

Favorable outcome in patients with intracranial hemorrhage due to ruptured brain AVM

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Neurology® 2017;88:1–2

Despite all efforts, intracranial hemorrhage still has a dismal prognosis, with up to 61% mortality after 2 years.¹ Several authors have concluded that intracranial hemorrhage due to a brain arteriovenous malformation (AVM) has a better clinical outcome.^{1–3} Only one study specifically addressed this issue and used a relatively small sample, comparing the outcome of 90 patients with a ruptured AVM from the Scottish Intracranial Vascular Malformation Study to the outcome of 60 patients with a spontaneous intracranial bleeding included in the Oxford Vascular Study.¹ Those investigators found better outcomes after AVM-related hemorrhages independently of patient age and other known predictors of intracranial hemorrhage outcome. This difference in outcome warrants a thorough radiologic investigation in every patient presenting with an intracranial hemorrhage.

In this issue of *Neurology*®, Murthy et al.⁴ confirm and expand on these findings. The authors used the Nationwide Inpatient Sample (NIS) to identify patients hospitalized for an intracranial hemorrhage between January 2002 and December 2011. Because the NIS does not include data representing severity of intracranial bleeding such as the size of the hematoma or the presence of hydrocephalus, they conducted a confirmatory analysis using data from patients hospitalized with an intracranial hemorrhage at New York–Presbyterian Hospital. The primary predictor used was AVM, as defined by ICD-9-CM code 747.81. The primary outcomes chosen were inpatient mortality and home discharge disposition. They excluded patients <18 years of age and patients with traumatic brain injury. They also excluded visits ending in transfer to a higher-acuity hospital to prevent double counting.

In their analysis, they identified 619,167 hospitalizations for intracranial hemorrhage using the NIS. Among these, 4,485 patients had a brain AVM. Patients with an AVM were younger, were more often male, and had fewer stroke risk factors such as hypertension and hyperlipidemia. Seizures and hydrocephalus treated with ventriculostomy occurred more often among patients with an AVM (13% vs 6%). Inpatient mortality was 1.9% among patients with

an AVM vs 29.5% in patients with an intracranial hemorrhage without an AVM. Rates of home discharge were 46.9% among patients with an AVM vs 19.7% in patients with an intracranial hemorrhage without an AVM.

In the confirmatory analysis based on 342 patients with an intracranial hemorrhage, 34 without and 308 with an AVM, patients with an AVM were younger (43 vs 63 years old) and more often male. Patients with an AVM ambulated independently at discharge more often in comparison to patients without an AVM (62% vs 29%). Inpatient mortality occurred less often among patients with an AVM (13% vs 25%). A more favorable functional outcome occurred in patients with an AVM, even after correction for age and comorbidities. The authors concluded that patients with an intracranial hemorrhage with an AVM have lower inpatient mortality and more favorable discharge disposition than those with hemorrhage due to other causes. It is worth noting, however, that compared to spontaneous intracerebral hemorrhage, an inpatient mortality of 1.9% to 13% in patients with a brain AVM is not negligible.

It remains unclear why the outcome of patients with a brain AVM is better. The biggest reason may be their younger age and fewer comorbidities. It cannot be excluded that fast treatment of predilection places of rebleeding such as intranidal aneurysms plays a role. Therefore, especially in young patients, early imaging to rule out a brain AVM is warranted. Although the intracerebral hemorrhage often compresses the AVM, structural and treatable causes of early rebleeding such as an intranidal aneurysm can often be seen on an early CT angiography.⁵ When in doubt, repeat imaging of intracranial vessels 6 to 8 weeks after the bleed when the hematoma has resolved can reveal the underlying AVM.

The finding that patients with an intracranial hemorrhage due to an AVM more often underwent placement of a ventriculostomy might reflect 2 mechanisms: (1) some AVMs cause intraventricular bleeding with relatively little parenchymal damage, potentially explaining the better outcome, and (2) early relief of increased intracranial pressure may lead

See page 1882

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to a better outcome. Because the NIS data have neither the location of the hematoma nor the presence of hydrocephalus, the contribution of these reasons remains unknown and worthy of additional study. Therefore, in the presence of hydrocephalus, early neurosurgical consultation may improve patient outcomes. These findings support a comprehensive approach to the treatment of patients with an AVM, ideally by a dedicated neurovascular team including neurosurgeons.

STUDY FUNDING

No targeted funding reported.

DISCLOSURE

The author reports no disclosures relevant to the manuscript. Go to Neurology.org for full disclosures.

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