Anesthesia for Endovascular Surgery

Adrian W Gelb, MB, CHB, 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. Uses include definitive treatments (aneurysms, stents, thrombolysis), adjuvant treatments (decreasing vascularity, functional testing), and palliative treatments (intra-arterial 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 have mainly been done in the Radiology department, but surgeons are now learning these techniques, so that appropriate angiographic equipment is being installed in operating theaters. There is also an ever-expanding list of physicians who have joined the interventionalist ranks, including radiologists, vascular surgeons, neurosurgeons, neurologists, and cardiologists, thereby further increasing the number of possible venues. The medical backgrounds, the training, and the procedure location vary greatly. While cardiologist have led the way in many of these approaches, similar approaches are now being used for all parts of the vascular tree, arterial and venous.

Functions of the anesthesiologist include: 1) maintain physiological stability; 2) maintain patient immobility to improve the quality of images and/or treatment; 3) manage anticoagulation; 4) manipulate systemic or regional blood pressure; 5) treat 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. Unlike surgeons who are usually familiar with communicating significant complications to the anesthesiologist, this may not be the case with other interventionalists. Thus establishing a communication pattern is vitally important.

Before starting, ensure that the following are available:

- O_2 both piped and cylinders
- suction that *reaches* the patient
- anesthetic machine and supplies equivalent to the operating room
- anesthetic cart with all the drugs usually available in the OR
- manual resuscitator bag (e.g., Ambu), resuscitation drugs and immediate availability of a defibrillator
- extensions for the breathing circuit and IV lines; confirm adequacy of IV access before the arms are tucked
- *all* routine monitors
- sufficient electrical outlets
- adequate lighting
- immediate (easy) access to the patient or a mechanism to achieve that
- adequate and suitable padding for patient comfort and to prevent tissue injury
- good and easy two way communication with the radiology staff
- 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 of any of them. However, there is an increasing trend toward general anesthesia, as procedures are getting longer due to complexity. 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 LMA 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 intra-arterial catheters, and it may be preferable to have a separate (radial) arterial catheter.

Intravenous 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 intra-abdominal 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. CSF 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 hard to monitor or reverse.

Deliberate hypertension may be beneficial when there is acute arterial occlusion, including from emboli, and in patients with (cerebral) vasospasm. The aim is to try and improve collateral blood flow. 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 also increasingly 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.

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 OR as well as potentially multiple sites around the hospital, including 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.

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AUTHOR QUERIES

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