Emergency Neurological Life Support Intracerebral Hemorrhage Protocol Version 5.0

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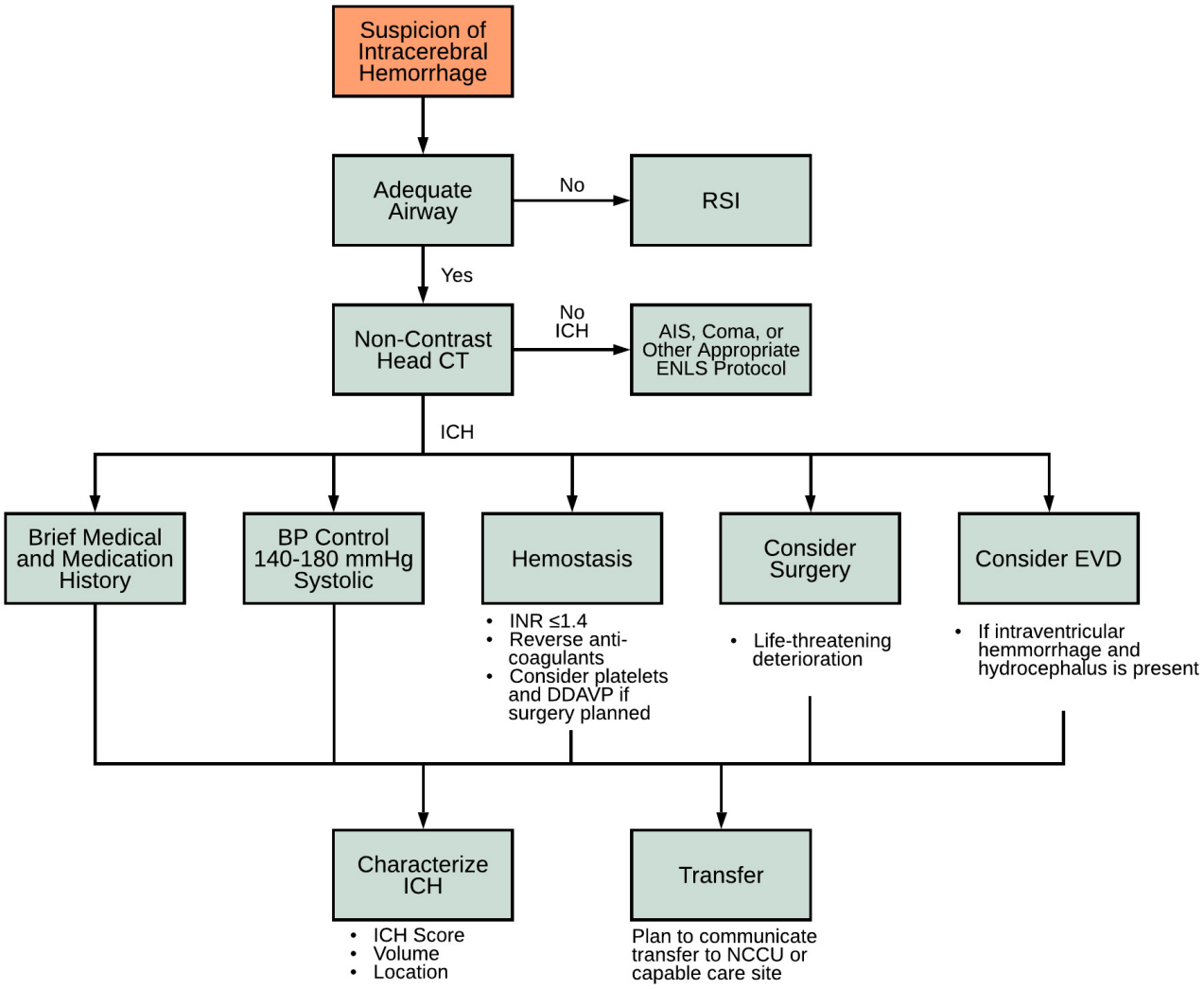
ENLS Intracerebral Hemorrhage Management Algorithm



