## Making the Diagnosis

### Emergency Department
- Call Stroke Level 1 for symptom onset < 24 hours from LKW
- Refer to NIH Stroke Scale (document in all patients)

### Inpatient
- Consult Stroke Team- Internal Stroke Code
- Call ERT for evaluation of patient with stroke symptom onset < 24 hours from LKW:
  - UH Main and East: 6-3133
  - ERT will activate Stroke Code after initial evaluation

### Initial Diagnostic Evaluation
With the exception of Level 1 alerts, consult Neurovascular / Neurosurgery Service when ICH diagnosis is confirmed on CT.

### Primary Tests (for all patients)
- Non-contrast head computed tomography (CT) or magnetic resonance imaging (MRI)
- Complete blood count (CBC)
- Platelet count and platelet function assay
- Blood chemistry (electrolytes, BUN, creatinine)
- PT/aPTT/INR
- Troponin
- Type and cross
- HbA1C
- Serum alcohol level
- Liver function tests
- Toxicology screen
- Urine drug screen
- Electrocardiogram (ECG)
- Consult Hematology for known or suspected hematologic disorders

### Additional Tests (consider in special cases)
- CT angiography and contrast-enhanced CT to help identify patients at risk for hematoma expansion
- When there is clinical or radiological suspicion for underlying structural lesions, including vascular malformation and tumors, consider the following:
  - CT angiography
  - CT venography
  - Contrast-enhanced CT
  - Contrast-enhanced MRI
  - MRI angiography
  - MRI resonance venography
- Conventional cerebral angiography for possible small AVM or fistulae that can be missed on CT angiography or MRI angiography

## Determine ICH Score and Max ICH Score:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Value</th>
<th>ICH Score Points</th>
<th>Max ICH Score Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIHSS</td>
<td>0-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7-13</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14-20</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥21</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>GCS score</td>
<td>3-4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>≤69</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>70-74</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>75-79</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>≥80</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraventricular Hemorrhage</td>
<td>Yes</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ICH Volume (cm³)</td>
<td>&lt;30</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥30</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Lobar ICH volume (cm³)*</td>
<td>&lt;30</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>≥30</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Nonlobar ICH volume (cm³)*</td>
<td>&lt;10</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>≥10</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Infratentorial origin of ICH</td>
<td>Yes</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Oral Anticoagulation</td>
<td>Yes</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total ICH Score</td>
<td>0-6</td>
<td></td>
<td>0-10</td>
</tr>
</tbody>
</table>

*More than 1 point for the Max ICH volume score can only be attained with 2 distinct ICH (1 large lobar and 1 large nonlobar)
  - Lobar ICH defined as ICH originating at the cortex and cortical-subcortical junction
  - Nonlobar ICH defined as deep (basal ganglia, thalamus, internal capsule, deep periventricular white matter), cerebellar, and brainstem origin

## Antithrombotic-Associated and Anticoagulant-Associated ICH Management
- See Appendix B: Reversal of Coagulopathy-Associated Intracerebral Hemorrhage algorithm.
- For patients previously on antiplatelet agents, there is no evidence that platelet transfusion improves outcomes in ICH. A single dose of desmopressin (DDAVP) 0.4mcg/kg can be considered.
- For recommendations on anticoagulant reversal, please refer to the OSUWMC guidelines:
  - Dabigatran (Pradaxa®) Reversal Treatment for Bleeding Events
  - Rivaroxaban, Apixaban: Factor Xa Inhibitors - Reversal Treatment for Bleeding
Thrombolytic Reversal
- For recommendations on symptomatic hemorrhagic conversion after alteplase (tPA) administration, please refer to Appendix B.

Initial Medical Care
- Admit to ICU or PCU for monitoring and management
- Perform dysphagia screen prior to any oral intake
- Manage clinical seizures with appropriate antiepileptic therapy
  - Prophylactic anticonvulsant medication should not be used
- Normotonic fluids are strongly recommended
  - Avoid hypotonic fluids to prevent exacerbating brain edema
- Treat sources of fever and administer acetaminophen to lower temperature in febrile patients
- Treat hypoglycemia / hyperglycemia
- Arterial line placement for continuous BP monitoring
- Continuous EEG:
  - Depressed clinical exam inconsistent with the neurological deficits of ICH

Hypertension Management
- High systolic BP is associated with greater hematoma expansion, neurological deterioration, dependency, and death following ICH
- Early and rapid BP lowering improves patients’ chances of achieving better functional recovery
- Rapid lowering of SBP to 130 - 150 mmHg, preferably targeting a SBP of 140 mmHg
  - Rapid aggressive reduction of BP with IVP or continuous IV infusion with frequent BP monitoring every 5 min.
    - hydralazine, labetalol, nicardipine, esmolol (avoid nitroprusside)
    - Clevidipine can be considered in patients who have failed nicardipine therapy

