



## Review article

### Anesthesia in Interventional Radiological Procedures – A Review

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#### ABSTRACT

Interventional radiology (IR) came a long way in the path of development of minimally invasive therapies. Need for anesthesia and sedation for some of these procedures have increased as it cause significant discomfort to the patient and requires patient immobility. As recommended by The Royal College of Radiologists and the Joint Commission for Accreditation of Healthcare Organizations, use of sedation anywhere within the hospitals should be under the direct monitoring and vigilance of Department of Anesthesiology. There are a few procedures in interventional radiology that are performed under sedation or monitored anesthesia care but general anesthesia provides improved visualization of structures, temporary apnea and absence of patient movements, optimal image acquisition and treatment delivery. The purpose of IV sedation is not just to provide analgesia and comfort to the patient, anxiolysis and ensure that the patient does not move but also to rapidly reduce sedation when neurologic testing is required.

**KEY WORDS:** Anesthesia, Interventional radiology, sedation, Monitored anesthesia care.

#### INTRODUCTION

Interventional radiology (IR) came a long way in the path of development of minimally invasive therapies. [1] Need for anesthesia and sedation for some of these procedures have increased as it cause significant discomfort to the patient and requires patient immobility. An interventional radiologist is a practitioner of radiology who performs minimally invasive procedures using imaging guidance such as fluoroscopy, CT scan and ultrasound. Insertion of catheters and guide wires for performing procedures such as biopsies, collection of draining fluid or abscesses, insertion of drainage catheters and dilatation and stenting of narrowed ducts or vessels.

The role of interventional radiologist in other fields has significantly increased especially : hepatobiliary (84%), vascular (82%), cancer (68%), Gynecology (61%), neuroradiology (23%) and miscellaneous (25%) [1]. In 88% of the departments, a dedicated person, which may be a nurse (52%), radiologist (41%), anesthetist (35%) and others (10%), provides sedation. Half of the departments have a sedation protocol and 49% of departments require a competency-based training for giving sedation. 20% of departments have a lead anesthetist responsible for IR. 52% of the IR lists have anesthetic cover and 81% of them have a

dedicated anesthetic assistant. As recommended by The Royal College of Radiologists and the Joint Commission for Accreditation of Healthcare Organizations, use of sedation anywhere within the hospitals should be under the direct monitoring and vigilance of Department of Anesthesiology [2].

When attempting technically challenging procedures, the need of anesthesia professionals who can provide pain relief, anesthesia and make appropriate decisions for the safety of the patient is the need of the hour. Critical conditions where interventional radiology is used increasingly such as vascular insult, ischemic limbs, gastrointestinal, variceal or gynecological hemorrhage, hepatobiliary and renal drainage in septic patients, it seems compulsory to have a professional as one individual cannot concentrate on resuscitation and technically challenging radiological procedure.

A mailed questionnaire survey among Belgian interventional radiologists revealed that a trained anesthetist was present 54% of the time while giving sedation for the procedure. [3] General anesthesia is usually reserved for neuroradiological procedures (82%), transjugular intrahepatic portosystemic shunt (TIPS) (56%) and aortic stent grafting (70%).

The procedures are rarely carried out in operation theatre and are often done in

a. Cardiac catheterization lab (Angioplasty and Stenting, Thrombolysis, Inferior Vena Cava filter placement and removal, IABP insertion, Device closure, CMV, Pacemaker implantation etc.)

b. Interventional neuroradiology (Aneurysm embolization, Thrombolysis, Cerebral angioplasty & stent placement, Epidural drug injections, Chemoembolization etc.)

c. Others (Biliary interventions, Chemoembolization, Cryotherapy, Thoracostomy, Catheter embolization, Dialysis and Fistula/Graft Declotting and Interventions, Nephrostomy & stenting, Biopsy, Foreign body retrieval, Chest interventions, TIPS, Vascular access, Nerve blocks, Radiofrequency ablation of tumors, Sclerotherapy, Kyphoplasty & vertebroplasty, Peritoneal ports, Percutaneous abscess drainage etc.)

Procedures done for intracranial vascular pathologies such as embolization of vascular tumors and arterio-venous malformations (AVM), coiling of cerebral aneurysms and balloon occlusion of arteries of some vascular lesions.

## **ANAESTHETIC CONSIDERATIONS**

### **Pre-anesthetic Checkup**

All patients in whom interventional radiological procedure is to be done, requiring anesthesia must be seen by the anesthesiologist and a thorough preanesthetic checkup should be done. History of DM, IHD, Hypertension, Renal impairment & status of their optimization, possibility of pregnancy & reaction to radio contrast dyes should be taken into consideration. Relevant physical examination and lab investigations should be done & informed consent be taken.

