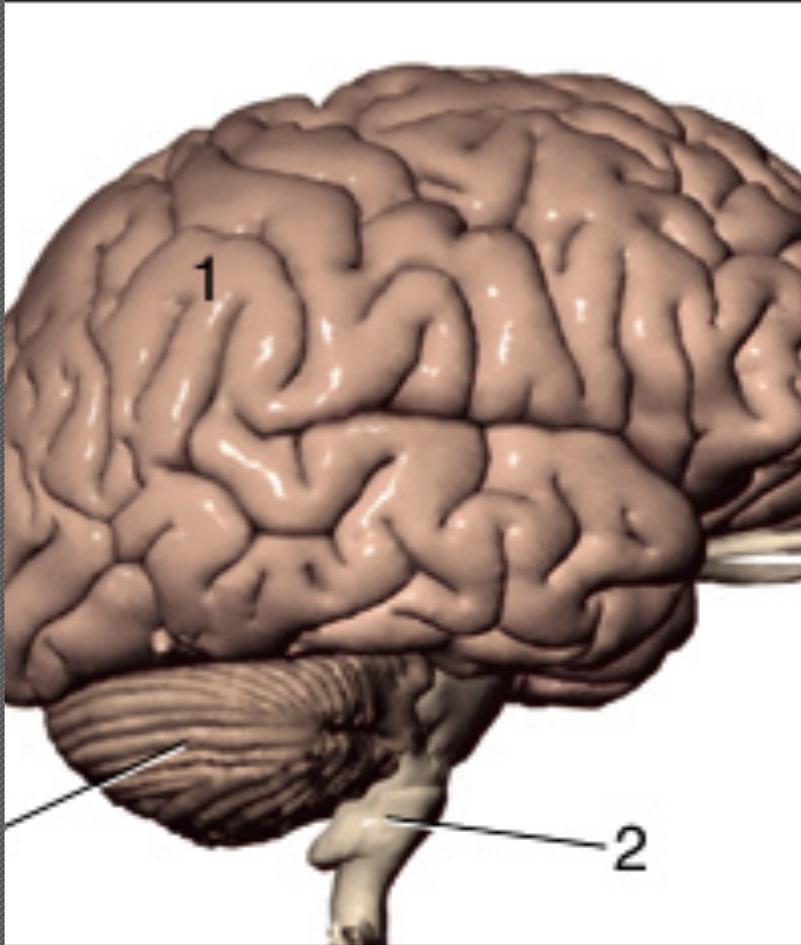


Clinical Neuroanesthesia for the occasionally interested anesthesiologist



Reza Gorji, M.D.
Director of
Neuroanesthesia
University Hospital
Syracuse, New York

Neuroanesthesia

- Anesthesia for simple neurotrauma
- Anesthesia and craniotomy for mass lesions
- Anesthesia and craniotomy for aneurysm and avms
- Anesthesia for posterior fossa craniotomies
- Anesthesia for GDC

Neuroanesthesia

- Anesthesia for (intracranial) neuroanesthesia requires understanding of relationships between CeBF, CPP, CMRO₂, and ICP
- We use techniques and drugs that manipulate these relationships to make surgery and anesthesia successful and safe
- We do make a difference; when problems occur, the basics are usually violated



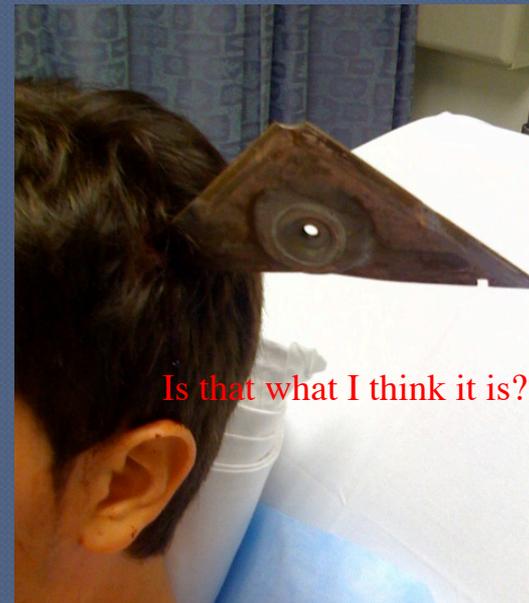
Questions

1. What are 2 types of neurotrauma?

Anesthesia for simple neurotrauma

7:00 am arrive to work for a nice present from the OOD

What are the implications?
What are the plans?



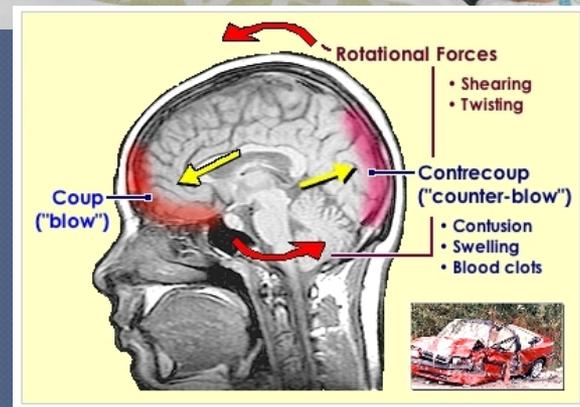
Anesthesia for simple neurotrauma



What are the plans for this patient?

Anesthesia for “survivable” neurotrauma

1. Always ABCs first
2. Ventilate
3. Oxygenate
4. Resuscitate → establish access
5. A-Line (*don't delay case*)
6. Maintain CPP
 - a. Reduce ICP
 - b. Maintain MAP
7. Pay attention and improvise
save the patient's life

