



Case report

RADIATION NECROSIS AFTER CAVERNOMA RADIOSURGERY SIMULATING BRAIN HIGH-GRADE GLIOMA – A CASE REPORT AND REVIEW OF THE LITERATURE

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ABSTRACT

We report a 62-year-old female patient who came to our institution due to pain and limited movements in the neck area, nausea, and headache. The magnetic resonance imaging (MRI) revealed a single larger and two smaller lesions with the appearance of cavernomas in the left parietal brain region. The patient was consulted with a neurosurgeon and was judged to be inoperable. Radiosurgery was performed in the cavernoma with a total focal dose of 15Gy. 11 months after the radiotherapy, during a routine follow-up MRI scan, a tumor-like lesion with extensive perifocal edema and midline dislocation, with heterogeneous structure and ring-like enhancement was reported in the left parietal brain region. After follow-up for 15 months, the last MRI showed almost complete reverse development of the described lesion, with marked reduction of volume, edema, and contrast enhancement. Along with MRI features of the lesion, some of which overlap with high-grade glioma characteristics, the evolution of the lesion is in favor of a radiation necrosis zone.

Keywords: radiation necrosis, radiosurgery, cavernoma, high-grade glioma, MRI,

INTRODUCTION:

Radiation therapy is an integral part of the modern therapeutic spectrum. Stereotactic radiosurgery (SRS) by means of 3D imaging delivers very precisely focused radiation beams to the area of a brain tumor or vascular malformation. The radiation effects include effects on vascular endothelial cells and neuroglial cells, especially oligodendrocytes [1, 2]. Imaging findings after SRS of the brain chronologically may be acute, early delayed, and late delayed, with the first two -reversible and transient, the last usually irreversible [1, 2]. Cerebral radiation necrosis is a late, delayed injury which can occur several months or years after the irradiation [1, 2, 3]. This complication can occur in 3% up to 24%, according to different reports [2].

On pathology, the radiation necrosis zone shows fibrinoid necrosis of the small vessels, capillary leakage, brain parenchymal necrosis and demyelination of surrounding tissue [2, 3]. The hypoxia leads to VEGF overexpression and produces angiogenesis with leaky capillaries, disruption of the blood-brain barrier (seen on gadolinium-enhanced MRI) and marked perilesional edema [2, 4]. MRI shows contrast enhancing intraaxial lesion with central necrosis and perifocal edema, usually at the site of the highest dose of radiation. The periventricular white matter is a common site for radiation necrosis, as in our case, due to increased susceptibility to microvascular damage [5].

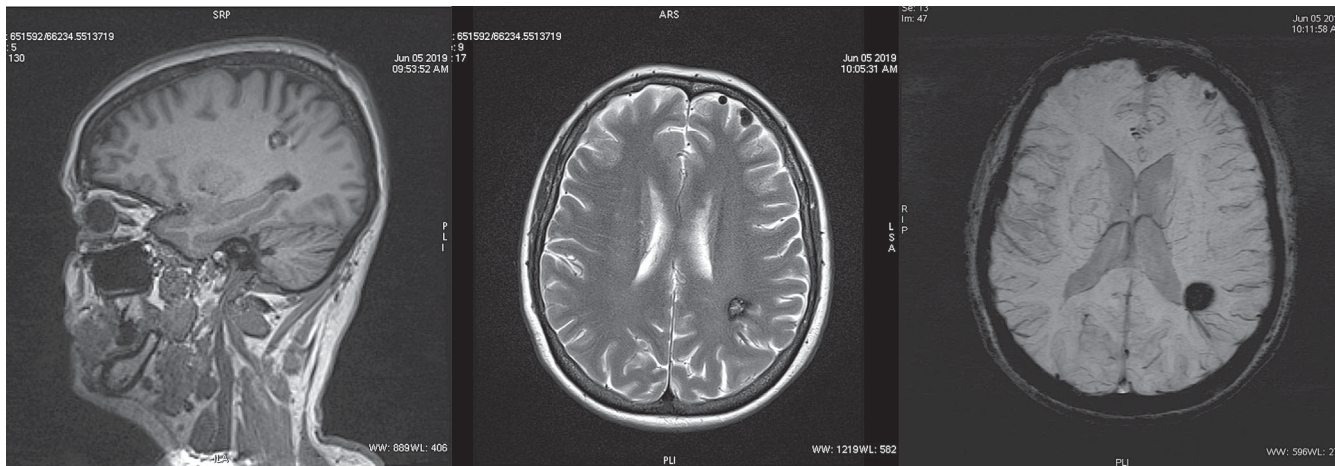
Radiation necrosis due to the presence of contrast-enhancement (sometimes ring-like), mass effect and perifocal edema can clearly resemble a brain tumor [5]. The radiographic appearance of high-grade glioma could be the same. Contrast enhancement could be like “Swiss cheese” or ring-like, there is diffusion restriction because of coagulative necrosis in the early phases [2, 6]. In favor of radiation, necrosis are large disproportionate perifocal edema and decreased cerebral blood flow and volume [2]. Follow-up imaging is very important because the improvement of edema and lesion volume over time with subsequent gliosis, fibrosis and volume loss are in favor of radiation necrosis [2, 3]. Sometimes brain biopsy is needed for patients with worsening symptomatic and MRI findings [5].

