ORIGINAL ARTICLE

Cerebral Arteriovenous Malformations: Outcome after Microsurgery

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ABSTRACTS

Objectives: *To find out the results of microsurgical excision of cerebral Arteriovenous Malformations.*

Material and Methods: *This study was conducted from January 2005 to December 2007 at the department of Neurosurgery, PGMI Lady Reading Hospital Peshawar. A total of 12 patients of cerebral AVMs were included in this study. All the patients, who undergone surgery for cerebral AVMs, irrespective of their age and gender, were included in the study. Their clinical features, radiological reports, peroperative findings and surgical outcome were analyzed in different aspects.*

Results: *Of the total 12 patients, there were 8 males and 4 female patients. Their age ranged from 14 years to 36 years with the mean age of 23.4 years. Six patients presented with primary intracerebral hemorrhage, five cases with seizures and one patient was diagnosed incidentally after a minor head trauma. There were four patients with AVMs on left parietal region, one at right occipital, two at left occipital, two at frontal, one at right parieto occipital, one at left fronto parietal and one at right parietal region of the brain. In our study the out come of excision of AVMs at the eloquent areas of the brain was good in young patients as compared to the old patients. There was single mortality in our study.*

Conclusion: *Microsurgical techniques and appropriate radiological investigation is the basis for good surgical outcome.*

Keywords: *Arteriovenous Malformations, Microsurgical Excision, Eloquent area of the Brain, Vascular malformations.*

INTRODUCTION

Arteriovenous malformations (AVMs) are abnormal congenital vascular lesions of the brain, that constitute a fistulous connection between the arterial and venous systems and that lack a normal intervening capillary bed. Typically, these lesions are triangular, with the base toward the meninges and the apex toward the ventricular system. AVMs appear as serpiginous isointense or slightly hyperintense vessels that strongly enhance following contrast administration on computed topographic scanning. Calcification is identified in 25 to 30% of cases.[1] On magnetic resonance imaging (MRI), the typical AVM appears as a tightly packed "honeycomb" of flow voids on T_1 and T_2 weighted images, caused by high flow velocity signal loss. Phase contrast magnetic resonance angiography (MRA) can be useful in the depiction of flow, but complete definition of complex lesions and their internal angio architecture requires a cerebral angiogram. On cerebral angiography, parenchymal AVMs appear as tightly packed masses of enlarged feeding arteries and dilated tortuous veins with little or no intervening parenchyma within the nidus. Arteriovenous shunting with abnormal early filling of veins that drain the lesion is characteristic of AVM.[2]

Abnormalities of the vascular structure of the head and brain have been long recognized. McCormick published an influential classification system in 1996. He described the arteriovenous malformation (AVM), cavernous malformation, venous malformation and

telangiectasia. Historically luschka and Virchow originally described arteriovenous malformation in mid 1800. Olivecrona performed the first surgical excision in 1932. The estimated incidence of AVM in general population is 1 per100,000 per year in USA, they account for between 1 and 2% of all strokes, 3% of strokes in young adults, 9% of subarachnoid hemorrhage and of all primary intracerebral hemorrhage.[3] Patients with cerebral AVMs may also present with headache, seizures or may be asymptomatic and found incidentally.[6-8] The treatment of cerebral arteriovenous malformations (AVM) or vascular anomalies are the challenging neurosurgical procedures. Small AVMs of the eloquent area of the brain area usually subjected to Radiosurgery.[4]

This article reviews the experience of ours institution for microsurgical excision of AVM of the cerebral cortex. This overview focuses on the clinical presentation, radiological investigations and neurological outcome after microsurgical excision of cerebral AVMs.

MATERIAL AND METHODS

This retrospective study was conducted in the department of Neurosurgery, Postgraduate Medical Institute, Govt Lady Reading Hospital Peshawar, from January 2005 to December 2007. All consecutive patients who were referred or admitted to the neurosurgical unit were included in the study. One patient who refused surgery was excluded from this study. CT scan was primarily done which was followed by CT angiogram. Modified Rankin Scale (MRS) score before and after surgery, incidence of hemorrhage, angiographic characteristics, Spetzler – Martin (SM) grade, the surgical outcomes, and other treatment outcomes, complications and deaths were recorded on appropriate proforma. If a new neurological deficit due to treatment was present, outcome was recorded as follows: MRS score of 1 (minor deficits not interfering with lifestyle), MRS score of 2 (minor disability but capable of self – care in all aspects of life), MRS score of 3 (moderate disability requiring some help with self – care), MRS score of 4 (moderately severe disability preventing independence but not requiring constant attention) and MRS score of 5 (severe disability requiring constant attention). Outcome was measured according to downgrade of neurological function due to surgery. Downgrade was defined as new permanent neurological deficit after surgery. Significant morbidity was defined as a decrease in MRS score > 1 from baseline. Spetzler – Martin (SM) grade was based on an aggregate on the basis of lesion size, location in eloquent area and pattern of venous drainage. One point was assigned to small (< 3 cm) AVM, 2 points for medium (3 – 6 cm) AVM, 3 points for large (> 6 cm) AVM, one point each for adjacent to eloquent brain and deep venous drainage. Grade VI referred to extremely large and diffuse AVM. Systemic condition of the patient was considered as well.

