

Definition

Blunt cerebral vascular injury (BCVI) is defined as injury to the carotid or vertebral arteries. The severity of the injury can range from a mild endoluminal vascular irregularity to complete transection of the vessel. The degree of severity is described on a grading scale which determines further work-up and treatment. BCVI is a rare injury that can have devastating neurological consequences such as stroke.

Incidence

- In adults, BCVI is diagnosed in approximately 0.1% of patients hospitalized for trauma unless a screening program has been initiated. When asymptomatic patients are screened, the incidence rises to 1% of all blunt trauma patients and as high as 2.7% in patients with an Injury Severity Score of ≥ 16 . Resultant neurologic morbidity is reported at up to 80% with mortality of up to 40%³.
- The incidence of BCVI in children is significantly higher than previously suspected. In the largest multi-center pediatric study to date, 0.4% of pediatric patients admitted with blunt trauma to the head, neck or face were retrospectively noted to have confirmed BCVI. Unfortunately, only 16% of patients who were at high risk for BCVI underwent any vascular imaging¹.

Etiology

The spectrum of BCVI includes simple intimal disruption, thrombosis, & pseudoaneurysm as well as vessel occlusion and vessel transection. In many cases the diagnosis is delayed until the development of a neurologic deficit. Adult and pediatric trauma literature recommends screening for BCVI in asymptomatic patients who may be at high risk for BCVI based on physical exam findings or other identified injuries.

Guideline Eligibility Criteria

Patients from newborn through adolescence with blunt head, face, or neck trauma and abbreviated injury score (AIS) ≥ 1 .

Guideline Exclusion Criteria

- Patients without blunt head, face, or neck trauma are excluded from this guideline.
- Patients with AIS < 1 are excluded from this guideline.
- This is a guideline only. Individual circumstances need to be considered, as there may be times when it is appropriate or desired to deviate from this guideline.

Diagnostic Evaluation

History

- Assess for history of blunt force trauma to head, face, or neck.
- Mechanisms may include MVC, auto vs ped, ATV crash, hanging, or strangulation mechanism.

Physical Examination

- [Memphis Screening Criteria](#)
- [Denver Screening Criteria](#)

Imaging

- Head, Face, cervical spine imaging as indicated – identify basilar skull fractures, cervical spine fractures and/or ligamentous injury, LeFort II or III fractures.
- Neck CT Angiogram (CTA) as indicated for patients meeting [Memphis](#) or [Denver Criteria](#).
 - ◇ CTA data including flow through Circle of Willis is included with Neck CTA. Head CTA does not need to be ordered in addition to the neck CTA for the purpose of evaluating for BCVI.
- MRA of head/neck may be appropriate for a small subset of patients that will require MRI for other diagnostics.

Critical Points of Evidence

Evidence Supports

- In pediatric trauma, there is very little research on this injury, and it is hypothesized that many children are not being screened properly ¹.
- The EAST guidelines cite Level II evidence that patients presenting with any neurologic abnormality unexplained by a diagnosed injury should be evaluated for BCVI ³.
- There is Level III evidence that pediatric trauma patients should be evaluated using the same criteria as the adult population. Level III evidence for risk factors includes patients with Glasgow Coma Scale (GCS) ≤ 8 ; petrous bone fracture; diffuse axonal injury; cervical spine fracture; and Lefort II or III facial fractures ³.
- Level II evidence for treatment states that grades I and II injuries should be treated with antithrombotic agents such as aspirin or heparin ³.
- Level III recommendations state that either heparin or antiplatelet therapy can be used with seemingly equivalent results ³.
- Grade III injuries (pseudoaneurysm) rarely resolve with observation or heparinization, and invasive therapy (surgery or interventional) should be considered. In patients with an early neurologic deficit and an accessible carotid lesion, operative or interventional repair should be considered to restore flow. In children who have suffered an ischemic neurologic event, aggressive management of resulting intracranial hypertension up to and including resection of ischemic brain tissue has improved outcome as compared with adults and should be considered for supportive management ³.
- Follow-up angiography is recommended in grades I to III injuries. To reduce the incidence of angiography-related complications, this should be performed 7 days post-injury ³.
- Recent studies comparing CTA and MRA favor the use of MRA in pediatrics (in appropriate circumstances) to reduce overall cancer risk ¹¹.

Evidence Lacking/Inconclusive

- Though there are multiple BCVI screening tools available including the Memphis or Denver Criteria (DC), Utah Scoring and EAST Criteria, all three have a sizable false negative rate. Currently the most widely accepted and utilized criteria are the Denver and Memphis tools ¹⁵.

- According to Azarakhsh et al, the Memphis Criteria is a tried and tested tool that is well described in the literature ⁴.
- Studies have concluded that while the cervical seatbelt sign is a common indicator for CTA, cervical abrasions alone is not an predictor of BCVI and should not warrant a CTA without further risk factors identified ¹⁴.
- Concomitant hemorrhagic injury has traditionally been considered a contraindication to anticoagulant therapy for BCVI. In a 10 year adult retrospective study looking at patients with BCVI and traumatic neurologic injury, authors concluded that the benefit of early treatment for BCVI markedly outweighs the risk. Hemorrhagic TBI worsened in 6.25% of patients who were not given pharmacologic therapy compared with 5.1% in the group who received aspirin or heparin therapy for BCVI ⁵.