CASE DESCRIPTION:

A 62-year-old female patient was admitted in June 2019 to our hospital with pain and limited movements in the neck area, nausea, and headache. The MRI showed typical “popcorn” like lesion 11/10/10mm, an intense on

SWI with blooming artefacts, suggestive of cavernoma in the left parietal lobe (Fig. 1). There were 2 very small (2 mm, 4 mm) cavernomas and DVA (developmental venous anomaly) cortically in the same region, visible only on SWI series.

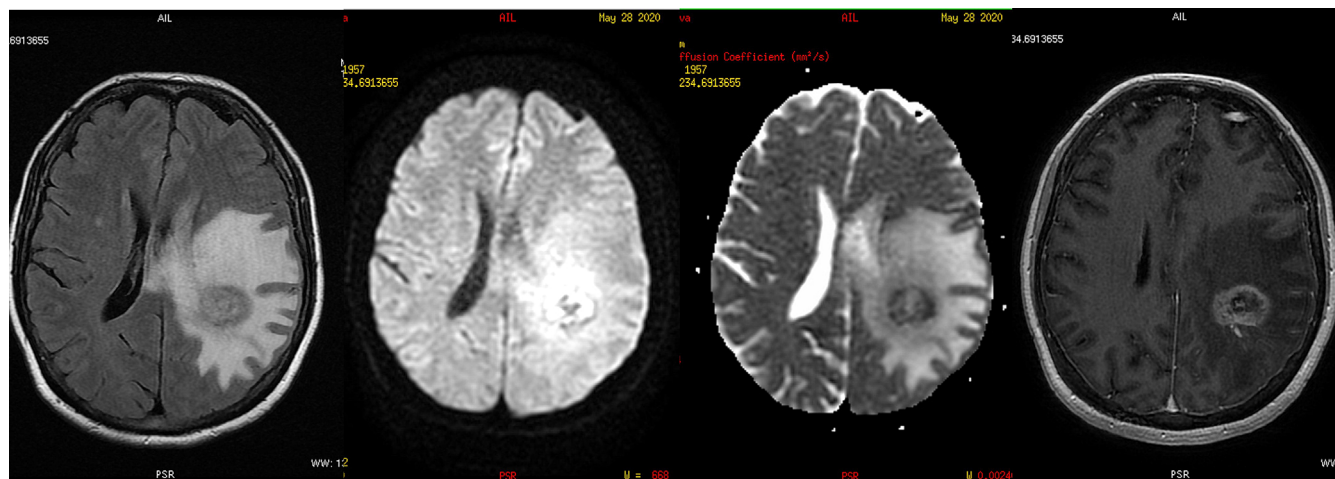
Fig. 1. First MRI 05. 06. 2019: SAG 3D T1, AX T2, AX SWI show lesion with MRI features of cavernoma in the left parietal lobe.



After consultation with a neurosurgeon, the patient was referred for radiotherapy. Radiosurgery was performed in July 2019 in the cavernoma with a total focal dose of 15Gy. The first MRI after the radiotherapy in September 2019 did not show any significant difference, only a reduction of the medio-lateral dimension by 1,5 mm. The second MRI in December 2019 showed a small zone of 2 mm in the caudal aspect of the cav-

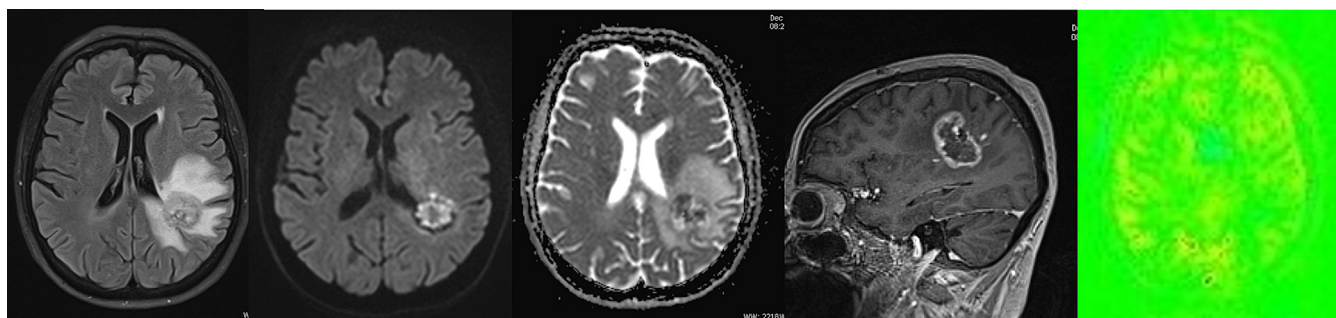
ernoma, hyperintense on T1, T2, result in bleeding in the late subacute phase and enlargement in the cranio-caudal aspect with 1,5 mm. The next MRI on 28.05.2020 showed a ring-like enhancing lesion with mass effect, marked perifocal edema and diffusion restriction, resembling possibly high-grade glioma (Fig. 2). The patient suffered from headache and slight right sided central hemiparesis.

