Session: L031
Session: L091

Why Does My Patient Scheduled for Endoscopic Sinus Surgery Have Severe Groin Pain?

Kirk Lalwani, M.D., F.R.C.A and Christine S. Martin, M.D.
Oregon Health and Science University, Portland, OR

Disclosures: These presenters have no financial relationships with commercial interests

Stem Case and Key Questions Content

A 15 year-old male is scheduled for endoscopic sphenoid sinusotomy and nasal tumor removal. He underwent an angiogram and embolization of the tumor the day before. You are paged from the preoperative area because the patient is complaining of severe groin pain that began at 2am. Your examination shows tenderness with palpation, no swelling, and intact distal pulses.

1. What are the anesthetic considerations for angiography, and specifically, for embolization and sclerotherapy?

2. What is your differential diagnosis of the groin pain?

3. What are the immediate and delayed post-operative complications of angiography?

4. What are the management options for the most common complications after an angiogram?

After appropriate management of the groin pain you then proceed with the operative case. Induction and intubation are uneventful. Part way through the case there is brisk bleeding in the surgical field that limits the surgeon's ability to proceed with the tumor resection. The patient's blood pressure is 130/70 and the surgeon requests a hypotensive anesthesia regimen.

5. Describe a hypotensive anesthetic regimen and debate the risks and benefits of this regimen.

6. What monitors should be used when performing a hypotensive anesthetic?

7. What are the hemodynamic goals of a hypotensive regimen?

There is improvement in the operative conditions and the case proceeds. At the end of the case the surgeon requests that the patient not cough during emergence and extubation.

8. What are the available techniques for minimizing the risk of coughing during emergence and extubation? Discuss their pros and cons in this scenario.

Thirty minutes after his arrival in the recovery room you are notified that the patient has new right eye pain. Attempts are made to contact the surgeon and your exam shows diminished pupillary reactivity to light and decreased visual acuity.

9. What are the most serious complications after endoscopic sinus surgery?

10. Describe the ophthalmologic complications after endoscopic sinus surgery. What assessments should be done to evaluate for these complications?

11. What are the management options for ophthalmologic complications after endoscopic sinus surgery?

The surgeon is notified of the patient's symptoms. A retrobulbar hematoma is suspected, and because of the patient's change in vision, immediate surgical decompression is required.

Model Discussion Content

Anesthesia for Angiograms

Anesthesia in remote locations poses difficulties related to an unfamiliar location, limited availability of backup anesthesia equipment and staff, as well as additional equipment in the room that frequently changes position. When developing the anesthetic plan for angiography, one must pay close attention to the physical examination, especially the airway. Manipulation of the airway may be more difficult because of the positioning of imaging equipment. Furthermore, difficult airway equipment may not be immediately available in the vicinity. A patient's ability to lie flat should also be evaluated. A history of allergic reaction to contrast should be obtained. A reliable peripheral IV should be placed in order to administer contrast agents if needed. As angiograms are performed outside of the operating room, special attention should be paid to communication with other staff members in the radiology department. Patient immobility may be required, especially if interventions such as embolization or sclerotherapy are planned. Therefore general anesthesia or an awake, cooperative patient may be required. Other factors that may influence the decision to use general anesthesia versus sedation for angiograms include the patient's age, mental status, ability to cooperate and history of pulmonary disease. Procedural factors such as duration and patient positioning should also be considered. Regardless of anesthetic technique, standard ASA monitors are required for all patients. Invasive arterial pressure monitoring is also recommended for all intracranial procedures and those needing post-operative blood pressure monitoring or frequent laboratory blood samples. If arterial cannulation is difficult, then a side port of the femoral artery introducer sheath can be used to monitor the arterial pressure. Deliberate manipulation of the blood pressure may be required during the procedure, such as inducing hypertension during periods of vessel occlusion or spasm[1]. Hypotension may be needed to decrease blood flow in an arteriovenous malformation (AVM) prior to injection of liquid embolizing agent.

