

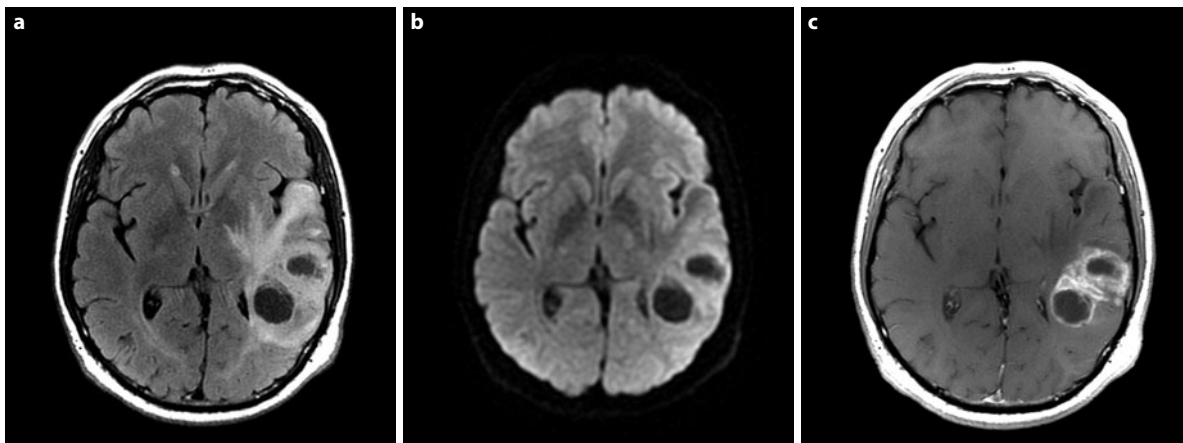
## Tumor Progression

### Morphofunctional MR Follow-up in Glioblastoma Multiforme

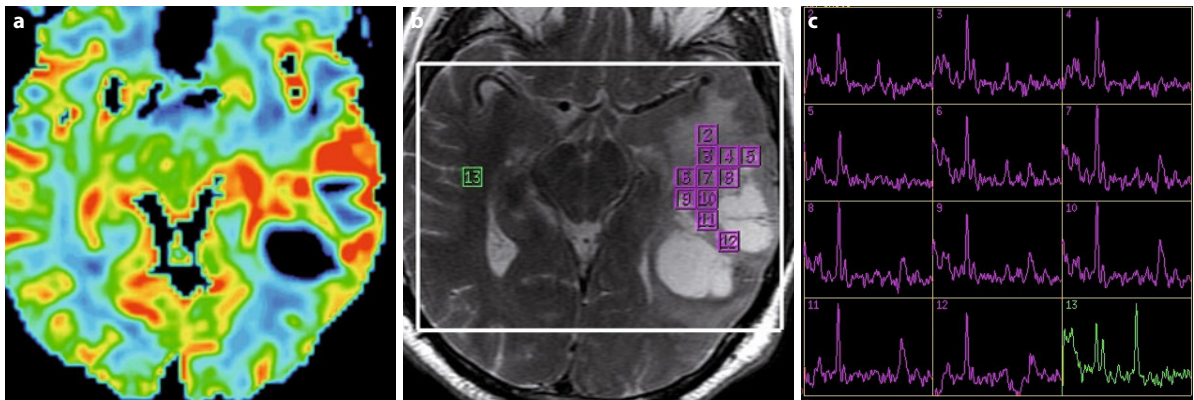
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- 66-year-old patient with (unmethylated MGMT gene promoter) left posterior temporal glioblastoma multiforme treated with surgery and subsequent radiotherapy and concomitant adjuvant chemotherapy
- Morphofunctional MR follow-up performed with morphologic study, diffusion, perfusion and spectroscopy preoperatively, at 48 hours, 4, 7 and 9 months after surgery

