



- UCH/ENTERPRISE
- UCMC
- WCH
- DRAKE - LTCH
- DRAKE - BWP
- DRAKE - SNF
- DRAKE - OUTPATIENT
- AMBULATORY/UCPC
- LEGAL/COMPLIANCE
- MEDICAL STAFF
- MEDICATION MGMT
- OTHER

## STANDARD OPERATING PROCEDURE

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<b>SOP #</b>	<u>UCH-NEURO-SOP-009-07</u>		
<b>SOP NAME</b>	<u>Management of Intracerebral and Intraventricular Hemorrhage</u>		
<b>ORIGINATION DATE</b>	<u>03/12/2013</u>		
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### I. STANDARD OPERATING PROCEDURE

Administrative     Interdepartmental     Departmental     Unit Specific

This document details the process and guidelines for management of intracerebral and intraventricular hemorrhage.

### II. PURPOSE

Define treatment options for managing ICH/IVH. Patients with Intracerebral and Intraventricular Hemorrhage (ICH/IVH) sustain the primary insult at the initial time of bleed. Secondary damage to the brain occurs as a result of complications associated with the initial insult. These guidelines are developed to provide team members with information on managing patients after ICH/IVH and suggesting interventions to treat the associated complications.

### III. DEFINITIONS

None

## IV. PROCEDURE

### A. Assessment

1. Clinical assessment includes:
  - a. Glasgow Coma Scale. NIHSS. ICH Score. Cranial nerve exam (pupillary response, extraocular movements, facial symmetry, corneal and gag reflexes); motor strength; motor tone; sensory assessment; and vital signs. Note any seizure activity.
2. Diagnostic assessment of ICH/IVH may include:
  - a. Brain imaging: CT, MRI
  - b. Cerebral vascular imaging: angiogram, CTA, MRA, MRV
  - c. Neuro- monitoring options:
    - 1) Intracranial pressure (ICP); EEG

### B. Initial Management - Emergency Department or on ICU admission. Implement initial general resuscitation protocols. Appropriate interventions include:

1. Airway Management
  - a. Supplemental O<sub>2</sub> to maintain SaO<sub>2</sub> > 92%.
  - b. Intubate for respiratory distress, GCS < or equal to 8, inability to protect airway: Use RSI Protocol. Titrate ventilator to maintain PaO<sub>2</sub> >100 mm Hg, and PaCO<sub>2</sub> Normalized
2. Circulation
  - a. Establish minimum of 2 large bore IVs
  - b. Place NG/Foley if indicated.
3. Draw initial assessment labs
  - a. CBC, renal profile, and cardiac enzymes; consider TEG profile, Platelet Function Assay if clinically indicated.
4. Hemostasis
  - a. Discontinue any anticoagulant/antiplatelet agents
  - b. Reverse coagulopathy for those patients on oral anticoagulants.
  - c. For those patients where it is decided not to use an anticoagulant reversal agent, must be documented in the medical record with rationale.
  - d. Anticoagulation Reversal Protocol
  - e. For acute warfarin related intracranial or spinal bleeding with INR > 1.4, administer one dose of vitamin K 10mg IV
  - f. For acute warfarin related intracranial or spinal bleeding with INR > 1.4, administer four factor PCC (dosing determined by weight and INR level).
  - g. For acute dabigatran related intracranial or spinal bleeding, administer idarucizumab.
  - h. For acute intracranial or spinal bleeding related to oral Xa inhibitors (apixaban, rivaroxaban, edoxaban) administer andexanet alfa.
  - i. For fibrinogen < 150 give 10pk cryoprecipitate
  - j. For platelets < 50,000 administer two 5 pack of platelets
  - k. Current heparin use and PTT > 50, protamine 50mg IV x 1

1. Patients with other coagulation factor deficiency should receive appropriate factor replacement
5. Place arterial line if indicated during initial care. If patient has limited peripheral access and/or multiple infusions or blood draws requiring additional access may consider central intravenous catheter placement.
6. Diagnosis/Assessment:
  - a. Obtain baseline exam including GCS and NIHSS.
  - b. Document ICH Score within 6 hours of admission or prior to any surgical intervention.
  - c. Perform immediate CT head without contrast.
  - d. Can consider early CT angiogram to assess vasculature and for patients who may be at high risk for hematoma expansion.
  - e. Arrange for other appropriate diagnostic imaging such as MRI of the brain or additional vascular imaging if indicated.
7. Hemodynamic Management:
  - a. Blood Pressure Control
  - b. For initial SBP between 150 and 220 mmHg and no contraindication to BP treatment, consider acute lowering of SBP to 140-160 mmHg, based on clinical judgement.
  - c. For initial SBP >220 mmHg it is reasonable to consider aggressive reduction of BP with a continuous IV infusion and frequent BP monitoring.
8. Sedatives and analgesics as indicated for mechanical ventilation. Preferred agents based on desired goal:
  - a. For Sedation: use propofol for mechanically ventilated patients.
  - b. For Analgesia: use fentanyl
9. Management options for signs of intracranial hypertension or herniation.
  - a. Hyperventilation (temporary)
  - b. Mannitol
  - c. Hypertonic Saline Per NSICU Protocol
  - d. Consider surgical options
  - e. Consider placement of ICP monitor/ventriculostomy
    - 1) Preferred device: ventriculostomy. If in ED, consider transfer to ICU or OR for placement.
10. Management options for signs of hydrocephalus or intraventricular hemorrhage.
  - a. Keep ventriculostomy to open to drain as specified by neurosurgery
  - b. Monitor intracranial pressure (ICP) every hour, goal ICP < 20 mm Hg. (unless otherwise specified by physician).