Embolization

Embolization can be performed using a variety of embolic materials, which can be divided into two categories: solid agents and liquid agents. Solid agents include coils, PVA particles, detachable balloons, and gelfoam. Coils are usually made of platinum and are most commonly retrievable coils so they can be repositioned or removed[1]. The preferred agents for preoperative embolization of tumors are Polyvinyl Alcohol (PVA) particles. They produce temporary occlusion of blood vessels lasting from a few days to weeks. They can also be used to embolize some types of vascular malformations and fistulae. Liquid agents used for coiling are n-butyle-2-

cyanoacrylate (NBCA) and ethylene vinyl alcohol (EVOH). Because these materials are non-adhesive, injection may need to take place over several minutes. Advantages of liquid agents over solid agents include its ability to reach difficult anatomical locations and penetrate larger number of feeding vessels in one injection[1]. After embolization of an AVM, the interventional radiologist may request modest hypotension to prevent cerebral edema and hemorrhage. In this case, the goal should be to keep the mean arterial pressure 15-20% below the patient's baseline for 24 hours.

Sclerotherapy

Sclerotherapy can be used to treat vascular and lymphatic malformations. Commonly used agents include 100% alcohol and 3% sodium tetradecyl sulphate (STS). Injection of these agents can cause complications, especially injury to the skin and nerves. A retrospective study of 24 patients that received sclerotherapy found that seven patients experienced complications directly related to the injection sclerotherapy procedure[2]. Nerve palsies caused by nearby sclerosant injection resolved over time. Skin ulcerations caused by sclerosant extravasation were managed conservatively and all eventually healed.

Angiogram Complications

Vascular access site-related complications include hematoma formation, retroperitoneal hemorrhage, pseudoaneurysm formation, AVF creation, acute thrombosis, distal embolization, dissection and infection. Early complications include bleeding, hematoma and retroperitoneal hemorrhage.

A) Bleeding & Hematoma

Bleeding from the access site is the most frequent complication after accessing the femoral artery. However, their incidence has decreased significantly since the mid 1990s. This is likely due to the use of smaller sheaths, careful administration of anticoagulation intra-operatively and decreased use of heparin post-operatively[3]. Signs of hemorrhage and hematoma are usually evident within 12 hours and include local discomfort, local swelling, hypotension and decreasing hematocrit. Hematomas can cause femoral nerve compression, which can take weeks or months to resolve. Surgical repair may be required if the hematoma is expanding despite compression or if there is potential for skin necrosis.

B) Retroperitoneal Hemorrhage (RPH)

A retroperitoneal space hemorrhage (RPH) is the most life-threatening complication seen after accessing the femoral vessels. It can occur if the arterial puncture occurs above the inguinal ligament. The patient may present with hypotension and ipsilateral flank pain. It typically presents within 3 hours after the catheterization procedure[3]. One patient series reported that three fourths of patients with RPH require blood transfusions and 16% require operative management. It also carries a 10% mortality rate[3]. Reversal of systemic anticoagulation may be necessary if bleeding persists or is associated with hemodynamic instability.

C) Arteriovenous Fistula

More delayed complications, such as arteriovenous fistula and pseudoaneurysm, may not become apparent for days to weeks after the angiogram. An arteriovenous fistula forms when ongoing bleeding from the arterial puncture site decompresses into the adjacent venous puncture site. It is rarely symptomatic. Physical exam may show the presence of a thrill or continuous bruit at the site of catheter placement. The diagnosis should be confirmed with

Doppler ultrasound. These can be treated conservatively, endovascularly (stent, coil) or surgically.

