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Deaconess REGIONAL TRAUMA CENTER

Traumatic Brain Injury Management

Purpose: To provide practice management guidelines for traumatic brain injury patients based upon the National Brain Trauma Foundation Guidelines

Goals:

Early diagnosis and management of severe traumatic brain injuries

Prevent causes of secondary brain injury during resuscitation (hypoxia, hypovolemia, hypocarbia, anemia, hyperthermia, hypo/hyperglycemia)

Rapidly identify and treat mass lesions

Identify need for ICP/CPP monitoring and management of intracranial hypertension (ICH)

Definitions:

- Mild head injury: Glasgow Coma Scale (GCS) score 13 – 15
  GCS score after adequate cardiopulmonary resuscitation
- Moderate head injury: GCS 9 – 12
- Severe head injury: GCS 3 – 8

Guidelines:

A. Initial management
   a. Primary and secondary survey
   b. Establish level of consciousness and any focal neurologic deficits
   c. Airway
      i. Intubate all unconscious patients (GCS $\leq$ 8) to secure airway
         1. Use sedation and short acting neuromuscular blockade if necessary
      ii. Maintain cervical spine immobilization in all unconscious or symptomatic patients
         1. Symptomatic means neck pain or
   d. Breathing: oxygenation and ventilation
      i. Administer high flow oxygen to all patients with suspected head injury
      ii. Monitor oxygen saturation
         1. Avoid hypoxia
            a. $SaO_2 < 90\%$ or $PaO_2 < 60$ mmHg

iii. Ventilation
    1. Avoid hyperventilation
        a. Unless signs of herniation are present
    2. Maintain PaCO2 35-40 mmHg

e. Circulation
    i. Pre-hospital
        1. Avoid SBP < 85 mmHg
    ii. Resuscitate to goal of mean arterial pressure (MAP) > 85 mmHg to maintain a presumptive cerebral perfusion pressure (CPP) > 60 mmHg
    iii. Fluids
        1. Infuse 0.9% NaCl and/or blood

f. Recognize and treat herniation syndromes
    i. Signs
        1. Pupils
            a. Anisocoria (asymmetric), irregular, or sluggish reaction, progressing to fixed, dilated, nonreactive
        2. Motor
            a. Hemiparesis, decerebrate posturing, Babinski reflex
        3. Progressive neurologic deterioration, not attributable to extracranial causes
    ii. Emergency treatment of herniation
        1. Hyperventilation
        2. Mannitol, if not hypotensive
        3. Hypertonic saline
    iii. In the absence of a herniation syndrome, do not initiate treatment for intracranial hypertension, until CT scan is done or ICP monitor inserted

g. Manage all wounds in a sterile manner

h. Indications for head CT scan (without IV contrast)
    i. Unconscious
    ii. History of loss of consciousness
    iii. Focal neurologic deficits
    iv. Post-traumatic seizure
    v. Decreasing level of consciousness
    vi. Penetrating injury
    vii. Skull fracture

i. If the initial GCS is < 8 in the Emergency Department, the Traumatic Brain Injury Orders (DHS Trauma Injury Focused) should be initiated

j. Indications for Neurosurgery consultation
    i. Moderate or severe head injury
        1. GCS < 13
    ii. Post-traumatic seizure
    iii. Unequal pupils
    iv. Neurologic deficit
    v. Abnormal head CT scan
        1. Contusion
        2. Subdural hemorrhage (SDH)

3. Subarachnoid hemorrhage (SAH) in patient with GCS < 15 and/or on any anticoagulant medication
4. Edema
5. Compressed basal cisterns
6. Skull fracture

k. Patients with only a tiny SAH, normal GCS (15), and who are not on any anticoagulant medications can be managed by the Trauma Surgeon with serial neuro examinations
    i. Neuro checks at least every 2 hours
        1. If the patient has a change in neuro status, Trauma Surgeon should repeat head CT and consult Neurosurgeon
        2. Repeat head CT and Neurosurgical consultation should be obtained if there is a change in neuro status
            a. Neurosurgery consultation may also be obtained at the Trauma Surgeon's discretion
        3. Upon discharge, patient should follow up in Trauma Clinic 2 weeks post discharge to ensure normal functioning and no residual symptoms (i.e. headache, nausea, inability to perform ADL, etc.)

