Endovascular treatment of B-AVM

KG TERBRUGGE

Professor of Radiology and Surgery; University of Toronto; Canada

Embolisation can be carried out as a unique treatment, the intended goal being partial and targeted, palliative, curative or in combination with surgery or stereotactic radiosurgery. It may be performed in elective or in emergent fashion depending on the indication and circumstances.

A. Partial (targeted) Embolisation

The rationale for partial embolisation is derived from the concept that the patient (host) will be asymptomatic as long as equilibrium exists between the patient (host) and the AVM. Treatment should be carried out once the patient becomes symptomatic to reestablish this equilibrium.

Partial, targeted, endovascular treatment when carried out with a complete understanding of the clinical-angioarchitecture relationships in mind will result in improved natural history.

If the indications for partial treatment were the elimination of angioarchitectural changes noted following a recent haemorrhage then follow up angiography should be done within days of the embolisation procedure if there was a concern that the goal was in fact not achieved or an unstable situation was created during the treatment.

B. Partial (Palliative) Embolisation

Partial embolisation can be performed for those patients who on clinical follow-up examination demonstrate objective evidence of progressive neurological deficit and whose B-AVM cannot be cured by current technology. The majority of these AVMs are large in size and in deep locations.

Certain lobar locations have shown perilesional edema that may center on the venous outflow channels suggesting venous congestion or even occlusion to be the possible mechanism for the progressive neurological deficits in these patients. As we are currently unable to target directly the venous component of the angioarchitecture we tend to focus our embolisations towards occlusion of the largest shunts within the nidus, thereby decreasing the venous hyperpressure.

Stabilization or reversal of the neurological deficit may occur even after limited partial treatment and post embolisation clinical monitoring is carried out to verify objectively the clinical status of the patient

C. Curative Embolisation

Curative embolisation refers to complete anatomical obliteration of the malformation by the endovascular route. If embolisation is to be

curative, a permanent non biodegradable agent must be used to form a cast of the pathological angioarchitecture.

Cure by the endovascular route, as demonstrated by the immediate post-embolisation angiogram, must be confirmed by a follow-up at least 6 months later and preferably 1 or 2 years later to confirm the stability of the result.

D. Preoperative Embolisation

Pre-surgical embolisation of BAVM represents a well accepted and often performed application of endovascular therapy. Its role has become firmly established over the past 20 years.

The goal of therapy under these circumstances is to facilitate surgical removal of the AVM. The specific goals of such embolisation should therefore be discussed with the vascular neurosurgeon to provide the best possible benefit at surgery at the lowest combined (endovascular + surgery) risk for treatment associated complications to the patient. In our experience the risk associated with presurgical embolisation using NBCA is exceptionally low with less than 1% procedure related morbidity and no mortality.

E. Embolisation prior to Radiosurgery

The purpose of embolisation prior to stereotactic radiosurgery can be two fold: overall size reduction and targeted embolisation towards specific angioarchitectural abnormalities.

1. Size Reduction

Embolisation can be used to decrease the size of the malformation to a volume, which can then be radiated, with a reasonable chance of accomplishing a cure. The size of the AVM and the dose given in particular to the margins of the AVM represent the most important indicators for success of stereotactic radiosurgery irrespective of the type of device used (Bragg-Peak Proton Beam, Gamma Knife or Linear Accelerator).

2. Targeted Embolisation Prior to Stereotactic Radiosurgery

Embolisation can be performed prior to radiation therapy in patients in whom angioarchitectural changes are demonstrated which might be responsible for previous clinical symptoms

or represent markers for possible future haemorrhagic events (aneurysm etc.).

When planning the embolisation prior to radiosurgery either to reduce the size or to eliminate angioarchitectural weaknesses, it is imperative that a permanent embolic agent such as NBCA is used.

F. Emergency Embolisation

There are few indications for emergency embolisation in adults. Urgent need for embolisation may arise when the angiographic study at the time of presentation demonstrates the presence of an arterial (or intranidal) pseudoaneurysm or an enlarging aneurysm on one of the feeding arteries, which was demonstrated on a previous examination. Embolisation should probably also be done early if a venous pseudoaneurysm is demonstrated at the time of haemorrhagic presentation.

G. Embolisation Results

The specific goal of the embolisation will be different in each patient and should always be related to providing the patient with a benefit at a risk which should outweigh the natural history. During this risk management process it becomes obvious that the complications related to endovascular treatment (and similarly for surgery and radiation therapy) will have to be within a certain range in order to provide a positive risk-benefit ratio to the patient.

Complete obliteration of BAVMs by embolisation alone has been reported to be possible in 10%-40% of AVMs. Valavanis et al⁶ noted that in addition to small size and limited number of arterial feeders certain topographical locations, sulcal, deep extrinsic, favored complete obliteration outcome with embolisation alone. On the other hand limited data currently exists regarding the ability to achieve a complete cure when the up front goal of the treatment was to achieve complete obliteration by embolisation alone but may be as high as 70%⁷.

The results of embolisation of small size BAVMs (< 3 cm) compared favorably to surgery or stereotactic radiosurgery with respect to procedure related morbidity and mortality^{4,5,7}. However similar to surgical resection, complete obliteration with embolisation provides imme-

diate protection for future haemorrhage which does not apply for radiosurgery.

Our combined experience (AB, PL, KTB, >2500 patients with B-AVM embolized) has shown that procedure related non permanent neurological deficit was below 6%, permanent neurological deficit occurred in less then 2.5% and mortality was below 1.5%.

In summary: It is Imperative that each B-AVM patient is managed according to a num-

ber of guiding principles: the anticipated natural history, the anticipated positive impact of treatment and the established treatment record of the physicians involved. Only when the ratio is positive can we expect the patient to accept our treatment recommendation. Endovascular treatment of Brain AVM's represents a key component in the armamentarium of the multidisciplinary treatment team and its role continues to expand.

References

- 1 Al Yamany M, terBrugge KG et Al: Palliative Embolisation of Brain Arteriovenous Malformations Presenting with Progressive Neurological Deficit. *Interventional Neuroradiology* 6: 177-183, 2000.
- 2 Berenstein A, Lasjaunias P, terBrugge KG: Goals and Objectives in the management of Brain Arteriovenous Malformations. *Surgical Neuroangiography* 2 Ch 10 2003.
- 3 Meisel HJ, Mansmann U et Al: Effect of partial targeted NBCA embolisation in brain AVM. *Acta Neurochirurgica* 144: 879-887, 2000.
- 4 Pollock B, Flickinger J et Al: Factors Associated with Successful Arteriovenous Malformation Radiosurgery. *Neurosurgery* 42: 1239-1247, 1998.
- 5 Schaller C, Schramm J: Microsurgical Results for Small Arteriovenous Malformations Accessible for Radiosurgical or Embolisation Treatment. *Neurosurgery* 40: 664-674, 1997.
- 6 Valavanis A, Yasargil MG: The Endovascular Treatment of Brain Arteriovenous Malformations. *Advances and Technical Standards in Neurosurgery* 24: 131-214, 1998.
- 7 Willinsky R, Goyal M et Al: Embolisation of Small (<3 cm) Brain Arteriovenous Malformations. Correlation of Angiographic Results to a Proposed Angioarchitecture Grading System. *Interventional Neuroradiology* 7: 19-27, 2001.

Karel Gerard terBrugge, M.D.
Western Hospital
Diag & Therap Neuroradiology
399 Bathurst Street
CND Toronto Ontario M5T 2S8, Canada