Intralesional Hemorrhage and Gross Hemorrhage in Two Young Patients after Brain Irradiation

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Abstract
Background: Radiotherapy to the brain may produce endothelial damage to the vessels of the white matter resulting in hemorrhagic vasculopathy or true vascular malformations.
Case Report: We report on two children with previous irradiation of the brain presenting with intracranial hemorrhage during follow-up of medulloblastoma and acute lymphatic leukemia respectively.
Discussion and Conclusion: Development of cavernomatous malformations in patients who had radiotherapy of the brain is not unknown. Histopathological differential diagnosis between arteriovenous malformations, cavernomas and telangiectasies may be difficult in these cases as well as differentiation from radiation induced hemorrhagic vasculopathy. MRI is adequate for detection of these lesions and may add to differential diagnosis.

Key Words: Brain irradiation · Intracerebral hemorrhage · Cavernous malformation · MRI

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Intraläsionale Blutung und Massenblutung nach Schädelbestrahlung bei zwei jungen Patienten

Zusammenfassung
Fallbericht: Es werden zwei Fälle vorgestellt mit intrakranieller Blutung nach früherer Schädelbestrahlung wegen Medulloblastom beziehungsweise akuter lymphatischer Leukämie.

Schlüsselwörter: Schädelbestrahlung · Intrazerebrale Blutung · Kavernom · MRT

Introduction
The origin of cavernous malformations of the brain is still unclear. They are classified as developmental low-flow vascular malformations and may be associated with venous malformations or capillary telangiectasias. However, de novo formation of cavernomas was demonstrated [2] as well as development of a cavernoma or similar vascular lesions after brain irradiation.
The clinical significance of cavernous malformations or hemorrhagic “cavernoma-like” lesions developing in the follow-up of children with brain irradiation is yet not well known [3]. We report on two young patients who had radiotherapy of the brain presenting with hemorrhage into and adjacent to a suspected cavernoma.

Case Reports

Patient No. 1
A 16-year-old girl had surgery of an infratentorial medulloblastoma 4 years prior to admission. Additional therapy included combined chemotherapy, intrathecal application of $8 \times 2$ mg vincristine, and irradiation to the brain with a total brain dose of 55.2 Gy. During follow-up MRI showed no abnormalities but 4 years later a lesion of the inferior frontal lobe was detected with an increased signal on T1- and T2-weighted images (T1WI, T2WI) (Figure 1a). There were no clinical signs and next follow-up study showed a progression of the suspected cavernoma (Figure 1b). 6 months after first visualization the lesion had continuously enlarged (Figure 1c). The girl complained of occasional slight headaches, and surgical evacuation of the lesion was performed. Histopathologic examination showed a massive hemorrhage within a pseudocyst containing thin walled, enlarged vessels and confirmed diagnosis of a typical cavernous malformation.

Patient No. 2
A 7-year-old girl with acute lymphatic leukemia 3 years ago had been treated with combined chemotherapy and supportive brain irradiation with a dose of 12 Gy. Since that time she remained in complete remission. Now she was referred with acute onset of headaches, vomiting, and unwellness. She was somnolent, but had no focal neurological deficits. CT showed an intracerebral hematoma in the anterior corpus callosum and the adjacent frontal lobes (Figure 2a). Cerebral panangiography did not reveal any abnormality. On MRI there was an acute intracerebral hematoma adjacent to a second lesion with rim-like low intensity in the right cingulate gyrus (Figure 2b, arrow). The hematoma was evacuated and a cavernoma was removed. On pathological examination only small parts of a vascular malformation were found with dilated thin walled, but also fibrotic, thick walled vessels with elastic fibers surrounded by areas of old and acute hemorrhage, not clearly distinguishable between true arteriovenous and cavernous malformation.

Discussion
Typically the clinical syndromes of intracranial cavernomas may be divided into seizures, focal neurological deficits and hemorrhage [1]. The population of patients with asymptomatic cavernomas is increasing with the widespread use of MRI in the work-up of patients with various neurological problems. The appearance of cavernomas on MRI is dependent from the stage of hemorrhage and may be divided into four types [15]: type I = hyperintense on T1WI and T2WI, type II = mixed signal intensity within a dark hemosiderin ring, type III = hypo- or isointense on T1WI and T2WI, type IV = only visualized on gradient echo images. Mottolese et al [8] demonstrated the high hemorrhagic risk of cavernomas in the pediatric age group often revealed by sudden onset of intracerebral hematoma. Rapid growth of a cavernous malformation due to recurrent hemor-