



# **Emergency Neurological Life Support<sup>®</sup> Intracerebral Hemorrhage Protocol Version 6.0**

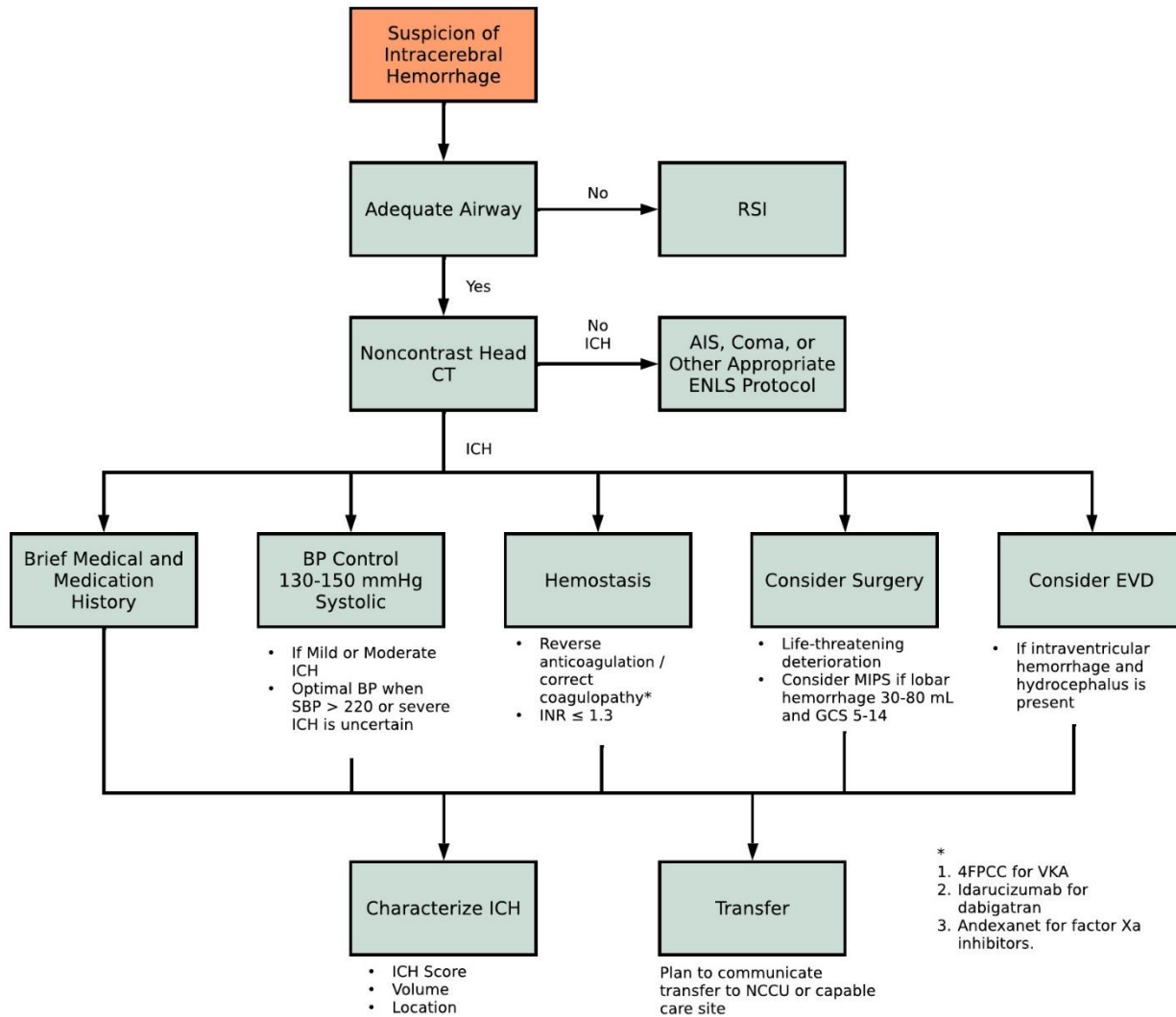
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# INTRACEREBRAL HEMORRHAGE MANAGEMENT ALGORITHM



## INTRACEREBRAL HEMORRHAGE CHECKLIST FOR THE FIRST HOUR

- Complete blood count with platelet count, PT, PTT, INR; If dabigatran or factor Xa inhibitor use is suspected but cannot be confirmed, if available, obtain a thrombin time (TT) or anti-Xa level, respectively.
- CT head results: hematoma volume, location, presence of intraventricular hemorrhage
- Glasgow Coma Scale (GCS) score
- Calculate ICH score.