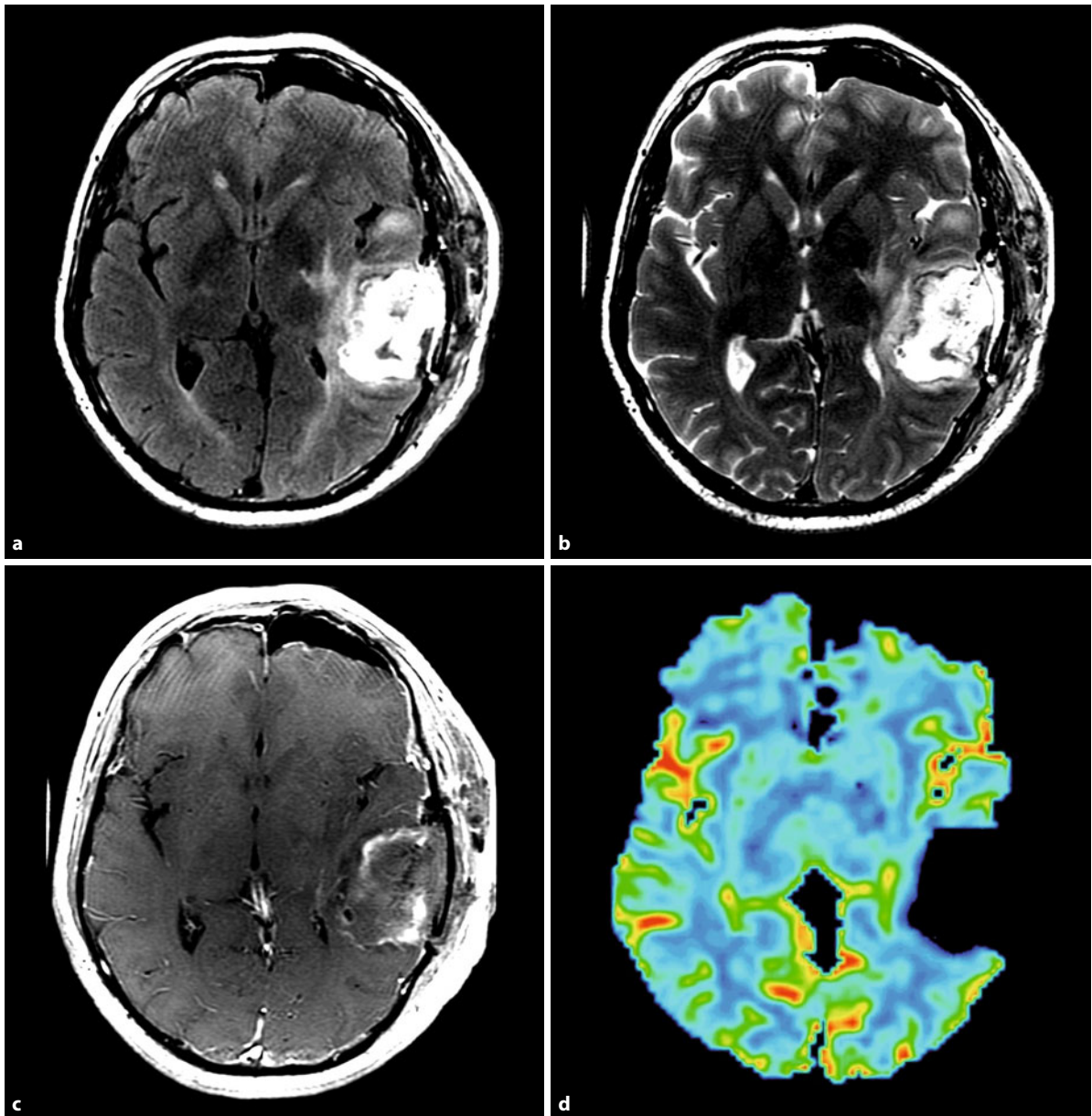
#### Preoperative Imaging



**Fig. 31.1** **a** MR FLAIR sequence shows a partly cystic voluminous heterogeneous expansive lesion infiltrating the left temporal cortical-subcortical region, with extensive perilesional hyperintense signal indicating edema-infiltration that extends forward to the posterior arm of the internal capsule and the posterior portion of the external capsule. The lesion extends deep to the temporal horn, trigone and occipital horn of the left ventricle ependyma. A reduction of CSF spaces, compression of the ipsilateral ventricle and mild right-deviation of the midline can also be appreciated. **b** MR diffusion-weighted image confirms the presence of two large cysts with higher intralesional diffusion coefficient suggestive of necrotic-cystic nature. **c** Contrast-enhanced MR SE T1-sequence shows intense enhancement with the presence of two inhomogeneous areas of rim enhancement with cystic-like areas indicating necrosis

