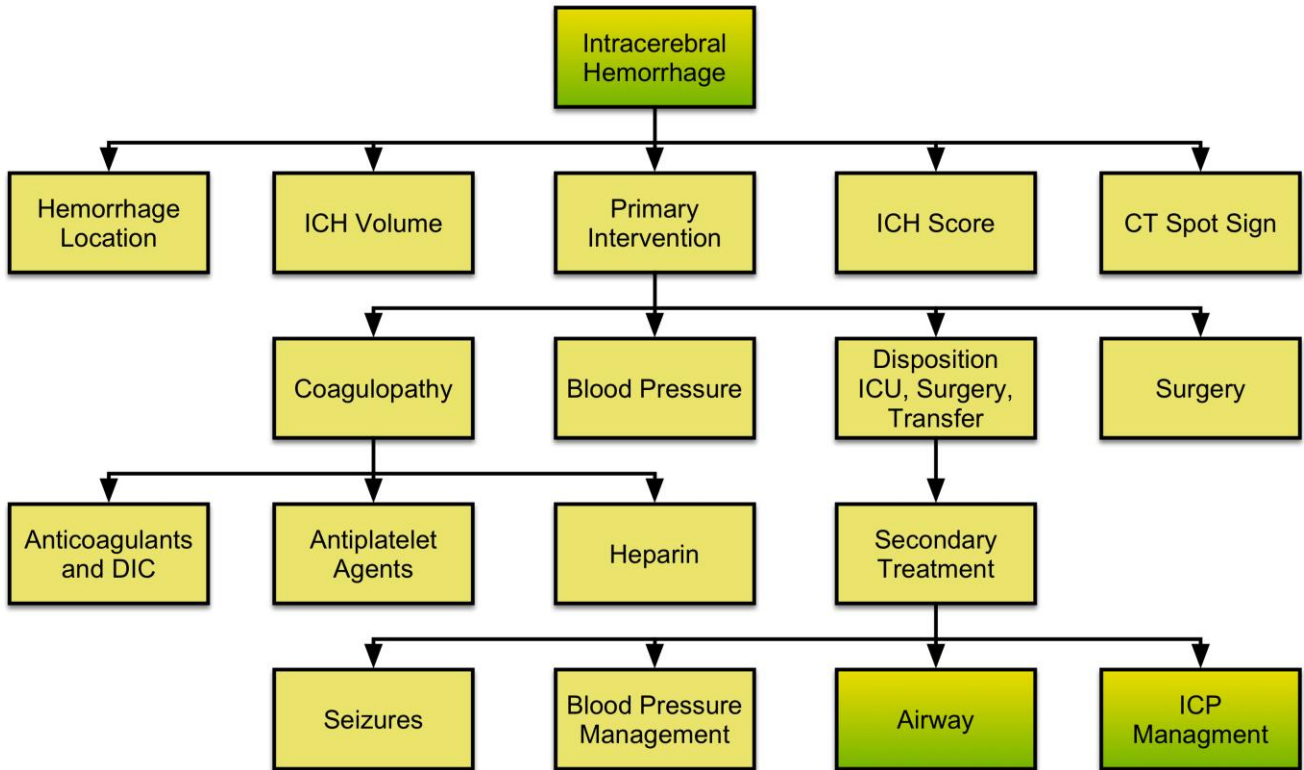


Emergency Neurological Life Support

Intracerebral Hemorrhage

Version: 2.0

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[Checklist & Communication](#)

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Checklist

- Check PT, PTT, INR
- Obtain head imaging results
- Measure hematoma volume
- Calculate GCS
- Calculate ICH Score

Communication

- Age
- ICH volume and location
- GCS
- ICH Score
- Presence of hydrocephalus
- Blood pressure
- Coagulation parameters and anticoagulant reversal treatments given
- Plan for surgery

Disposition: ICU, Surgery or Transfer

ICU admission

NeuroICU admission is preferable. If a NeuroICU bed is not available, then general ICU admission is preferred. The key is to have frequent neuro checks in patients who may suffer a decline in neurological and/or airway status so interventions can occur quickly. If the patient is not ventilated and not on IV antihypertensive agents, then a step-down unit is an alternative as long as frequent neuro checks can be obtained.

If the patient is a surgical candidate, then direct transfer to the OR may be an option. If ICU services are not available or surgery is not available, consider emergent transfer to an institution with these services. Critical care transportation may be necessary depending on airway status, hemorrhage location and size, and judgment about the risk of neurological worsening in transport.

Airway

Is the patient's airway stable?

