Adult Intracerebral Hemorrhage

Prior to making any medical decisions, please view our disclaimer.

Guidelines for Emergency Management of Intracerebral Hemorrhage

Intracranial hemorrhage includes a broad category of pathology such as epidural (EDH), subdural (SDH), subarachnoid (SAH), intraventricular (IVH), and intracerebral (ICH) hemorrhage. Identification of patients with suspected intracranial hemorrhage requires urgent brain imaging. Unenhanced CT is the study of choice given its availability, ease of use and sensitivity to subarachnoid hemorrhage, but MR imaging may contribute to the evaluation and management of suspected brain hemorrhage. For patients with ICH, the following underlying conditions must always be considered: coagulopathy, trauma, vascular lesions (e.g. arteriovenous malformations and dural arteriovenous fistulas) venous thrombosis, aneurysmal rupture, hemorrhagic conversion of ischemic injury (HT), and hemorrhagic mass lesions such as tumors.

Func Score Calculator
While this is not a part of the MGH Adult Intracerebral Hemorrhage protocol, the FUNC score may be useful to clinicians by providing guidance in clinical decision-making and patient selection for clinical trials. Please refer to the Tools page.

The Following Guidelines Apply to Intracerebral Hemorrhage (ICH)

These guidelines should be used only as medical and educational reference tools. They are not intended to be used as a diagnostic decision-making system and must not be used to replace or overrule a physician's judgment or diagnosis. Application of this information in a particular situation remains the professional responsibility of the practitioner.

The following steps should be considered in parallel rather than in sequence, especially in the stabilization of vital functions and correction of coagulopathy.

A. Assess vital functions. Determine if intubation is required for patient safety during imaging evaluation. If so, consider use of an ultra-short acting neuromuscular blockade or sedative-hypnotics agent to allow for rapid return of motor control and assessment of neurologic deficits. Establish if co-morbid acute myocardial injury is a risk in patients with severely elevated BP. Endotracheal intubation can cause transient elevation in ICP; etomidate is favored for induction when elevated ICP is a concern. The use of fentanyl may attenuate transient ICP elevation.

B. Blood pressure management. All patients who require treatment with continuous intravenous antihypertensive therapy should undergo urgent placement of an intra-arterial catheter for blood pressure monitoring. Consider central venous catheter for central venous pressure monitoring as well as administration of IV antihypertensive medications. Once a physician determines that a patient requires treatment with IV antihypertensive therapy, he/she must designate an individual who will remain at the bedside and monitor effectiveness of therapy until blood pressure is controlled.

Elevated blood pressure (suggested medications in approximate order of preference):
- Labetalol: 5-100mg/hr by intermittent bolus doses of 10-40mg or continuous drip (2-8mg/min)
- Nicardipine: 5 mg/hr increased by 2.5 mg/hr q15 minutes to max 15 mg/hr
- Esmolol: 250 mcg/kg as a load; maintenance use, 25-300 mcg/kg/min
- Enalapril: 0.625-5mg IV Q6h
- Hydralazine: 5-20mg IV Q30min
- Nitroprusside: 0.1 - 10 mcg/kg/min

The optimal blood pressure goal is not clear. For patients presenting with severely elevated blood pressure (>220mmHg), consider a 25% reduction initially. For patients presenting with SBP <220mmHg, acute lowering of systolic BP to 140 mmHg for 7 days (as per INTERACT2) is probably safe and may be effective for improving functional outcome [1]. Any clinical deterioration in association with reduction of BP should prompt reconsideration of ongoing BP management strategy. Patients who are placed on multiple high dose BP medications in the acute setting frequently require less medications at lower doses in the sub-acute setting (days to weeks) and vigilance is required to avoid risk of hypotension.

C. Hypotension: The etiology of hypotension must be established. Volume replenishment is the first approach. Isotonic saline or colloids can be used and monitored with central venous pressure. If hypotension persists after correction of volume deficit, continuous infusions of vasopressors should be considered, particularly for low systolic BP (>90mmHg).