D) Pseudoaneurysm

A pseudoaneurysm occurs when a hematoma remains in continuity with the arterial lumen. This results in movement of blood into and out of the hematoma cavity during systole and diastole. A common sign of a pseudoaneurysm is a pulsatile mass with a systolic bruit over the catheter insertion site. The vast majority of pseudoaneurysms occur within the first three days after removal of the arterial sheath. The few remaining cases develop by seven days after sheath removal. Options for the treatment of smaller pseudoaneurysms include either direct ultrasound-guided compression or ultrasound-guided local injection of thrombin or collagen into the pseudoaneurysm cavity. The success rate of ultrasound-guided injection of bovine thrombin was investigated in a series of 240 patients with simple or complex pseudoaneurysms[4]. The primary success rate was 96 percent with simple pseudoaneurysms and 89 percent with complex pseudoaneurysms. Furthermore, a review of 34 studies with 1388 patients found the overall success rate to be 97.2%[4]. Surgical repair of a pseudoaneurysm may be required if it becomes very large, rapidly expands, appears infected, causes skin necrosis or there is failure of minimally invasive management.

Hypotensive Anesthesia

The standard hypotensive anesthetic technique during ESS involves lowering the blood pressure below the pre-anesthetic mean value and to position the patient at 15° in reverse Trendelenburg position to reduce venous congestion[6]. However, this is not without risk because prolonged decreased cerebral perfusion may result in neurological damage associated with personality changes, cerebrovascular accidents and even death.

A) Anesthetic Techniques

A variety of techniques are available to induce hypotension under anesthesia. Some regimens use agents that also produce cerebral vasodilation, such as isoflurane and nitroprusside. Increasing the concentration of inhaled anesthetic delivered will result in hypotension by increasing peripheral vasodilation and decreasing myocardial contractility. Controlled hypovolemia and infusions of nitroglycerin or nicardipine are other techniques used to induce hypotension.

Boezaart and colleagues compared the use of esmolol infusions versus sodium nitroprusside infusion for inducing and maintaining controlled hypotension in 20 patients undergoing endoscopic sinus surgery. They reported better operative conditions at a higher mean arterial blood pressure (MABP) in the esmolol group compared with the sodium nitroprusside group[5]. Ideal surgical conditions were achieved in the esmolol group at MABP >65 mmHg[5]. In the sodium nitroprusside group, a MABP of 50-54 was needed to provide an adequate surgical field[5]. Administering a pre-medication of metoprolol, a beta-blocker, was studied in eighty patients scheduled for functional endoscopic sinus surgery (FESS)[6]. Patients in the beta-blocker group received 100mg of metoprolol prior to induction. The study did not find a difference in surgical field bleeding between the two groups. However, it demonstrated better operative conditions in subjects with a lower mean heart rate (less than 60 BPM)[6].

B) Monitoring and Hemodynamic Goals

Standard ASA monitors are mandatory, even for patients who receive sedation alone. Placement of an intra-arterial line is dependent on the degree and duration of induced

hypotension as well as the patient's comorbidities.
The hemodynamic goals should be to provide an optimized surgical field while ensuring the patient has adequate perfusion to all end organs, especially the brain, heart and kidneys. The specific blood pressure target will vary greatly from patient to patient depending on his or her age and baseline blood pressure. Knowing the patient's pre-operative baseline blood pressure is mandatory for performing induced hypotension.

Techniques for Blunting Coughing Reflexes

There are various anesthetic techniques that can be utilized to minimize coughing during emergence from general anesthesia with tracheal intubation. In pediatrics, a deep extubation is commonly used to avoid coughing. Administration of short-acting narcotics, such as fentanyl, alfentanil or remifentanil, can also serve to blunt coughing reflexes. Lee and colleagues utilized a group of 29 patients to determine the ED95 of alfentanil to suppress coughing during emergence after a general anesthetic with desflurane. A dose of 14.0 mcg/kg was the calculated 95% effective dose of alfentanil needed to suppress coughing during emergence[7]. Administration of lidocaine is another option for cough suppression during emergence. Lidocaine can be administered intravenously, topically or placed in the cuff of the endotracheal tube. A study published in 2011 investigated the utility of 2% lidocaine placed in the cuff of the endotracheal tube to suppress coughing during emergence. A group of 50 patients, all of whom were smokers, were randomized to an ETT cuff filled with lidocaine or saline[8]. Coughing during emergence occurred less often in the lidocaine group (28%) than the saline group (80%), which was a statistically significant difference ($P<0.001$)[8]. Topical lidocaine has also been studied as a technique to minimize coughing during extubation. In one study, 50 patients received either endotracheal lidocaine 160mg or placebo prior to intubation[9]. When compared to placebo, the lidocaine group and a lower incidence of coughing both before (26% versus 66%, $P<0.01$) and after (4% versus 30%, $P<0.022$) tracheal extubation[9].