Fig. 2. The MRI on 28. 05. 2020: AX T2 TIRM, AX DWI, AX ADC, AX 3DT1+C revealed a tumor-like lesion at the place of cavernoma with mass effect, perifocal edema, with restriction on DWI and ring-like contrast-enhancement.



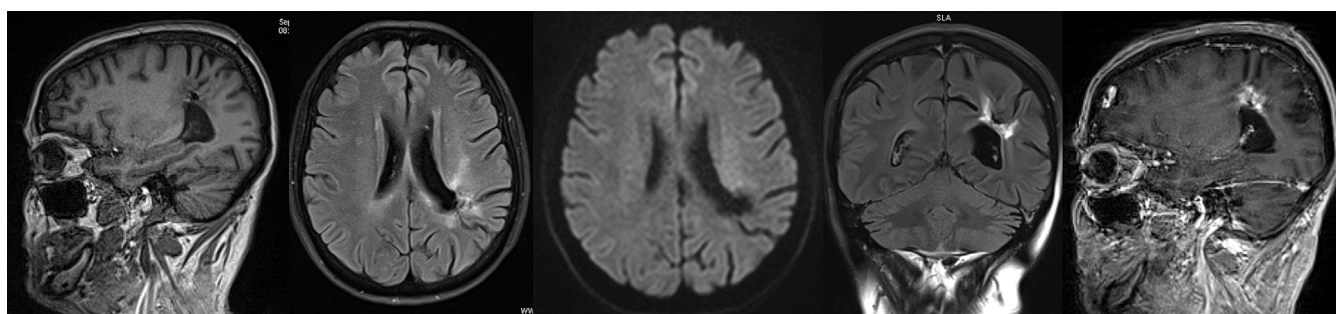
The next several follow-up MRI examinations in July and December 2020 showed slight progression of the lesion slight reduction of edema, and the ASL perfusion study did not show elevated perfusion in the lesion (Fig. 3).

Fig. 3. The MRI on December 2020: AX T2 TIRM, AX DWI, AX ADC, SAG 3DT1+C, ASL showed slight progression of the tumor-like lesion at the place of cavernoma with slightly reduced mass effect, perifocal edema and lack of elevated perfusion.



The last MRI on 30. 09. 2021 showed nearly complete resolution of the lesion with encephalomalacia zone with perifocal dense hemosiderosis, traction, fibrosis, and gliosis (Fig. 4), which finally sealed the diagnosis of radiation necrosis.

Fig. 4. The last MRI on 30. 09. 2021: SAG 3DT1, AX T2 TIRM, AX DWI, postcontrast COR T2 TIRM+C and SAG 3DT1+C show marked reduction of the lesion with encephalomalacia changes, traction, gliosis, and lack of diffusion restriction.



DISCUSSION:

Our differential diagnosis, in this case, was first radiation necrosis and a high-grade glioma in the background.

The co-existence of cavernomas and high-grade gliomas is very rare but known, and there are several reports about it [7]. All reports concluded that the rapid growth of a cavernoma must be suspicious for malignant tumor appearance [7, 8, 9, 10]. There are many theories about this phenomenon, including the consequence of radiotherapy, with a possible mechanism of VEGF (vascular endothelial growth factor) elevated expression [11, 12].

The evolution of radiation necrosis is not always irreversible and is possible to regress over time to complete resolution, as in our case [2, 6].

The overlap of MRI features between radiation necrosis and high-grade glioma is well known – intraxial lesion with mass effect, perifocal edema, ring-like contrast-enhancement, diffusion restriction in the early stage. The main difference is in the perfusion, which typically must be elevated in tumors because of neo an-

giogenesis [2].

ASL perfusion is not routinely used in oncologic imaging of the brain because of the quality of the images, signal to drop out and distortion due to susceptibility effects and labelling failure of the incoming blood when there are susceptibility artefacts [2, 13]. There are reports that ASL perfusion is higher in glioma than in radiation necrosis [2, 14].

Diagnosis in such cases, based only on MRI imaging, is not sure and requires a biopsy or follow-up over time.

CONCLUSION:

Radiation necrosis is a relatively new possible consequence of radiation therapy with still unknown pathophysiologic mechanism, course, and prognosis, and it remains a diagnostic challenge. Based on the clinical history, MRI features, and continuous diagnostic imaging follow-up of the patient, the final diagnosis in our case was radiation necrosis.

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Please cite this article as: Georgiev R. Radiation necrosis after cavernoma radiosurgery simulating brain high-grade glioma – a case report and review of the literature. *J of IMAB.* 2023 Apr-Jun;29(2):4924-4927. [Crossref - <https://doi.org/10.5272/jimab.2023292.4924>]

Received: 06/02/2023; Published online: 17/05/2023



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