B. Intracranial pressure (ICP) and cerebral perfusion pressure (CPP) monitoring
    a. Need for ICP/CPP monitoring will be determined by the Neurosurgery service
        i. General indications
            1. Severe head injury
                a. GCS 3-8 after resuscitation and considering presence of paralytics and sedatives plus abnormal CT scan
            2. Inability to monitor neuro exam
                a. Prolonged sedation or anesthesia
        ii. Technique
            1. ICP
                a. Parenchymal ICP monitoring catheter (Camino) or ventricular catheter
            2. CPP
                a. Arterial line needed for continuous monitoring
                    i. CPP = MAP – ICP

C. ICP/CPP treatment. See Appendix A for flowchart.
    a. Parameters
        i. Normal ICP = 0-10 mmHg
        ii. Treatment threshold > 20-25 mmHg
        iii. Goal CPP = 60-70 mmHg

b. Hyperosmolar therapy
    i. Mannitol
        1. For treatment of intracranial hypertension
            a. Effective doses range from 0.25 – 1 gram/kg
                i. Given by intermittent bolus infusion Q 4-8 hours
                    1. See Appendix A for starting dose
            b. Euvolemia must be maintained
                i. Foley mandatory
                ii. CVP monitor recommended
            c. Monitor serum osmolality
                i. If serum osmolality exceeds 310 mOsm/kg, contact Neurosurgeon before administering Mannitol
            d. Monitor serum sodium
    ii. Hypertonic Saline
c. Barbiturates
    i. High dose barbiturates may be considered for hemodynamically stable, salvageable, severe head injury patients with intracranial hypertension refractory to maximal medical and surgical therapy
d. Drugs contraindicated or to use with caution in TBI patients
    i. Steroids should not be used in patients with severe traumatic brain injury
    ii. Ketamine should not be used in patients who require frequent neuro checks
        1. Use Ketamine with caution in TBI patients with elevated ICP

D. Early post-traumatic seizure prophylaxis
    a. Anti-convulsants may be considered in the following patients
        i. GCS < 10
        ii. Cortical contusion
        iii. Depressed skull fracture
        iv. Subdural hematoma
        v. Epidural hematoma
        vi. Temporal lobe contusion
        vii. Penetrating head wound
        viii. Seizure within 24 hours of injury
    b. Therapy should be considered for 7 days

E. Nutritional support
    a. Enteral feeds should be instituted within 72 hours of injury unless contraindicated
    b. Consult Dietician for feeding recommendations

