Chapter 7
Management of Intracerebral Hemorrhage (ICH) in the ICU

Abbreviations

CT	Computed tomography
PCO_2	Partial pressure of carbon dioxide
ICP	Intracranial pressure
CPP	Cerebral perfusion pressure
SBP	Systolic blood pressure
FFP	Fresh frozen plasma
PCC	Prothrombin complex concentrate

7.1 Introduction

Intracerebral hemorrhage (ICH) is a severe and life-threatening condition caused by the rupture of blood vessels within the brain. The management of ICH in the ICU is a critical process involving stabilization, control of intracranial pressure (ICP), management of coagulation, prevention of complications, and rehabilitation. Recent guidelines underscore the importance of a systematic, evidence-based approach in managing patients with ICH, which this guide aims to elaborate for ICU residents, offering practical insights into the management and decision-making process. The chapter follows the flowchart-based management with emphasis on recent updates to optimize patient care and outcomes [1, 2] [Ref. Algorithm 7.1].

7.2 Initial Assessment and Classification

History & CT Suggestive of Trauma?

- Yes: Traumatic ICH
- No: Spontaneous ICH

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7.3 Traumatic ICH

Initial Management

- Follow advanced trauma life support (ATLS) principles.
- Actions: Secure airway, stabilize blood pressure, immobilize the spine, and correct any coagulopathy.
- Perform a rapid neurological exam.
- Actions: Assess Glasgow Coma Scale (GCS) score and pupil response.

Medical Management

ICP Management

- Elevate head of bed to 30 degrees and keep the head straight.
- Osmotic therapy.
- Mannitol (0.25–1 g/kg IV bolus) or hypertonic saline.
- Optimize sedation and analgesia to prevent ICP spikes.
- Maintain euvolemia for adequate cerebral perfusion.
- Target PCO_2: 30–35 mmHg. Avoid hypercapnia, which can increase ICP.
- Target ICP < 20 mmHg, target CPP 60–70 mmHg.
- Target SBP between 100 and 110 mmHg.

Update: It is recommended to maintain smooth, sustained blood pressure control, which has shown to reduce the risk of hematoma expansion.

Coagulation Management

- Administer tranexamic acid (TXA) within 3 hours of injury.
- Reverse anticoagulation.
- Correct platelet count.

Update: For anticoagulation reversal, specific agents such as idarucizumab for dabigatran/RRT (renal replacement therapy), andexanet alfa for factor Xa inhibitors, and prothrombin complex concentrate (PCC) for vitamin K antagonists should be used based on the anticoagulant involved. Activated charcoal should be used if there is history of intake of direct oral anticoagulant in last few hours. PCC may be used if specific antidotes are not available.

Seizure Prophylaxis

- Levetiracetam or phenytoin for early seizure prophylaxis.

Update: Prophylactic use of antiseizure medications without documented evidence of seizures is generally not recommended as it may not improve outcomes.

Surgical Intervention

- Indications: Large hematomas, neurological deterioration, signs of herniation.
- Procedures: Decompressive craniectomy, hematoma evacuation.
- Use of external ventricular drainage (EVD) if hydrocephalus is present.

Update: Minimally invasive surgery for hematoma evacuation may reduce mortality, though improvement in functional outcomes remains neutral. Larger cerebellar hemorrhages (>15 mL) and signs of neurological deterioration require immediate surgical intervention.

7.4 Spontaneous ICH

Initial Management

- Ensure airway control, stabilize blood pressure, and correct impaired coagulation.
- Perform a rapid neurological exam to identify immediate needs and guide further management.

Update: Recognize the importance of early neuroimaging markers to predict hematoma expansion, as this is associated with worse outcomes.

7.5 Medical Management

ICP Management

- Same protocol as in traumatic ICH.

Blood Pressure Control

- Initiate treatment in 2 hours of ICH and achieve target in 1 hour. Target SBP: 130–150 mmHg.
- Rationale: Balances reducing bleeding risk while maintaining cerebral perfusion.

Update: Implementing acute blood pressure lowering with minimal variability appears to improve outcomes and limit hematoma expansion.

Coagulation Management

- Same as in traumatic ICH.
- Platelet may be transfused in ICH due to antiplatelets only if patient undergoes surgical intervention.

Surgical Intervention

- Indications: Patients with GCS of 5–12 and supratentorial ICH of >20 to 30 ml volume.
- Procedures: Minimally invasive surgery for hematoma evacuation.
- Use of external ventricular drainage (EVD) for spontaneous ICH with large IVH and impaired level of consciousness.
- Indications: Posterior fossa ICH with neurological deterioration, brain-stem compression, hydrocephalus or bleed volume $\geq$ 15 ml.
- Procedures: Complete surgical removal of hematoma with or without EVD.