**C. Intensive Care Unit**

1. Review all initial care needs from Section II A
  - a. Place Arterial line/Central lines if clinically indicated.
  - b. Initiate analgesia if mechanically ventilated, monitor for effects on MAP.
2. Respiratory Management
  - a. Maintain SaO<sub>2</sub> > 92% with supplemental O<sub>2</sub> as needed

- b. If intubated, goal PaCO<sub>2</sub> = 35 - 45 mm Hg.
- 3. Neurological Examinations
  - a. Nursing documentation of hourly vital signs and GCS. NIHSS documentation every 12 hours. Cranial nerve exam documented every shift.
- 4. Hemodynamic Management
  - a. Blood Pressure Control: Target BP 140-160/90 mm Hg unless contraindications.
  - b. See above protocol for treatment if outside target range.
  - c. Administer fluids. Avoid hypervolemia or hypovolemia, fluid balance goal is a range of 0 - 500 ml positive every 24 hours. Goal is euvolemia.
  - d. Fluid options: Normal Saline with or without 20 meq KCl, Normosol or Lactated Ringer's solution
- 5. Ventriculostomy / Acute Phase ICP Management
  - a. If IVH is present consider ventriculostomy placement for evidence or symptoms of hydrocephalus.
  - b. Keep ventriculostomy open to drain as specified by neurosurgery
  - c. Monitor ICP every hour, goal ICP < 20 mm Hg (unless otherwise specified by physician).
  - d. Notify neurosurgical resident for ICP elevation.
  - e. Management options for signs of intracranial hypertension or herniation
    - 1) Hyperventilation (temporary)
    - 2) Mannitol
    - 3) Hypertonic Saline per NSICU Protocol
    - 4) If ventriculostomy in place, ensure patency.
    - 5) Neurosurgery consider surgical treatment options.
- 6. Seizure prophylaxis
  - a. In patients with GCS < 8, consider continuous EEG monitoring x 72 hours.
  - b. Antiepileptics may be indicated based on clinical situation including presence of clinical seizure activity or evidence on EEG.
- 7. DVT Prophylaxis
  - a. SCD's bilateral Lower Extremities
  - b. On day 2 if hematoma stability has been documented on follow up head CT may start SQ low-molecular weight heparin or unfractionated heparin.
  - c. Perform screening lower extremity ultrasounds when indicated for leg swelling or symptomatic DVT.
- 8. General Care Issues
  - a. Glucose: Initiate treatment for hyperglycemia. Goal glucose < 180 mg/dL.
  - b. Sodium: Maintain in normal range (135 - 146 mEq/L).
  - c. Magnesium: Maintain > 1.8 mg/dL.
  - d. Temperature: Goal is normothermia. Culture per NSICU protocol for fever > 101.5 F

- e. Nutrition: address within first 24 – 48 hours after admission. Keep NPO while awaiting imaging and neurosurgical plan.
  - f. Early Physical, Occupational, and Speech Therapy consultations.
  - g. Consult to Social Services
  - h. Consult other ancillary departments such as nutrition services, wound care, diabetes education, etc. as indicated.
9. Multidisciplinary Management
- a. Patients admitted to the NSICU with ICH/IVH have a multidisciplinary team including neurosurgery and neurocritical care who evaluate patients before and after surgery and/or endovascular procedures.
  - b. Patients undergoing endovascular procedures will also be evaluated prior to and post procedure by a physician from interventional radiology.
  - c. Consultations to other services for pre and/or post-operative evaluation such as internal medicine, cardiology, pulmonology will be made on an as needed basis per the patient’s clinical status and past medical history.

**D. Surgical Treatment / Management**

- 1. For patients with cerebellar hemorrhage who have poor or declining neurological status due to brain stem compression and/or hydrocephalus will be evaluated for early surgical intervention
- 2. Open craniotomy for basal ganglia hematomas is not recommended; Minimally invasive clot evacuation can be applied in select cases based on determination of Neurosurgery Attending.

**V. RESPONSIBILITY**

<b>Tasks</b>	<b>Responsible Staff</b>
ICP insertion, ventriculostomy, hemicraniectomy, evacuation of hematoma	Neurosurgery
Medical & Nursing Management	Emergency Physician and Neurocritical Care Physicians, Neurosurgery APNs, MLPs and NSICU Nursing Staff

**VI. KEY WORDS**

Intracerebral Hemorrhage  
 Intraventricular Hemorrhage  
 Hemorrhage  
 Intraventricular  
 Intracerebral  
 Management of Hemorrhage

**VII. APPENDIX**

None

**VIII. RELATED FORMS**

None

**IX. REFERENCES / CITATIONS**

- A. Hemphill J, Greenberg SM, Anderson CS et al. Guidelines for the Management of Spontaneous Intracerebral Hemorrhage: A Guideline for Healthcare Professionals from the American Heart Association/ American Stroke Association. *Stroke*. 2015 46: 2032-2060