Increased Intracranial Pressure (ICP) Management (See Appendix A: ICP algorithm)
- Consider inpatients with GCS score ≤ 8, clinical evidence of impending transtentorial herniation, significant IVH, or hydrocephalus
- ICP monitoring will be initiated after evaluation by Neurosurgery

Pharmacological and Mechanical VTE Prophylaxis (See Deep Venous Thrombosis (DVT): Prevention guideline)
Place sequential compression devices (SCDs) barring any contraindications.
- After documentation of cessation of bleeding in non-surgical patients, consider low-dose subcutaneous low-molecular-weight heparin or unfractionated heparin with hemiplegia or immobility after 1 to 4 days.
- In post-surgical patients, pharmacologic VTE prophylaxis is at the discretion of surgical team
- Consider placement of a temporary vena cava filter for patients who develop an acute proximal venous thrombosis, particularly those with clinical or subclinical PE
- When deciding whether to add long-term anti-thrombotic therapy several weeks or more after placement of a temporary vena cava filter, consider:
  - The cause of the hemorrhage
  - Associated conditions with increased thrombotic risk (e.g., atrial fibrillation)
  - Patient’s health and mobility

General Medical Care
- Temperature should be kept < 99.1°F (37.3°C)
- Glucose should be monitored (normoglycemia is recommended)
- Manage elevated HgbA1C and/or fasting lipids
- Correct any major nutritional or hydration problems
- Provide stroke education
- Provide tobacco cessation information
- Consult the following as indicated:
  - Physical Medicine and Rehabilitation
  - PT
  - OT
  - Speech Language Pathology
- Withdraw care recommendations should be cautious and occur after aggressive care for patients without preexisting DNR orders
  - Consider Palliative Care consult
- In patient with atrial fibrillation restarting anticoagulation treatment should be considered 7-8 weeks after spontaneous ICH to optimize the benefit from treatment and minimize the risk.

Surgical Care
- Ventricular drainage as treatment for hydrocephalus is reasonable in patients with decreased level of consciousness
- For patients with cerebellar hemorrhage > 3 cm, who are deteriorating neurologically or who have brain stem compression and/or hydrocephalus from ventricular obstruction, surgical removal of the hemorrhage should occur as soon as possible
- Consider injection of alteplase (TPA) into hematoma, minimally invasive clot evacuation, decompressive craniectomy, or evacuation of supratentorial ICH by standard craniotomy for select patients
- The patient should be assessed by the neurosurgeon both before and after surgery
Prevention of Recurrent ICH

- Address ongoing blood pressure needs to maintain BP <130/80 mmHg
- Recommend discontinuation of tobacco use, heavy alcohol use, and substance abuse
- For some patients, avoid long-term anticoagulation as treatment for nonvalvular atrial fibrillation after spontaneous lobar ICH due to the relatively high risk of recurrence
- Anticoagulation after nonlobar ICH and antiplatelet therapy after all ICH might be considered, particularly when there are definite indications for these agents

Discharge Planning

- Involve patient’s family/caregiver in assessment of post discharge needs, decision making and treatment planning.
  - Perform full NIH Scale and Modified Rankins Scale at discharge as well as at 90-days post-discharge
  - Follow-up outpatient appointment with the Neurovascular Stoke Team scheduled prior to discharge

Multidisciplinary Focus

- Provide education for patient’s family and caregivers on:
  - Stroke:
    - Activation of EMS system
    - Pathology
    - Prevention
    - Signs/ symptoms
    - Actions to take
  - Follow-up appointments/therapy
  - Treatment plan
  - Community resources and how to access those resources

Rehabilitation Services

- Encourage patient’s family/caregiver to participate in the rehabilitation sessions and to be trained to assist the patient with functional activities
- If the patient is aphasic, staff should assist the patient and family in establishing a communication pattern before discharge

Case Manager

- Arrange family and team meeting to discuss:
  - Patient progress
  - Rehabilitation goals
  - Discharge needs or issues
  - Explanation of next level of care
  - Providing care and support associated with these deficits
  - Means of coping with stress associated with these impairments
- Consider availability of support services and desires of the patient’s family/caregiver
- Provide information about discharge plans and post-discharge management to primary care physicians and community services

Associated Tools

Order sets
- Stroke Alert [2993]
- Hemorrhagic Stroke Confirmed [2972]
- Admission Spontaneous Intracerebral Hemorrhage (ICH / IPH) [2190]

Quality Measures

- Venous thromboembolism (VTE) prophylaxis
- Dysphagia screening
- Stroke education
- Assessed for rehabilitation
- Severity measurement performed for SAHand ICH patients (overall rate)
- Procoagulant reversal agent initiation for intracerebral hemorrhage (ICH)

