

Anesthesia Protocols for Neurosurgery:

Craniotomy for Aneurysm

Purpose: intracranial aneurysms are outpouchings of weakened vessel wall that are at risk for spontaneous rupture and intracerebral hemorrhage. They occur at major bifurcations within the Circle of Willis, the most common location being at the junction of the anterior cerebral artery and anterior communicating artery (30%). Aneurysms are most commonly treated by microsurgical clip ligation.

Length: 6-8 hours

Anesthetic considerations:

Room set-up:

- Drips: 2 Alaris Brains: Top brain with two syringe pumps for remi +/- Propofol, bottom brain with 4 Alaris channel pumps for carrier, phenylephrine infusion, esmolol (don't spike until needed), and clevidipine or sodium nitroprusside +/- Propofol – if history of PONV
- Uppers: most commonly phenylephrine; also have bolus syringes
- Downers: clevidipine or sodium nitroprusside (SNP), esmolol
 - Dilute bolus syringes: clevidipine 1 TB syringe with undilute clevidipine 0.5 mg/ml, one syringe dilute clevidipine 0.05 mg/ml; SNP dilute to 25-50 mcg/ml
- Water Blanket cooler/warmer: check with surgery team to determine whether plan is for direct or indirect bypass, if direct with cooling, set water blanket temp to 4 deg Celsius after patient is asleep
- Art/CVP transducer
- Drugs: Fentanyl (at least 500 mcg), Remifentanyl (at least 250 mcg in bolus syringe), Mannitol 0.5g/kg (leave in warm blanket closet until ready to use, prevents crystal formation), furosemide (available but don't need to draw up); ICG dye (reconstitute ICG vial with 10mL of sterile water), decadron 8mg (given with antibiotics), IV Tylenol, Zofran
- Additional emergency drugs: atropine for profound bradycardia, magnesium 2gm for torsades de pointe, speak with the surgeon beforehand about the utility of adenosine and have some available, take note of appropriate dosing
 - If the patient is warm: Adenosine 0.5mg/kg – 1mg/kg
 - If the patient is being cooled: Adenosine 12mg, may repeat x 2
- Special green-white bite block if neuromonitoring

Preop: Midazolam 2 mg, Aprepitant (Emend) 40-80 mg PO from pharmacy given in preop with a sip of water if history of PONV; pre-induction arterial line if patient having active ischemic symptoms, TIA, neurologic symptoms; keep MAP at patient's preoperative baseline; T&S + verification.

Induction: Fentanyl 7-10 mcg/kg, Propofol 1-2 mg/kg (doses may be reduced depending on response), Rocuronium 0.6 – 1.0 mg/kg; bolus pressors PRN to maintain patient's MAP at pre-induction baseline to maintain CPP and minimize risk of hypoperfusion

Maintenance: Isoflurane <1% (0.5 MAC maximum if neuromonitoring) + 50% N₂O + 50% O₂ with high flows (4 LPM total) to facilitate cooling

If patient has history of PONV substitute nitrous for Propofol infusion 50 mcg/kg/min.

Lines: additional IV access 16G+, CVC, special temp foley with adapter for bladder irrigation on rewarming; if difficult with CVC placement consider placement of PICC line (see special procedures page)

Monitors: standard ASA, art line, CVC (brown port to transducer, white or blue for drips), Sed Line if no neuromonitoring to assess for burst suppression just prior to artery cross-clamping, temp foley with irrigation adapter tubing, esophageal temp probe

Hemodynamic Goals: minimize risk of aneurysm rupture, SBP < 120, MAP ~ 60 unless otherwise specified by surgeon; avoid coughing/bucking, maintain constant depth of anesthesia

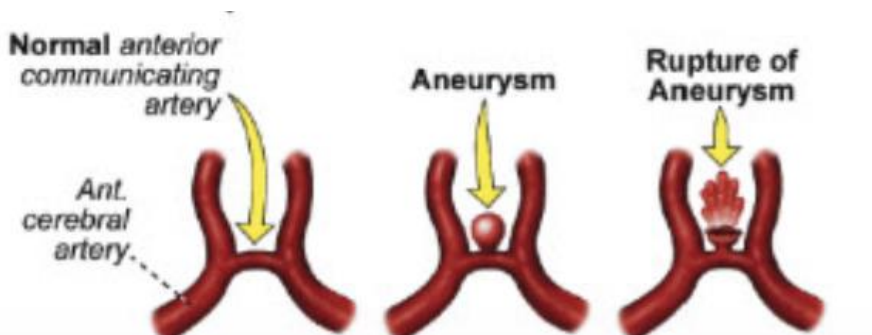
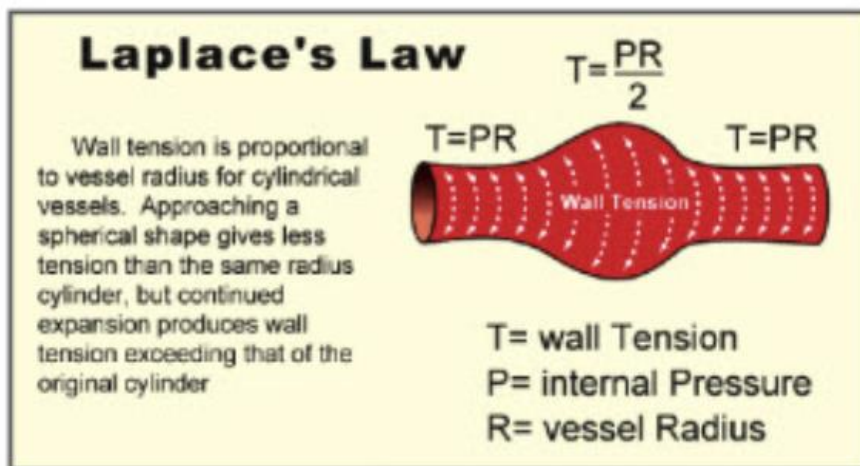
Surgical Steps, what to consider during your anesthetic:

