**Goal:** Standardizing stroke evaluation and work-up to identify stroke etiology and improve outcomes.

**Key Points:**
- Identification of stroke symptoms.
- The expansion of the Stroke Alert window to 24 hours from Last Known Well (LKW).
- Rapid evaluation for the safe administration of TPA and/or endovascular therapy.

**Initial Assessment/Triage**
- Use National Institutes of Health (NIH) Stroke Scale to assess patient for signs/symptoms of stroke.
- Rapidly assess from initial time of last known well (LKW) per patient and/or family.
  - Last known well (LKW) < 24 hours.
- Presence of active stroke signs and symptoms may include but are not limited to:
  - Face numbness or weakness especially on one side of the body.
  - Arm/leg numbness or weakness especially on one side of the body.
  - Slurred speech or difficulty speaking or understanding.
  - Decreased level of consciousness.
- Finger-stick glucose > 60 mg/dl or < 400 mg/dl.
- Any other clinical indications at the discretion of the ED physician.
- Patients who received thrombolytics and/or are candidates for mechanical stroke intervention transported to OSUWMC through Telestroke.

**Making the Diagnosis**

**Emergency Department**
- Activate Stroke Alert per policy:
  - Stroke Level 1
  - Stroke Level 2

**Inpatient**
- Consult Stroke Team - Internal Stroke Code.
- Call ERT (6-3133) for evaluation of patient with stroke symptom onset < 24 hours from LKW.
- STAT RN will activate Stroke Code after initial evaluation.

**Acute Stroke Evaluation – For All Patients**
- IV access should be obtained in at least two sites (at least one 18-gauge antecubital):
  - One site for administration of tPA.
  - One site for IV fluids or other medications.
- Patient taken directly to Radiology for STAT imaging per Stroke Alert policy.
- Glucose > 60 mg/dl.
- Blood pressure goal of <220/120.
- If patient to receive tPA, blood pressure must be <185/110.
- Maintain tPA, blood pressure goal.

**Labs on Arrival**
- STAT Glucose POCT, PT with INR (as indicated).
- Additional labs: PT, INR, aPTT, CBC with platelet count, electrolytes, BUN, creatinine, troponin, fibrinogen.

**Labs for Administration of Thrombolytics**
- Blood glucose must be completed prior to the initiation of IV alteplase in all patients.
- Other tests, for example, INR, aPTT, and PT may be considered in patients on known blood thinners or with suspected coagulopathies.
- For additional information, refer to:
  - Intra-Arterial and Intravenous Alteplase for Stroke.
  - ED Pharmacist Stroke Alert Response Algorithm.
- Complete Thrombolytic Therapy Checklist.

**Additional Evaluation – For Selected Patients**

**General Stroke Evaluation**
- EKG, HbA1c, lipid profile, LFT.
- Magnetic resonance (MR) brain scan.
- Magnetic resonance angiography (MRA) or computed tomography angiography (CTA) of the head and neck.
- Transcranial Doppler.
- Carotid ultrasound.
- CT perfusion or magnetic resonance perfusion.

**Large Artery Atherosclerosis Stroke Subtype**
- Consider cerebral angiography (CCA) to confirm noninvasive testing, particularly in patients with:
  - 30-40% stenosis by ultrasound or > 50% stenosis by MRA in the symptomatic carotid artery.
  - Occlusion by carotid ultrasound in the symptomatic carotid artery.
Cardio-aortic embolic Stroke
- Transthoracic echocardiography (TTE) or Transesophageal echocardiography (TEE).
- Cardiac monitoring.
- Hypercoagulable work-up should be considered for patients with no clear embolic stroke etiology.

Cryptogenic Stroke
- Hypercoagulable work-up for cryptogenic stroke or unexplained arterial or valvular thrombosis:
  - PT, PTT, Protein C and S
  - Antithrombin III activity
  - Prothrombin gene mutations
  - Factor V Leiden gene mutation
  - Activated protein C
  - Anticardiolipin antibody
  - Beta2-glycoprotein I antibodies
  - Lupus anticoagulant
  - Homocysteine level
  - Factor VIII activity
  - D-Dimer
  - Lipoprotein
  - MTHFR
- Venous Ultrasound should be considered in patient with patent Foramen Ovale.
- Prolonged cardiac monitoring should be considered.

Patient Care

Immediate Care
- Use airway support (if needed).
- Treat hypoxia.
  - Give supplemental oxygen to patients with O2 Sat < 94% and a decreased LOC.
  - Treat fever when temp > 37.5°C (> 99.6°F).
- Treat hypoglycemia (< 60 mg/dL).
  - See OSUWMC Diabetes: Hypoglycemia Treatment in Non-Pregnant Adults guideline.
- Blood Glucose goal 140 -180 mg/dL.
- Maintain strict NPO until Swallow Screen is performed by nursing prior to oral intake.
  - If patient fails the screen, then Speech Therapy will complete dysphasia screening.
    - OSUWMC Swallow Screen Video.
- Correct any major nutritional or hydration problems.
- Provide continuous cardiac monitoring until stroke etiology has been identified.
- Position all patients with dysphagia HOB at least 30° for all oral intake. Monitor neurologic response to any elevation of head of bed.