ICH may continue to expand and the patient's mental status and airway may become compromised. Continued airway assessment is critical especially in posterior fossa hemorrhages. Therefore, frequent neuro checks are important in this early phase of ICH to identify and intervene in a patient who is declining.

See ENLS protocol [Airway, Ventilation and Sedation](#) for discussion on how to intubate.

Anticoagulants and DIC

INR > 1.4

See the ENLS reference [Pharmacotherapy](#) for a detailed listing of medications and dosing for reversal of anticoagulant drugs.

Consider vitamin K antagonist reversal with purified factor concentrates or FFP if patient has taken warfarin or other vitamin K antagonists, followed by vitamin K 10 mg IV. 4-factor prothrombin complex concentrates (PCC) are preferred to FFP. To calculate the volume of plasma or IU of prothrombin complex concentrate:

1. Decide on target INR
2. Convert INR to percent (%) functional prothrombin complex:

| INR Range | Percent function prothrombin complex |
|-----------|--------------------------------------|
| > 5 | 5% |
| 4.0 - 4.9 | 10% |
| 2.6 - 3.9 | 15% |
| 2.2 - 2.5 | 20% |
| 1.9 - 2.1 | 25% |
| 1.7 - 1.8 | 30% |
| 1.4 - 1.6 | 40% |
| 1.0 | 100% |

3. Calculate dose:

(Target in %PC - Current level in %PC) X weight (kg) = mL of FFP or IU of PCC needed

Example: a patient with INR on arrival = 7.5, target INR 1.5, body weight = 80 kg:

$$(40-5) \times 80 = 2,800$$

Therefore, the needed dose is 2,800 mL of FFP or 2,800 IU of PCC.

Reference: Schulman, S. Care of patients receiving long-term anticoagulant therapy. NEJM (2003) 349:675

For patients with ICH and having taken dabigatran, idarucizumab may be used to reverse the anticoagulant effects of dabigatran. The recommended dose of idarucizumab is 5 g, provided as two separate vials each containing 2.5 g/50 mL idarucizumab. If idarucizumab is not available consider rVIIa 80µg/kg.


While no specific reversal agents exist for direct Xa inhibitors, one could consider activated charcoal if the last dose was within 8 hours. Consider PCC 30 IU/kg for rivaroxaban or apixaban. FFP and vitamin K are not effective.

 [Flowchart](#)

Antiplatelet Agents

Aspirin, clopidogrel, prasugrel, etc.

If the patient has been taking antiplatelet drugs, it is reasonable to transfuse with platelets and consider administering DDAVP 0.3 mcg/kg IV however there is little evidence basis for this practice.

 Flowchart

Blood Pressure

Should BP be lowered?

Keep SBP below 140 mm Hg; consider using IV nicardipine with or without IV labetalol.

See ENLS reference [Pharmacotherapy](#) for details on IV antihypertensive dosing.

Hemorrhage Location

Brain location of ICH

Determine where the hemorrhage is located (may be more than single site).
Options include:

- lobar
- basal ganglia
- thalamus
- cerebellum
- midbrain
- pons
- intraventricular

 [Flowchart](#)

Coagulopathy

Is there an underlying coagulopathy?

If yes, consider presence of oral or parenteral anticoagulants, antiplatelet agents, liver failure and DIC.

Control BP

Continue to control blood pressure

Keep SBP below 140 mm Hg; consider immediate treatment with IV labetalol and using IV nicardipine infusion to maintain control.

See ENLS reference [Pharmacotherapy](#) for details on IV antihypertensive dosing.

Heparin

Recent heparin administration

Administer protamine sulfate IV 1 mg per 100 U heparin received in last 2 hours; maximum dose 50 mg IV.

See ENLS reference [Pharmacotherapy](#) for details on IV anticoagulant reversal dosing.

ICH Score

Calculate the ICH score

The ICH score can be calculated as follows:

| Component | Criteria | Points |
|-----------------------------|-----------------|--------|
| CGS | 3-4 | 2 |
| | 5-12 | 1 |
| | 13-15 | 0 |
| ICH Volume | ≥ 30 ml | 1 |
| | < 30 ml | 0 |
| Intraventricular hemorrhage | Yes | 1 |
| | No | 0 |
| Infratentorial origin | Yes | 1 |
| | No | 0 |
| Age | ≥ 80 years | 1 |
| | < 80 years | 0 |
| Total | | 0-6 |


The ICH score is a method to determine severity of illness. Although it is correlated with mortality, one should not use any particular score to limit care.

ICH Volume

Measure the hematoma volume

If the blood is within the brain parenchyma, use the ABC/2 method.

