Anesthetic Management of Posterior Communicating Artery Aneurysm Clipping

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Learning Objectives

- Identify the important anesthetic considerations for patients with intracranial aneurysms
- Discuss potential adverse outcomes and treatments
- Discuss management of cross clamping the internal carotid artery

INTRODUCTION

Intracranial aneurysms present a significant risk to patients due to the possibility of a subarachnoid hemorrhage (SAH). This is an immediate, life-threatening complication with a very high rate of morbidity and mortality. Endovascular coiling in the IR suite is the typical treatment for intracranial aneurysms, but surgical clipping via open craniotomy is necessary in some. Precise management of these patients when they present for surgery is crucial to ensure adequate cerebral perfusion while avoiding rupture. This case highlights the importance of coordination between the surgical, anesthesia, and neuromonitoring teams to ensure the best outcome for the patient.

CASE REPORT

A 63-year-old female presented for a posterior communicating artery (PCA) aneurysm clipping that was endovascularly coiled in 2011. Past medical history was significant for COPD and the previous aneurysm. Induction was performed with fentanyl, propofol, rocuronium, and phenylephrine prior to intubation. After induction, a radial arterial line and 2 16G IVs were placed. Infusions of remifentanil and propofol were used to maintain anesthesia with phenylephrine and nicardipine infusions used to maintain desired hemodynamics. Muscle relaxants were not used after induction to facilitate neuromonitoring of MEPs. Serial blood gases were drawn throughout the case with the initial samples showing elevated and increasing $PaCO_2$ levels. This was treated with increased minute ventilation along with a blood transfusion due to declining hemoglobin levels. After exposure of the dura, mannitol was administered to facilitate surgical exposure of the brain. Urine output was tracked with a foley catheter to ensure adequate replacement of losses. Brief periods of burst suppression with controlled hypertension (MAPs 100-120) were requested by the surgeon when clamping the internal carotid artery to facilitate confirmation of aneurysm clipping. This was achieved by increasing the rate of the propofol infusion along with a bolus.

CASE REPORT

At the end of the case, the patient was extubated in the OR to facilitate a preliminary neurological exam before transportation to the ICU. The patient was later reintubated in the ICU due to agonal respirations and CT was acquired due to unresponsive left pupil but was clear. Attributed to CN III manipulation. Patient was extubated the next evening and discharged from the hospital on postop day 6. She has recovered well since discharge from the hospital with only CN III palsy remaining.

Figure 1

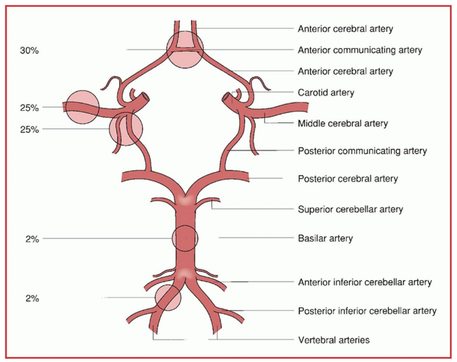
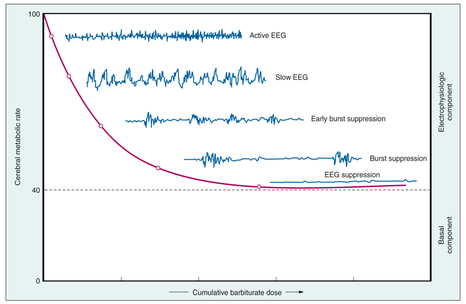


Figure 2



DISCUSSION

The primary complication of concern for these procedures is SAH resulting from rupture of the aneurysm as it will quickly lead to death. Intra-arterial BP monitoring aided us in recognizing and quickly treating fluctuations in BP. Infusions and boluses of nicardipine were used to treat hypertension due to the quick onset and short duration of the medication. Phenylephrine was additionally used to augment cerebral perfusion pressure as needed. Postoperative neurological dysfunction is a large risk to any patient undergoing an open craniotomy. To reduce this risk, full neuromonitoring (SSEPs, MEPs, and EEG) was used. Studies have not shown one agent, intravenous or inhalational to be superior to other options for neurosurgery, though volatile anesthetics should be minimally used when measuring MEPs. The choice of anesthetic should be directed by patient comorbidities, additional monitoring required, and provider preference. Our choice of propofol and remifentanil was due to familiarity and the ability to facilitate a quick emergence to conduct a neurological exam to identify deficits. After opening of the dura, surgeons typically request mannitol be given to facilitate brain relaxation and improve exposure. The ensuing diuresis was tracked by urine output and replaced 1:1 with crystalloid to maintain normovolemia. When isolating and placing the clips over the neck of the aneurysm the internal carotid artery was clamped for brief periods to facilitate limited flow and reduce the chance of uncontrolled hemorrhage. Throughout this time there is significant risk of ischemia to the portions of the brain downstream from the point of clamping. The total time was 21 minutes over 2 periods. To aid in reducing the ischemic effect, systolic blood pressure was elevated to 150+ with MAPs >100 to facilitate collateral perfusion throughout the brain. Additionally, a large bolus of propofol and an increased infusion rate was used to achieve burst suppression on the EEG. This was to reduce $CMRO_2$ to near basal levels, but it has only been shown to be effective when temporary clamp time is >10 mins. Decreasing body temperature could've additionally been employed to reduce the basal portion of $CMRO_2$, but it was not employed for this case. Once the position of the clips had been confirmed with contrast angiography the surgeon began to close. The goals for emergence are a quick wakeup allowing a neurological exam, but one that puts minimal stress on the newly clipped aneurysm or increases in blood pressure. Remifentanil was our choice to manage this as it will metabolize quickly while giving time to administer longer acting medications once the neurological exam has been completed. Although there is great care taken to prevent rupture of the aneurysm, a thorough anesthetic plan must include a plan for if it were to occur.

DISCUSSION

In the event of rupture, immediate action must be taken by the surgeon to get the hemorrhage under control. The anesthesia provider can assist with controlled hypotension. Drastic measures like stopping the heart with adenosine can be performed in life-threatening scenarios. Additional intraoperative considerations including the trend of Na+ on ABGs along with urine output. Serial ABGs showing Na+ increasing above 145 with significant urine output should quickly lead the diagnosis of diabetes insipidus and should be treated with a desmopressin or vasopressin infusion. Syndrome of Inappropriate ADH (SIADH) and cerebral salt wasting (CSW) are possible as well during neurosurgery. These will present with hyponatremia and are differentiated based on volume status. SIADH will have hypervolemia while CSW will have hypovolemia, although treatment for each is to restore Na+ levels while correcting volume issues.

CONCLUSIONS

Although most intracranial aneurysms are managed via endovascular coiling, some may require craniotomy, especially if there is recurrence. Craniotomies to repair these aneurysms require a combination of vascular surgery and neurosurgery leading to complex cases for the anesthesia provider. While there are many considerations, the most important are the tight management of the blood pressure and protection of the brain during surgical exposure and clamping of the arteries during clipping. Employing a full TIVA with propofol and remifentanil allowed us to account for these considerations, getting the patient safely through surgery and into the postoperative stage.

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