Evidence Against

Imaging to identify BCVI (Neck CTA) exposes the patient to a small amount of radiation.

Practice Recommendations

- Patients who meet [Memphis](#) or [Denver](#) Screening Criteria will have Neck CT Angiogram.
 - ◇ CTA data including flow through Circle of Willis is included with Neck CTA. Head CTA should not need to be ordered separately in order to evaluate for BCVI.
- MRA neck may be obtained when appropriate.

Memphis Screening Criteria

- Any basilar skull fracture.
- Any cervical spine fracture and/or ligamentous injury.
- Neurological exam not explained by brain imaging.
 - ◇ Lateralizing deficits
 - ◇ Anisocoria
 - ◇ Amaurosis Fugax
 - ◇ Concerns with Level of Consciousness.
- Horner's syndrome
- LeFort II or III fracture
- Neck soft tissue bruising in patients **who already require CT Head/Neck/Face**; or isolated "clothesline" injury, **deep** soft tissue injury, or hematoma.

Denver Screening Criteria

- Arterial Hemorrhage
- Cervical Bruit
- Expanding Cervical Hematoma
- Focal neurologic deficit
- Neurologic exam incongruous with CT findings
- Stroke on Secondary CT scan
- Mandibular Fracture
- Complex skull fracture, basilar fracture, or occipital condyle fracture
- TBI with GCS <6
- Fracture of ribs 1-3

- Blunt Cardiac Rupture
- Scalp degloving
- TBI with thoracic injury
- TBI with vascular injury

Denver Grading System

Grade	Description
Grade I	Irregular vessel wall or dissection/intraluminal hematoma with <25% stenosis.
Grade II	Intraluminal thrombus or raised intimal flap is visualized, or dissection/intraluminal hematoma with \geq 25% stenosis.
Grade III	Pseudoaneurysm
Grade IV	Vessel Occlusion
Grade V	Vessel Transection

Patient meets Screening Criteria

Initial Neck CTA (or MRA if appropriate)

- If positive for vessel injury and patient has other injuries (polytrauma)
 - ◇ If no contraindications: start heparin gtt with goal PTT 40-50 sec; do not bolus.
 - ◇ Pedi neuroradiologist to over-read CTA the following morning:
 - a. If initial read demonstrates Grade I injury, hold treatment until confirmed by pedi neuroradiologist.
 - ◇ Consult Pediatric Neurosurgery, Hematology and/or Endovascular as appropriate for management and follow ups.
 - ◇ Follow up Neck CTA or MRA at 7-10 days post-injury.
- If positive for vessel injury and patient has no other injuries (no polytrauma):
 - ◇ If no contraindications: start ASA; pedi dose 5mg/kg/day
 - ◇ Pedi neuroradiologist to over-read CTA the following morning:
 - a. If initial read demonstrates Grade I injury, hold treatment until confirmed by pedi neuroradiologist.
 - ◇ Consult Pediatric Neurosurgery, Hematology, and/or Endovascular (if appropriate) for management and follow ups
 - ◇ Follow up Neck CTA – 7-10 days post-injury.
- Contraindications include need for operative intervention for other injuries (intracranial or intra-abdominal bleeding) and/or ongoing bleeding. Re-evaluate for resolution of contraindications and start anticoagulation or antiplatelet therapy when appropriate.

Follow-up Neck CTA or MRA (7-10 days post-injury)

- Resolved injury:
 - ◇ Stop treatment

- Grade I, IV injury:
 - ◇ ASA x 3 - 6 months-discuss timing with clinician
 - ◇ Re-image at 3 - 6 months
- Grade II, III, V injury:
 - ◇ ASA (5mg/kg/day) & consider Plavix (1mg/kg/day; <2yo dosing: 0.2mg/kg/day)
 - ◇ Four Vessel DSA (Digital Subtraction Angiography)
 - a. Resolved injury
 - i. Stop treatment
 - b. Grade II, III injury
 - i. Endovascular repair (stent) if practical
 - ii. Continue ASA +/- Plavix x 3 - 6 months
 - iii. Re-image at 3- 6 months
 - c. Grade I, IV injury
 - i. Continue ASA x 3 - 6 months
 - ii. Re-image at 3 - 6 months
 - d. Grade V injury
 - i. Endovascular repair (embolize) if practical
 - ii. Continue ASA x 3 - 6 months
 - iii. Re-image at 3 - 6 months

Admission Criteria

Patients with identified BCVI will be admitted to the Trauma Service.

Consults and Referrals

Neurosurgery, Hematology, Interventional Radiology, Vascular Surgery, & Critical Care as indicated.

