

CRANIOTOMY FOR ANEURYSM – THE BASICS

ANESTHETIC CLINICAL GUIDELINES AND CONSIDERATIONS

Steven Robicsek, MD, PhD

robicsek@ufl.edu

Department of Anesthesiology, University of Florida
Illustrations by David Peace, Department of Neurosurgery

SECTION 1: BACKGROUND.....	PAGE 1
SECTION 2: CLINICAL PATHWAY.....	PAGE 2
SECTION 3: REFERENCES.....	PAGE 3
Section 4: Notes.....	Page 4

SECTION 1: BACKGROUND

Overview

This is meant to be a VERY general guideline to get you through your first day of an “average” intracranial aneurysm or a brief refresher. It is also meant to get the basic setup on paper as a foundation for in depth discussion.

- Relative Value Code: 00210

What we need to know in addition to normal workup

- SAH¹ - be able to describe Hunt-Hess Grade classification
- What neurologic deficits² does the patient have?
- Location (anterior vs posterior circulation)
- Size and type (saccular vs fusiform)

Surgical Considerations

- Total procedure time 4-6 hrs
- Post-clip interoperative angiography on most cases

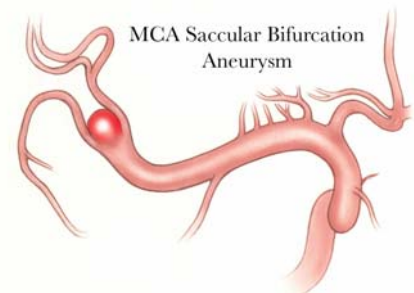
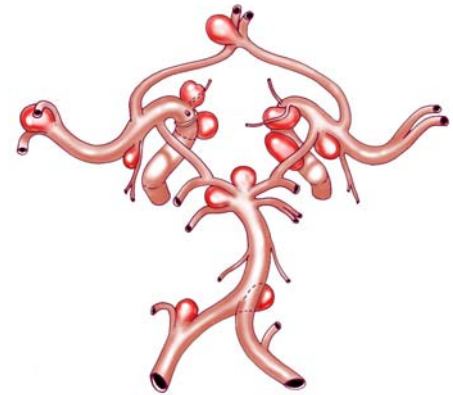
Pre-Operative

OR Set up

- Water mattress on OR stretcher
- Normal saline on Y transfusion set x 2
- 2 transducers: arterial line & CVP monitoring

Other considerations

- Blood: T&C x 4 units
- Transportation
 - Close ventriculostomy
 - If intubated discuss sedation ± paralysis. Coughing may be very detrimental as can hypoventilation with resulting hypercapnea.



SECTION 2: CLINICAL PATHWAY

Intraoperative Considerations

Monitors

- Standard ASA
- Arterial line pre vs post induction
- Central venous access. Consider long arm CVP (success rate: right>left, basilic>cephalic)
- **Somatosensory Evoked Potentials (SSEP)**³⁴
 - - UPPER EXTREMITY: Stimulation of peripheral median or ulnar nerve) brachial plexus @ Erb's point cervical spine cortical
 - - LOWER EXTREMITY: Stimulation of posterior tibial nerve @ ankle or common peroneal sciatic nerve @ popliteal fossa cervical spine cortical
- EEG⁵

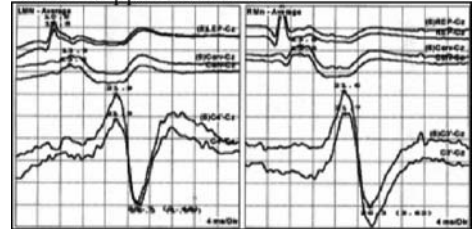
Induction

- STP or propofol
- Sufentanil or fentanyl
- Esmolol
- NMB: Vecuronium or pancuronium (RSI - SUX vs rocuronium)
- If increased ICP is of concern, make securing the airway and minimizing hypercapnea a priority

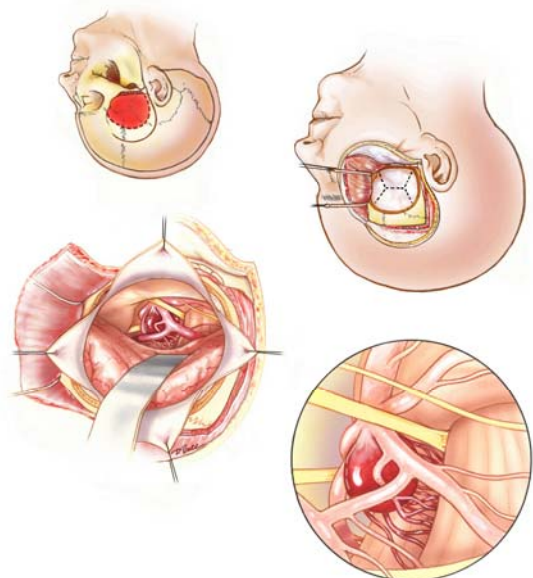
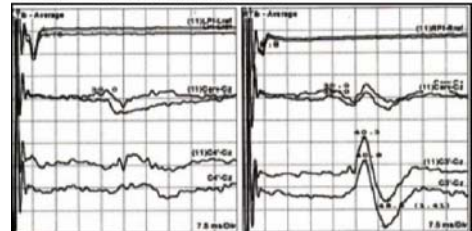
Maintenance