### Interventions:

- Airway assessment and management
- Coagulopathy reversal (goal INR  $\leq 1.3$  if on warfarin)
- BP lowering (goal: systolic BP 130-150 mmHg if presenting SBP 150-220 mmHg) for mild-moderate ICH, and limit BP variability
- Surgical hematoma evacuation (if indicated)

## 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.

## COMMUNICATION

### Prehospital to ED (before diagnosis of ICH)

- Circulation — blood pressure and pulse
- Airway status — patent airway/supraglottic device/endotracheal tube
- Breathing — respiratory status
- Age/gender
- GCS, pupils
- Signs and symptoms
- Last known normal
- Brief relevant medical history — previous stroke, hypertension, coagulopathy
- Current medications — anticoagulants and antiplatelets

### Handoff 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

## INITIAL DIAGNOSIS

The initial presentation of ICH is frequently indistinguishable from ischemic stroke, but is somewhat more likely to be associated with headache, reduced level of consciousness, and progressive neurological decline. Emergent head CT is necessary to distinguish ICH from other stroke subtypes. One should consider obtaining CT angiography with the initial head CT, which is useful to assess for vascular malformations and can identify the presence of a “spot sign” suggesting a higher risk of hematoma expansion.

### Noncontrast CT

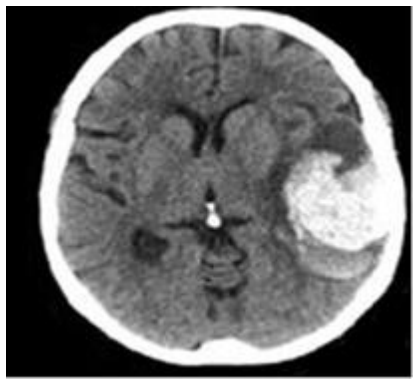
Noncontrast computed tomography (CT) is the most commonly used modality given that it can be done quickly, can be used for critically ill patients, and has a very high sensitivity and specificity for acute parenchymal hemorrhage.

The BAT score (Blend sign, Any hypodensity, Time from onset to noncontrast head CT) based on noncontrast head CT has been reported to have a 50% sensitivity, 89% specificity, and 82% accuracy to predict hematoma expansion when the score is >3.

#### Individual Components of the BAT Score

Variable	Point
<b>Blend Sign</b>	
Present	1
Absent	0
<b>Any Hypodensity</b>	
Present	2
Absent	0
<b>Time from onset to NCCT</b>	
<2.5 h	2
≥2.5 h or unknown	0

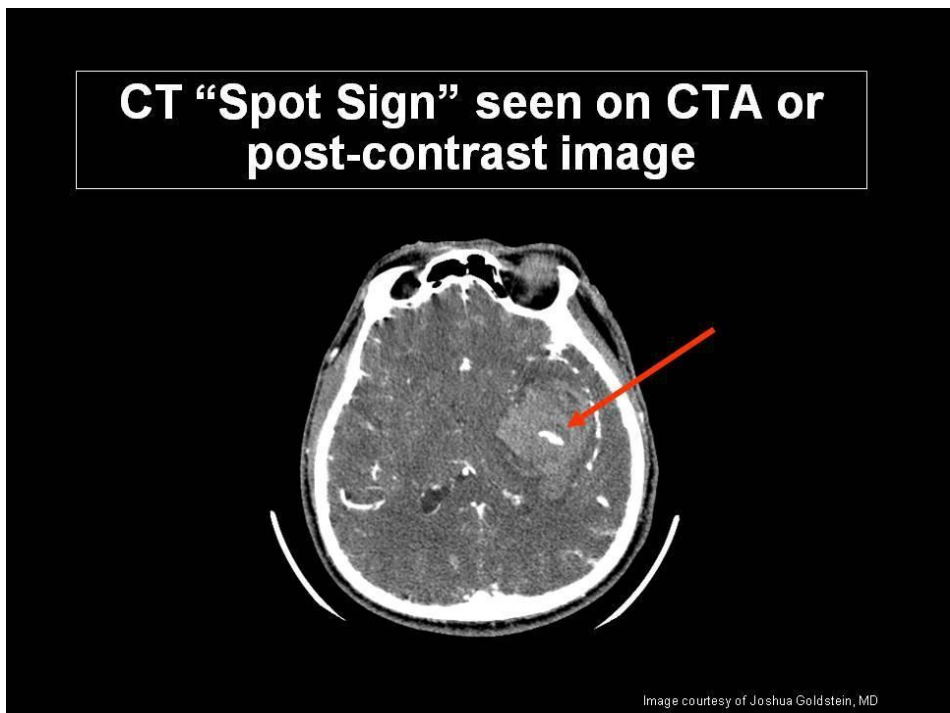
*NCCT Indicates noncontract computed tomography*



