Anesthesia for Endovascular Surgery

Adrian W. Gelb, MBChB, DA, FRCPC

Endovascular surgery or interventional radiology refers to treatments for diseases by the delivery of drugs or devices by endovascular access, most commonly arterial access. Uses include definitive treatments (aneurysms, stents, thrombolysis), adjuvant treatments (decreasing vascularity, functional testing), and palliative treatments (intraarterial chemotherapy). There has been a rapid increase in the use and success of these approaches and anesthesiologists are increasingly involved in caring for the patients. In many hospitals these procedures are mainly performed in the radiology department but surgeons are now learning these techniques so that appropriate angiographic equipment is being installed in operating theaters. Although cardiologists have led the way in many of these approaches, similar approaches are now being used for all parts of the vascular tree, e.g., aorta, renal and iliac arteries, and the venous system.

Functions of the anesthesiologist include 1) maintaining physiological stability; 2) maintaining patient immobility to improve the quality of images and/or treatment; 3) managing anticoagulation; 4) manipulating systemic or regional blood pressure; 5) treating unexpected complications, e.g., hemorrhage, vascular occlusion; 6) rapid emergence to allow early assessment; and 7) patient transport to and from the radiology suites.

The safe administration of anesthetic care in a remote location requires careful preparation. If you have not worked at the site before then visit the venue well in advance of starting the case. Also, speak with the interventionalist so as to have a clear understanding of what will be done, what position will be used, the duration of procedure, and expectations from anesthesia. Although surgeons are usually familiar with communicating significant complications to the anesthesiologist, this may not be the case with radiologists. Thus, establishing a communication pattern is vitally important.

Before starting, ensure that the following are available:

1) Oxygen, both piped and cylinders.
2) Suction that *reaches* the patient.
3) Anesthetic machine and supplies equivalent to the operating room.
4) Anesthetic cart with all the drugs usually available in the operating room.
5) Manual resuscitator bag (e.g., Ambu), resuscitation drugs and immediate availability of a defibrillator.
6) Extensions for the breathing circuit and IV lines; confirm adequacy of IV access before the arms are tucked.
7) *All* routine monitors.
8) Sufficient electrical outlets.
9) Adequate lighting.
10) Immediate (easy) access to the patient or a mechanism to achieve it.
11) Adequate and suitable padding for patient comfort and to prevent tissue injury.
12) Good and easy two-way communication with the radiology staff.
13) A way to rapidly call for help from anesthesia colleagues as well as equipment (e.g., intubation aids).

The choice of anesthetic technique varies among centers with no clear demonstrated superiority for any of them. However, there is an increasing trend towards general anesthesia as procedures are getting longer and more complex, and easily controlled immobility significantly reduces motion artifact in the images and may also allow more precise delivery of the treatment. The choice of general anesthetic technique should be guided by the pathology, comorbidities, and personal preferences. No specific agents have been shown to be superior. Both endotracheal intubation and laryngeal masks are successfully used. In procedures not involving the head and neck, the laryngeal mask airway is often a very suitable choice, but in head/neck procedures one should make sure how the head will be placed and/or moved. It is possible to transduce arterial blood pressure and obtain blood samples from the femoral arterial sheath but this is frequently damped by the intraarterial catheters, and it may be preferable to have a separate (radial) arterial catheter.

IV sedation can be used to relieve anxiety, pain, and discomfort while keeping the patient cooperative enough to breath-hold or be immobile when requested. For intraabdominal vascular procedures, regional techniques (epidural/spinal) supplemented by

sedation can also be used. The intra-arterial insertion of multiple catheters may cause limb ischemic pain which is well managed with a regional. Cerebrospinal fluid drainage may also form part of spinal cord protection during proximal aortic procedures. Proposed management of a bloody tap in a patient who will be anticoagulated needs to be discussed with all participants in advance. Care should be used with nasopharyngeal airways, as they may cause troublesome bleeding in anticoagulated patients.

Anticoagulation is required to prevent thromboembolic complications and the protocol to be used should be discussed in advance. After a baseline ACT, IV heparin as repeated boluses or an infusion is usually given so as to maintain the ACT at 2–3 times normal. Protamine should always be immediately available and, after communication with the interventionalist, should be given if there is hemorrhage and also at the end of the procedure as guided by ACT. In patients with heparin-associated thrombocytopenia direct thrombin inhibitors may be used. Sometimes antiplatelet drugs, e.g., abciximab, ticlopidine, are also given in the management of thromboembolic complications but their effects are usually long lasting and difficult to monitor, and reversal may require the transfusion of specific clotting factors.

Deliberate hypertension may be beneficial when there is acute arterial occlusion, including from emboli, and in patients with (cerebral) vasospasm. Depending on co-morbidities, an initial mean blood pressure increase of 30% using a phenylephrine infusion is a common approach. The aim is to try and improve collateral blood flow but this must always be weighed against the potential risk of producing hemorrhage into an evolving infarct. Hypotension is used much less frequently but is sometimes useful to test cerebrovascular reserve during trial occlusion and to slow flow during the injection of arteriovenous malformations.

Angioplasty and stents are increasingly also being used to treat carotid stenosis in lieu of carotid endarterectomy. Distension of the carotid artery may cause significant bradycardia, which usually responds to atropine or glycopyrrolate, but has been reported to require external pacing. Equipment for the latter must be immediately available. Other complications include thromboembolism, dissection, transient ischemic episodes, and stroke.