1. Phenylephrine: 2-10mcg/kg/min
2. Dopamine: 2-20mcg/kg/min
3. Norepinephrine: 0.05-0.2mcg/kg/min

Send the following labs STAT: PT/INR, PTT, CBC with platelets , fibrinogen, electrolytes, BUN/Cr, glucose, liver function tests, type and screen to blood bank.

Consult neurology for all ICH and IVH patients, and page stroke/neurocritical care research fellow (pager 13370).

Consult neurosurgery for the following:
0. Traumatic intracranial hemorrhage (EDH, SDH, etc)
1. SAH or other suspected hemorrhage from cerebral aneurysm
2. ICH from suspected vascular malformation
3. ICH with clinical or CT signs of significant mass effect or midline shift
4. Cerebellar ICH. Indications for surgery include hematoma greater than 3cm in diameter, brainstem compression, and hydrocephalus [2].

5. Hematoma evacuation can be considered for patients with lobar ICH who demonstrate progressive clinical deterioration as a potential life-saving measure. For ICH in a superficial lobar distribution without intraventricular extension, there may be a small survival benefit to early surgical evacuation when compared to standard conservative medical management based on results of the STICH2 (Surgical Trial in Intracerebral Hemorrhage 2) trial [3]. Additionally with the advent of minimally invasive surgery, patients may still benefit from surgical evacuation. A formal protocol for minimally invasive surgical (MIS) hematoma evacuation at MGH is listed separately.

6. Patients who are candidates for intracranial pressure monitoring or emergency external ventricular drain placement. Limited data exists regarding indications for monitoring and treatment of ICP in ICH. In cases where CSF drainage may be necessary to control hydrocephalus and/or ICP, a ventriculostomy catheter should be considered. Management of ICP in ICH is largely generalized from TBI guidelines including keeping ICP<20mmHg and cerebral perfusion pressure (CPP) target of 50-70 (CPP=MAP-ICP).

Imaging Considerations: Consider the differential diagnosis to guide imaging choices:

0. Non-contrast head CT: Obtain urgently/emergently for ALL intracranial hemorrhage patients. This is the imaging study of choice given availability, ease of use and sensitivity for acute blood products.

1. CT Angiography: For all spontaneous ICH, all SAH patients, and in the context of suspected underlying vascular lesion (e.g AVM). MR angiography can also be considered, but CTA is faster and provides greater vascular resolution. Ensure no contraindication to contrast use, such as renal failure or contrast allergy. The presence of a spot sign on CTA can help predict hematoma expansion [4]. If an aneurysm is confirmed, contact neurosurgery immediately and see the subarachnoid hemorrhage protocol.

2. MRI: For ICH secondary to possible underlying neoplasm (primary or secondary), amyloid angiopathy or other degenerative process, or cavernous malformation. The most helpful sequences are GRE or SWI. Contrast MRI or contrast CT can also be considered (see Lunder 6 MRI protocols). This imaging may be useful initially and should be repeated 6-12 weeks later if clinical suspicion is high, once hemorrhage products have undergone reabsorption. MRI is also invaluable if hemorrhagic conversion of an ischemic infarct is suspected. Utilize DWI and GRE sequences. If acute ischemic stroke is suspected (onset less than 12 hours), contact acute stroke team immediately (Beeper 34CVA).

3. MRV: for hemorrhage secondary to venous sinus thrombosis or cortical vein thrombosis. CT venography can also be useful, though it provides more limited tissue information.

4. Digital subtraction angiography (DSA) may be useful in any setting where an underlying lesion is suspected but not confirmed by non-invasive imaging, or where better vascular detail is needed for diagnostic or treatment purposes.

Contact the Neuroendovascular service (pager 33722) to consult.

Measure/calculate the following, where applicable:

0. ICH volume: Measure volume using ABC/2 method, where A is the greatest hemorrhage diameter by CT, B is the diameter 90 degrees to A and C is the approximate number of CT slices with hemorrhage multiplied by slice thickness in cm.