### **Monitoring:**

Monitoring should be done in the same standard as in operation room (OR) such as electrocardiogram (ECG), pulse oximetry, noninvasive blood pressure (NIBP), capnography and temperature monitoring [4]. Indications for arterial line cannulation and monitoring of arterial sample includes induced hypotension or hypertension, neurosurgical procedures, haemodynamically unstable patients and patients requiring frequent activated clotting time (ACT) monitoring. [5] CVP cannulation should be done in patients having serious co-morbidities or are haemodynamically unstable requiring vasoactive drug infusions. [5]

Neurological monitoring that includes electroencephalogram, somatosensory and motor evoked potentials, transcranial Doppler ultrasound etc. might be indicated in monitoring central nervous system functions during the procedure. Bladder catheterization is required for urine output monitoring.

## **Choice of Anesthesia techniques**

The anesthetic considerations for endovascular interventional neurological procedures are very much similar to traditional neurosurgery. As the cranium is not opened the management of intracranial pressure is very challenging. Blood pressure, intravascular volume and PaCO<sub>2</sub> should be managed aggressively. [5] Rapid hemodynamic control and prompt emergence from anesthesia is the key. [6, 7] There are a few procedures in interventional radiology that are performed under sedation or monitored anesthesia care but general anesthesia provides improved visualization of structures, temporary apnea and absence of patient movements, optimal image acquisition and treatment delivery such as embolization of AVM or coiling of aneurysm. [8, 9]

Getting a good IV access is a must before starting general anesthesia or monitored anesthesia care (MAC) is a must. Two intravenous cannula of at least one greater than 18 G or more is needed for major surgeries.[10] Triway connector with long extension tubing provides easy access to the IV line for bolus injections. The time and dose of heparin should be recorded as in case of aneurysm or vessel rupture antagonism of heparin with protamine sulphate may be required (1mg/100units of heparin). A better control over the airway, an immobile patient, good control over raised intracranial tension and enhanced cerebral protection are the advantages with general anesthesia. [6]

**Controlled ventilation can be achieved with ETT and spontaneous ventilation with LMA can be also tried.**

### **Induced hypotension**

To decrease the blood flow in the feeding artery before injecting glue for embolization of AVM, hypotension is induced. [8] Drugs like sodium nitropruside, nitroglycerine, esmolol, labetalol and diltiazem may be used.

### **Blood pressure augmentation**

In order to maintain the circulation in ischemia prone area by adequate flow through collaterals, systemic blood pressure needs to be increased. [11] Phenylephrine (1 µ/kg) bolus is used followed by infusion titrated to desired blood pressure of 30-40% above baseline. [8] ECG monitoring should be done for signs of myocardial ischemia. Dopamine infusion can be used in patients with slow heart rate and when phenylephrine is not available. [10] In absence of adequate collateral pathways deliberate hypertension may not provide desired results. [11]

### **Sedation and monitored anesthesia care (MAC)**

The purpose of IV sedation is not just to provide analgesia and comfort to the patient, anxiolysis and ensure that the patient does not move but also to rapidly reduce sedation when neurologic testing is required. A multimodal method using Midazolam 1 mg bolus, Fentanyl 1-2 mcg/kg, followed by a Propofol infusion at 10 – 25 mcg/kg/min very commonly used. [8] Various complications seen during

MAC are shivering, airway patency and respiratory depression, and other cardio respiratory complications.

### Post Operative Management

Emergence after AVM embolization and coiling of aneurysms is very crucial. Rapid and smooth emergence without any hemodynamic swings, coughing, or straining leading to increases in intracranial pressure is very important. [12] Sudden increase and blood pressure and straining and coughing may cause intracranial hemorrhage. [7] Patient should be shifted to post anesthesia care unit (PACU) for further recovery. A PACU should be well equipped with trained staff, monitoring facilities and resuscitation equipment. [8] Some patients require intensive care after endovascular neurological procedures. Such patients should be transferred to ICU, HDU or PACU under the supervision of the anesthesiologist and ECG blood pressure and SpO<sub>2</sub> should be monitored during the transfer. [7]

Post operatively the cases of AVM should be maintained on a lower BP and those with occlusive disease and cerebrovasospasm should have a BP on higher side. [11] Continuous monitoring of neurological status and airway of the patient should be done. Anticoagulation with heparin 3000-5000 units IV bolus followed by 1000 units per hour to maintain an ACT of 2.5X baseline ACT.

### Complications and their Management

Intracranial hemorrhage and thromboembolic stroke are the two most common and serious complication of interventional neuroradiology procedures. [8] The incidence of the same during coiling of cerebral aneurysms is around 2.4 and 3.5% and during AVM embolization it is 1-8%. [12, 13] If some neurological complication occurs, it is the primary responsibility of the anesthesiologist to secure the airway, maintain oxygenation and circulation of the patient. [9, 12] In case of severe hemorrhage, heparin should be reversed with protamine 1mg for every 100 units heparin and further protamine requirement should be guided by ACT. [5]

In case of hemorrhage blood pressure should be kept low and once the bleeding has stopped it should be kept slightly high. [8] If vascular occlusion occurs, deliberate hypertension is induced to maintain distal perfusion during and post procedure. [10] Anaphylactic reactions to contrast material have decrease after increased use of non ionic agents however patients with such history should be given steroids and anti histaminic before the procedure. [7, 14]

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