Cerebral Arteriovenous Malformations

Introduction

The endovascular treatment of cerebral arteriovenous malformations (AVMs) is a controversial topic because of the availability of alternative therapeutic options (surgery and radiosurgery), absence of standardized credentialing for the interventional therapist, lack of uniformity of opinion regarding goals of therapy for individual patients, and variety of available interventional techniques and embolic agents. Moreover, the presence of an AVM confers the risk of death or permanent neurologic deficit to the patient, and endovascular therapy carries similar significant risks. This document is intended to provide a framework for the standardization of physician responsibility in treating patients with AVMs.

Choice of treatment method typically depends on clinical presentation; size, location, and angioarchitectural features of the AVM; patient age; and, in many instances, the treatment capabilities of the team. The treatment applied should be less risky than the natural history of the disease process, which suggests a hemorrhage rate of approximately 3% per year.

The neurointerventional procedure should be performed with full consideration of the operator qualifications, pre-procedural planning, procedural conduct, and post-procedural care outlined in General Considerations for Neurointerventional Surgical Procedures (p 1). Procedural and post-procedural blood pressure control may require continuous intra-arterial pressure monitoring. Emergency provisions should include availability of an in-house neurosurgeon capable of providing back-up for ventriculostomy placement and performing emergent surgery.

Indications

Indications for embolization (endovascular therapy) of cerebral AVMs include the following: primary embolization (complete angiographic occlusion and/or obliteration of the AVM, staged angiographic occlusion and/or obliteration of the AVM, occlusion of the nidus or pedicle aneurysm); adjuvant embolization (in preparation for surgery, in preparation for radiosurgery, intraoperative embolization); palliative embolization (to reduce arterial steal phenomenon or progressive neurologic deficit, to reduce venous hypertension effects, to reduce headache, to reduce intractable seizures, to reduce high output cardiac failure); and subtotal embolization (otherwise estimated to benefit the patient).

Threshold: A review should be prompted when cerebral AVM embolization is performed for other indications.

Efficacy

Indicators include clinical and technical indicators. Clinical indicators are reduction of neurologic deficit due to arterial steal or venous hypertension; reduction of severity, duration, or frequency of headaches; reduction of severity, duration, or frequency of seizures; reduction of signs and symptoms of high output cardiac failure; and reduction of frequency of hemorrhagic events. Technical indicators are complete angiographic occlusion and/or obliteration of the AVM, obliteration of the nidus or pedicle aneurysm, occlusion of targeted portion of the AVM, occlusion of the targeted feeding artery, diminished flow through the AVM, and diminished flow through the targeted feeding artery.

Threshold: A review should be prompted when less than the prescribed percentages of the clinical or technical efficacy goals are met, as outlined below.

Clinical threshold: $<$75% of cases achieve goal.

Technical threshold: $<$80% of cases achieve goal.

Safety

Indicators include clinical complications and technical and/or procedural complications. Clinical complications are categorized as death, major complications (permanent neurologic deficit), minor complications (permanent neurologic deficit), transient neurologic deficit, and other clinical embolization-related complications. Note that puncture site complications, allergic reactions to contrast media, and other non-embolization-related clinical complications default to the ''diagnostic angiography'' guidelines section.

Technical and/or procedural complications include failure to obtain proper informed consent, a retained catheter fragment, device failure directly contributing to an untoward clinical outcome, operator error directly contributing to an untoward outcome, inadvertent arterial occlusion and/or dissection or rupture, and hemorrhage.

Threshold: Neurologic deficits predicted by AVM location and/or provocative testing that are considered acceptable for treatment are not considered to be complications associated with treatment. A review should be prompted when the complication rate surpasses the following threshold values.

Indicator	Threshold (%)
Death	0
Major (permanent neurologic deficit)	10
Minor (permanent neurologic deficit)	10
Transient neurologic deficit	20
Other clinical embolization-related complications	10
Alopecia	10

A review should be prompted when the technical and/or procedural complication rate surpasses the following threshold values: failure to obtain proper informed consent (0%), a retained catheter fragment (5%), device failure directly contributing to an untoward clinical outcome (5%), operator error directly contributing to an untoward outcome (5%), and inadvertent arterial occlusion and/or dissection (10%).

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