References


Guideline Authors

- Ciaran Powers, MD, PhD.
- Michel Torbey, MD
- Noah Grose, RN, BSN, MSN, ACNP-BC
- Peg Baylin, PharmD
- Keaton Smetana, PharmD, BCCCP
- Vivien Lee, MD
- Kelsey Kauffman, PharmD

Guideline Approved


Disclaimer: Clinical practice guidelines and algorithms at The Ohio State University Wexner Medical Center (OSUWMC) are standards that are intended to provide general guidance to clinicians. Patient choice and clinician judgment must remain central to the selection of diagnostic tests and therapy. OSUWMC's guidelines and algorithms are reviewed periodically for consistency with new evidence; however, new developments may not be represented.
Appendix A: Increased Intracranial Pressure (ICP) Management Algorithm

Criteria for ICP Management
- If ICP is > 22 mmHg for more than 5 minutes or ICP is > 25 mmHg

Initial Interventions
- Troubleshoot ICP to ensure accuracy of monitored data
- Call Neurosurgery House Officer or neurocritical care team
- Elevate head of bed 30°, midline position
- Assess level of sedation and pain
- Check temperature (treat if > 99°F, cooling blanket)
- Arterial blood gases (ABG)

ICP normal?
- Targets:
  - ICP < 22 mmHg
  - CPP > 60 mmHg
  (Formula: CPP = MAP - ICP)*

Stepwise Treatment
1. Stat head CT
2. Cerebrospinal fluid: Drain if appropriate. Consult Neurosurgery if considering ventriculostomy or lumbar drain, if not already in place.
3. Hyperosmolar therapy:
   - Mannitol 0.5-1.5g/kg or 3% NaCl 4mL/kg
   - 23.4% 30mL Administer over 5-10 minutes
   - Mannitol: consider holding if osmolar gap >/= 20 mOsm/kg
   - Hypertonic saline: 3% maximum 500 mL, consider holding for osmol greater than 320 mOsm/kg or serum Na greater than 160 (target serum osmol 300-320 mOsm/kg and serum Na 145-155)
4. Sedation: propofol, bolus dose 0.5-1 mg/kg can be considered, continuous infusion max rate of 80 mcg/kg/min, or possibly induce pentobarbital coma, loading dose 5-15 mg/kg, max administration rate of 50 mg/min, then 1-5 mg/kg/hr.
5. Hyperventilation: PaCO₂ 30-35 mmHg, use for no longer than 30 minutes.
6. Surgical decompression (if surgical candidate).

Consider other causes, such as:
- Hypercarbia
- Hypoxia
- Hyperthermia
- Hypoglycemia
- Inadequate sedation/ analgesia
- Suctioning
- Mass lesion
- Cerebral edema
- Technical problem with ICP monitor

Reassessment
- Monitor ICP
- Neuro exam

ICP normal?
- Observe

Neuro exam normal?
- Observe

Criteria for ICP Management
- If ICP is > 22 mmHg for more than 5 minutes or ICP is > 25 mmHg

* Key: CPP = Cerebral Perfusion Pressure; MAP = Mean Arterial Pressure

Notes: (1) ICP and CPP targets can be adjusted, based on physician judgment. (2) Use of vasopressors to maintain CPP greater than 70 is discouraged in patients with traumatic brain injury.

Appendix B: Reversal of Coagulopathy-Associated Intracerebral Hemorrhage (ICH) Algorithm

**Goal: Correction of INR ≥ 1.4**

- **Give Phytanadione (Vitamin K) 10 mg by slow IV INFUSION over 15 minutes (Do NOT give subcutaneously or intramuscular due to erratic absorption.) AND EITHER**
  - Four-factor Prothrombin Complex Concentrate (PCC) [Kcentra™] *See Contraindications and Precautions.** RISK (thromboembolism) vs. BENEFIT must be considered.
  - Baseline INR
    - < 4
    - ≥ 4
  - Kcentra ® Dose
    - 25 units/kg
    - 35 units/kg
  - OR
    - Fresh Frozen Plasma 10-15 mL/kg if INR < 2 and no emergent intervention planned

**After Reversal Agent Administered**

- Recheck INR 15-30 minutes after administration and every 6 hours for the first 24 hours
- If repeat INR ≥ 1.4, consider additional FFP for persistent bleeding or re-dosing Kcentra ® with reduced dose [Do not exceed a maximum cumulative dose of 5000 units or 50 units/kg in a 24-hour period
- Phytanadione may be repeated every 12 hours, although consider the need for re-anticoagulation

**INR remains ≥ 1.4**

- Consider giving FFP 10-15 mL/kg rounded to the nearest unit size (Volume for each unit is 250-275 mL)
- Check INR immediately following FFP with recheck in 6-24 hours
- If INR remains elevated at recheck, consider more FFP

**OR**

- Consider giving Recombinant factor VII 1 mg IVP over 2-5 minutes.
- Recheck INR after 15-30 minutes
- If INR remains elevated, repeat dose

---

**References:**