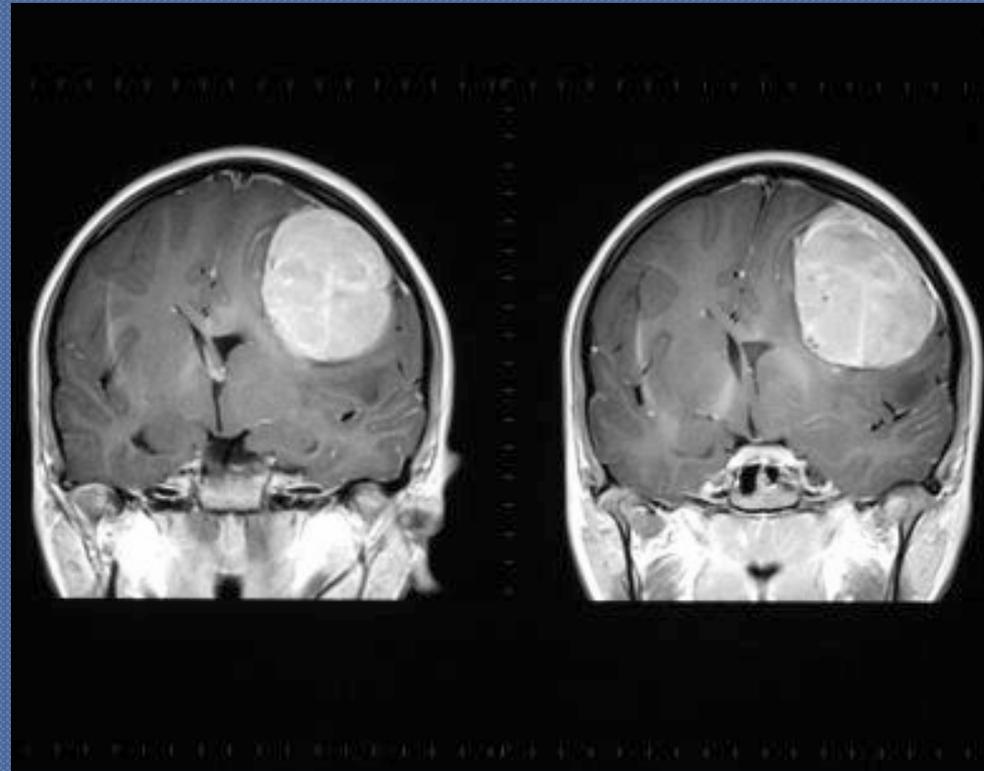


Questions

1. What are 2 types of neurotrauma?
2. What are etiologies for intracranial mass?

Anesthesia and craniotomy for mass lesions

- Intracranial masses may be congenital, infectious, neoplastic or vascular (ie: abscess, tumor or clots)
- Signs of high ICP present(N/V, HTN, bradycardia, personality changes, consciousness level, papilledema, seizures...)
- Growth rate of mass can be guessed from rapidity of symptoms
- Intracranial compliance curve; effect of slow versus fast volume expansion



Questions

1. What are 2 types of neurotrauma?
2. What are etiologies for intracranial mass?
3. Describe preop eval of pt w/ cerebral mass. Are premedications contraindicated?

Anesthesia and craniotomy for mass lesions

Preoperative evaluation

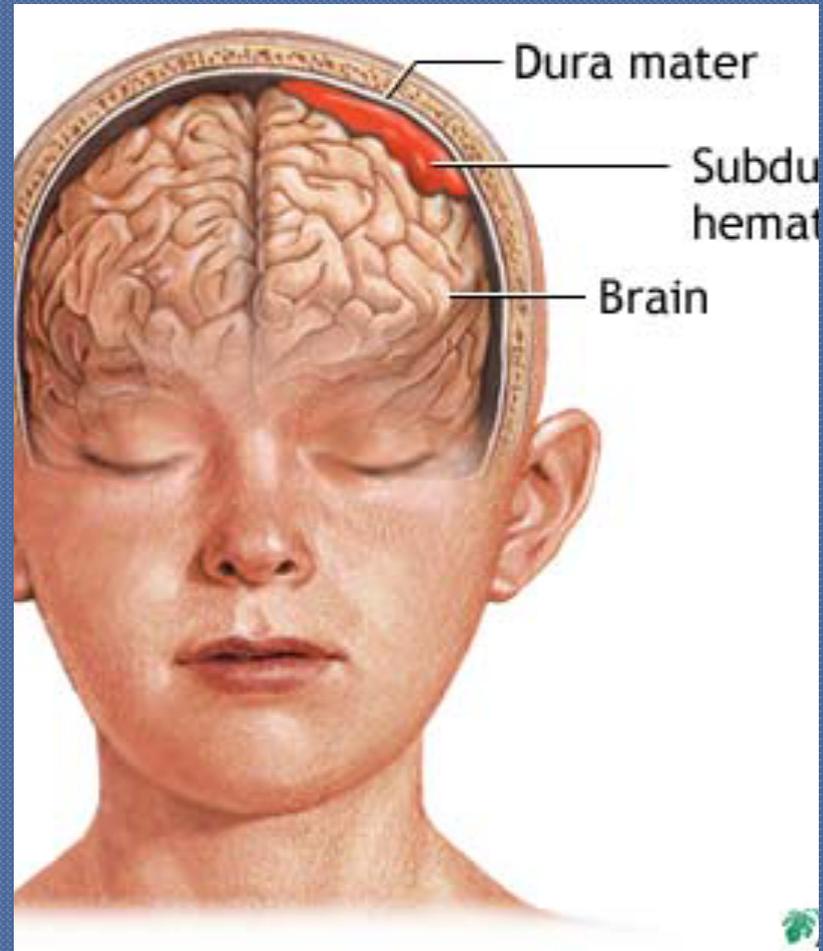
- Typical history and physical
- Obtain neurological history
- Ascertain presence of high ICP
- SMA⁷ to look of corticosteroid induced hyperglycemia, diuretic induce electrolyte abnormalities; anticonvulsant levels
- CT/MRI for presence of edema, midline shift, location of mass (deep or superficial)



Anesthesia and craniotomy for mass lesions

Premedication

- Premeds include benzodiazepines, corticosteroids, anticonvulsants, diuretics and whatever else is needed to make the patient ready for surgery
- Watch for signs of hypoxia and hypoventilation