- **O₂/Air/Isoflurane**
- **Fluids**
 - NS
 - Hetastarch (max 20cc/kg)⁶
- Mayfield pin placement
 - STP (or propofol) (± 0.5 mg/kg) + esmolol (± 0.5 mg/kg)
- **Non depolarizing neuromuscular antagonist**
 - Ensure profound paralysis throughout procedure. (TOF should never exceed 1/4⁷)
- Full body Bair Hugger set to cool.
- Set water mattress to 20° C
- **Sufentanil** infusion 0.2ug/min/kg
- ET isoflurane = 0.4%
- Send ABG to evaluate ETCO₂ / pCO₂ gradient
- Target core temperature = 32 – 33° C
- **Mannitol** 0.5 – 1.0 g/kg per surgery on incision
- **Phenytoin / Phosphenytoin**⁸. Administered for postoperative seizure prophylaxis. Phenytoin is for post-op seizure control so administer over 1hr (emergency @ 1mg/kg/min). Phosphenytoin (\$60/1g) dosed as phenytoin equivalent, (emergency = 3mg/kg/min).
- **Mild hyperventilation** after dural opening to pCO₂ 30 - 32
- Set up:
 - - **Phenylephrine** 40ug/cc on mini drip (60 drop/cc)
 - - **Nitroprusside**^{9,10} and Baxter pump available
 - 2nd infusion pump for STP infusion

SSEP - Upper Extremities



SSEP - Lower Extremities



- **Aneurysm clips:**
 - - **Gold clips** are temporary. If you see one waiving around the field start thinking cerebral protection, barbiturate coma, send an ABG.
 - - **Silver (titanium) clips** are permanent. If you see these placed ask if they are finished with the clip placement. If so begin warming
- **Barbiturate cerebral protection:** Insure adequate volume status, 100% O₂, and isoflurane off. Wait if situation allows. If the patient is hypovolemic, profound hypotension may occur during STP administration. If you cannot wait, begin phenylephrine wait for blood pressure to begin to elevate then titrate STP to 90% burst suppression while maintaining normotension.
 - Typical loading dose 5-10mg/kg; Typical maintenance 10-20 mg/kg/hr)¹¹
- After placement of **permanent aneurysm clip** (Figure B):
 - Begin rewarming patient
 - Water mattress to 40° C
 - Bair Hugger to maximum warmth
 - Sufentanil to 0.1ug/kg/hr

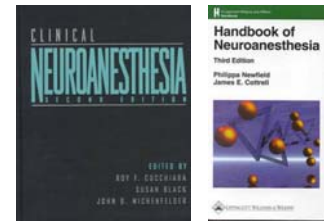


Emergence

- 15 min prior to surgical completion: discontinue sufentanil, isoflurane
 - TOF = 1/4; 100% O₂
- Extubation considerations
 - Pre-surgical Hunt-Hess Grade (1-2 possible, 3-4 unlikely)
 - Total amount of STP administered
 - Airway & CN IX, X, XII
 - Fluid status

Post-operative Considerations

- Ondansetron 4-8mg Q 2hrs PRN nausea
- Narcotic PRN pain
- Neurological check Q2 hrs
- Typically discharged to SICU



PRINCIPLE REFERENCES

Clinical Neuroanesthesia 2nd ed.,
 RF Cucciarra, S Black, JD Michenfelder eds. Churchill-Livingston, 1998
 Handbook of Neuroanesthesia 3rd ed.,
 P Newfield & JE Cottrell, eds. Lippincott Williams & Wilkins, 1999

