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Why Do Benign Tumors Hemorrhage?

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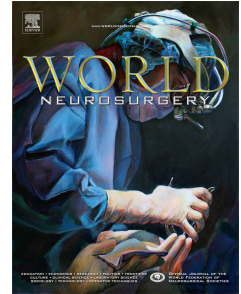
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Hemorrhage of intracranial tumors is a well-known phenomenon. The presentation is often dramatic with headache, nausea, vomiting, etc. and may be the first sign that the patient has an intracranial mass lesion. Tumoral hemorrhage is most commonly associated with high-grade lesions such as metastases and high-grade gliomas. However, low-grade tumors such as low-grade gliomas, pituitary adenomas, and meningiomas are also known to hemorrhage. Often, mechanisms such as rapid tumor growth, necrosis, blood vessel infiltration by tumor or tumor thrombus, etc. are implicated in the occurrence of intratumoral hemorrhage.[1] However, these are factors that often do not apply to low grade tumors such as meningiomas and therefore other pathophysiologic mechanisms must be sought.

Hemorrhage within meningiomas is a rare occurrence. These hemorrhages may be intratumoral, intracerebral, subdural, subarachnoid, or a combination of these. In 2004, Kuzeyli, *et al.* reported on 11 patients with intratumoral hemorrhage. This was out of a total of 126 patients with meningiomas whom they operated on. However, only two of these patients had radiographically recognized macroscopic hemorrhages, for an incidence of 1.5%. These authors postulated that the presence of microcysts and/or micronecrosis may increase the risk of intratumoral hemorrhage in patients with meningiomas.[2] Niiro, *et al.* reviewed 6 patients whom they had cared for who presented with hemorrhagic meningiomas. This represented 2.0% of the meningiomas treated at that institution over the same time period. These authors hypothesized that higher proliferative index may increase the risk of hemorrhage.[3] Other mechanisms of hemorrhage that have been proposed include thin-walled tumor vessels, erosion of intracranial blood vessels by a growing tumor, tumor necrosis, and stretching of bridging veins.[4]

In this month's issue of *World Neurosurgery*, Wang, *et al.* offer a histological analysis of hemorrhagic meningiomas. In their manuscript, they review the pathology of six hemorrhagic meningiomas and compare them to twelve non-hemorrhagic meningiomas. They identified

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