

SUB-ARACHNOID HEMORRHAGE: MANAGEMENT PROTOCOL:

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Definitions

SAH 0 is the day of hemorrhage.

SAH grading scale

1, 2; neurologically normal, symptoms only (HA, photophobia, meningismus)

3; sleepy or very somnolent, but following commands

4; not following commands, brainstem reflexes working

5; one of more brainstem reflexes affected

Initial Management: SAH days 0-3

Blood Pressure: hypertension, a response to pain and stress, is seen often in patients following SAH. Studies have shown that re-rupture is associated with rapid changes in blood pressure, not the absolute value. In addition, the cooperative study showed no decreased risk of re-bleeding with induced hypotension (Sahs 1981). Therefore, hypertension, unless extreme, does not need to be treated. It is often is very important to maintain good perfusion, especially given the frequent incidence of hydrocephalus and the loss of autoregulation.

- **all patients to have an arterial line placed**
- **central lines for all patients going to the OR or angio suite; for all Grade 3's or higher (make sure they are placed in the upper extremity)**
- **start nimodipine at 30 mg po/ng q2 hours**
- **MAP range: 70 – 100**
- **if MAP > 100 despite being on nimodipine, control with nicardipine drip**
- **if MAP < 70, contact ICU team**
- **if they have a ventriculostomy, maintain CPP > 60 (CPP requirement takes precedence over MAP range)**

Cardiac and ECG abnormalities: seen in 50% of patients, T wave enlargement or inversion, QT prolongation, ST segment changes, and U waves are very common (Marion 1986). This often reflects real sub-endocardial ischemia, but can produce large MI's and significant arrhythmias.

- **continuous ECG monitoring.**

- all patients to get EKG and cardiac enzymes sent on admission. if there are abnormalities, obtain an echocardiogram.

Hydrocephalus: ventricular enlargement is noted in up to 70% of patient series, depending on criteria. It is associated with a higher grade, an intraventricular bleed, and older age (Mayberg, 1994). With the placement of a vent, 50-80% of patients will show an improvement in neurological status (van Gijn 1985, Milhorat 1987). Its advantages include reducing ICP, clearing blood products from CSF, and brain relaxation during surgery. Disadvantages include a 5-10% risk of infection (Rajshekar 1992), and a theoretical increased risk of re-bleed (this has not been substantiated in the larger series).

- ventriculostomy IMMEDIATELY for all patients who are not following commands (Grades IV and V).
- in Grade 3 patients, should get ventric placed if very somnolent, difficult to arouse; if drowsy only (“good” grade 3), defer ventriculostomy
- Ventriculostomy in any patient with neurological deterioration while in the hospital
- Keep Ventric open at 20 cm
- Ventriculostomies will not be changed routinely
- Make sure that prophylactic antibiotics are given 30 minutes before placement (2 gms ancef; 1 gm vancomycin if there is an allergy)

Fluid and Electrolyte Balance:

All patients need daily sodium as hyponatremia is common. Most often, this is the result of cerebral salt wasting. Replacement can include saline, oral salt tablets, and 3% NaCl. Also, there is evidence that high magnesium levels is protective during ischemia.

- maintain euolemia (NOT hypervolemia); start NS with 20 meq/L KCl at 100 cc/hr (remove KCl if serum potassium is high). **NO PATIENT SHOULD GET MORE THAN 3 LITERS OF FLUID PER DAY, INCLUDING ALL MEDICATIONS, DRIPS, AND COLLOID OR BLOOD USE. MEASURE I'S AND O'S CAREFULLY.**

- maintain Na+ >135

- maintain serum mg++ > 2.0.

Seizure prophylaxis: seizures often result from aneurysm rupture, but do not cause aneurysm rupture. Because of increasing data that anticonvulsant use worsens neurological recovery following any injury (and specifically SAH), no prophylaxis to be given UNLESS the patient has a seizure while in the hospital.

-Do not start Dilantin even if there was a history of seizure at time of rupture or at another hospital.

-If the patient had a load before arrival, discontinue use here.

-If the patient has a seizure here, load as we do for trauma patients.

**- Do not check dilantin levels routinely
(only if pt. has further seizures or evidence of toxicity)**

- Continue anticonvulsants if patient has prior history of epilepsy.

Other Medications:

- pepcid for ulcer prophylaxis

-morphine sulfate for pain

-Ondansetron for nausea: DO NOT use phenergan (too sedating)

- if the patient is intubated and needs sedation, use propofol**
- pravastatin if serum cholesterol is high (obtain serum cholesterol on admission)**
- laxatives**
- chlorhexidine mouthwash if intubated**

Repair of Aneurysm

The international cooperative study on the timing of surgery has established certain facts (Kassell 1990).