Neurocritical Care Society ENLS EMERGENCY NEUROLOGICAL LIFE SUPPORT

Intracerebral Hemorrhage Checklist for the First Hour

☐ Complete blood count with platelet count, PT, PTT, INR
☐ CT head results: hematoma size, location, presence of intraventricular hemorrhage
☐ Glasgow Coma Scale (GCS) score
☐ Calculate ICH score
☐ Interventions:
    ☐ Coagulopathy reversal (goal INR ≤ 1.4)
    ☐ Blood pressure lowering (goal systolic 140–180 mmHg)
    ☐ Surgical hematoma evacuation (if indicated)
    ☐ Airway/ventilation management

Communication

Prehospital to ED (before diagnosis of ICH)

☐ Airway status−patent airway/supraglottic device/endotracheal tube
☐ Breathing−respiratory status
☐ Blood pressure and pulse
☐ Age/gender
☐ GCS, pupils
☐ Signs and symptoms
☐ Last known normal
☐ Brief relevant medical history−previous stroke, blood thinners, bleeding
☐ Current medications

Sample EMS call
"This is Medic 1 with a stroke alert—85-year-old male, acute right hemiparesis, on aspirin 81 mg. Last known normal at 1300. Vital signs stable. ETA30 min."

Hand-off after ICH diagnosis has been made

☐ Age
☐ GCS, pupil exam
☐ Hematoma volume and location
☐ Other CT findings (intraventricular hemorrhage, hydrocephalus, spot sign)
☐ ICH score
☐ Airway status
☐ Blood pressure, target, and treatment initiated
☐ Coagulation parameters (INR, PT, PTT, platelet count, WBC, Hgb) and reversal treatment if any
☐ Medications given
☐ Plan for surgery if any

Sample Sign-Off Narrative

"I am signing out a 62-year-old man with known hypertension and atrial fibrillation who is presumed to be on warfarin."
"He was found at home this morning at 9 AM by his wife who last saw him normal at 7 AM. He was talking to EMS and had left-sided weakness, GCS in the field was 13, and BP was 170/100."
"On arrival to the ED here, he was the same, so we drew labs and sent him for a head CT."
"CT completed at 10 AM showed a 20 ml right thalamic ICH with mild IVH, but no hydrocephalus. There is about 4 mm of right-to-left midline shift. CTA/CTP showed no AVM or aneurysm, but there is a positive spot sign."
"When he returned to the ED, he was sleepier, with a GCS of 9, and his left-sided weakness was worse. So he has an ICH score of 2. His labs came back with an INR of 1.9."
"We intubated him using rocuronium and etomidate. PCC infusion of 2250 IU (estimated weight 90 kg; dose of 25 IU/kg) is going in now. He also had 10 mg of IV vitamin K."
"Neurosurgery has been called, and they are on their way to see him. He is in ED Resuscitation Room 1, intubated and sedated now on propofol at 60 mcg/kg/min and fentanyl 50 mcg/hr. His BP is 140/85 with no other treatment."

Intracerebral Hemorrhage (ICH)

Initial Diagnosis

Intracerebral Hemorrhage (ICH) typically produces a sudden, new headache followed by progressive neurological signs. The onset is usually sudden and the 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.

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.

Adequate 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. In general, if an ICH patient is comatose, rapid sequence intubation (RSI) should be undertaken with a goal of normoventilation.