Patient Education in Hospital
Document that patients or their caregivers receive educational materials during the hospital stay addressing at a minimum:
- Provide written information.
- Signs and symptoms of stroke.
- Modifiable risk factors.
- Family history assessment.
- When to seek medical attention/how to activate EMS.
- Medications prescribed at discharge.
- Follow-up after discharge.

Nursing Care after Thrombolytic Administration
- For patients who have received tPA, assess vital signs, modified NIH scale (including pupils), and any symptoms not included in the modified NIH at the following frequencies:
  - Every 15 minutes during infusion then,
  - Every 15 minutes for 2 hours then,
  - Every 30 minutes for 6 hours then,
  - Every hour for 16 hours (total of 24 hour after completion of thrombolytic therapy).
- Continue vital signs and modified NIH scale (including pupils), and any symptoms not included in the modified NIH at least every 4 hours.
  - Frequency of checks should be based on the patient’s stability and other comorbid conditions.
- Blood pressure goal of SBP < 180 mmHg and DBP < 105 mmHg for 24 hours after thrombolytic administration.
- Perform frequent monitoring and assessment for worsening of neurological deficits or bleeding for up to 24 hours after tPA administration.
  - Stop tPA infusion with signs of clinical deterioration and call the physicians (per orders).
- Monitor for bleeding and implement bleeding precautions after thrombolytic therapy.

Nursing Care without Thrombolytic Administration
For patients who do not receive thrombolytics, assess vital signs and modified NIH scale (including pupils) at the following frequencies:
- Every 30 minutes for 1 hour.
- Every 1 hour for 4 hours.
- Then every 4 hours.
- Blood pressure goal of SBP < 220 mmHg and DBP < 110 mmHg during acute phase.
- Perform frequent monitoring and assessment for worsening of neurological deficits.
General Interdisciplinary Care
- Consult PT, OT, and Speech Language Pathology as indicated.
- Institute early bowel and bladder care to prevent complications.
- Avoid use of indwelling catheters, if possible, to reduce risk of UTI.
- Initiate fall precautions - the patient should be told not to ambulate without assistance.
- Start ROM exercises in the early phase of the acute stroke care once risk has been assessed.
- Place a nasoenteral tube in patients who cannot swallow or, if severity warrants, place a percutaneous endoscopic gastronomy tube to provide proper nutrition.
- Perform nutritional status assessment.
- Initiate VTE prophylaxis by end of hospital day 2, or document contraindications.
- Initiate early rehabilitation.
- Endovascular procedures as indicated.

Pharmacological Treatment

Antihypertensive Therapy
Manage hypertension appropriately:
- Withhold antihypertensive agents unless the SBP > 220 mmHg or DBP > 120 mmHg.
- Prior to administering tPA, blood pressure SBP < 185 mmHg or DBP < 110 mmHg.
- After tPA administration (and for 24 hours), blood pressure SBP < 180 mmHg or DBP < 105 mmHg.
- After endovascular treatment (and for 24 hours), blood pressure SBP <180 mmHg or DBP <105 mmHg.
- When treatment is indicated, lower BP cautiously.
  - Aim for a 10-15% reduction in BP.

Antithrombotics, Antiplatelets, or Anticoagulants
- Administer by end of hospital day 2.
- For patients receiving thrombolytic therapy, give aspirin or antithrombotic agent 24 hours after thrombolytic completion and HCT without hemorrhage.
- If atrial fibrillation documented, discharge patient on anticoagulation unless contraindicated.
- If therapeutic heparin is indicated, local practice usually involves infusion initiation at 12 units/kg/hr with no bolus and a lower aPTT goal initially of 20 below the standard target range.

Thrombolytic Reversal
- Abruptly discontinue alteplase in any patient with an intracranial hemorrhage or if one is suspected.
- In small, asymptomatic hemorrhagic conversion, conservative medical management may be considered after weighing the risks and benefits of reversal agents. (See OSUWMC ICH Guideline Appendix B)

Endovascular Care

Immediate Care
- If patient received tPA prior to endovascular consideration, treat BP accordingly.
- Withhold antihypertensive initially unless SBP > 220 mmHg or DBP > 120 mmHg or unless contraindicated.
- After recanalization, bring BP down to the limits prescribed for patient after thrombolytic therapy.
  - SBP < 180 mmHg.
  - DBP > 105 mmHg.
- Maintain limits for at least 24 hours after completion of procedure.
- Use mechanical devices or intra-arterial thrombolytic to achieve recanalization.
- Transfer patient to Neuroscience ICU after procedure.

