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**Embolization of Spinal Arteriovenous Fistulae,
Spinal Arteriovenous Malformations, and
Tumors of the Spinal Axis**

AJNR Am J Neuroradiol 2001, 22 (8 suppl) S28-S30
http://www.ajnr.org/content/22/8_suppl/S28

This information is current as
of July 24, 2025.

Embolization of Spinal Arteriovenous Fistulae, Spinal Arteriovenous Malformations, and Tumors of the Spinal Axis

Spinal Dural AVF

Indications

The presence of spinal dural AVF is an indication for treatment in all patients; embolization may be contraindicated in those patients in whom the anterior spinal artery originates from the same pedicle as the spinal dural AVF.

Efficacy

Indicators: The indicators of the efficacy of the endovascular management are technical and clinical success. Technical success is defined as occlusion of the targeted vessels. Clinical success is obliteration of the vascular malformation definitively or adjunctively or improvement or stabilization of symptoms.

Indicator	Threshold (%)
Technical	
Failure to occlude targeted vessels	19
Clinical	
Definitive/adjunctive goals met	60
Neurologic improvement	60

Safety

Indicators: When the following complications and corresponding thresholds are exceeded, a review should be conducted.

Indicator	Threshold (%)
Neurologic complications	
Death	0
Major deficit	2
Life-altering complication, such as paralysis	
Minor deficit	5
Not significantly altering life style	

Spinal Cord AVMs

Indications

The indications for embolization of spinal cord AVMs include all symptomatic patients with lesions that can be cured; adjuvant therapy before surgery/radiosurgery; and palliative therapy when total obliteration is not practical and the patient suffers from progressive neurologic deficit or high risk of hemorrhage (associated aneurysm or pseudoaneurysm, previous hemorrhage) or when partial embolization is thought to be of benefit (presence of AVF, outflow restriction with venous ectasia).

Efficacy

Indicators: The indicators of the efficacy of the endovascular management are technical and clinical success. Technical success is defined as occlusion of the targeted vessels. Clinical success is obliteration of the vascular malformation definitively or adjunctively or improvement or stabilization of symptoms.

Indicator	Threshold (%)
Technical	
Failure to occlude targeted vessels	10
Clinical	
Neurologic improvement	50

Safety

Indicators: When the following complications and corresponding thresholds are exceeded, a review should be conducted.

Indicator	Threshold (%)
Neurologic complications	
Death	0
Major deficit	10
Minor deficit	5
Permanent deficit	10
Transient deficit	10

Perimedullary AVFs

Indications

The presence of a perimedullary AVF, even if clinically silent, is an indication for treatment. Em-

bolization is indicated if sufficiently superselective catheterization can be performed; surgery may be the best therapeutic modality in cases of type 1 (smallest) perimedullary AVF.

Efficacy

Indicators: The indicators of the efficacy of the endovascular management are technical and clinical success. Technical success is defined as occlusion of the targeted vessels. Clinical success is obliteration of the vascular malformation definitively or adjunctively or improvement or stabilization of symptoms.

Indicator	Threshold (%)
Technical	
Failure to occlude targeted vessels	10
Clinical	
Neurologic improvement	70

Perimedullary AMSs

Safety

Indicators: When the following complications and corresponding thresholds are exceeded, a review should be conducted.

Indicator	Threshold (%)
Neurologic complications	
Death	0
Clinical worsening	10

Epidural and Perispinal Vascular Malformations

Indications

Indications include adjunctive (preoperative) and/or palliative treatment when the patient suffers from neurologic or cardiac symptoms.

Efficacy

Indicators: The indicators of the efficacy of the endovascular management are technical and clinical success. Technical success is defined as occlusion of the targeted vessels. Clinical success is obliteration of the vascular malformation definitively or adjunctively or improvement or stabilization of symptoms.

Indicator	Threshold (%)
Technical	
Complete occlusion of lesion	50
Partial occlusion of lesion	80
Failure to occlude targeted vessels	10
Clinical	
Symptomatic improvement	<50

Safety

Indicators: When the following complications and corresponding thresholds are exceeded, a review should be conducted.

Indicator	Threshold (%)
Neurologic complications	
Death	0
Major deficit	5
Minor deficit	10
Transient deficit	20

Spinal Axis Tumor Embolization

Indications

The indications for embolization of hypervascular tumors of the spinal axis include decreasing surgical morbidity by reducing blood loss, shortening operative time, increasing the chance of complete resection, relieving intractable pain, reducing expected tumor recurrence, decreasing systemic toxicity of intra-arterial chemotherapy, stabilization of function, and sole treatment for a patient who is at poor risk for surgical therapy, radiation therapy, and/or chemotherapy.

The hypervascular tumor types for which embolization may be indicated include benign tumors (hemangiomas, aneurysmal bone cysts, osteoid osteomas, osteoblastomas, chondromas), malignant tumors (giant cell tumors, chordomas, osteogenic sarcomas, chondrosarcomas, hemangiopericytomas, lymphomas, multiple myelomas, plasmacytomas), metastatic tumors (renal cell carcinomas, thyroid carcinomas, other hypervascular metastases), and spinal cord tumors (hemangioblastomas).

Threshold: When <95% of the procedures are performed for the above indication, a review should be conducted.

Efficacy

Indicators: The indicators of the efficacy of the endovascular management are technical and clinical success. Technical success is defined as occlusion of the targeted vessels. Clinical success is decrease in expected blood loss during surgery or palliation of symptoms.

Indicator	Threshold (%)
Technical	
Failure to occlude targeted vessels	<10
Clinical	
Failure to reduce operative blood loss	<50
Palliation of symptoms	<50

Safety

Indicators: When the following complications and corresponding thresholds are exceeded, a review should be conducted.

Indicator	Threshold (%)
Neurologic complications	
Death	0
Minor deficit	3
Tissue necrosis and/or ulceration	5

Puncture site complications, allergic reactions to contrast media, and contrast media-induced nephropathy will be recorded in the angiography section.

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