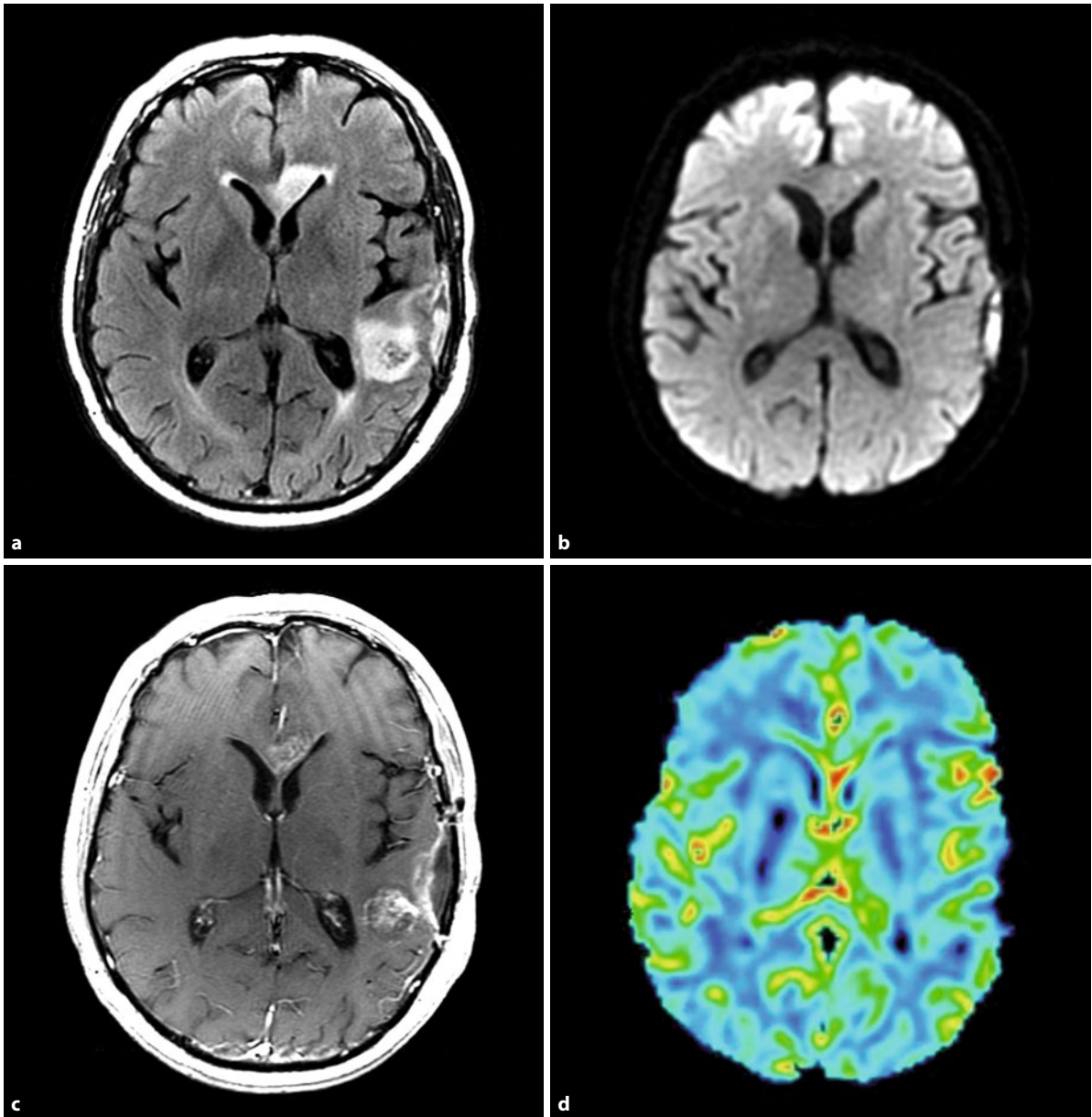


**Fig. 31.2** **a** MR perfusion study shows inhomogeneous increase in perfusion with hypoperfused areas in the context of the expansive/infiltrative lesion. **b,c** Multi-voxel MR spectroscopy with long echo times shows an increase in the Cho/Cr and Cho/NAA ratios (indices of increased proliferative activity), with a high lipid peak compatible with the presence of necrosis

