

PRACTICE GUIDELINE

Effective Date: 30 April 2010

Manual Reference: **Deaconess Trauma Services**

TITLE: BLUNT CEREBROVASCULAR INJURY (BCVI)

Practice management guidelines

For extracranial or intracranial cerebrovascular injuries

Cerebrovascular injuries (carotid and vertebrobasilar vasculature)

PURPOSE:

1. To define screening for blunt cerebrovascular injury (BCVI).
2. To define the appropriate modality for the screening and diagnosis of (BCVI).
3. To define the mechanism of treatment of BCVI.
4. To defined the duration of treatment for BCVI.
5. To define the mechanism of monitoring the response to treatment.

GOAL: Early recognition and management of extracranial blunt carotid injury, extracranial blunt vertebral artery injury, and intracranial vascular injury is the goal of this discussion. These injuries are uncommon and potentially highly lethal. Certain kinematics have a distinctive role in predicting the injury. The presence of specific traumatic mechanism and the signs of vascular injury are the only reliable mechanisms to suggest vascular diagnostic procedures.

ANATOMY:

1. The extracranial carotid artery extends from the aorta on the left and the innominate artery on the right to the respective bifurcations
2. The external carotid artery continues on to the face. The internal carotid artery proceeds to the base of the skull (calvarium) and gives no branches from its origin until inside the calvarium.
3. The carotid vessels enter the calvarium through the carotid canal and the foramen lacerum creating the anterior cerebral circulation
4. The vertebral arteries extends from their origins on the subclavian arteries through the foramina transversaria of the sixth through first cervical vertebral bodies. *N.B.*, The vertebral artery sometimes enters the foramen in the transverse process of the fifth vertebra, and has been seen entering that of the seventh vertebra.
5. The vertebral arteries penetrate the ligament between the skull and the first cervical vertebra (atlantooccipital membrane) and enter the calvarium through the foramen magnum
6. Inside the calvarium the vertebral arteries anastomose creating the basilar artery and the posterior cerebral circulation.

PATHOGENESIS GUIDELINES:

1. Injury mechanisms consist of the following:
 - A. Severe cervical hyperextension/rotation or hyperflexion particularly if associated

- with:
 - i. Displaced midface or complex mandibular fracture
 - ii. Closed head injury consistent with diffuse axonal injury
- B. Near hanging resulting in anoxic brain injury
- 2. Resultant injuries as risk factors for extracranial or intracranial BCVI:
 - A. Seatbelt abrasion or other soft tissue injury of the anterior neck resulting in significant swelling or altered mental status
 - B. LeFort II or III fracture
 - C. Cervical spine fracture patterns:
 - i. Subluxation
 - ii. Fracture extending into the transverse foramen (foramen transversarium)
 - iii. Fractures of C 1-3
 - D. Basilar skull fracture
 - i. Carotid canal involvement
 - ii. Petrous bone fracture
 - iii. Fracture clivus
 - E. Diffuse axonal injury with a Glasgow Coma Scale ≤ 8
 - F. Near hanging with an anoxic brain injury
- 3. Signs and symptoms of BCVI.
 - A. Arterial hemorrhage
 - i. Cervical (hematoma)
 - ii. Oropharyngeal
 - iii. Epistaxis
 - B. Cervical bruit
 - C. Expanding cervical hematoma
 - D. Focal neurologic defect
 - E. Neurologic examination incongruous with CT scan findings
 - F. Ischemic stroke on secondary CT scan
- 4. Grading scale for vascular injury is as follows:
 - Grade I: Intimal irregularity with $<25\%$ vessel narrowing
 - Grade II: Dissection or intramural hematoma with $> 25\%$ vessel narrowing
 - Grade III: Pseudoaneurysm
 - Grade IV: Occlusion
 - Grade V: Transection with extravasation

GUIDELINES FOR DIAGNOSTIC STUDIES (USING RISK FACTORS AND SIGNS):

1. Patients presenting with any neurologic abnormality that is unexplained by a diagnosed injury should be evaluated for BCVI
2. Blunt trauma patients presenting with epistaxis from suspected arterial source following trauma should be evaluated for BCVI
3. Asymptomatic patient with significant blunt head trauma (see risk factors) should be evaluated for BCVI.
4. Pediatric trauma patients should be evaluated using the same criteria as the adult population
5. **The risk factors for extracranial or intracranial in BCVI**
 - A. Seatbelt abrasion or other soft tissue injury of the anterior neck resulting in significant swelling or altered mental status
 - B. LeFort II or III fracture
 - C. Cervical spine fracture patterns:
 - i. Subluxation
 - ii. Fracture extending into the transverse foramen (foramen transversarium)
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 - D. Basilar skull fracture
 - i. Carotid canal involvement
 - ii. Petrous bone fracture
 - iii. Fracture clivus
 - E. Diffuse axonal injury with a Glasgow Coma Scale ≤ 8
 - F. Near hanging with an anoxic brain injury
6. **The signs of BCVI are:**
 - A. Arterial hemorrhage
 - i. Cervical (hematoma)
 - ii. Oropharyngeal
 - iii. Epistaxis
 - B. Cervical bruit
 - C. Expanding cervical hematoma
 - D. Focal neurologic defect
 - E. Neurologic examination incongruous with CT scan findings
 - F. Ischemic stroke on secondary CT scan
7. Appropriate screening and diagnostic procedures for BCVI are
 - A. Diagnostic four vessel cerebral angiography (DFVCA) remains the gold standard.
 - B. Duplex ultrasonography is **not** adequate for screening for BCVI.
 - C. CT angiography (multi-slice multi-detector) has adequate sensitivity and specificity for diagnostic screening for BCVI (**and has become the accepted procedure**).

TREATMENT

1. Grade I and II injuries should be treated with anti-thrombotic agents, such as aspirin, or with heparin. Some authors still recommend heparin if there is no contraindication reserving antiplatelet agents for those patients with relative contraindications to heparin. (Level 2)
2. If heparin be selected for treatment, the infusion should be started without a bolus and titrated to partial thromboplastin time (PTT) of 50-60 seconds. (Level 2)
3. In patients in whom anticoagulant therapy is chosen, conversion to warfarin titrated to prothrombin time/international normalized ratio (PT/INR) of 2-3 for 3-6 months is recommended (Level 3 [see 7 below]).
4. Grade III injuries (pseudoaneurysm) rarely resolve with observation or anticoagulant therapy, and invasive therapy (surgery or angio-interventional) should be considered. *N.B.* Carotid stents placed without subsequent antiplatelet therapy have been noted to have a high rate of thrombosis in this population. (Level 3)
5. In patients with an early neurologic defect and an accessible carotid lesion, operative or interventional repair should be considered to preserve or restore flow. (level 3)
6. 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 to adults and thus and should be considered for supportive management. (Level 3)
7. Duration of therapy:
 - A. The duration of anti-thrombotic therapy at the present time is unclear and no specific recommendation can be made.
 - B. Monitoring the response to therapy does not have a specific recommendation. Clinical follow up remains to be most satisfactory approach.
 - C. Follow up angiography is recommended for grade I - III injuries. In order to reduce the incidence of angiography related complications this should be performed after 7 days post injury. (Level 2)

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