1. the best surgical outcomes were in patients where clipping was delayed 11-14 days from SAH.
2. the best overall outcomes were the same in 2 groups: those with early surgery (SAH days 1-3) and those with delayed surgery (11-14). The better surgical outcomes obtained with delay were negated by the re-bleeding and spasm related complications during the wait. The worst outcomes were in patients treated in days 4-10.
3. the best outcomes were in those with good grades operated early Days 1-3.

Other guidelines:

1. NINDS Cerebral Aneurysm Information Page (www.hinds.nih.gov) - “surgery is usually performed within the first 3 days”
2. Cochrane review (www.cochraneconsumer.com) - “no evidence on best time for surgical treatment of aneurysmal subarachnoid hemorrhage”

OUR POLICY: If deemed appropriate by the attending, repair the aneurysm, by clipping or coiling, within 3 days of bleeding.

FOLLOWING REPAIR (SAH days 3-6)

Blood Pressure:

- all patients to have an arterial line
- MAP range: 70 – 100
- if MAP > 100 despite being on nimodipine, control with nicardipine drip
- if MAP < 70, contact ICU team
- if they have a ventriculostomy, maintain CPP > 60 (CPP requirement takes precedence over MAP range)

Fluids: After a general anesthetic, pulmonary edema is a frequent problem whether the aneurysm was treated by clipping or coiling. Sometimes, this will have a neurogenic etiology and will be unavoidable. But in other situations, excess fluid given during repair coupled with a baseline weak heart of a temporarily stunned myocardium leads to edema.

- goal: maintain euvolemia (DO NOT FLUID OVERLOAD PATIENT – GOAL IS EUVOLEMIA NOT HYPERVOLEMIA). IN ALL CIRCUMSTANCES, INCLUDING DURING VASOSPASM TREATMENT, NO PATIENT SHOULD GET MORE THAN 3 LITERS OF FLUID PER DAY, INCLUDING ALL MEDICATIONS, DRIPS, AND COLLOID OR BLOOD USE. MEASURE I’S AND O’S CAREFULLY.

- hold IVF post-procedure until patients urine output is less than 100 cc/hr for 2 hours, then start NS with 20 meq KCl/L to maintain UO between 50-100 cc/hr (note: no dextrose in the IV solution).

Nimodipine: as there are prospective, randomized trials showing the benefit of nimodipine with SAH, all patients are to receive the drug (Barker 1996). Must be given po or ng. The only side effect is hypotension. Total dose per day must be 180 mg.

- start with 30 mg q2
- if significant hypotension is not noted, go to 60 mg q4.
- If the pressure is too labile at 30 mg, then D/C.
- D/C nimodipine on transfer out of ICU

Ventriculostomy: clamp to drain following repair for 24 hours. If ICP > 25, then drain as necessary. After 24 hours, open to drain at 10 cm.

Serum Glucose: strict control per ICU protocols

VASOSPASM PERIOD (SAH days 6-10)

The incidence of vasospasm is correlated with the grade of the hemorrhage. For grade 2 patients, 30% will show spasm on angiogram, 50-60% for grade 4, over 70% for grade 5. Overall, 20-30 % will become symptomatic (Sahs et al, 1981).

Once a patient reaches SAH day 6, allow permissive hypertension: MAP range increased to 70-130.

Keep albumin > 3

All patients with visible SAH on CT get angiograms on SAH day 6 or 7. (exceptions; LP positive only, ICH only, IVH only). For poor grade patients (4 or 5), consider a day 4 angiogram.

Depending on results of angiography and clinical picture, patients will be divided into 3 categories:

- 1. no vasospasm – no treatment, observe for 24 hours, then transfer to floor**
- 2. mild – 5% albumin 250 cc IV bid, observe in ICU until SAH day 10, then transfer to floor.**
- 3. moderate or severe vasospasm:**
 - a. angioplasty or vasodilator injection (to be decided by the attending and endovascular surgeon).**
 - b. HT treatment: place Swan Ganz catheter and maintain Wedge between 10-16, CI > 4.5 and MAP > 100.**

- c. If any neurological deterioration during treatment, increase minimum MAP until deficit resolves; go to angiogram for further treatment**
- d. Follow-up angiogram, to assess resolution, SAH day 10 or 11**

On floor and discharge from the hospital: NO nimodipine. This means the only medications patients will be discharged with are pain medications, laxative, and anticonvulsants only if they had seizures in our hospital.

This protocol was reviewed and approved on 11/14/07 by:

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