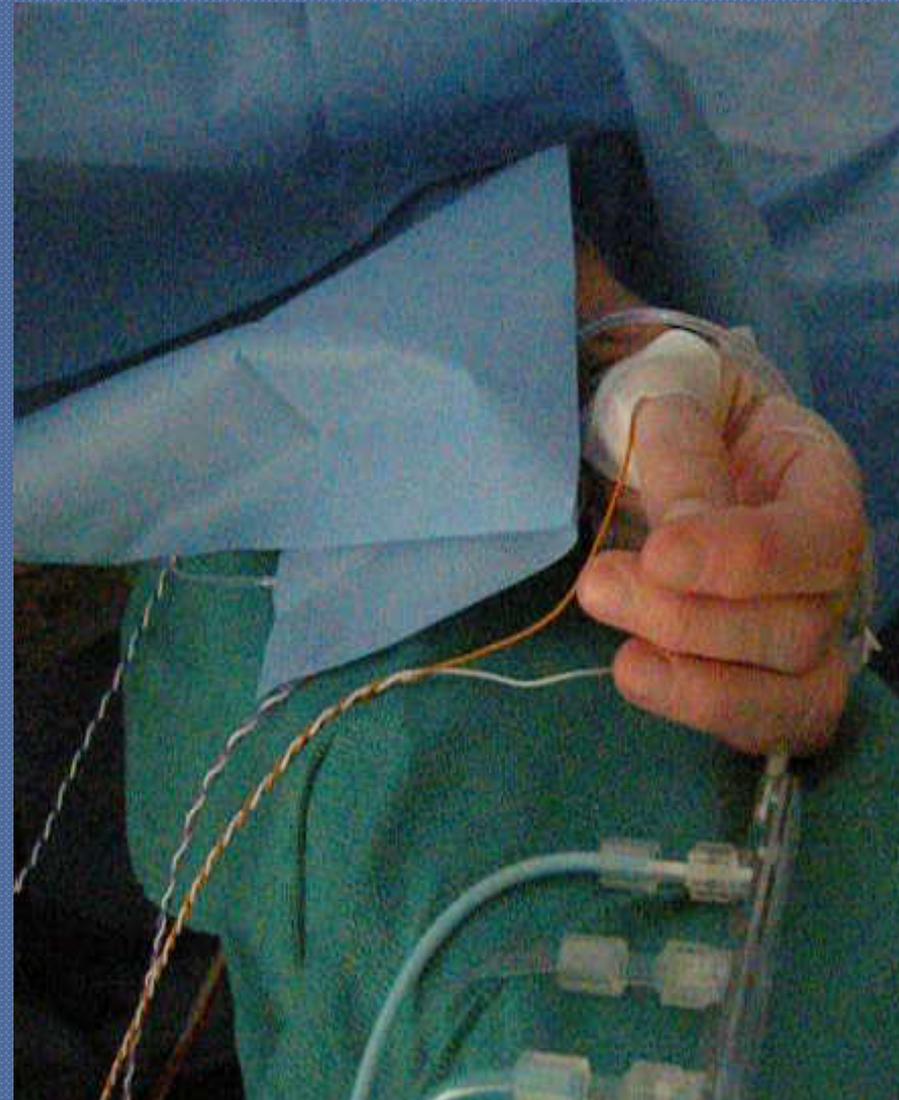
-
1. What are 2 types of neurotrauma?
 2. What are etiologies for intracranial mass?
 3. Describe preop eval of pt w/ cerebral mass. Are premedications contraindicated?
 4. How do you induce and monitor patient?

Anesthesia and craniotomy for mass lesions

Intraoperative Management

Monitoring

- ASA monitors
- A-line: Positioning, rapid changes in BP, access for electrolytes and PaO₂ and PaCO₂
- Central Access
 - Where and why?
 - When and why?
- Foley Monitor: Yes
- NMB Monitor: Yes; No MOVEMENT ALLOWED W/ HEAD CLAMPS OR NOT
- Neurologic Monitors as needed: EPs, EEGs, ICP Monitor* (Zero the ICP monitor at the EAM)



Anesthesia and craniotomy for mass lesions

Induction

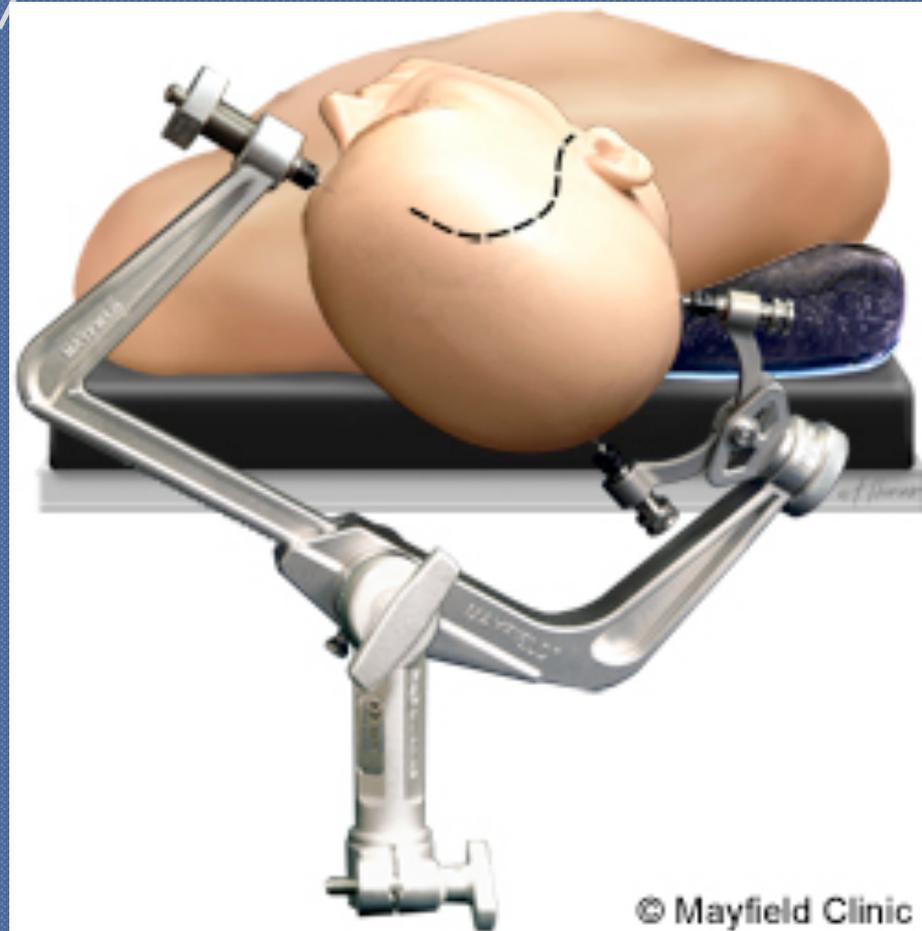


- A critical part of the case
- Goals: Minimize raising ICP and maintaining CeBF
- Technique:
 - Hyperventilate
 - Prop, Thio, Etom
 - Fentanyl 3-10 mcg/kg
 - Lidocaine 1-2 mg/kg
 - Hyperventilate
 - NMB
 - Intubate efficiently
- Bad Airway: AWAKE is an option
- Have other drugs ready: esmolol, NTP, NTG, hydralazine