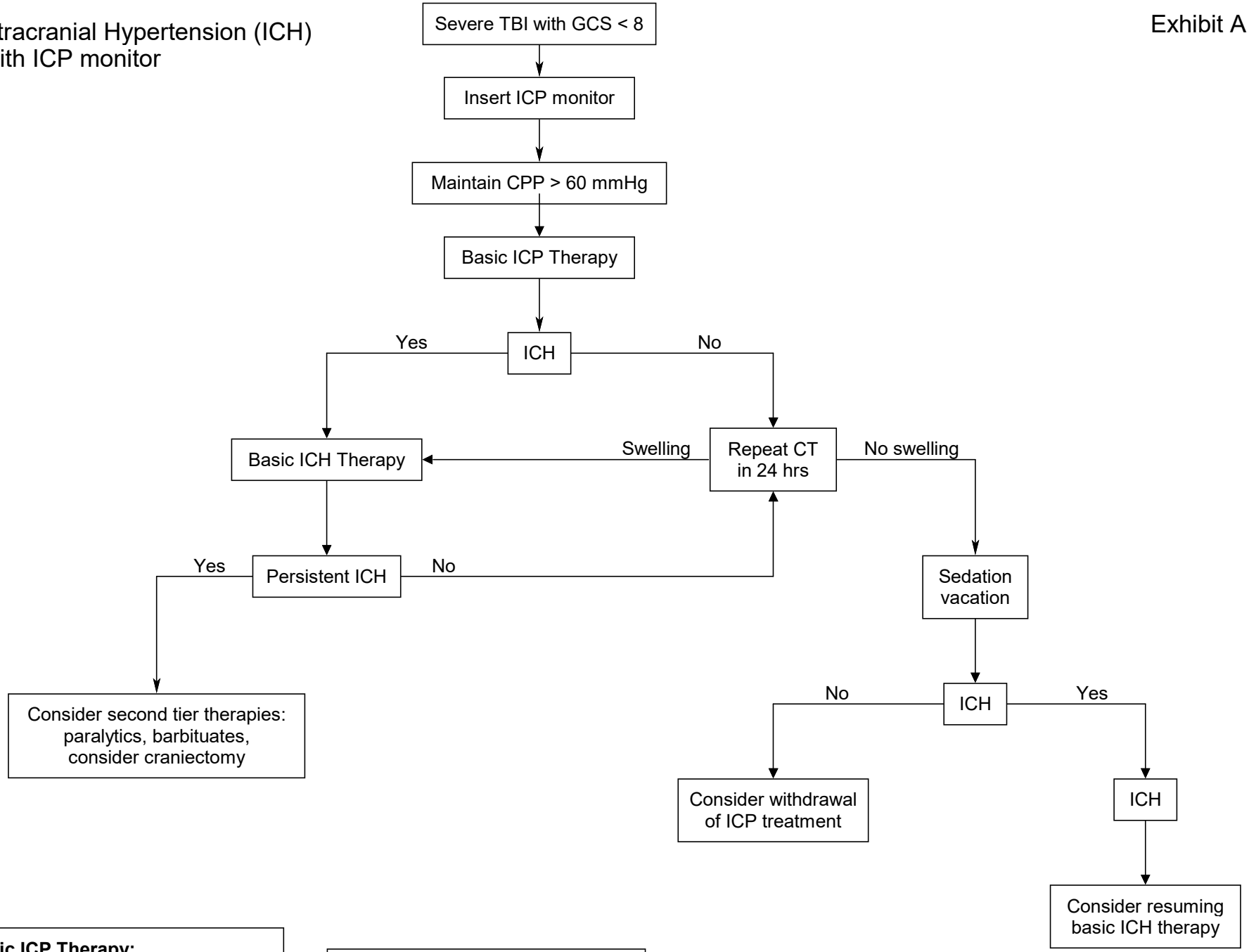
F. Normothermia Protocol
    a. See Nursing Policy in Mosby's
    b. This should be instituted for moderate and severe TBI patient (i.e. GCS < 13) with fever greater than 100.4º F
    c. Use Normothermia Order Set in EPIC

References:

- Brain Trauma Foundation, Inc. Guidelines for the Management of Severe Traumatic Brain Injury. 2016. http://www.braintrauma.org
- Chestnut, R.M., Hendricks, B.A., et al (2012) A Trial of Intracranial-Pressure Monitoring in Traumatic Brain Injury Vol 367 (26) New England Journal of Medicine

Exhibit A

Treatment of Intracranial Hypertension (ICH) with ICP monitor



Basic ICP Therapy:

- **intubation, sedation, analgesia**
- **maintain normal PaCO2 (35-40)**
- **hourly pupil checks**
- **no sedation vacation unless otherwise ordered**
- **no Precedex**
- **maintain MAP >85**