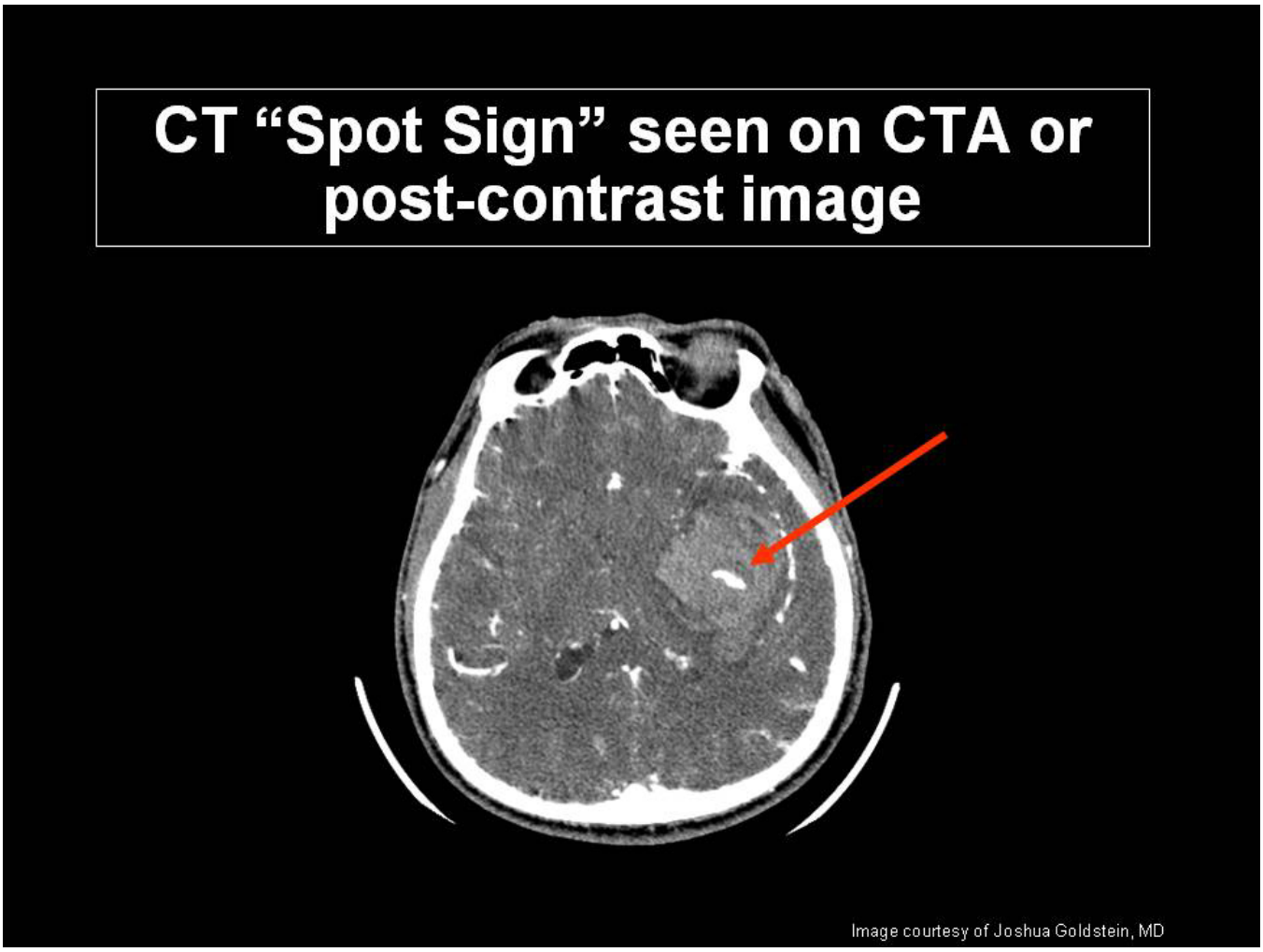
See ENLS protocol Airway, Ventilation and Sedation for discussion on how to intubate.

Non-Contrast CT

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. Non-contrast computed tomography (CT) is the most commonly used modality given that it can be done quickly, can be used for critically ill patients, and has a very high sensitivity and specificity for acute parenchymal hemorrhage.

Other findings – Contrast 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:



Brief Medical and Medication History

As with all strokes, it is important to obtain a brief history on the onset of symptoms and when the patient was last seen normal. Prehospital providers should attempt to get a medical history and list of medications prescribed for the patient with specific attention to antiplatelets, anticoagulants, and antihypertensive medications.

BP Control

Should BP be lowered?