Anesthesia and craniotomy for mass lesions

Positioning

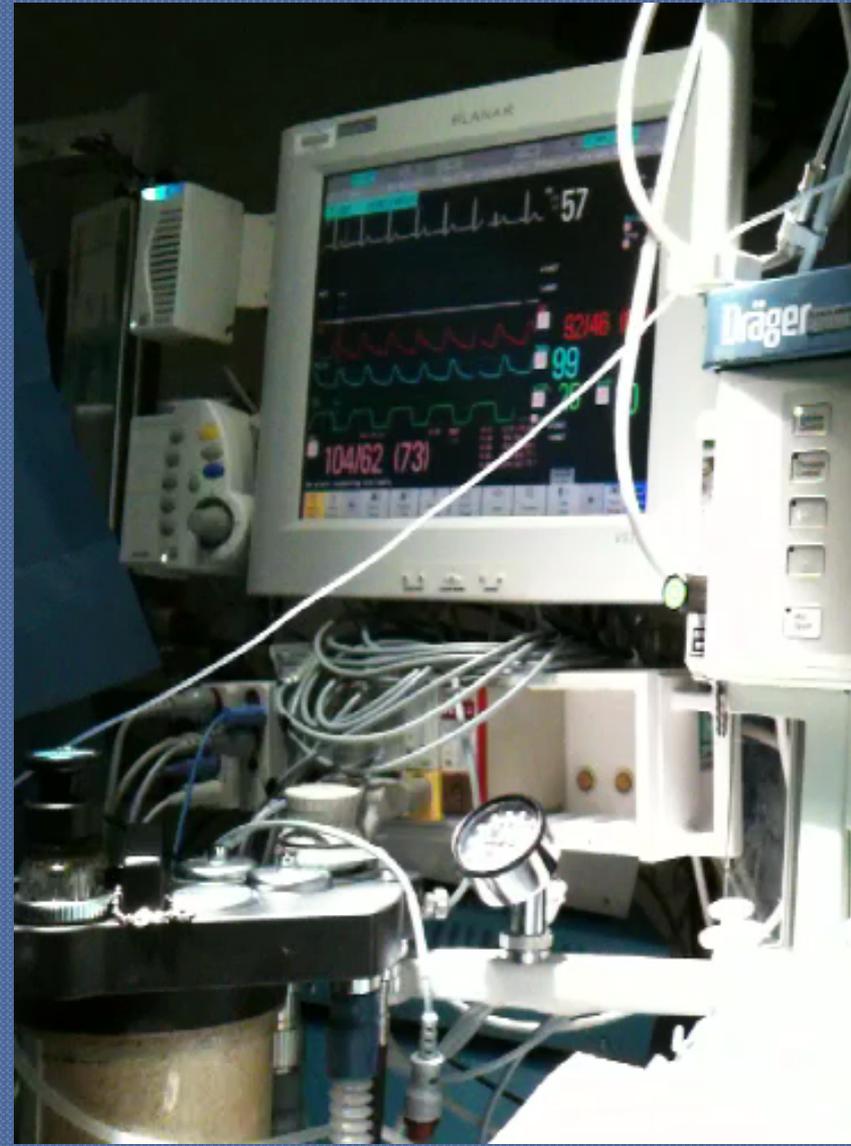
- Supine Position for frontal/parietal/temporal cranis
- Head is inadvertently turned to one side
- Head Clamp is often placed. **AVOID PATIENT MOVEMENT**
- Poor positioning can lead to problems during the entire case
- Secure your lines before draping
- Put drips close to vein



Anesthesia and craniotomy for mass lesions

Maintenance of Anesthesia

- 2 overall techniques: Nitrous-narcotic-relaxant and balance anesthesia with volatile agent
- Nitrous-narcotic-relaxant technique: 70% nitrous, 30% oxygen, narcotics (fentanyl 2-5 mcg/kg/min), pancuronium 0.02-0.05 mg/kg/hr
- Balanced: 50-70% nitrous, muscle relaxant, volatile agent usually isoflurane 0.5-1 MAC
- TIVA (propofol, +/- NMB, narcs, dex ...)
- Hyperventilate to PaCO₂ of 25-30
- No PEEP unless needed
- IVF= 0.9% NaCl; avoid dextrose containing and hypoosmolar solutions
- Can use hetastarch and albumin; remember fluid shifts are minimal
- Goals wrt to fluids in neuro: keep them dry but maintain CePP



Anesthesia and craniotomy for mass lesions

Emergence

- Emergence is as important as induction
- Extubation is important to allow for neurological examination of patient
- Sloppy emergence may result in sloppy outcome
- Sloppy emergence---> Cerebral edema and hemorrhage among other things
- Extubate patients if normal criteria are met + if High ICP is not out of control
- Reverse NMB, control BP carefully with drugs and wake patient up once head clamp is off



Questions

1. What are 2 types of neurotrauma?
2. What are etiologies for intracranial mass?
3. Describe preop eval of pt w/ cerebral mass. Are premedications contraindicated?
4. Describe 3 problems specific to posterior fossa craniotomies.

Anesthesia for Posterior Fossa Craniotomy Introduction

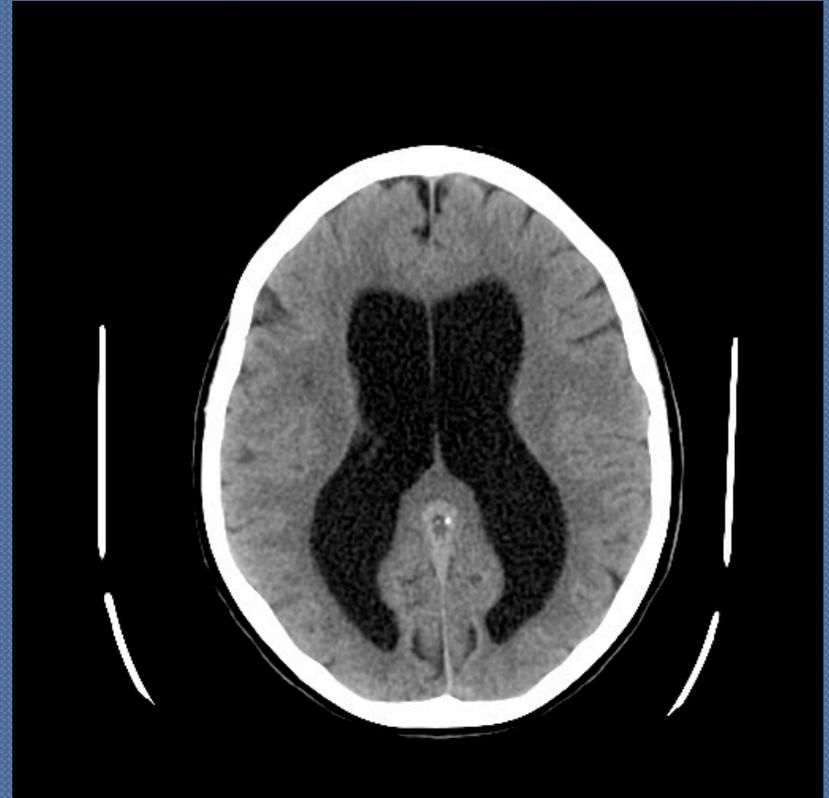
3 main problems exist here

- Unusual Positioning
- Potential for brainstem injury
- Obstructive hydrocephalus