RESULTS

There were 12 patients admitted or referred to the department of neurosurgery from January 2005 to December 2007 with an admitting impression of AVM. The mean age of patients was 23.4 years, with a range of 14 to 36 years. There was a male predominance (8, 66%) compared to females (4, 34%). The mean length of hospital stay was 7.2days (range of 4 to 11 days). The presenting symptoms are listed in Table 1.

Table 1: *Clinical presentation of the Patients.*

Clinical Presentation	Number of Patients	Percentage
Intracerebral Hemorrhage	06	50%
Seizure	05	41.7%
Incidental	01	08.3%

Majority of patients presented with intracerebral hemorrhage (50%). The second most frequent presentation was seizure (41.7%). Incidental diagnosis was in one case (8.3%). The average duration of symptoms was 5 days, with a range of 1 day to 9 days. No patient had a family history of AVM.

The clinical signs on admission were: Motor weakness (8 patients – 66%), cranial nerve deficits (2 patients – 16.7%), sensory abnormalities (1 patients – 8.3%), Majority of patients had a Glasgow Coma Scale (GCS) score of 15 on admission (10, 83%), one patients had a GCS score of 14 (8.3%), and one had a score of 13. All patients underwent craniotomy and excision of AVMs. There were 9 patients (75%) with small AVMs (size less than 3 cm), 2 patients (16.7%) with moderate – sized AVM (between 3 – 6 cm), and 1 patients (8.3%) with large AVM (> 6 cm). There were 4 patients with AVMs located adjacent to eloquent cortex (33.3%).

Eight patients were discharged without additional neurological deficit**.** Of these 8 patients, one had a

seizure postoperatively, but this was controlled with medication. Two patients had a MRS score of 1; one had a homonymous hemianopsia after excision of his occipital AVM, and another had a Medical Research Council (MRC) Grade 4 ± 5 weaknesses of her left extremities after excision of her parietal AVM (which bled prior to surgery). These patients had neurological downgrades from their admission MRS scores of 0.

One patient died secondary to bleed in the operative area.

Table 2: *Distribution of the Cerebral AVMs.*

Site of AVM	Number of Patients	Percentage
Left parietal	04	33.3%
Left Occipital	02	16.66%
Right Frontal	02	16.66%
Right Occipital	01	08.3%
Parieto Occipital	01	08.3%
Left Fronto Parietal	01	08.3%
Right Parietal	01	08.3%

DISCUSSION

There has been an increase in the number of patients with AVM admitted in our institution. The mean age of patients in this series was 23.4 years, whereas it was common in the 11-30 age groups in the previous series. These probably partly reflect improving diagnostic facilities and increasing age of general population. The male: female ratio is 2:1 in the present study; it was 1.7:1 shown by Michelsen in his study.5 In another study conducted by Kuhmonen and colleagues,[9] the average age of patients was 32.8 years and male (17) to female (32) ratio of 1:1.9.

The most common clinical presentation in this series was intracerebral hemorrhage, whereas it was headache in one of the study conducted in Philippines.[16] The incidence of patients with AVMs presenting with epilepsy and without clinical evidence of hemorrhage varies between 17 – 40%.[10,11] Turjman and colleagues12 studied 100 patients with intracranial AVMs and their presentation were epilepsy 47% cases, intracerebral hemorrhage in 40% cases and other features of presentation in 13% patients. The incidence of hemorrhage in the present study was 50%, and mortality rate of 8.3%. This was lower than the estimated mortality rate of 10 – 29% associated with AVMs in previous reports**.** The improved mortality rate may have been partly due to timely excision of the AVMs.

The treatment of cerebral arteriovenous malformation is mostly dependent on the size and location of AVMs. Radiosurgery is considered to be the first treatment option in case of small AVMs, especially when the location is in the eloquent area of the brain. In case of larger AVMs pre operative embolization reduces the complications like pre operative bleeding and post operative perfusion pressure breakthrough phenomenon. In our study all the patients were subjected to surgery due to the non availability of these facilities. Radiosurgery can be considered alternative for microsurgery in most of the cases.[13-15]

CONCLUSION

In conclusion, the risks of surgery for patients with Spetzler – Martin (SM) grade 1 and 2 AVMs are low. As surgery immediately negates the risk of hemorrhage from the lesion after excision, we believe these low – grade AVMs are best treated with microsurgical resection. However, patient selection, skill and experience of the surgical team are important factors in achieving these low rates.

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