1. GCS
2. NIHSS
3. A baseline severity score such as ICH score [5] or FUNC score [6] may be useful to clinicians by providing guidance in clinical decision making and guide patient selection for clinical trials. However, because withdrawal of aggressive measures is commonly sought by both family and physicians in the setting of ICH, withdrawal of care within the first 24 hours becomes the single most important predictor of survival after ICH [7] and may have introduced bias into previous scoring systems. One recent study has shown that limiting new do-not-resuscitate orders in the first 5 days after ICH reduced mortality without increasing severe disability at 90 days [8]. Current guidelines from the American Stroke Association recommend new care limiting orders be considered after the second full day of care is provided [9].

Correct coagulopathy

0. Warfarin

- **Immediate therapy**
  - If patient is on warfarin and INR is elevated: administer vitamin K 10mg IV over 10 minutes and EITHER prothrombin complex concentrates (4FPCCs) or FFP. PCC has the advantage of more rapid INR reversal than FFP and should be considered.

  **4F-PCC dosing (Consult Blood Bank Fellow on call in order to obtain):**

  - INR > 6: 50U/kg (not to exceed 5,000 units total)
  - INR 4-6: 35 U/ kg (not to exceed 3500 units total)
  - INR 2-3.9: 25 U/kg (not to exceed 2500 units total)

- **4F-PCC dosing:**

  - INR > 6: 15 mL/kg
  - INR 4-6: 12 mL/kg
  - INR 2-3.9: 10 mL/kg

  INR should be repeated 15 minutes after infusion of 4F-PCC or FFP. The goal INR is <1.4. Of note, intravenous vitamin K is associated with a small risk of severe allergic reaction. When administered intravenously, the rate should not exceed 1mg/minute. Reversal of anticoagulation by any means (vitamin K, FFP, or PCC) is associated with a risk of thrombosis depending upon the patient's underlying indication for anticoagulation.

  **Follow-up therapy**
• STAT PT/INR q 4 hrs x 24; then q 6 hrs x 36; then as needed.

• If the INR is greater than 1.3 at 4 hours, administer second dose of Vitamin K 10 mg IV. Additional administration of fresh frozen plasma (FFP) can be considered. Evaluate the patient for disseminated intravascular coagulation and phone consult a staff member of neurology, transfusion medicine or hematology. The Blood Bank attending or fellow on call should be paged.

• Patients with anticoagulant-related ICH are at high risk for prolonged bleeding and hematoma expansion. Consider repeating a non-contrast cranial CT scan every 6 +/- 2 hours from time of initial CT scan until ICH volume is stable. In addition, CT scanning should be repeated when any neurologic deterioration occurs.

1. Other causes of coagulopathy:
   - Patients taking aspirin can be considered for platelet transfusion.
   - For patients taking other antithrombotic agents (clopidogrel, ticlopidine, low-molecular weight heparins, etc), phone consult with the blood bank fellow on call, the acute stroke attending, or hematology.

2. Direct Oral Anticoagulants (DOACs), Target Specific Oral Anticoagulants (TSAOCS), or Novel Oral Anticoagulants (NOACs) (dabigatran, rivaroxaban, apixaban, edoxaban):
   - It is not clear whether any currently available option reverses these agents. In addition, their half-lives are much shorter than warfarin. Half lives in healthy subjects (likely longer in the elderly and with poor renal function):
     1. Dabigatran: 12-14 hours
     2. Rivaroxaban: 5-9 hours
     3. Apixaban: 9-14 hours
     4. Edoxaban: 10-14 hours
   
   As of 2015, MGH is participating in international clinical trials of DOACspecific antidotes; page “Research ED pager” (pager 15295) to determine eligibility. While many hospitals have adopted a protocol using 4F-PCC to reverse these agents, this literature is in flux; page the blood bank fellow on call to discuss if current data supports any specific therapy

3. Standard (Unfractionated Heparin)
   - Discontinue the heparin infusion and order Protamine sulfate 25 to 50 mg intravenously at a rate not exceeding 5 mg/min. Monitor for signs of anaphylaxis; the risk is higher in diabetics who have received insulin.

Follow-up therapy
   - STAT PTT q1 hour for the next 4 hours, then q4 hours through 12 hours of hospitalization.

4. Low Molecular Weight Heparin
   - Protamine sulfate only partially reverses the anti-factor Xa activity of lowmolecular-weight heparin.