Target SBP between 140 and 180 mmHg with the specific threshold determined based on patient comorbidities and level of chronic hypertension. Initiate BP management immediately using a titratable agent to ensure target is reached quickly with minimal potential for overshoot. IV beta-blockers and IV calcium channel blockers are most commonly used in first hours.

See ENLS Pharmacotherapy module for details on IV antihypertensive medications and dosing.

Hemostasis

Is there an underlying coagulopathy?

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

Anticoagulants and DIC, INR > 1.4

See the ENLS reference Pharmacotherapy module for a detailed listing of medications and dosing for reversal of anticoagulant drugs.

Rapid vitamin K antagonist reversal is recommended with purified factor concentrates or FFP if patient has taken warfarin or other vitamin K antagonists concurrent with vitamin K 10 mg IV administered by slow IV push. 4-factor prothrombin complex concentrates (PCC) are superior to FFP. Weight based dosing for PCC (or FFP only if PCC is not available) with the dose adjusted based on INR is recommended.

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 5g, provided as two separate vials each containing 2.5 g/50 mL idarucizumab. Activated charcoal (50 gm) should also be given if ICH occurs within 2 hours of most recent dabigatran dose. If idarucizumab is not available, consider activated PCC FEIBA or 4 factor PCC; these approaches have not been formally tested and do not fully reverse dabigatran coagulopathy.

The currently recommended approach is to use Andexanet alpha as a reversal agent for direct Xa inhibitors, but clinical trials of its efficacy are ongoing. For dosing, depending on the agent that the patient is on, please refer to ENLS Pharmacotherapy module.

Antiplatelet Agents

If the patient has been taking antiplatelet drugs (aspirin, clopidogrel, prasugrel, etc.), it is reasonable to transfuse with platelets if they are undergoing a neurosurgical procedure and consider administering single dose of DDAVP 0.4 mcg/kg IV.

Heparin + Recent Heparin Administration

Administer protamine sulfate IV 1 mg per 100 U heparin received in last 2 hours; maximum dose 50 mg IV. Protamine sulfate in the same dose can be used in an attempt to reverse the effect of low molecular weight heparin that was given within the prior 8 hours, but this reversal may be incomplete.

See ENLS Pharmacotherapy module for details on IV anticoagulant reversal dosing.

Neurosurgical Interventions

Is the patient a surgical candidate?

Patients with cerebellar ICH who are clinically deteriorating or have brainstem compression should undergo surgical removal as soon as possible. Initial treatment in these cases with ventricular drainage alone rather than surgical evacuation is not recommended.

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. Decompressive hemicraniectomy might be considered a life saving measure in deteriorating patients.

Patients with IVH should be monitored closely for developing hydrocephalus. When present, hydrocephalus is treated by placement of an EVD to facilitate CSF diversion.