Formula for Estimating ICH Hematoma Volume



A x B x C

2

Select CT slice with largest ICH
A = longest axis (cm)
B = longest axis perpendicular to A (cm)
C = # of slices x slice thickness (cm)

Estimated volume of spheroid
Correlates well w/ planimetric CT analysis

Kothari et al. *Stroke* 27:1304-1305, 1996

Image courtesy of J. Claude Hemphill III, MD, MAS

ABC/2 method for estimating ICH hematoma volume. Right basal ganglia intracerebral hemorrhage. The axial CT image with the largest cross sectional area of hemorrhage is selected. In this example, the largest diameter A is 6 cm, the largest diameter perpendicular to A on the same image B is 3 cm, and hemorrhage is seen on 6 slices of 0.5 cm (5 mm) thickness for a C of 3 cm (not shown). Thus, the hematoma volume is $(6 \times 3 \times 3)/2 = 27$ cc. Note that for C, if the hematoma area on a slice is approximately 25-75 % of the hematoma area on the reference slice used to determine A, then this slice is considered half a hemorrhage slice, and if the area is <25 % of the reference slice, the slice is not considered a hemorrhage slice.

ICP Elevated

Is the patient at risk for high ICP?

Consider ICP monitoring if $GCS \leq 8$ or the patient has symptomatic hydrocephalus.
See ENLS protocol [Elevated ICP and Herniation](#) for management recommendations.

Intracerebral Hemorrhage (ICH) Diagnosis

ICH diagnosis confirmed

Intracerebral Hemorrhage (ICH): ICH typically produces a sudden, new headache followed by progressive neurological signs. The onset is usually sudden and many patient's neurological symptoms progress over a few hours likely due to continued intracerebral bleeding. It is not possible to be certain whether the stroke is due to hemorrhage or ischemia based on signs and symptoms alone, so some form of emergent brain imaging is necessary.

Topic Co-Chairs:

Edward Jauch, MD MS

Jose A Pineda, MD

J. Claude Hemphill, MD, MAS

Other findings

CT spot sign

If IV contrast was administered during the CT scan, extravasation of contrast within the hematoma may suggest active bleeding. This is called the spot sign as shown in the figure:

CT “Spot Sign” seen on CTA or post-contrast image

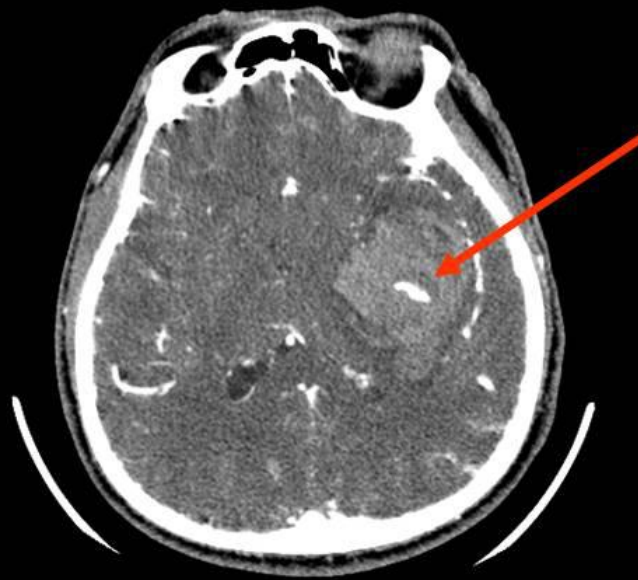


Image courtesy of Joshua Goldstein, MD

Primary Intervention

First steps for intervention

Intervention for ICH is classified as "primary" meaning what can be done to impact the patient right now, and "secondary" once these primary interventions are addressed. One should consider the secondary interventions of blood pressure control, declining neurological exam requiring airway protection, concurrently.

Secondary Treatment

Begin secondary interventions

Secondary interventions are critical in the ongoing care of the ICH patient, especially in consideration of transfer of the patient from the Emergency Department to the intensive care unit or to a hospital with a higher level of care.

Seizures

Seizure management

- Do not administer anticonvulsants prophylactically.
- Treat clinical seizures with benzodiazepines then anticonvulsants.
- Consider EEG monitoring if the patient's level of consciousness is less than is likely explained by the size and location of the hemorrhage.

Surgery

Is the patient a surgical candidate?

Cerebellar ICH should be considered for surgery urgently depending on size. Typically, surgery is considered for hematomas in excess of 3 cm in any dimension, and neurosurgery should be consulted urgently for any patient with cerebellar ICH and hydrocephalus.

Consider surgery for lobar ICH with mass effect in severely affected but salvageable patients and as a life-saving measure in patients who are herniating.