Complications after Endoscopic Sinus Surgery (ESS)

Early series have reported major complications in 1-2% of patients undergoing endoscopic sinus surgery. May and Levine published results from a series of 2108 patients undergoing ESS. The rate of major complications was 0.85%, with minor complications occurring at a rate of 6.9%[10]. These complications can be divided into categories of bleeding, infection and damage to adjacent structures. Bleeding complications include intraorbital hemorrhage, intracranial hemorrhage, retrobulbar hematoma and hemorrhage requiring blood transfusion. The most serious possible infections are meningitis and brain abscess. Structural damage can be further divided into ophthalmologic and neurologic injuries. There are also a variety of minor complications that may occur after ESS including bronchospasm, and periorbital edema or ecchymosis.

A) Ophthalmologic Complications

Ophthalmologic injuries include damage to the optic nerve, ocular muscle injury and lacrimal duct obstruction requiring surgical correction. The most common major orbital complication is an orbital or retrobulbar hematoma. In the May and Levine series this complication occurred at a rate of 0.05%[10]. Clinical findings of a hematoma include proptosis, pain around the eye and dilation of the pupil with decreased reactivity to light[10]. If an orbital hematoma is suspected, orbital massage should be initiated and pressures measured with an ophthalmometer[11]. Orbital hemorrhage can also occur during surgery while the patient is under general anesthesia. To determine the threat of visual loss the pupillary reflexes, degree of proptosis, orbital firmness,

and the presence of retinal artery pulsation should be evaluated.
A limited orbital hemorrhage that produces only mildly elevated intraocular pressure and mild proptosis without compromised vision can be managed medically. Medical treatment options include diuretic agents (intravenous mannitol or acetazolamide), topical drugs to lower the intraocular pressure, and systemic corticosteroids[12]. These should be continued for 24-48 hours to reduce the intraocular pressure and improve orbital compliance and proptosis. If the patient's vision is compromised by the hematoma, surgical decompression is required within 60-90 minutes to prevent permanent loss of vision.

The optic nerve is vulnerable to injury during operations involving the ethmoid and sphenoid sinuses. Damage to the nerve can occur with direct trauma or indirect damage, which can occur with orbital hemorrhage. Optic nerve injury can result in either immediate or delayed blindness. Unfortunately, there is no proven treatment for damage to the optic nerve. According to a meta-anlysis of 244 case reports, patients with optic nerve injury have benefited from intravenous corticosteroids and optic canal decompression[12].
If diplopia occurs after ESS, the patient should be evaluated for damage to the medial rectus or superior oblique muscles. An examination of ocular motility should be performed. Additional imaging, such as an orbital CT or MRI should be performed if a patient has a deficit in ocular motion after FESS. This imaging will help identify the location and severity of the injury to the extraocular muscles These injuries are usually caused by direct trauma to the muscle tissue. The medial rectus muscle is the most vulnerable to injury because it is adjacent to the thin lamina papyracea[12]. Management of these injuries varies depending on the location and severity, but often includes a course of systemic corticosteroids to minimize inflammation and scarring.