¹ **Hunt Hess Classification** (based on clinical Sx): **0**=unruptured; **I**=minimal headache or nuchal rigidity; **II**=moderate to severe headache, nuchal rigidity +/- cranial nerve palsy; **III**=drowsiness, confusion, or mild focal deficit; **IV**=stupor, hemiparesis, early decerebrate rigidity, vegetative disturbances; **V**=deep coma, decerebrate rigidity, moribund. Does not predict development of cerebral vasospasm [Hunt WE, Hess RM: Surgical risk as related to time of intervention in the repair of intracranial aneurysms. J Neurosurg 1968; 28:14.]. **Fisher Grade** (based on blood revealed by CT scan): **I**=no subarachnoid blood detected; **II**=diffuse or thin vertical layer < 1mm; **III**=localized subarachnoid clot and/or vertical layer > 1mm; **IV**=intraventricular or intraparenchymal clot with diffuse or no SAH [Fischer CM, Kistler JP, Davis JM: Relation of cerebral vasospasm to subarachnoid hemorrhage visualized by computerized tomographic scanning. Neurosurg 1980; 6:1]. **Greene Grade** (proposed grading system for scoring traumatic SAH based on CT): **I**=thin layer <5mm; **II**=thick >5mm; **III**=thin <5mm with mass lesion; **IV**=thick >5mm with mass lesion [Greene et al. J Neurosurg 83:445-52, 1995]. **World Federation of Neurological Surgeons (WFNS)**: **I**=GCS=15, no motor deficit; **II**=GCS 13-14, no motor deficit; **III**=GCS 13-14, + motor deficit; **IV**=GCS 7-12, +/- motor deficit; **V**=GCS 3-6, +/- motor deficit
² ♦ Oriented to time, place & person. ♦ Good recent & remote memory. ♦ Nml attention span & concentration. ♦ Nml language.
 ♦ Normal fund of knowledge. ♦ CNII: Full visual fields to confrontation. ♦ CNIII,IV,VI: PERRL, full extraocular movements. ♦ CNV: ?
 ♦ CNVII: Full & symmetrical facial movement. ♦ CNVIII: Hears finger rub well bilaterally. ♦ CNIX,X: Symmetrical palate, nml gag.

◆CNXI: Nml trapezius & sternocleidomastoid. ◆Sensation: Intact to pin, touch, & proprioception in UE & LE. ◆Deep tendon reflexes: biceps, triceps, brachioradialis, patellar, ankle, Babinski, Hoffman. ◆Coordination: Nml finger to nose, heel to toe bilaterally.

³ Friedman, WA: Somatosensory evoked potentials in neurosurgery. Clin Neurosurg 34:187-238, 1988.

⁴

Drug Effects on SSEPs (from Black, Mahla, Cucchiarra in Miller 5 th ed. p.1324)		
	Latency	Amplitude
Isoflurane, enflurane, halothane, barbiturates, propofol, droperidol, diazepam, fentanyl, morphine	Increase	Decrease
Nitrous Oxide	0	Increase
Etomidate	Increase	Increase
Ketamine	0	Increase
Midazolam	0	Decrease

⁵

EEG burst suppression (from Black, Mahla, Cucchiarra in Miller 5 th ed. p.1324)	
Yes	No
isoflurane, sevoflurane, desflurane, enflurane, barbiturates, propofol, etomidate	N ₂ O, benzodiazepines, narcotics, ketamine, halothane (at clinical %)

⁶ Coagulopathy with the use of hetastarch in the treatment of vasospasm. Platelet and reticuloendothelial dysfunction. Trumble ER, et al: J Neurosurg 82:44-7, 1995.

⁷

Minutes until detectable twitch response		
# Responses to single-twitch stimuli at 1 Hz 3 sec following 50-Hz tetanus for 5 sec		
Post-tetanic Counts	Atracurium	Pancuronium
2	7	30
4	4	20
6	2	10
8	0-2	5

from Brull & Silverman in Clinical Anesthesia Practice RB Kirby & N Gravenstein, 1994 p. 418.

⁸ After phenytoin administration, atrial and ventricular conduction depression and ventricular fibrillation have occurred, leading to fatality. Severe reactions are most commonly encountered in the elderly and seriously ill patients. Reduction of the rate of administration or discontinuing therapy may be warranted. Hypotension may also occur (7% in 1 study) during fosphenytoin therapy, using high doses and high rates of infusion.

⁹ Doses >3ug/kg/min may inhibit platelet aggregation. Doses >5-8ug/kg/min, 0.5mg/kgx24hrs, or >1mg/kgx2.5hrs watch for signs of cyanide toxicity; tachyphylaxis, lactate acidosis with high central venous pO₂. Rx: Na-thiosulfate 150mg/kg/15min. Precede w/4-6 mg/kg SNP in severe CN⁻ toxicity.

¹⁰ [wt(kg) x 60] / concentration (ug/cc) = cc/hr for 1ug/kg/min

¹¹ Another method: Begin with 10mg/kg/hr infusion, load with 5 mg/kg. If burst suppression is not achieved load another 5 mg/kg and increase infusion to 15 mg/kg/hr, repeat again if necessary.