Caregiver Education

Provide medication side effects and signs and symptoms of bleeding to report.

Follow- Up Care

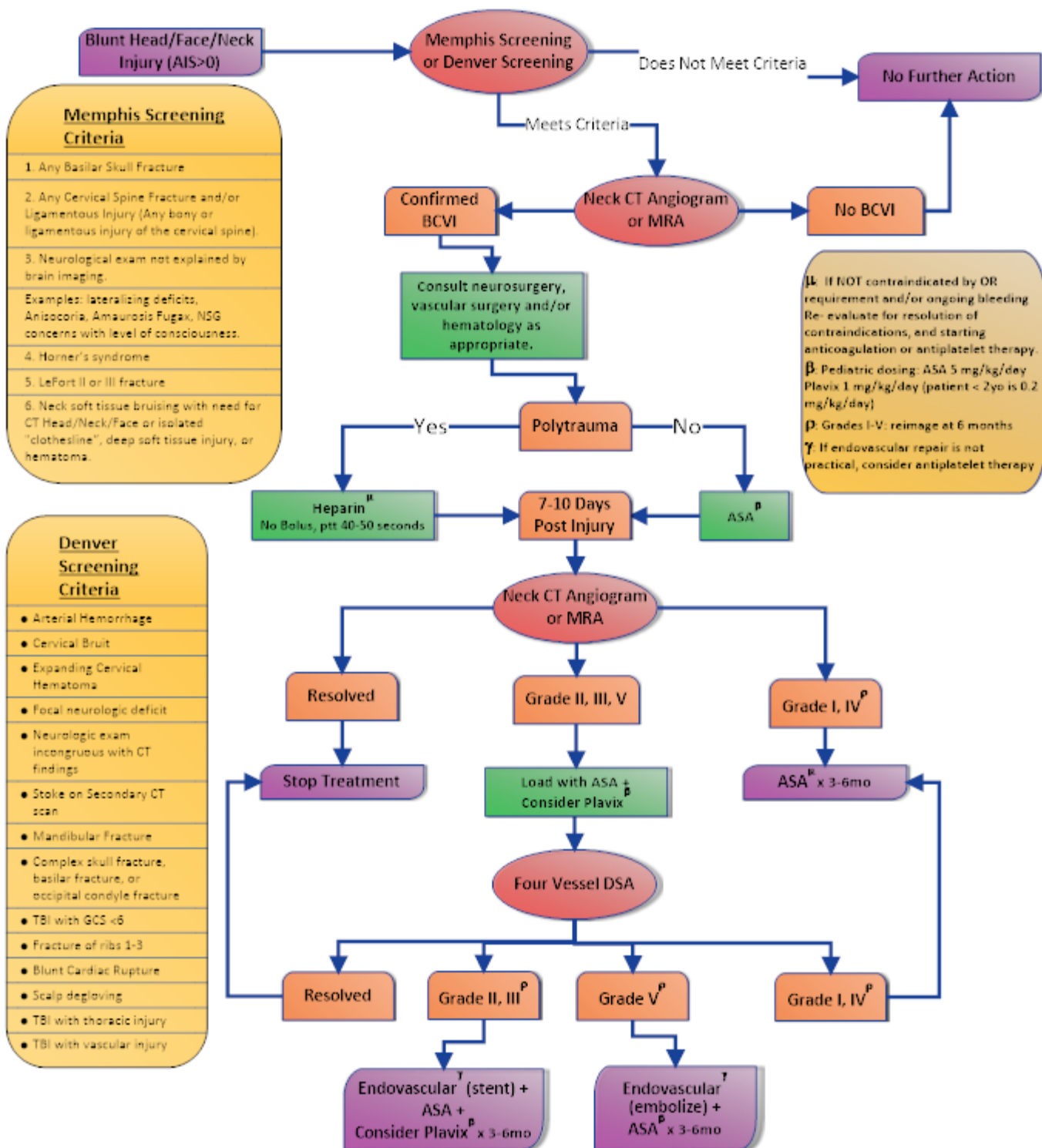
Patient found to have BCVI

- Continue ASA and/or Plavix for 3- 6 months as recommended for identified injury.
- Arrange for outpatient follow-up with neurosurgery, vascular surgery or hematology as appropriate. They will determine the plan for reimaging in the future.

Process Measures

- All patients meeting the following objective Criteria will have a CTA or MRA Neck:
 - ◇ Basilar skull fracture
 - ◇ Cervical spine fracture and/or ligamentous injury
 - ◇ LeForte II or III fracture

BCVI Algorithm



Related Policies

[MRI Contrast](#)

May-2018

Key Contributors

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Signatures

The signatures below indicate support for the attached guideline, protocol and/or algorithm. The intent is not to be prescriptive but to provide a cohesive, standardized, and evidence-based (when available) approach to patient care. The physician must consider each patient and family’s circumstance to make the ultimate judgment regarding best care.

Approved by Trauma Council: 10Jul2020

By: _____ Date _____
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