The injection of sclerosing agents such as absolute alcohol into congenital vascular abnormalities may be excruciatingly painful so that some are best done under general anesthesia. Lesions of the head and neck may be significant intubation challenges and all aspects of proposed management should be carefully evaluated and discussed in advance. Once injected the lesions often swell up enormously for 24–48 h and the patient may need to remain intubated and cared for in the intensive care unit. Preprocedural tracheotomy is rarely needed.

In conclusion, endovascular approaches to the treatment of disease is a rapidly growing field and will no doubt become a large component of our practices. The delivery of this care will take place in the operating room as well as potentially multiple sites around the hospital including the radiology, cardiology, and other departments. We need to strive to consolidate these activities or achieve a uniform level of care at all the remote sites.

Further Reading

Arepally A, Oechsle D, Kirkwood S, Savader SJ. Safety of conscious sedation in interventional radiology. Cardiovasc Intervent Radiol 2001;24:185–90.

Diringer MN. To clip or to coil acutely ruptured intracranial aneurysms: update on the debate. Curr Opin Crit Care 2005;11: 121–5.

Endovascular versus surgical treatment in patients with carotid stenosis. In: The Carotid and Vertabral Artery Transluminal Angioplasty Study (CAVATAS): a randomised trial. Lancet 2001; 357(9270):1729–37.

Fiorella D, Albuquerque FC, Han P, McDougall CG. Strategies for the management of intraprocedural thromboembolic complications with abciximab (ReoPro). Neurosurgery 2004;54:1089–9.

Harrigan MR, Levy EI, Bendok BR, Hopkins LN. Bivalirudin for endovascular intervention in acute ischemic stroke: case report. Neurosurgery 2004;54:218–22.

Hashimoto T. Interventional neuroradiology: anesthetic considerations. Anesthesiol Clin N Am 2002;20:347–59.

Haslam PJ, Yap B, Mueller PR, Lee MJ. Anesthesia practice and clinical trends in interventional radiology: a European survey. Cardiovasc Intervent Radiol 2000;23:256–61.

Jones M, Leslie K, Mitchell P. Anaesthesia for endovascular treatment of cerebral aneurysms. J Clin Neurosci 2004;11:468-70.

Hatsiopoulou O, Cohen RI, Lang EV. Postprocedure pain management of interventional radiology patients. J Vasc Interv Radiol 2003;14:1373–85.

Kemerink G, Frantzen M, Oei K, et al. Patient and occupational dose in neurointerventional procedures. Neuroradiology 2002;44: 522–528.

Kwon B, Han M, Oh C, et al. Procedure-related haemorrhage in embolization of intracranial aneurysms with Guglielmi detachable coils. Neuroradiology 2003;45:562–9.

Lai YC, Manninen PH. Anesthesia for cerebral aneurysms: a comparison between interventional neuroradiology and surgery. Can J Anaesth 2001;48:391–5.

Lee CZ. Physiologic monitoring and anesthesia considerations in acute ischemic stroke. J Vasc Interv Radiol 2004;15:S13–9.

Martin ML, Lennox PH. Sedation and analgesia in the interventional radiology department. J Vasc Interv Radiol 2003;14:1119–28.

McDermott VGM, Chapman ME, Gillespie I. Sedation and pateint monitoring in vascular and interventional radiology. Br J Radiol 1993;66:667–71.

Missant C, De Velde MV. Morbidity and mortality related to anaesthesia outside the operating room.. Curr Opin Anaesthesiol 2004; 17:323–7.

Molyneux A, Kerr R, Stratton I, et al. International Subarachnoid Aneurysm Trial (ISAT) Collaborative Group. International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised trial. Lancet 2002;360(9342): 1267–74.

Mueller PR, Biswal S, Halpern EF, et al. Interventional radiologic procedures: patient anxiety, perception of pain, understanding of procedure, and satisfaction with medication—a prospective study. Radiology 2000;215:684–88.

Mueller PR, Wittenberg KH, Kaufman JA, Lee MJ. Patterns of anesthesia and nursing care for interventional radiology procedures: national survey of physician practices and references. Radiology 1997;202:339–43.
Osborn IP. Anesthetic considerations for interventional neuroradiology. Int Anesthesiol Clin 2003;41:69–77.
Phatouros CC. Carotid artery stent placement for atherosclerotic disease: rationale, technique, and current status. Radiology 2000; 217:26–41.
Talke P. Intracranial vascular surgery. Curr Opin Anaesthesiol 2004; 17:357–361.
Watkinson AF, Francis IS, Torrie P, Platts AD. Commentary: the role of anaesthesia in interventional radiology. Br J Radiol 2002;75: 105–6.
Wieslander CK, Huang CC, Omura MC, Ahn SS. Endovascular workforce for peripheral vascular disease: current and future needs. J Vasc Surg 2002;35:1218–25.
Yadav JS, Wholey MH, Kuntz RE, et al. Protected carotid-artery stenting versus endarterectomy in high-risk patients. N Engl J Med 2004;351:1493–501.
Young WL. Anesthetic considerations for interventional neuroradiology. Anesthesiology 1994;80:427–56.