B) Neurologic complications-
Neurologic complications consist of cerebrospinal fluid leak, dural injury and intracranial penetration. Major intracranial complications occur when there is penetration of the floor of the anterior cranial fossa. When this occurs, it can cause meningitis, cerebral abscess, focal cerebral hemorrhage and CSF leak. The "washout sign" can occur when a defect in the dura is created and clear CSF fluid washes away blood from the ethmoid sinus roof.

References

1.
Varma MK, Price K, Jayakrishnan V, Manickam B, Kessell G. Anaesthetic considerations for interventional neuroradiology. Br J Anaesth. 2007 Jul;99(1):75-85. Epub 2007 Jun 11. Review. PubMed PMID: 17562678.
2.
Odeyinde SO, Kangesu L, Badran M. Sclerotherapy for vascular malformations: complications and a review of techniques to avoid them. J Plast Reconstr Aesthet Surg. 2013 Feb;66(2):215-23. doi: 10.1016/j.bjps.2012.09.002. Epub 2012 Oct 8. PubMed PMID: 23059134.
3.
Stone PA, Campbell JE. Complications related to femoral artery access for transcatheter procedures. Vasc Endovascular Surg. 2012 Nov;46(8):617-23. doi: 10.1177/1538574412457475. Epub 2012 Sep 11. Review. PubMed PMID: 22968347.
4.
Krueger K, Zaehringer M, Strohe D, Stuetzer H, Boecker J, Lackner K. Postcatheterization

pseudoaneurysm: results of US-guided percutaneous thrombin injection in 240 patients. Radiology. 2005 Sep;236(3):1104-10. Epub 2005 Jul 29. sPubMed PMID: 16055694.
5.
Boezaart AP, van der Merwe J, Coetzee A. Comparison of sodium nitroprusside- and esmolol-induced controlled hypotension for functional endoscopic sinus surgery. Can J Anaesth. 1995 May;42(5 Pt 1):373-6. PubMed PMID: 7614641.
6.
Nair S, Collins M, Hung P, Rees G, Close D, Wormald PJ. The effect of beta-blocker premedication on the surgical field during endoscopic sinus surgery. Laryngoscope. 2004 Jun;114(6):1042-6. PubMed PMID: 15179210.
7.
Lee MG, Chang YJ, Park JM, Park HY. The clinical effective dose of alfentanil for suppressing cough during emergence from desflurane anesthesia. Korean J Anesthesiol. 2011 Oct;61(4):292-6. doi: 10.4097/kjae.2011.61.4.292. Epub 2011 Oct 22. PubMed PMID: 22110881; PubMed Central PMCID: PMC3219774.
8.
Navarro LH, Lima RM, Aguiar AS, Braz JR, Carness JM, Módolo NS. The effect of intracuff alkalinized 2% lidocaine on emergence coughing, sore throat, and hoarseness in smokers. Rev Assoc Med Bras. 2012 Mar-Apr;58(2):248-53. PubMed PMID: 22569622.
9.
Minogue SC, Ralph J, Lampa MJ. Laryngotracheal topicalization with lidocaine before intubation decreases the incidence of coughing on emergence from general anesthesia. Anesth Analg. 2004 Oct;99(4):1253-7, table of contents. PubMed PMID: 15385385.
10.
May M, Levine HL, Mester SJ, Schaitkin B. Complications of endoscopic sinus surgery: analysis of 2108 patients--incidence and prevention. Laryngoscope. 1994 Sep;104(9):1080-3. PubMed PMID: 8072353.
11.
Maharshak I, Hoang JK, Bhatti MT. Complications of vision loss and ophthalmoplegia during endoscopic sinus surgery. Clin Ophthalmol. 2013;7:573-80. doi: 10.2147/OPTH.S40061. Epub 2013 Mar 20. PubMed PMID: 23658475; PubMed Central PMCID: PMC3607413.
12.
Bhatti MT, Stankiewicz JA. Ophthalmic complications of endoscopic sinus surgery. Surv Ophthalmol. 2003 Jul-Aug;48(4):389-402. Review. PubMed PMID: 12850228.

