BACKGROUND
Blunt injury to the carotid or vertebral vessels (blunt cerebrovascular injury [BCVI]) is diagnosed in approximately 0.1% among blunt trauma victims admitted to trauma centers.\textsuperscript{1-4} However, the majority of these injuries are diagnosed after the development of symptoms secondary to central nervous system ischemia, with a resultant neurologic reported BCVI-related mortality rates of 23\%, with 48\% of survivors suffering permanent severe neurologic sequelae.\textsuperscript{5-7} When asymptomatic patients are screened for BCVI, the incidence rises to 1\% of all blunt trauma patients and as high as 2.7\% in patients with an Injury Severity Score \(\geq 16\).\textsuperscript{1-4} This guideline addresses diagnosis and management of BCVI including screening for asymptomatic injury, screening modality, and management of BCVI (both symptomatic and asymptomatic), and appropriate follow-up for these injuries.

CLINICAL PRACTICE GUIDELINES (see attached algorithm)

I. Evaluation for BCVI\textsuperscript{8-11}
   a. SYMPTOMATIC - Trauma patients with any of the following signs or symptoms should be considered to have BCVI and further evaluation by a CTA is indicated:
      i. Arterial hemorrhage from neck, mouth, nose, ears
      ii. Large or expanding cervical hematoma
      iii. Cervical bruit in a patient younger than 50 years
      iv. focal or lateralizing neurologic deficit, including
      v. Evidence of cerebral infarction/ischemia on computed tomography (CT) or magnetic resonance imaging (MRI) scan unexplained by other factors like prolonged hypotension, hypoxia or cerebral herniation from mass effect.
      vi. Neurologic deficit that is incongruous with CT or MRI findings and unexplained by other injuries.

Any of these findings should prompt emergent diagnostic evaluation and interventions directed at hemorrhage control or stroke management.

b. ASYMPTOMATIC – Screening for BCVI is performed for high risk patients with high energy transfer mechanisms:\textsuperscript{8-11}
   i. Displaced mid-face fracture (LeForte II or III)
   ii. Basilar skull fracture with carotid canal involvement
   iii. Closed head injury consistent with diffuse axonal injury and GCS \(\leq 6\)
   iv. Cervical transverse foramen fracture from C1 to C6 level.
   v. Cervical vertebral body fracture.
vi. Near hanging with anoxia (if brain injury is compatible with favorable prognosis for survival)

vii. Clothesline type injury

c. Pediatric trauma patients should be evaluated using the same criteria as the adult population.

II. DIAGNOSIS OF BCVI\textsuperscript{10-11}

If BCVI is suspected, CT angiography (CTA) neck (≥ 16 slice multi-detector) at Grady Memorial Hospital is the preferred screening test for BCVI. If diagnosis is unclear, review with neuroradiologist or vascular surgery consult should be obtained for further clarification. For patients undergoing emergent MRI for complete cervical spinal cord injuries or vertebral subluxations/dislocations, MRA with Gadolinium is acceptable.

III. TREATMENT OF BCVI (see algorithm)\textsuperscript{8-11}

The primary management of these patients remains under the discretion of the trauma surgery service due to the high likelihood of concomitant injuries. Vascular surgery/Neurosurgery consultation should be obtained as needed by the primary trauma surgeon. No class I or II recommendations exist for the treatment of these injuries.

<table>
<thead>
<tr>
<th>Injury Grade</th>
<th>Denver Grades BCVI\textsuperscript{8}</th>
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<tbody>
<tr>
<td>I</td>
<td>Luminal irregularity or dissection with &lt; 25% luminal narrowing</td>
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<tr>
<td>II</td>
<td>Dissection or intramural hematoma with ≥ 25% luminal narrowing, intraluminal thrombus, or raised intimal flap</td>
</tr>
<tr>
<td>III</td>
<td>Pseudoaneurysm</td>
</tr>
<tr>
<td>IV</td>
<td>Occlusion</td>
</tr>
<tr>
<td>V</td>
<td>Transection with free extravasation</td>
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</tbody>
</table>

a. Grade I

i. First line therapy is controversial, but these injuries should be treated with antiplatelet or antithrombotic agents.

1. Administer Aspirin 325 mg po or 300 mg pr q day

2. Contra-indication to antithrombotic - For patients with TBI, Neurosurgery should be consulted prior to beginning therapy.

ii. Depending on the risk of bleeding as determined by trauma surgery, patients may be treated with aspirin 81 mg or no treatment in select patients.

b. Grades II, III injuries (pseudoaneurysms) and Grade IV

i. SYMPTOMATIC -

1. Vascular surgery (extra-cranial injury)/Interventional Neuroradiology (intra-cranial injury) consultation may be obtained to determine need for potential intervention at discretion of trauma surgeon
2. Administer Aspirin 325 mg po or 300 mg pr q day
3. Contra-indication to anticoagulation - For patients with TBI, Neurosurgery should be consulted prior to beginning therapy.
4. For select patients without contra-indication to anticoagulation, dual antiplatelet and antithrombotic therapy may be considered.
5. For patients selected for conversion to warfarin therapy, prothrombin time and international normalized ratio of 2-3 for 3-6 months are recommended.

ii. ASYMPOTOMATIC –
1. Patients should be managed with medical therapy - Aspirin 325 mg po or 300 mg pr q day
2. Vascular surgery (extra-cranial injury)/Interventional Neuroradiology (intra-cranial injury) consultation should be considered to facilitate follow-up imaging and possible delayed endovascular therapy.

iii. Patients with carotid stents need post-intervention dual antiplatelet therapy due to high rate of thrombosis without it and need follow up with endovascular service.

C. Grade V
i. These injuries require immediate surgical or endovascular intervention for control of bleeding.
ii. Trauma surgery, neurointerventional radiology, and vascular surgery may be consulted to discuss these injuries on a case-by-case basis.

IV. FOLLOW-UP
a. Patients with a confirmed BCVI should undergo a repeat CT Neck angiogram at 7 days post-injury or post-diagnosis to monitor progression of injury. More severe cases may need an earlier CTA.
b. BCVI patients need regular outpatient monitoring with trauma surgery for new neurologic symptoms that need further evaluation and imaging.
c. Patients with persistent CTA findings at 7 days should be continued on medical therapy and Vascular surgery (extra-cranial injury)/Interventional Neuroradiology (intra-cranial injury) may considered to facilitate follow-up imaging and possible delayed endovascular therapy.

REFERENCES


EVALUATION AND TREATMENT OF BLUNT CEREBEROVASCULAR INJURIES

Sign of BCI

Equivocal findings

Review with
Neurosurgeon or
Vascular Surgery
consult

Positive

Grade V Injury

Immediate
Intervention
Surgical/Endovascular

Immediate
Intervention
Surgical/Endovascular

Discontinue
Antithrombotic
therapy

Consult Vascular
Surgery for follow-up
imaging and possible
delayed endovascular
therapy

Injury Healed?

Antithrombotic/
Anticoagulation
therapy (see section III)

Repeat CT angiogram
neck in 7 days

Grade IV Injury

Grade V Injury

CT
Angio
Neck

Negative

STOP

Yes

No

STOP

Risk factors for BCI

No

CT
Angio
Neck

Negative

STOP

Yes

http://wcesttrauma.org/algorithm/WFATheme_file/v2/Pdfs/4.htm