Noncontrast head CT demonstrating blend sign.

**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:



## 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, Breathing and Mechanical Ventilation* for discussion on how to intubate.

## BP CONTROL

### Should BP be lowered?

Current guidelines recommend targeting an SBP of 130-150 mmHg for all patients with mild-to-moderate ICH with SBP of 150-220 mmHg. Optimal BP targets for individuals with severe ICH or SBP > 220 are less well-defined, but severe hypertension should be avoided and clinical judgment exercised in determining individual BP targets. Initiate BP management immediately using a titratable agent to ensure target is reached quickly with minimal potential for overshoot. IV calcium channel blocker infusions are most commonly used in the first hours.

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

## HEMOSTASIS

### Is there an underlying coagulopathy?

If yes, consider presence of anticoagulants, antiplatelet agents, liver failure and/or disseminated intravascular coagulation (DIC).

### Anticoagulants and DIC, INR > 1.3

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 4-factor prothrombin complex concentrate (PCC) for patients on warfarin or other vitamin K antagonists concurrent with vitamin K 10 mg IV. FFP can be used if PCC is unavailable. 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 on dabigatran, idarucizumab is recommended 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. 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.

For patients with ICH on an oral factor Xa inhibitor (e.g., apixaban, rivaroxaban), andexanet alfa is the only FDA-approved reversal agent and is recommended in the setting of life-threatening hemorrhage. Its use must be balanced with an increased risk of thrombosis, particularly ischemic stroke, compared with usual care. It has also not been tested in patients undergoing surgical interventions. If andexanet alfa is not available, consider PCC, though this approach has not been formally tested and does not fully reverse oral factor Xa inhibitor coagulopathy. For dosing, depending on the agent that the patient is on, please refer to the ENLS *Pharmacotherapy* module.



### Antiplatelet agents

A well-conducted randomized controlled trial found that platelet transfusions are associated with worse outcomes for patients experiencing ICH and taking an antiplatelet agent. Consequently, routine platelet transfusions are not recommended for this indication. Anyone undergoing neurosurgical intervention was excluded from this trial, so the efficacy in neurosurgical patients is uncertain and platelets may be considered. Some guidelines suggest a single dose of DDAVP 0.4 mcg/kg IV in this setting as well.

### Heparin + recent heparin administration

Administer protamine sulfate IV 1 mg per 100 units 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. Typical dosing is 1 mg protamine per 1 mg enoxaparin or 100 units dalteparin.

See the 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.

The role of minimally invasive surgery is still being defined; but based on a recent study, individuals with 30-80 mL lobar hemorrhage and GCS 5-14 appear to benefit from minimally invasive parafascular surgery (MIPS).

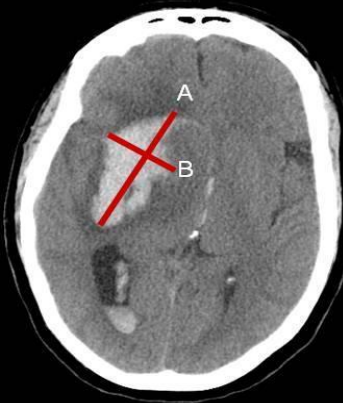
Patients with ICH should be monitored closely for developing hydrocephalus. When present, hydrocephalus is treated by placement of an EVD to facilitate CSF diversion.