Enoxaparin: 1 mg protamine for each mg of enoxaparin; if PTT prolonged 2-4 hours after first dose, consider additional dose of 0.5 mg for each mg of enoxaparin.

Dalteparin or tinzaparin: 1 mg protamine for each 100 anti-Xa IU of dalteparin or tinzaparin; if PTT prolonged 2-4 hours after first dose, consider additional dose of 0.5 mg for each 100 anti-Xa IU of dalteparin or tinzaparin.

5. Thrombolytic Agents
   - Check STAT labs: CBC, PT, PTT, platelets, fibrinogen and D-dimer.
   - If hypofibrinogenemia present, treat with antifibrinolytic or cryoprecipitate (or both) as follows:
     1. Give anti-fibrinolytic: eg, amicar 5 gram bolus i.v. over 15- 30 min
     2. If fibrinogen less than 100 mg/dL, then give cryoprecipitate 10 units. If still bleeding at 1 hr and fibrinogen level still less than 100 mg/dL, repeat cryoprecipitate dose.
   - Institute frequent neurochecks and therapy of acutely elevated ICP, as needed.

Additional Options or considerations

0. If patient has a known platelet disorder, give 6 units platelets.

1. For uncontrolled, life-threatening bleeding, consider aminocaproic acid (Amicar) 10 grams IV in 250 cc NS IV over 1 hr as a last resort . Note there is a significant risk of pathologic thrombosis with Amicar.

2. Serious systemic hemorrhage should be treated in a similar manner. Manually compress and compressible sites of bleeding, and consult appropriate additional services to consider mechanically occluding arterial or venous sources of medically uncontrollable bleeding

6. Platelet disorders
   - Thrombocytopenia (platelet count less than 100,000/uL)—Give 6-12 doses (1-2 doses) of platelets. Consult blood bank fellow on call to discuss whether a goal platelet level should be targeted.
   - Von Willebrand syndromes: Phone consult with a staff member of hematology or transfusion medicine for dosing of VWF factor concentrate. Treat with 0.3 mcg/kg DDAVP given IV over 30 minutes.

DDAVP may also benefit patients with:

0. Uremic platelet dysfunction.

1. Congenital platelet function disorders.

2. Recent ingestion of combinations of antiplatelet agents such (e.g. ASA and clopidogrel).
Thromboprophylaxis. For prevention of venous thromboembolism, intermittent pneumatic compression should be applied. Consider initiation of subcutaneous low molecular weight heparin for DVT prophylaxis between 1-4 days following ICH [9], generally at 48 hours after stability of the hemorrhage.

Glycemic Control. For glucose greater than 140 - 180 mg/dl institute insulin therapy either in the form of a sliding scale dose regimen or continuous IV drip. Avoid hypoglycemia.

Seizures. Anti-epileptic therapy should always be used for treatment of known clinical or electrographic seizures. Continuous EEG monitoring should be considered for ICH patients with depressed or fluctuating mental status. There is no data to suggest prophylactic anti-epileptic therapy decreases incident seizure risk.

Temperature—Maintain temperature less than or equal to 38 degrees using PO/PR acetaminophen 650 mg q6h. In the setting of poor airway control or if temperature remains elevated despite acetaminophen, consider external cooling.

Repeat neuro-imaging: Non-contrast cranial CT scan whenever concern for ongoing hemorrhage or hematoma expansion is raised or in the setting of clinical deterioration. Consider followup imaging at 6 hours and/or 24 hours to evaluate for hematoma expansion. (see anticoagulation-related hemorrhage above)

Dysphagia screening: A screening for dysphagia should be performed in all ICH patients to reduce the risk of pneumonia.

Screening for myocardial ischemia: Eletrocardiogram and cardiac enzyme testing should be performed. Resumption of antiplatelet agents should be considered in patients with high risk for coronary event.

References

7. Diringer MN, Edwards DF. Admission to a neurologic/neurosurgical intensive care unit is associated with reduced mortality rate after intracerebral hemorrhage. Critical Care Medicine 2001;29:635-40

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