

Contrast-enhanced MRI Versus Contrast-enhanced Ultrasound: A Comparison in Glioblastoma Surgery Using Intra-operative Fusion Imaging

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Introduction

To compare glioblastoma multiforme (GBM) contrast enhancement (location, morphology, margins, dimensions, and pattern) obtained with intra-operative contrast enhanced ultrasound (CEUS) to the images obtained with pre-operative Gd-enhanced T1 MRI, using real-time fusion imaging.

Methods

To compare glioblastoma multiforme (GBM) contrast enhancement (location, morphology, margins, dimensions, and pattern) obtained with intra-operative contrast enhanced ultrasound (CEUS) to the images obtained with pre-operative Gd-enhanced T1 MRI, using real-time fusion imaging.

Results

Fusion imaging for virtual navigation allowed to match the real-time CEUS scans to correspondent co-planar preoperative Gd-enhanced T1 MRI image in all cases with a positional discrepancy less than 2mm. Contrast enhancement of Gd-enhanced T1 MRI and CEUS was superimposable in all cases

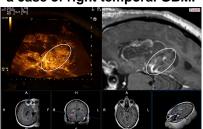
Results (Continued)

The qualitative analysis of contrast enhancement pattern demonstrated a similar distribution in CEUS and in Gd -enhanced T1 MRI in 9 patients: 7 lesions showed peripheral inhomogeneous ring enhancement and 2 lesions a prevalent nodular pattern. In one patient contrast enhancement pattern was different between the two modalities: CEUS showed enhancement of the entire bulk of the tumor while Gdenhanced T1 MRI, demonstrated peripheral contrast enhancement.

Conclusions

Glioblastoma contrast
enhancement with CEUS is
superimposable to that
provided by pre-operative
Gd-enhanced T1 MRI in
regards of location, margins,
morphology, and
dimensions, with similar
enhancement pattern in the
majority of cases, thus is of
potential use in surgical
management of GBM.

Navigated CEUS screenshot in a case of right temporal GBM.



In the upper part, CEUS scan is displayed together with the corresponding co-planar preoperative MRI. In the lower panel 4 reconstructions of pre-op MRI are presented. Must be noted how CEUS demonstrates a more intense contrast enhancement if compared to gd-enhanced T1 MRI. Moreover the CE morphology is also different. gd-enhanced T1 MRI depicts a big

necrotic area surrounded by a

ring shape solid tumor, whereas

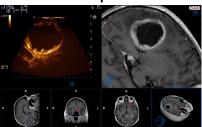
CEUS demonstrates that part of it

is extremely viable (ellipse). Intra-

operative findings have proved

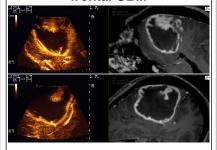
that it was solid/viable tumor.

Navigated CEUS screenshot in a case of left parietal GBM.



In the upper part, CEUS scan is displayed together with the corresponding co-planar preoperative MRI. In the lower panel 4 reconstructions of pre-op MRI are presented.

Navigation contrast-enhanced orthogonal US scans of left frontal GBM

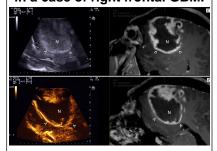


Top row, sagittal contrastenhanced US scan (left) and corresponding coplanar preoperative MR image (right). Bottom row, coronal contrastenhanced US scan (left) and corre- sponding coplanar preoperative MR image (right)

Learning Objectives

Intra-operative CEUS during GBM surgery allows obtaining similar information regarding location, morphology, margins and dimensions to that achieved with pre-operative Gd-enhanced T1 MRI and can be used as an intra-operative quidance in GBMs removal.

Comparison between B-mode, CEUS and gd-enhanced T1 MRI in a case of right frontal GBM.



In the upper panel B-mode scan is presented together with the corresponding co-planar preoperative MRI. In the lower CEUS scan is presented together with the corresponding co-planar preoperative MRI. B-mode appears less sharp in highlighting tumor margins if compared to CEUS. CEUS is capable to differentiate necrosis (N) and solid tumor (arrow head) while B-mode is more challenging in interpretation.