## CHARACTERIZE ICH

### Measure the hematoma volume

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

### Formula for Estimating ICH Hematoma Volume



$$\frac{A \times B \times C}{2}$$

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.

### Calculate the ICH score

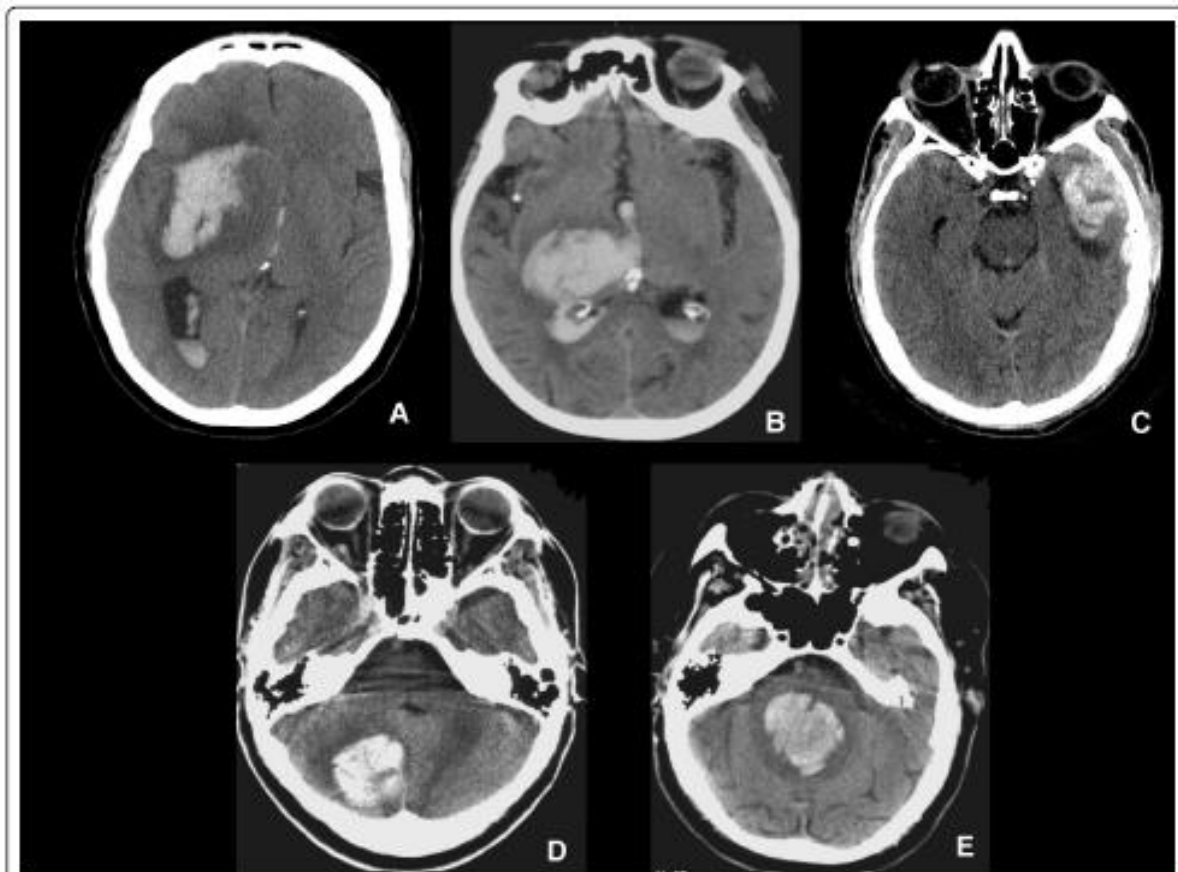
The ICH score can be calculated as follows:

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 the severity of illness and is recommended as a communication tool among providers rather than as a tool to precisely prognosticate an individual outcome. Because of the potential for self-fulfilling prophecies, use of the ICH score to triage patients to less-aggressive early management is not recommended.

## Location of ICH

ICH tends to occur in characteristic locations, with hypertensive ICH most frequently located in the basal ganglia, thalamus, pons (brainstem), and 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 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 preferred.

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.