ICP Management

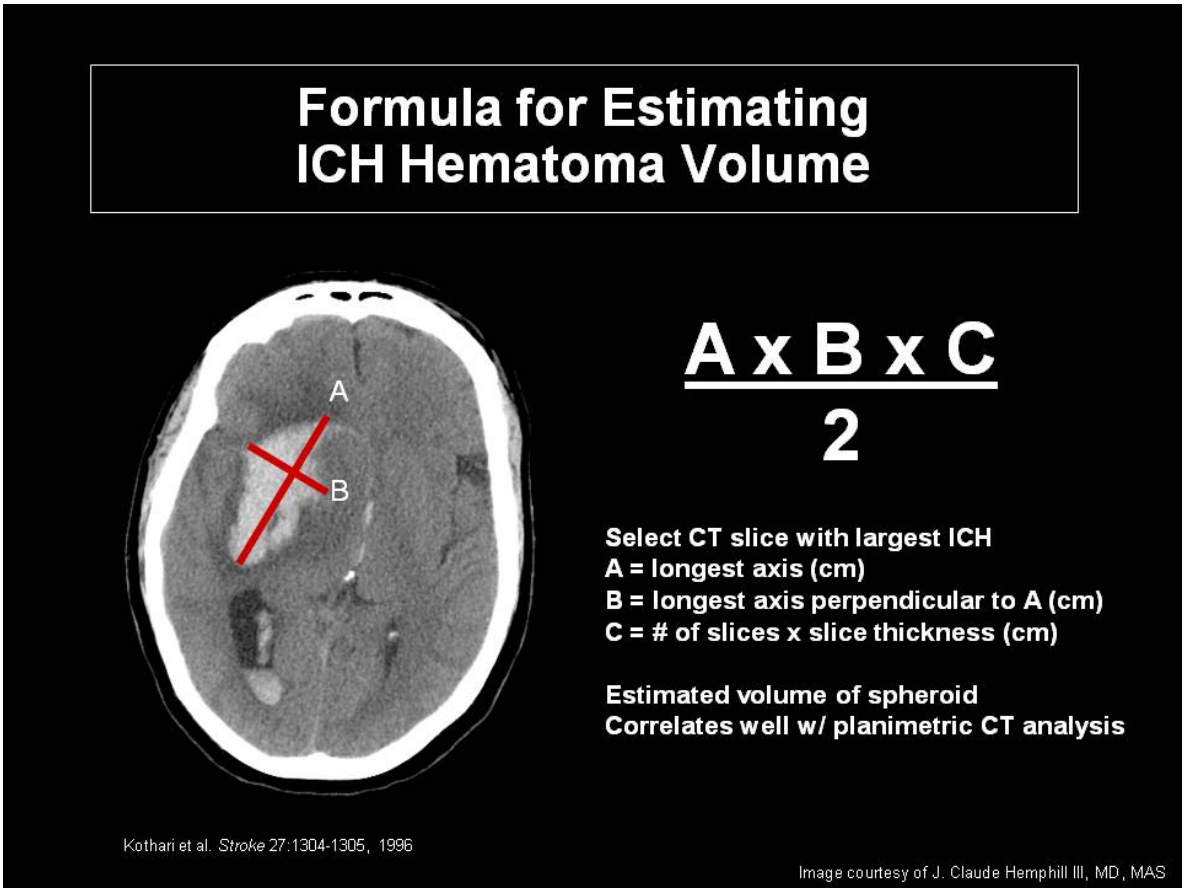
Current guidelines for ICP monitoring in ICH follow the approach in severe traumatic brain injury (TBI) with ICP monitoring recommended in patients with GCS<8, large hematomas with mass effect suggestive of elevated ICP, or hydrocephalus. However, because they represent distinct entities, TBI-specific recommendations should be extrapolated cautiously to ICH, which is itself a heterogeneous disease. In many instances, local pressure gradients from an expanding hematoma can result in severe brain compression and cerebral herniation that may not be initially reflected in global ICP measurements.

See ENLS Intracranial Hypertension and Herniation module for management recommendations.

Characterize ICH

Measure the hematoma volume

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



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 X 3 X 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.