**Early (48 Hours) Postoperative Follow-up**

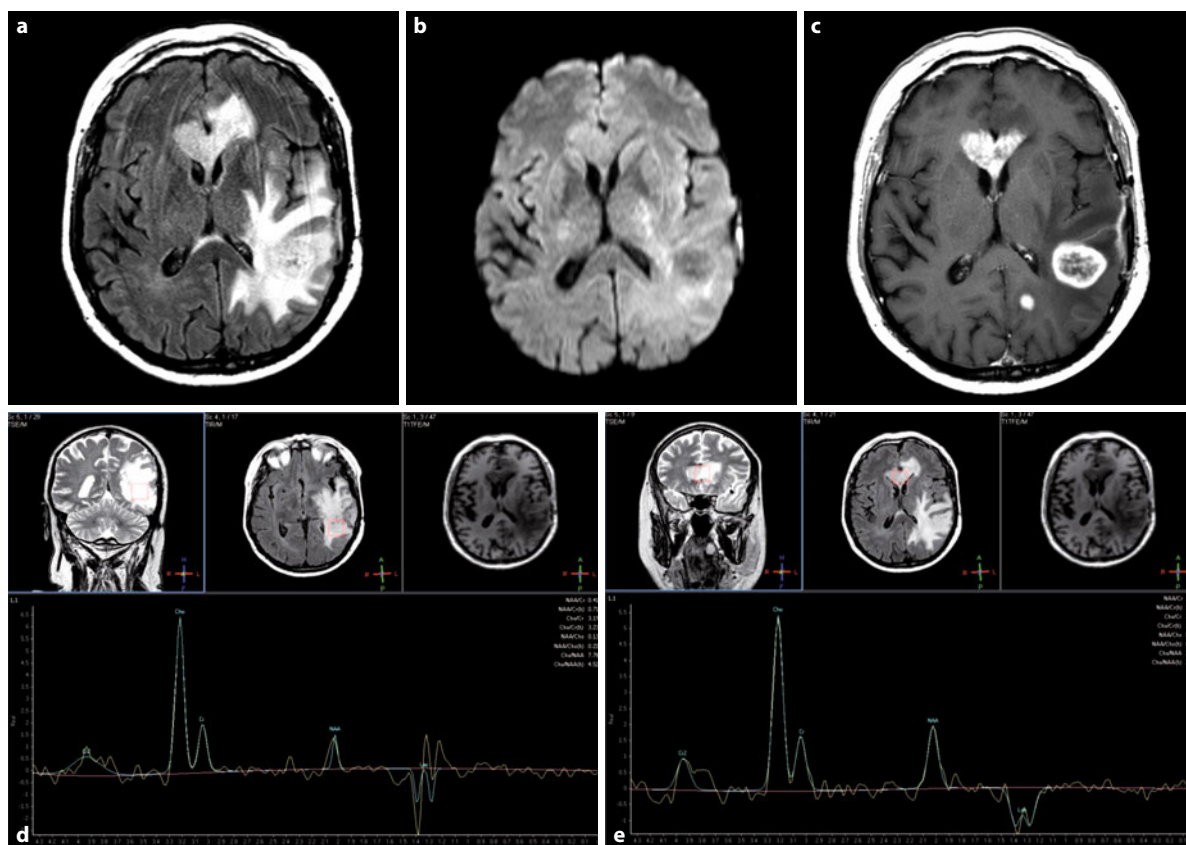
**Fig. 31.3** MR FLAIR (a), FSE T2-weighted (b) and contrast-enhanced SE T1-weighted (c) sequences visualize the left temporal-parietal craniotomy and partial removal of the expansive/infiltrative lesion previously documented. Some air bubbles and blood can be seen within the surgical cavity. At the edge of the cavity signs of injured BBB and traces of blood in the anterior region can be appreciated. A reduction in perilesional edema, persistent signs of lesion expansion as visualized in the preoperative images, the appearance of a layer of air in the frontal-polar region and moderate diastasis of the repositioned bone flap can also be appreciated. **d** MR perfusion study shows no appreciable signs of high perfusion at the margins of the surgical cavity

### Follow-up Performed at 4 Months After Surgery, Radiotherapy and Concomitant Chemotherapy



**Fig. 31.4** MR FLAIR (a) and diffusion-weighted (b) sequences show a reduction in size of the surgical cavity, with air and blood no longer appreciable. The air layer in the frontal-temporal regions and the signs of expansion are also no longer visible. c Contrast-enhanced MR SE T1-weighted sequence displays an increase in the thickness of the marginal zone with signs of altered BBB, the presence of some tissue with neoplastic appearance extending into the brain parenchyma. Another area with signs of altered BBB not shown in the previous examination can be seen in the genu of the corpus callosum, in the left parasagittal region. d MR perfusion study shows a slight increase in perfusion indices near the margins of the surgical cavity and at the genu of the corpus callosum

