also linked to tumor grade in histopathological assessments.

AIM OF THE WORK

This study aimed to assess the utility and effectiveness of ITSS grading in glioma classification and to investigate whether the level of intratumoral susceptibility signal intensity (ITSS) observed on high-resolution SWI correlates with findings from dynamic susceptibility contrast (DSC) perfusion MRI, MR spectroscopy, and histopathological analysis.

PATIENTS AND METHODS

Patients: The study prospectively and retrospectively enrolled thirty-six (36) patients referred to the Radiology Department of Alexandria Main University Hospital for assessment of brain glial tumors in the period between December 2023 and January 2025.

Methods: All patients were subjected to: Full history taking [demographic data, general medical history focusing upon the manifestations of focal neurological deficit, Symptoms of increased intracranial pressure and seizures and surgical history includes screening for cardiac pacemakers, cochlear implants, or other metallic implants incompatible with MRI, Pre-contrast MRI brain series, SWI, Post-contrast T1WI, DSC, MRI spectroscopy, Histopathology and CT brain if needed.

RESULTS

The study included thirty-six (36) patients with brain gliomas; there were twenty-five males and eleven females. Their ages ranged from 18 to 74 years. The patients are divided into 22 cases were high-grade gliomas and 14 cases were low-grade. In the present study, the relationship between intra-tumoral susceptibility signal (ITSS) patterns and glioma grade was evaluated using MR spectroscopy, perfusion imaging, and histopathological analysis. A statistically significant association was found between tumor grade and ITSS pattern across all three modalities, as illustrated in Figure 1. and Table 1.

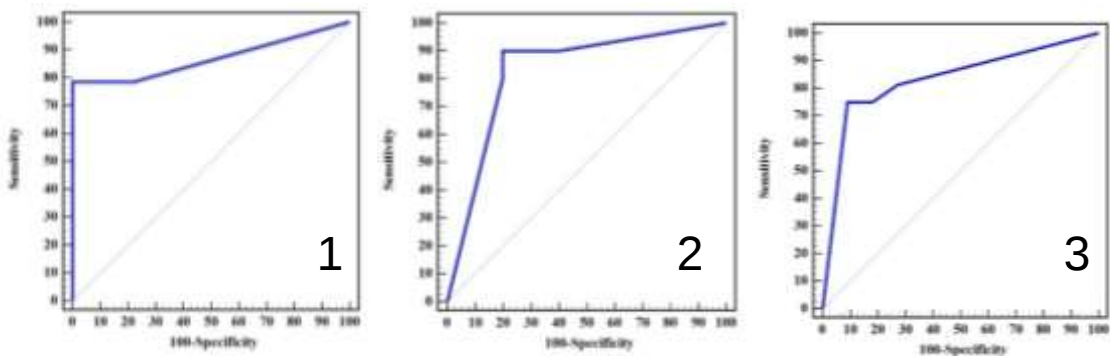


Figure 1: ROC curve for SWI grade to discriminate high grade from low grade (n = 11) gliomas using perfusion (1), histopathology (2) and spectroscopy (3)

Table 1: Diagnostic performance for SWI grade to discriminate high-grade gliomas from low-grade gliomas in cases that had undergone MR perfusion, histopathology and spectroscopy.

	AUC	p	95% C.I	Cut off#	Sensitivity	Specificity	PPV	NPV
SWI grade and perfusion	0.869	0.003*	0.716–1.000	>1	78.57	100.0	100.0	75.0
SWI grade and histopathological data	0.830	0.043*	0.580–1.000	>1	90.0	80.0	90.0	80.0
SWI grade and spectroscopy	0.832	0.004*	0.670– 0.995	>2	75.00	90.91	92.3	71.4

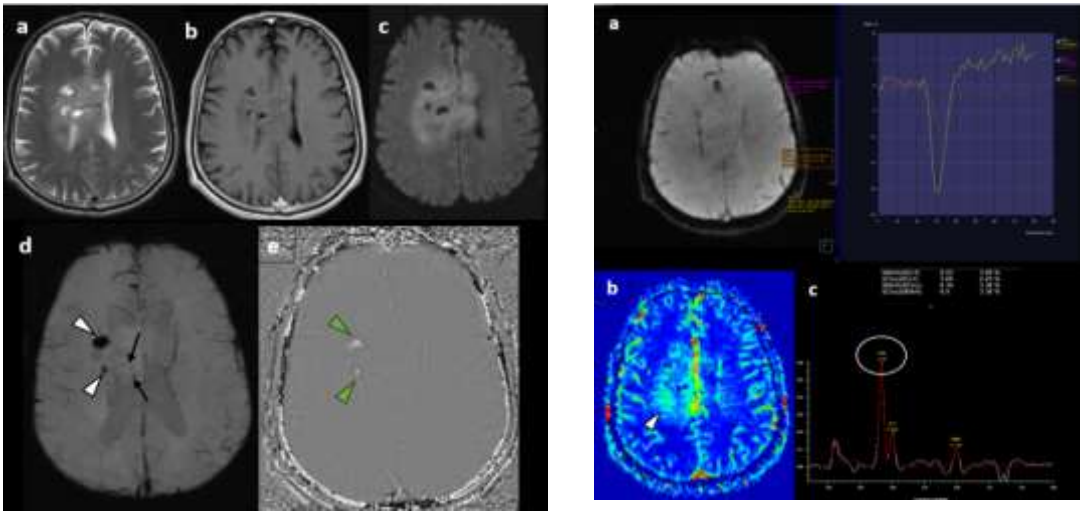


Figure 2: A 65-year-old male patient with persistent headache (a) Axial T2 showing infiltrative lesion involving the body of the corpus callosum. (b) Axial T1 post-GAD showing faint enhancement. (c) DWI; the lesion shows diffusion restriction. (d) HR-SWI; blooming dots (white arrowhead); the intra-tumoral non-enhancing cystic changes and mixed fine linear structures (arrows) seen hyperintense on the Phase image (e), (green arrowhead), confirming intra-tumoral hemorrhage (white arrow head) and neoangiogenesis (arrows) with increased ITSS.
Provisional diagnosis: ITSS grade 3, suggesting high-grade glioma.

Figure 3: (a) The lesion is hyperperfused compared to the contralateral NAWM (lesion: solid yellow line, NAWM: purple dashed line) (b)rCBV map shows areas of hyperperfusion (arrowhead) (c) MRS showing neoplastic curve (Cho/Cr=3.7and Cho/NAA=6.9).
Final diagnosis by advanced neuroimaging is high-grade glioma.

CONCLUSION

- HR-SWI provides valuable additional information for glioma grading by detecting ITSS associated with microhemorrhage, neovascularization, and after exclusion of calcification. Its presence, number, and morphological characteristics were found to correlate strongly with tumor grade.