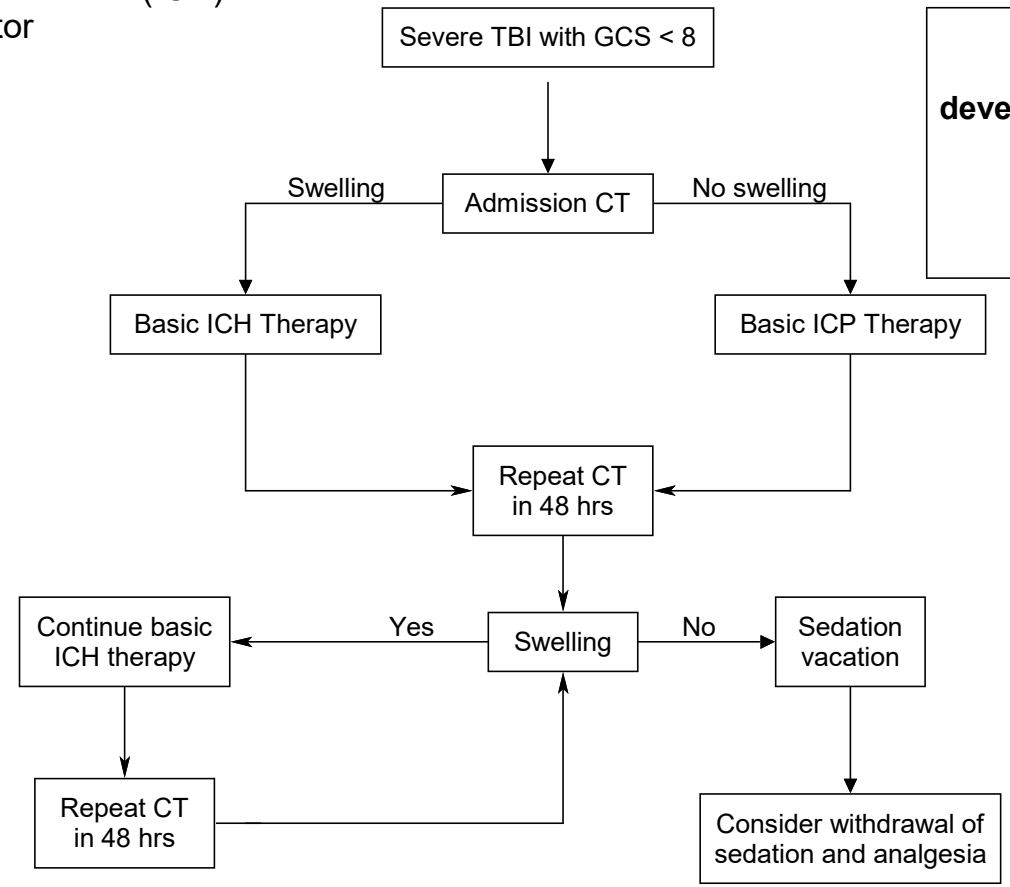
Basic ICH Therapy:

- **Basic ICP Therapy**
- **Mannitol 0.5 g/kg IV q 8 hrs or hypertonic saline**
- **Ventricular drainage**

If neuro worsening occurs (pupils become unreactive, development of pupil asymmetry >2 mm), obtain STAT head CT, and consider second tier therapies.

Exhibit B

Treatment of Intracranial Hypertension (ICH) without ICP monitor



If neuro worsening occurs (pupils become unreactive, development of pupil asymmetry > 2mm), obtain STAT head CT, and consider second tier therapies: paralytics, barbituates, consider craniectomy

Basic ICP Therapy:

- **intubation, sedation, analgesia**
- **maintain normal PaCO2 (35-40)**
- **hourly pupil checks**
- **no sedation vacation unless otherwise ordered**
- **no Precedex**
- **maintain MAP >85**

Basic ICH Therapy:

- **Basic ICP Therapy**
- **Mannitol 0.5 g/kg IV q 8 hrs or hypertonic saline**