7.6 Ongoing Management and Monitoring in ICH

Regular Assessments

- Neurological: Glasgow Coma Scale (GCS), NIHSS.
- Vital signs, ICP monitoring.
- Rationale: Detects early signs of deterioration.

Prevent Complications

- Infections, DVT, pressure sores.
  LMWH prophylaxis to be started at 24–48 hours from ICH onset after documenting stability on CT.
- Rationale: Reduces morbidity and improves outcomes.

Update: Avoid prophylactic corticosteroids for treatment of elevated ICP and platelet transfusions outside of emergency surgical or severe thrombocytopenia settings as they may worsen outcomes.

Glycemic control (60–180 mg/dL) and avoid hyperthermia.

7.7 Rehabilitation and Secondary Prevention

Early Mobilization and Rehabilitation

- Early mobilization, physical therapy, cognitive/speech therapy.
- Rationale: enhances recovery and minimizes long-term disability.

Update: Early mobilization within 24 hours of ICH has been shown to worsen short-term outcomes; start 24 to 48 hours post-stabilization for moderate ICH.

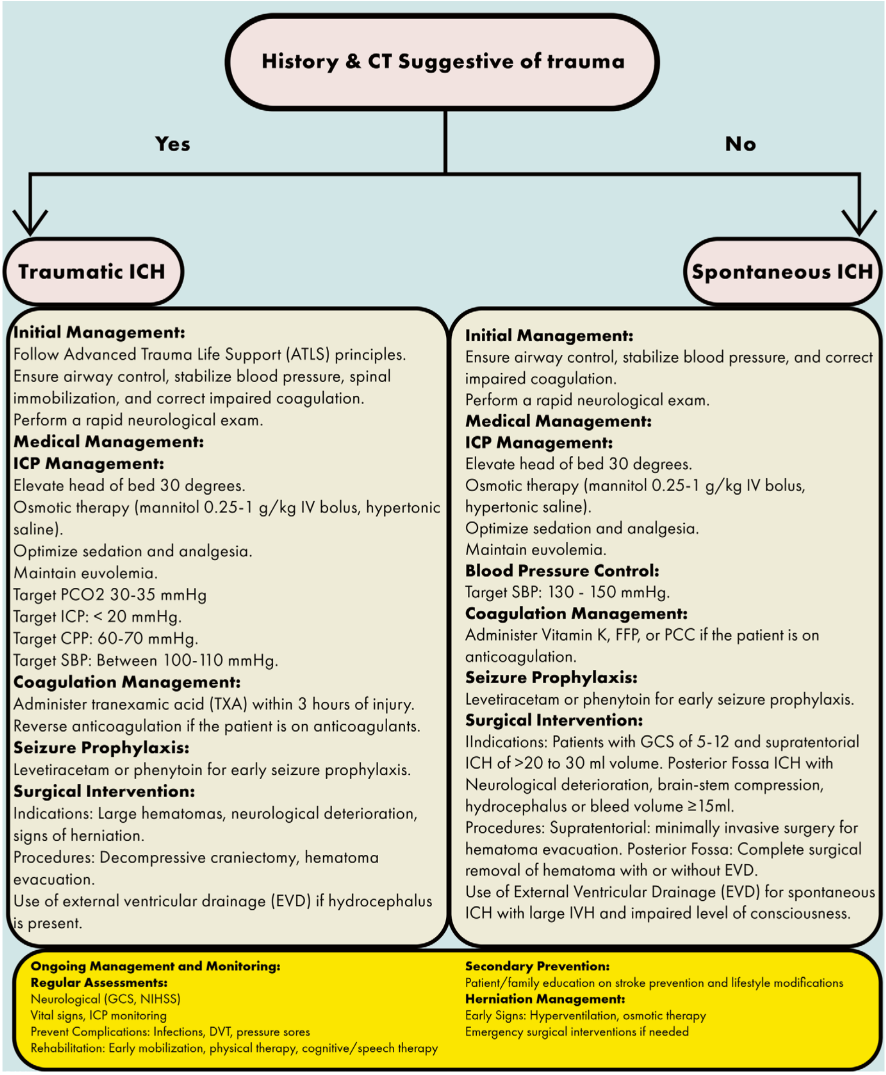
Patient/Family Education

- Education on stroke prevention, lifestyle modifications, and adherence to rehabilitation programs.

7.8 Conclusion

Managing intracerebral hemorrhage in the ICU requires a structured and evidence-based approach. Recent advancements in blood pressure management, anticoagulation reversal, surgical interventions, and rehabilitation should be incorporated into standard care to optimize outcomes. Adhering to these updated guidelines ensures comprehensive management, reduces morbidity, and enhances recovery in ICH patients.

Algorithm 7.1: Management of intracerebral hemorrhage (ICH) in the ICU



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