Selection Criteria
Last known well (LKW) <6 hours with:
- Modified Rankin Scale ≤3.
- ICA and/or M1 Large Vessel Occlusion (LVO)
- NIHSS >6: ASPECTS>6
- NIHSS 2-6: RAPID core <70ml, mismatch ratio >1.8 and mismatch volume >15ml

Last known well (LKW) 6-24 hours with:
- Modified Ranking Scale ≤ 3.
- ICA and/or M1 LVO
- NIHSS >6: RAPID core <70ml, mismatch ratio >1.8 and mismatch volume >15ml

Other LVO's (ACA, M2, VA, and BA) as well as wake up strokes with NIHSS 2-6 handled on a case-by-case basis.

Surgical Care

Immediate Surgical Care
- Pharmacological VTE prophylaxis - to be done at discretion of neurosurgeon.
- Decompressive craniectomy significantly reduces morbidity and mortality in patients with large, space-occupying hemispheric
infarction and also leads to improved functional outcome when performed within 48-hours of stroke onset.

- Patient assessment by neurosurgeon before and after surgery and endovascular procedures.

Cerebellar Infarction

**Decompressive Suboccipital Cranietomy**

**Indication Criteria**
- Neurological signs of brainstem compression:
  - Hypertension
  - Bradycardia
  - Cranial nerve dysfunction
  - Reduction of consciousness due to infarct (other causes exclude)
  - Mass effect on CT or MRI

**Exclusion Criteria**
- Clinical or radiological signs of severe irreversible brainstem ischemia.
- Lack of informed consent.

MCA Infarction

**Decompressive Hemicraniectomy**

**Indication Criteria**
- Clinically large MCA infarct.
  - NIH Stroke Scale $> 15$.
- Decreased level of consciousness due to infarct (other causes excluded).
- Radiographic signs of large MCA infarct:
  - Mass effect on CT or MR or
  - At least 50% of the MCA territory.
- Surgery within 48 hours after onset of symptoms (minimum of 6 hours after any thrombolytic therapy).

**Exclusion Criteria**
- Pre-stroke Modified Rankin Scale $\geq 2$.
- Two fixed dilated pupils.
- Other serious illness that could affect outcome.
- Known coagulopathy or systemic bleeding disorder.
- Lack of informed consent.

**Discharge Planning**

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

**Multidisciplinary Focus**
- Provide education for patient’s family/caregivers on:
  - Stroke (pathology, prevention, signs/symptoms, and actions to take).
  - Follow-up appointments/therapy.
  - Treatment plan.

**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, Speech Pathology should assist the patient and family in establishing a communication pattern before discharge.

**Case Manager/Social Work**
- Meets with family and team as needed to discuss:
  - Patient progress.
  - Rehabilitation goals.
  - Discharge needs or issues.
  - Explanation of next level of care.
  - Providing care and support associated with these deficits.
  - Ways to cope with stress associated with these impairments.
  - Respite care.
  - Post-stroke depression.
- Consider availability of support services and desires of the patient’s family/caregiver.
  - Provides community resources as needed to family/caregiver.

**Order Sets**
- ED: Stroke Alert [2265]
- ED: Ischemic Stroke – Confirmed (TPA) [2931]
- ED: Ischemic Stroke – Confirmed no TPA [2993]
- ED: Suspected Stroke Triage Protocol [2332]
- NV1: Stroke Bundle with and without TPA [4389]
- NV1: Admission Stroke – no TPA [2240]
- NV1: Admission Stroke – with TPA [2148]
- NV1: Internal Stroke – Confirmed Ischemic with TPA
- NV1: Internal Stroke alert – diagnostic ONLY [2238]
- NV1: Post Cerebral Angiogram (with or without intervention)
- NEU Stroke Consult/Evaluation[780]
- PMR: Admission Stroke Rehab [2030]
- PVS: Pre-Procedure Vascular Surgery Diagnostic Interventional (aka angiogram) [2976]
Guideline Authors

- Noah Grose, RN, BSN, ACNP-BC
- Michel Torbey, MD
- Ciaran Powers, MD, PhD
- Xuan Nguyen, MD, PhD
- Peg Baylin, PharmD
- Keaton Smetana, PharmD
- Casey May, PharmD
- Deepak Gulati, MD
- Michelle Graf, PT
- Kelsey Kauffman, PharmD
- Sharon Heaton MA, BSN, RN, EMT-P
- Andrew Slivka, MD
- Dorina Harper, CNS

Guideline reviewed by the Stroke Quality Committee.

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.

Copyright © 2018. The Ohio State University Wexner Medical Center. All rights reserved. No part of this document may be reproduced, displayed, modified, or distributed in any form without the express written permission of The Ohio State University Wexner Medical Center.

Quality Measures

All Joint Commission Stroke and Comprehensive Stroke Performance Measures

References