Anesthesia for Posterior Fossa Craniotomy Obstructive Hydrocephalus

- Small lesions can have a significant effect on ICP as obstruction to CSF outflow can occur at the level of 4th ventricle and cerebral aqueduct
- Patient will probably get ventriculostomy prior to induction of anesthesia



Anesthesia for Posterior Fossa Craniotomy Brainstem Injury

- Vital respiratory and circulatory centers can be injured by tumor, aneurysms and surgery itself
- Injury take the form of ischemia or infarction
- Clinical sequel include: postop apnea, aspiration, hypotension and bradycardia (and other rhythm disturbances)



Anesthesia for Posterior Fossa Craniotomy Positioning

- Most cases done in prone or lateral positions
- Rarely done in sitting positions (on exams)
- Most of the time, the head is above the heart regardless of position
- Head clamp and associated problems still present
- Advantage of sitting position: Less blood loss and better exposure
- Avoid injuries to peripheral nerves, ischial spine and head and eyes when positioning



Sitting Position in a young patient

What position is this??

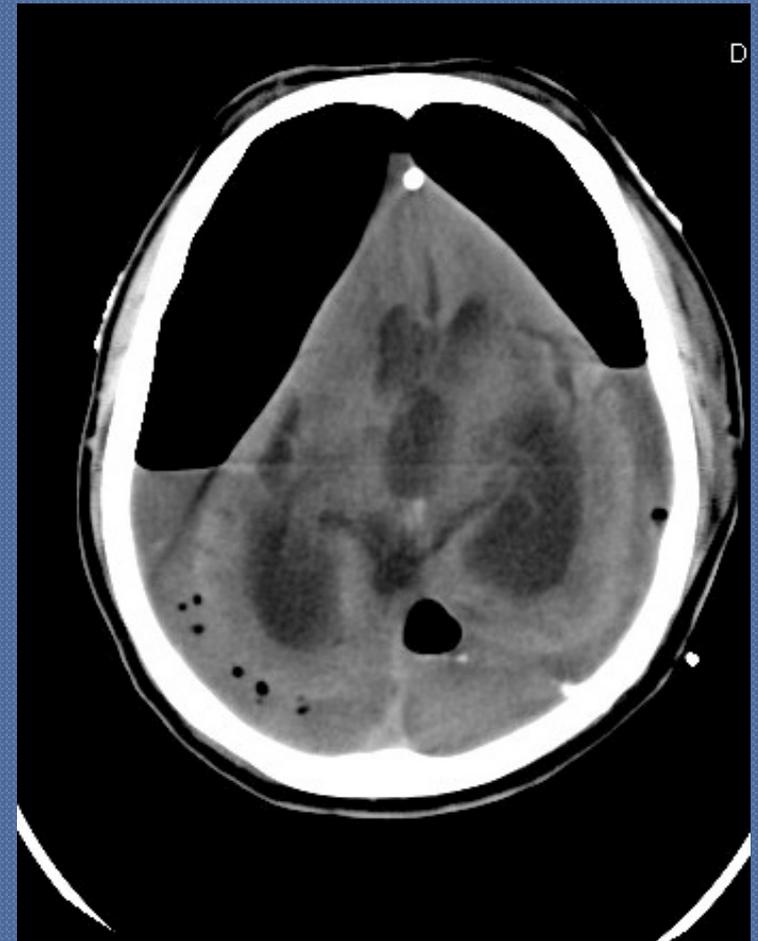


Anesthesia for Posterior Fossa Craniotomy Premedication

- Same as for supine tumors

Anesthesia for Posterior Fossa Craniotomy Maintenance

- Same as supine crani's
- Can avoid nitrous if sitting position or if the patient has pneumocephalus
- As always, turn off nitrous once dura is close in any crani case
- Use of nitrous oxide is very controversial in anesthesia



*Don't let this happen to you:
bad case of tension pneumo*

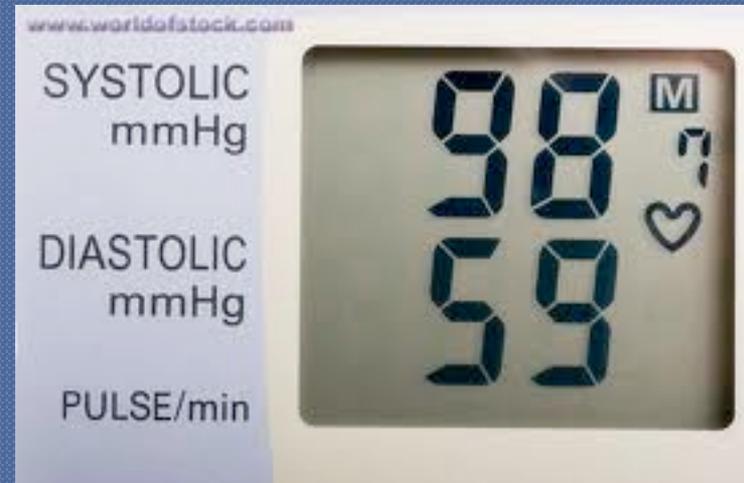
Anesthesia for Posterior Fossa Craniotomy Problems

- Positioning: covered already
- Pneumocephalus: just mentioned
- Postural hypotension
- Venous air embolism

Anesthesia for Posterior Fossa Craniotomy

Problems: Postural Hypotension

- Why does this happen:
 - Fluid restriction and diuresis
 - Position itself
 - Lower sympathetic tone with venous pooling in the presence of volatile agents
- Treat with vasopressors carefully rather than large amounts of fluid; perhaps lighten anesthesia too, compression stocking on



Anesthesia for Posterior Fossa Craniotomy

Problems: Venous Air embolism

- Occurs when pressure within a vein is sub-atmospheric
- Incidence is about 40%
- Contributory factors: low CVP, poor surgical techniques
- Physiological consequences: F (rate and amount of air); small bubbles are well tolerated and are exhaled; if the lungs is overwhelmed then PAP increases, cardiac output decreases as RV after load increases
- PaCO₂ slight increase, PaO₂ decrease if amount small
- Full hemodynamic compromise if large amounts of air
- Paradoxical Air Embolus: Can lead to CVA or coronary artery occlusion. PAE occurs when RAP exceeds LAP in the presence of a patent foramen ovale

