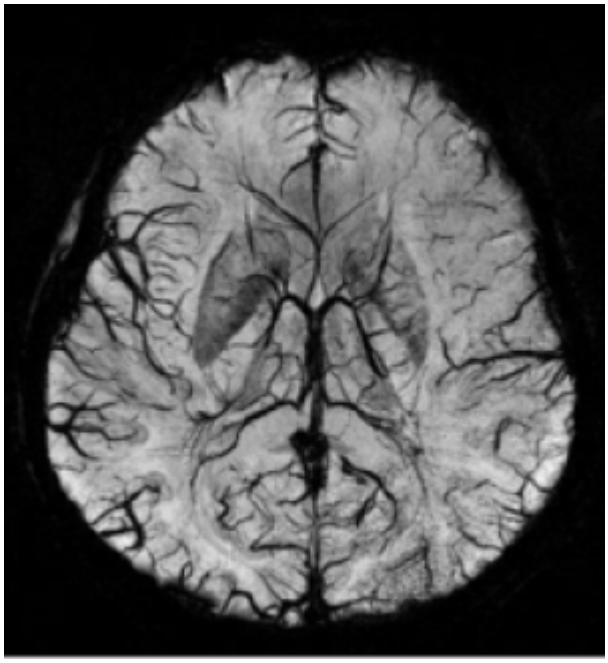
Susceptibility weighted imaging for glioma



Gradient echo T2WI MRI is the 3–4 × more sensitive test than FLAIR for demonstrating intraparenchymal blood (which appears dark) due to high sensitivity to the paramagnetic artifact. It is not as sensitive as SWI.

Susceptibility weighted imaging (SWI) of brain tumors provides information about neoplastic vasculature and intratumoral micro- and macrobleedings. Low- and high-grade gliomas can be distinguished by SWI due to their different vascular characteristics. The fractal analysis allows for the quantification of these radiological differences by a computer-based morphological assessment of SWI patterns.

SWI and CE-SWI are indispensable tools for diagnosis, preoperative grading, posttherapy surveillance, and assessment of glioma [1].

The theory that susceptibility signals show microvasculature that correlates with tumor grade has been well validated with the help of various studies. However, the cons of SWI lie within the technique itself. Small tweaks made in imaging parameters lead to varying subjective results. This lack of standardization of the SWI technique remains an obstacle in its integration into mainstream grading of gliomas. SWI for now plays an important role in detecting gliomas and guiding biopsies. The goal of noninvasive accurate grading of tumors is yet to be realized. Further studies with greater sample size and better collaborations are warranted in this regard [2].

Eighteen GBM patients were retrospectively analyzed. After completion of therapy, imaging was performed every 3 months. MRI was analyzed at the following time points: after the third and sixth cycle of adjuvant temozolomide chemotherapy, thereafter in 3 month intervals and at recurrence. The number of SWI positive tumor pixels was quantified and compared with progression as defined by the RANO criteria on T2- and contrast-enhanced T1-weighted MRI sequences (T1-CE).

The MRI interval between completion of the sixth chemotherapy cycle and last MRI before progression

was 390 ± 292 days. Between the last MRI before progression and at progression a significant increase in SWI positive tumor pixels was observed (P = .012), whereas tumor size remained unchanged (RANO T2: P = .385; RANO T1-CE: P = .165). The number of SWI positive pixels remained unchanged between last MRI before progression until progression (P = .149), whereas RANO T2 and T1-CE showed tumor progression (interval 128 ± 69 days).

SWI positive pixel count increases significantly prior to changes in tumor size (RANO). The findings may be explained by microbleeds compatible with stimulation of angiogenesis and possibly serve as an early biomarker of tumor progression [3].

Seventy-eight patients affected by brain tumors of different histopathology (low- and high-grade gliomas, metastases, meningiomas, lymphomas) were included. All patients underwent preoperative 3-T magnetic resonance imaging including SWI, on which the lesions were contoured. The images underwent automated computation, extracting 2 quantitative parameters: the volume fraction of SWI signals within the tumors (signal ratio) and the morphological self-similar features (fractal dimension [FD]). The results were then correlated with each histopathological type of tumor.

Signal ratio and FD were able to differentiate low-grade gliomas from grade III and IV gliomas, metastases, and meningiomas (P < .05). FD was statistically different between lymphomas and high-grade gliomas (P < .05). A receiver-operating characteristic analysis showed that the optimal cutoff value for differentiating low- from high-grade gliomas was 1.75 for FD (sensitivity, 81%; specificity, 89%) and 0.03 for signal ratio (sensitivity, 80%; specificity, 86%).

FD of SWI on 3-T magnetic resonance imaging is a novel image biomarker for glioma grading and brain tumor characterization. Computational models offer promising results that may improve diagnosis and open perspectives in the radiological assessment of brain tumors [4].

References

1)
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