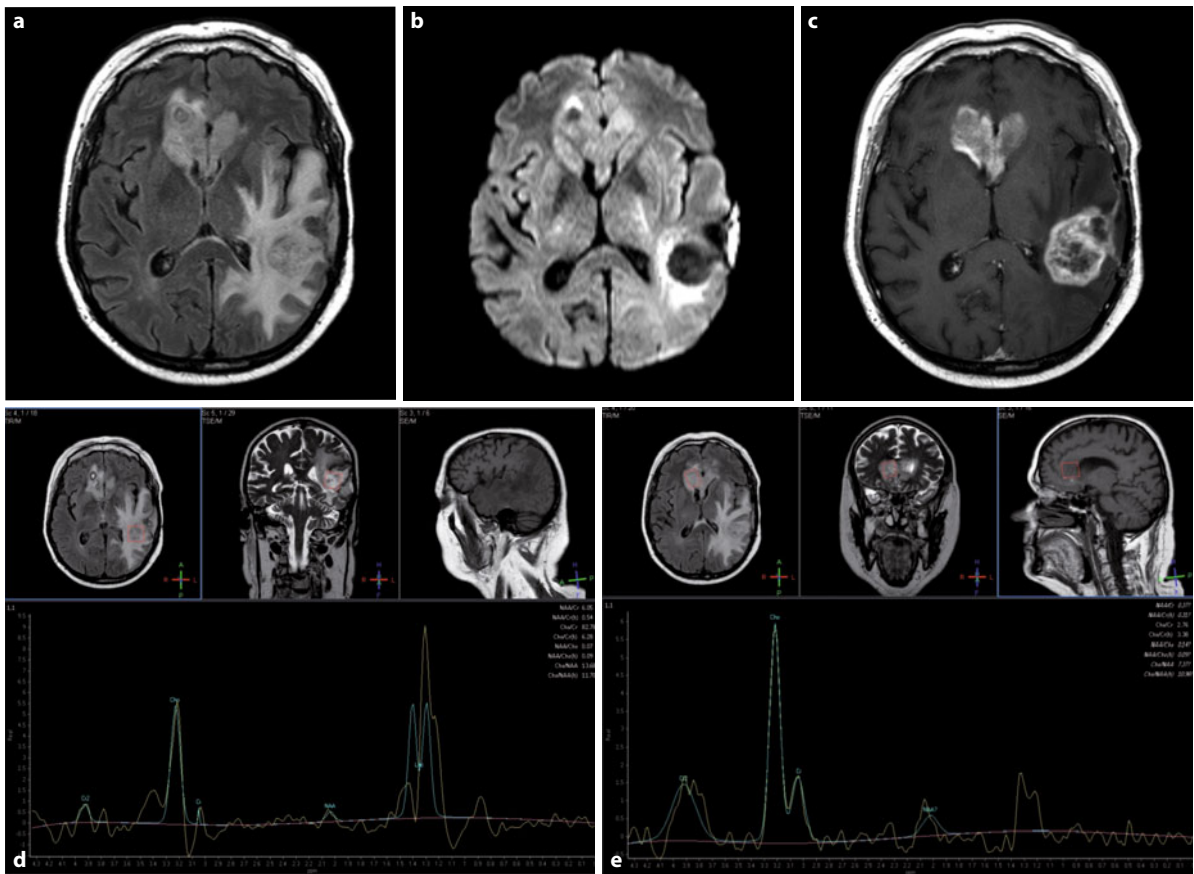
## Follow-up Performed at 7 Months After Surgery and Adjuvant Chemotherapy



**Fig. 31.5** MR FLAIR sequence (a) and diffusion-weighted imaging (b) show an increase in size of the expansive/infiltrative lesion peripherally in the left parietal-temporal surgical cavity. An increase in signal hyperintensity can also be seen indicating edema-infiltration peripheral to the lesion extending anteriorly in the left temporal-polar region, posteriorly in the retroparatrighonal area and deep to involve the capsules/nuclei. Signs of expansion are associated, with a reduction in the visualization of the CSF spaces and compression/shift of the left lateral ventricle. c Contrast-enhanced MR SE T1-weighted sequence shows an increase in the size of the lesion located at the genu of the corpus callosum, the appearance of another small area of disease in the left retrotrigonal region and increase in nodular enhancement at the surgery site. MR spectroscopy performed at the surgical margins (d) and at the genu of the corpus callosum (e) shows strong signs of tumor proliferation (high Cho/Cr and Cho/NAA ratios), and intense replacement/infiltration of the parenchyma from high-grade recurrence/progression (low ratio of NAA/Cr) primitive brain tumor



## Follow-up Performed at 9 Months After Surgery and Further Cycles of Adjuvant Chemotherapy



**Fig. 31.6** MR FLAIR sequence (a), diffusion-weighted imaging (b) and contrast-enhanced SE T1-weighted sequence (c) show further increased size of the expansive/infiltrative lesions located in left temporal-parietal region and at the genu of the corpus callosum, the latter having extended to the right hemisphere. MR spectroscopy at the surgical margins (d) and at the corpus callosum (e) show a further reduction in the NAA/Cr peak and increased lipid peak indicative of tumor necrosis