Anesthesia for Posterior Fossa Craniotomy

Problems: VAE; Monitoring

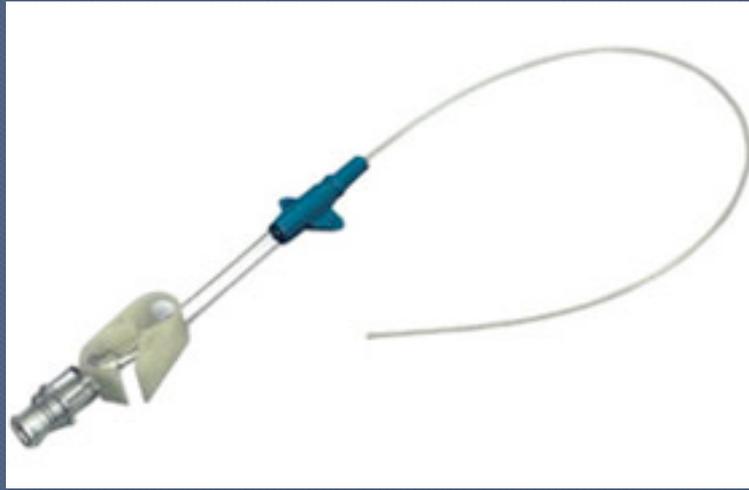
- TEE
- Precordial Doppler
- ETN_2 , $ETCO_2$,
Etvolatile agent
- Changes in PAP and
CVP
- Changes in ECG
and Blood Pressure
(very late)



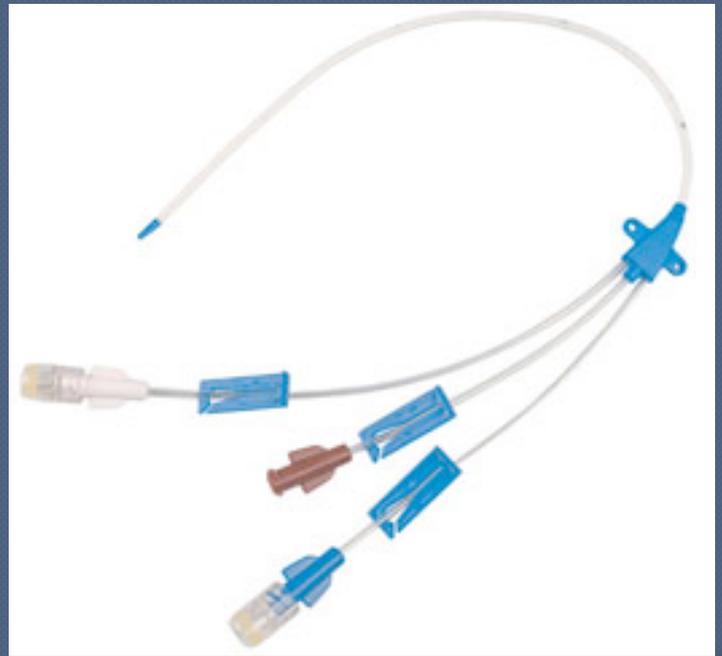
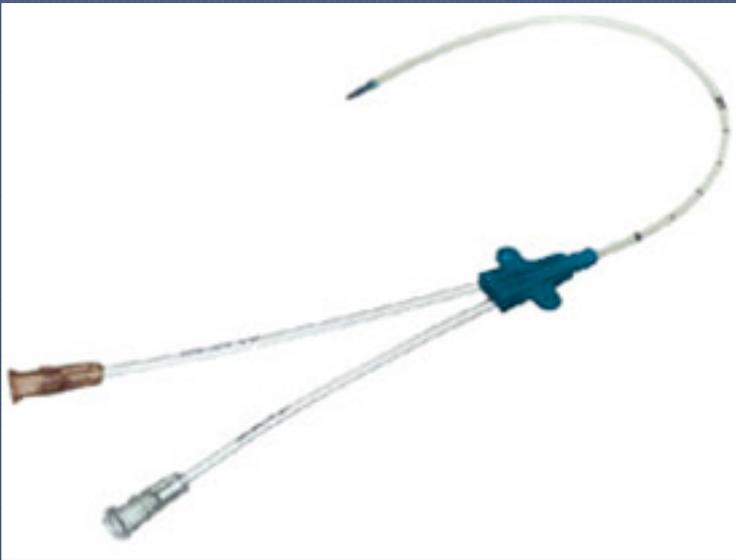
Anesthesia for Posterior Fossa Craniotomy

Problems: VAE; Placement of CVP

- Place multiorificed CVP at the junction of RA and SVC
- Easiest done with Fluoroscopy
- Also done with ECG looking for a biphasic p wave and then pulling back



Which is the correct line?



Anesthesia for Posterior Fossa Craniotomy

Problems: VAE: Treatment

- Surgeon flood area
- 100% O₂ and turn off nitrous
- Aspirate CVP
- Fluids
- Vasopressors to correct hypotension
- Bilateral jugular compression
- PEEP (?); this may cause paradoxical embolism
- If all else fails: turn the patient to LLD position
- Finally start CPR in the supine position and prepare for Wednesday morning