Calculate the ICH score

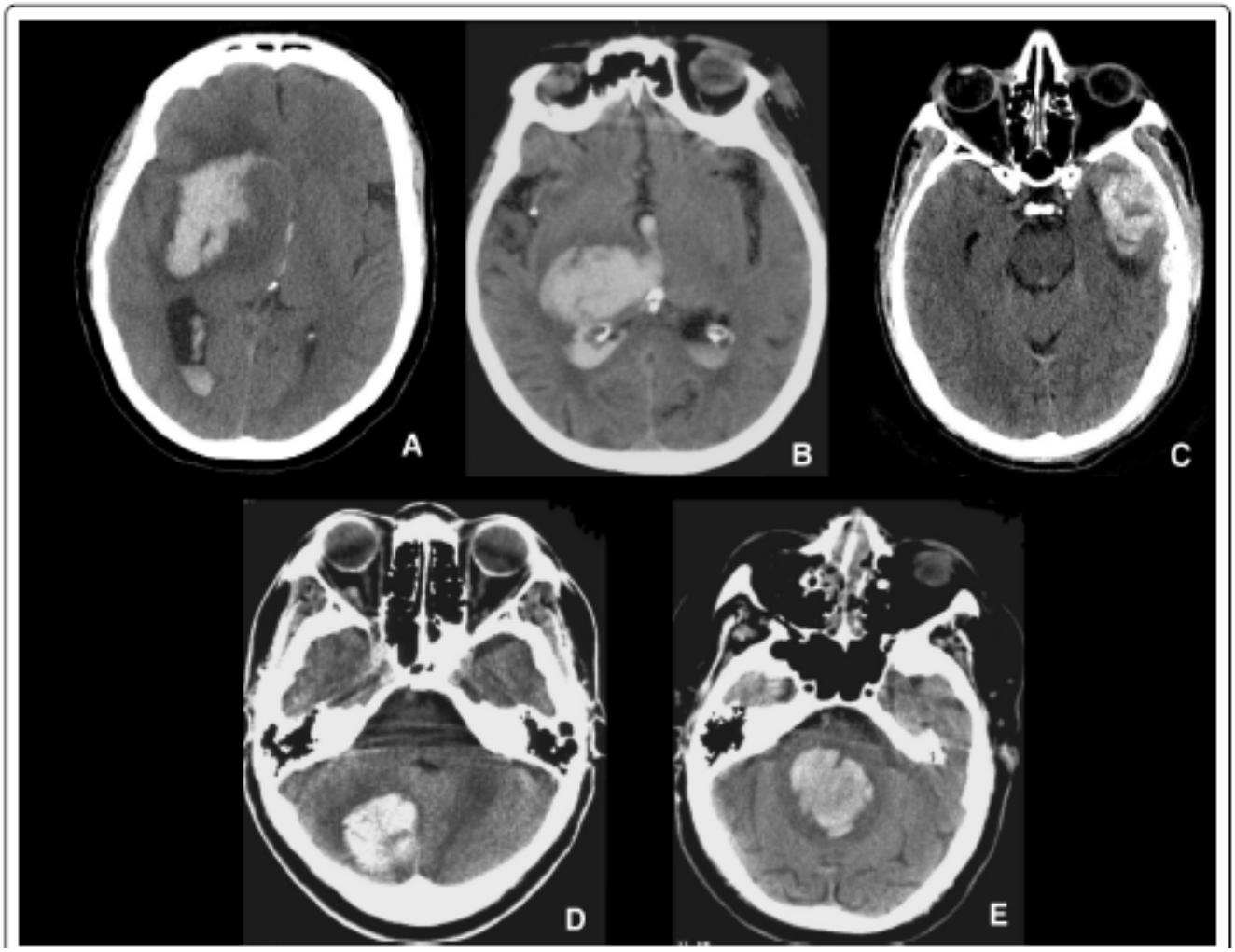
The ICH score can be calculated as follows:

Component	Criteria	Points
GCS	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 and as a communication tool among providers rather than as a tool to precisely prognosticate outcome. Although it is correlated with mortality, one should not use any particular score to limit care.

Location of ICH

ICH tends to occur in characteristic locations, with hypertensive ICH most frequently located in the basal ganglia, thalamus, pons (brainstem), cerebellum. ICH due to cerebral amyloid angiopathy or AVM tends to have a lobar location but may occur in more than one site. The origin of the hematoma is usually evident from the initial CT scan, and its location influences outcome and treatment.



Typical locations for ICH. ICH due to chronic hypertension is usually due to rupture of small penetrating arterioles and typically occurs in the basal ganglia (A), thalamus (B), cerebellum (D), and pons (E). ICH from cerebral amyloid angiopathy and sympathomimetic drugs of abuse such as cocaine or methamphetamine often occurs in lobar regions such as the temporal lobe (C). Supratentorial ICH would be considered as basal ganglia, thalamic, or lobar (A-C), whereas ICH originating in the cerebellum or pons would be considered infratentorial (D-E). A, B, and E also demonstrate IVH.

Transfer

NCCU, surgery, or another institution

NCCU admission is preferable. If a NCCU 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/NCCU 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.