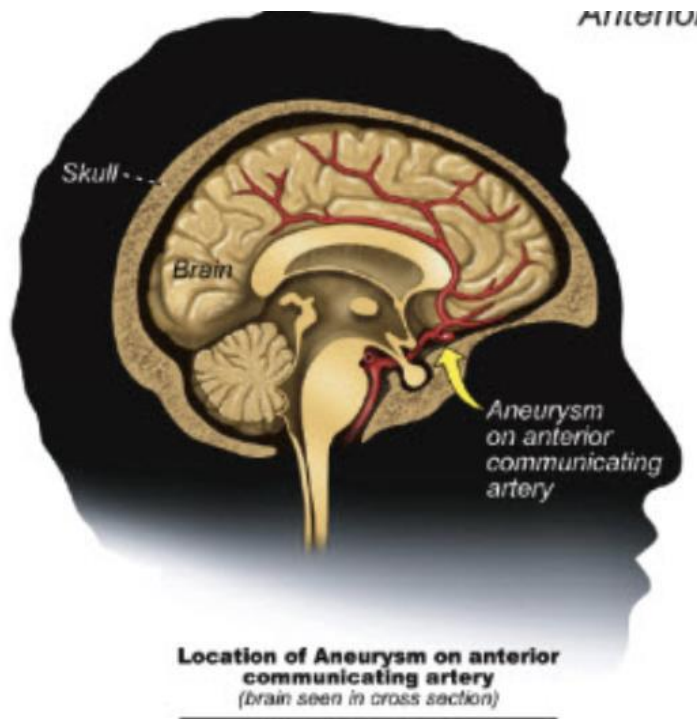
1. Skin incision and exposure of the skull
2. Craniotomy, bone flap removed, dura exposed, dura opened and folded back to expose brain
 - a. At this point if brain is edematous or swollen surgeons may ask for mannitol, lasix, or hyperventilation
 - b. Remember to maintain adequate depth of anesthesia
 - c. Confirm MAP or SBP goals with surgery team
 - d. Confirm location of emergency drugs in case of aneurysmal rupture: adenosine
 - e. It may be helpful to designate a healthcare professional in the room to provide carotid compression on the ipsilateral side to where the surgeons are working. Should the aneurysm rupture that person should be able to provide carotid compression to minimize bleeding.
 - f. If the aneurysm is large and there is concern it may rupture, the surgeon may perform a neck dissection and apply a loose surgical tie around the ipsilateral carotid artery; if the aneurysm ruptures, the tie can be tightened (noosed) and blood flow to the aneurysm can be minimized
3. Exposure of the aneurysm, microscope wheeled in to better visualize the vessel(s)
 - a. As brain tissue is retracted to expose the aneurysm it is essential to keep blood pressure down, prior to aneurysm exposure brain tissue acts to reinforce the walls of the fragile aneurysmal tissue, as this brain tissue is moved, the walls of the aneurysm are able to bulge without external support
4. Clamp is applied

- a. Mark this in the anesthesia record
5. Checking cerebral vessel flow after clamping:
 - a. ICG 3 mL, may be repeated
 - b. Pressure test, surgeon will ask for an increase in MAP to test the clamp and ensure that the aneurysmal tissue has been isolated from normal vessel; clarify MAP goals for the rest of the case/post-operatively
 - c. If cooling, start rewarming: blanket to 42 deg C, bladder irrigation with warm saline, Bair hugger to 42 deg C; make note of the lowest temperature from the esophageal temp probe and record for surgeon.
6. Closure of craniotomy
 - a. Administer Tylenol and Zofran
 - b. Discontinue Propofol if using when the surgical team begins to close the scalp
 - c. Wake up on Remi 0.05 mcg/kg/min
 - d. Extubate if appropriate and take to ICU

Complications: aneurysm rupture, seizures, stroke, hemorrhage, brain swelling

Images and Tables:





SAH Clinical Grading Scales

Grade	Hunt and Hess	WFNS
0		Intact aneurysm
1	Asx / mild HA	GCS 15
1a	Fixed neuro deficit s men. or brain rxn	
2	Mod to sev HA, CN palsy, nuchal rigidity	GCS 13–14 no motor deficit
3	Lethargy, confusion, mild focal deficit	GCS 13–14 motor deficit
4	Stupor, hemiparesis, early decerebrate	GCS 7–12 +/- motor deficit
5	Coma, decerebrate, moribund	GCS 3–6 +/- motor deficit

HUNT-HESS SCALE

- **GRADE 1:**
Mild headache, normal mental status, no cranial nerve or motor findings –(GCS* score 15, no motor deficits)
- **GRADE 2:**
Severe headache, normal mental status, may have cranial nerve deficit –(GCS score 13–14, no motor deficits)
- **GRADE 3:**
Somnolent, confused, may have cranial nerve or mild motor DEFICIT- (GCS SCORE 13–14, WITH MOTOR DEFICITS)
- **GRADE 4 :**
Stupor, moderate to severe motor deficit, may have intermittent reflex posturing- (GCS score 7–12, with or without motor deficits)
- **GRADE 5:**
Coma, reflex posturing or flaccid (GCS score 3–6, with or without motor deficits)