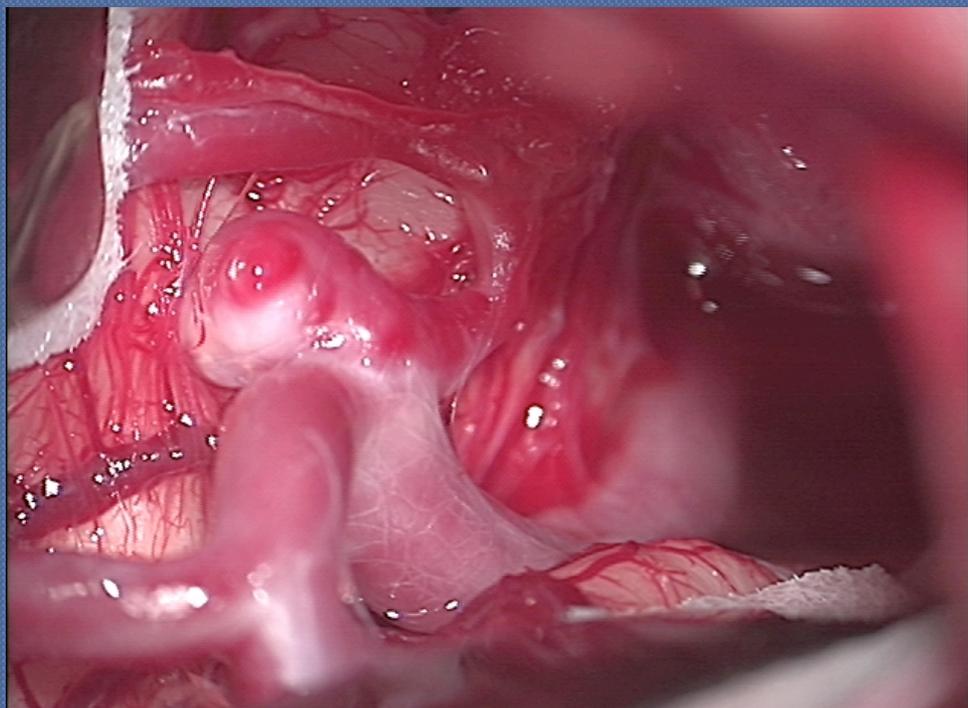
Questions

1. What are 2 types of neurotrauma?
2. What are etiologies for intracranial mass?
3. Describe preop eval of pt w/ cerebral mass. Are premedications contraindicated?
4. Describe 3 problems specific to posterior fossa craniotomies.
5. What type of neuro cases is dreaded by most anesthesia residents and attendings?

Anesthesia for Aneurysms and AVMs

Preoperative Management

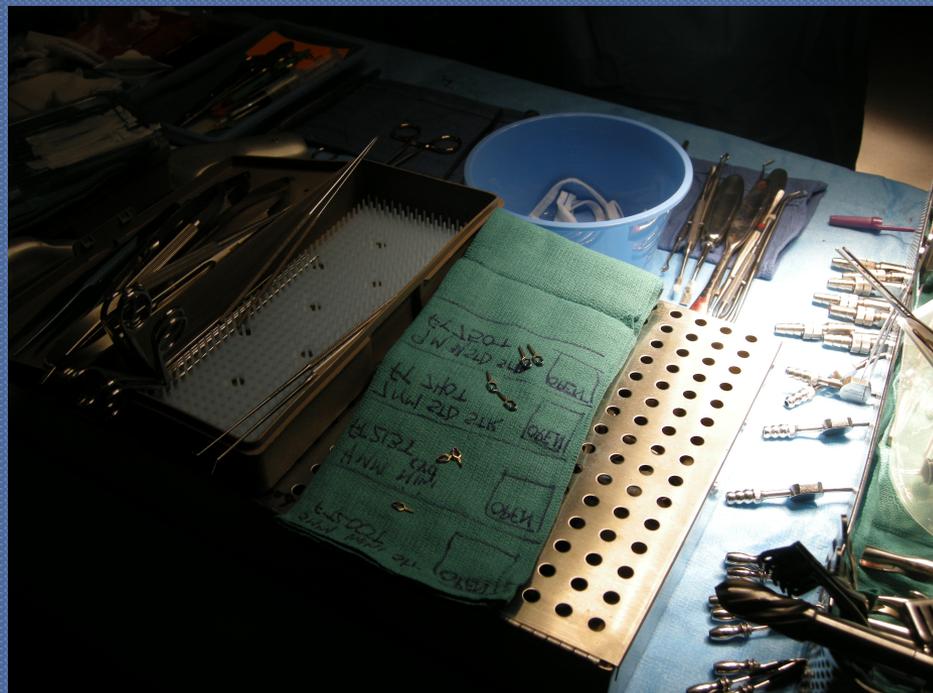
- Same goals as patients with tumors
- Most patients have normal ICP unless the aneurysm is ruptured



Anesthesia for Aneurysms and AVMs

Intraop Management

- Anesthetic technique very similar to tumors
 - Goals: Prevent rupture, ischemia and avoid/exacerbate vasospasm
- Few exceptions exist:
 - ICP may be normal so hyperventilation usually avoided unless it helps expose the aneurysm
 - Hyperventilation also avoided in patients with vasospasm
 - Induced hypotension may be employed
 - Barbiturate coma may be needed (if you can find barbs!!)
 - Potential for huge blood loss (In cases of rupture: Get help fast; lower blood pressure if needed, 100% oxygen, prepare for barbiturate coma)



Anesthesia for Aneurysms and AVMs Intraop Management

- Make sure you have large bore IV access
- Can justify central line placement for access and intravascular volume measurement
- Cordis placement good idea especially in cases of large AVMs



Anesthesia for Aneurysms and AVMs

Extubation

- If extubation is planned, you need to have complete control of blood pressure. Have a plan ready and be ready to act fast.
- In case of large AVM's, some advocate postop intubation because of risk of bleeding postop.

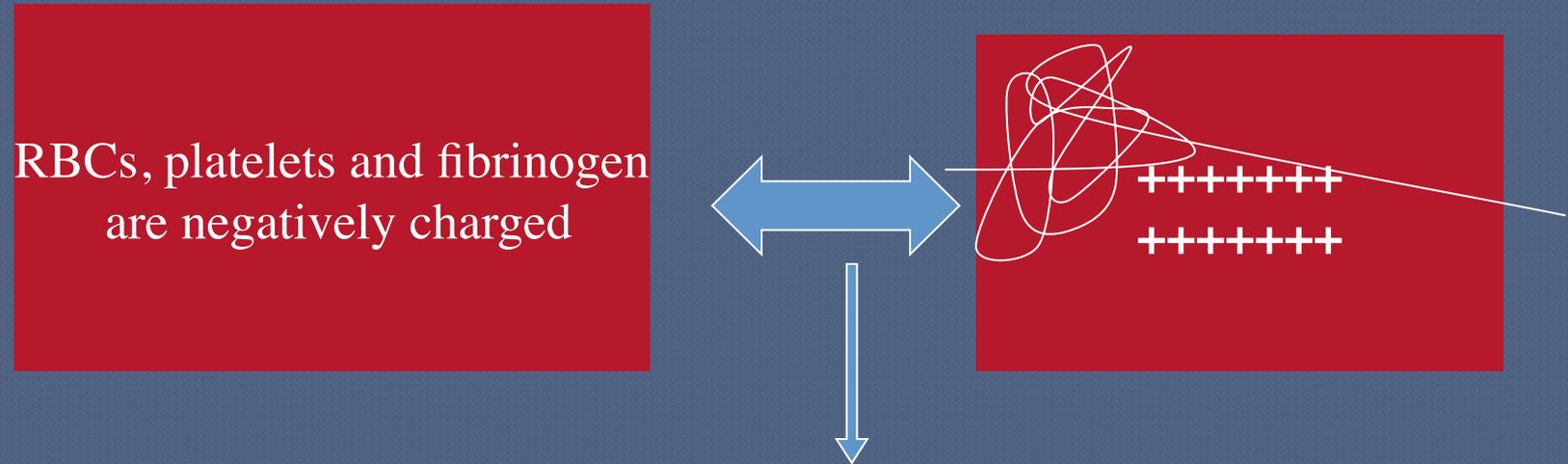


- Minimal invasive aneurysm surgery
- Anesthesia set up
- Problems: Bleeding (rupture) and ventriculostomy problems
- Goals: Like aneurysm

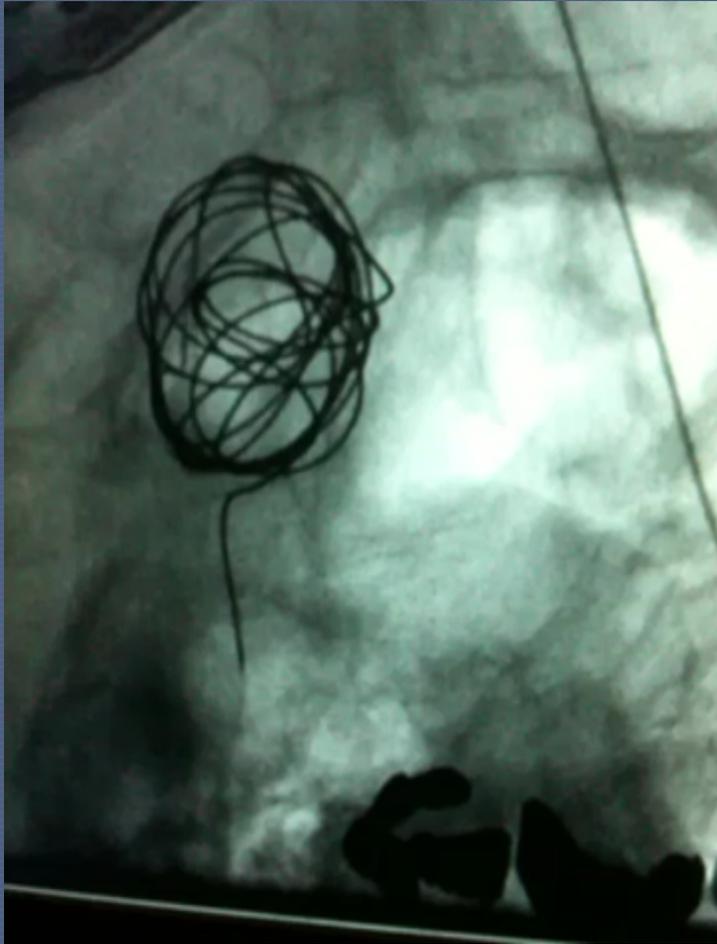


Mechanism Action

How does it work??



Electrolytic breakdown of SS wire from platinum coil
Electrothrombosis/Occlusion of Aneurysm
Subsequent endothelialization (WE HOPE!!)



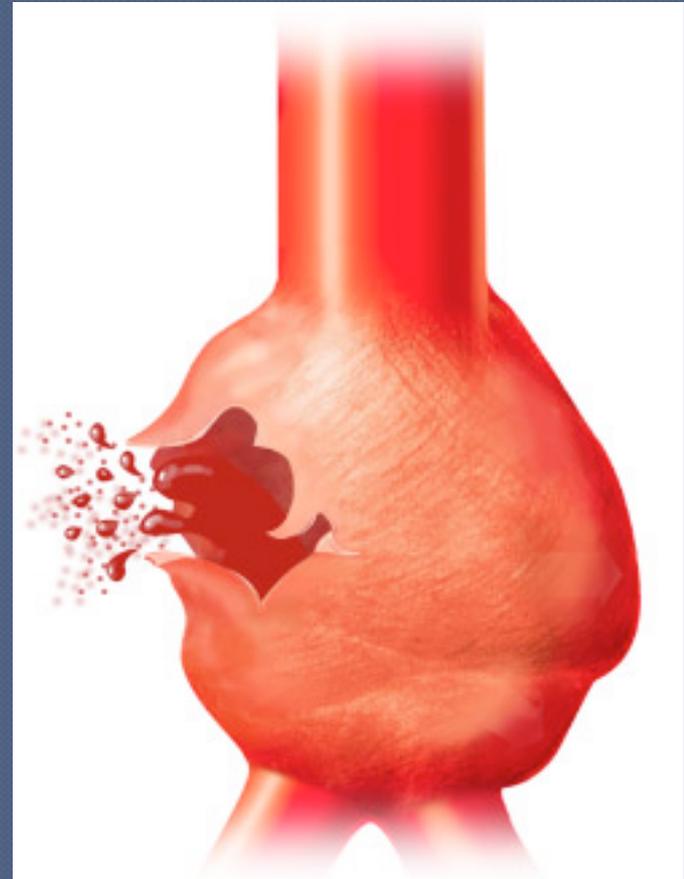
- A giant aneurysm being coiled

Common anesthetic problems during GDC

1. Staff vigilance; staying awake (yes I mean you)
2. Exposure to radiation
3. Aneurysm rupture and ICP issues
4. Lack of space for equipment
5. Away from operating room
6. Requests for TIVA

Common surgical problems during GDC

1. Uncooperative anesthesia staff
2. Poor aneurysm geometry for coiling
3. Aneurysm related:
 - a. Incomplete obliteration of aneurysm
 - b. Coil compaction
 - c. Coil migration
4. Failure of coil to detach
Allergic reaction to dye



Questions

1. What are 2 types of neurotrauma?
2. What are etiologies for intracranial mass?
3. Describe preop eval of pt w/ cerebral mass. Are premedications contraindicated?
4. Describe 3 problems specific to posterior fossa craniotomies.
5. What type of neuro cases is dreaded by most anesthesia residents and attendings?
6. How many of you are still awake and not in burst suppression?

What to do when you have a rupture?

1. Inform NS
2. Open ventriculostomy or have someone put one in
3. Head up 15 degrees
4. Hyperventilate to a PaCO₂ of 25-30
5. Consider mannitol 0.25-1 gm/kg and anticonvulsants
6. Consider thiopental/propofol infusion to burst suppression
7. Mild hypothermia (34 degrees) and steroids
8. Be ready to go to OR

