

Clinical Study

Blunt cerebrovascular injuries in association with craniocervical distraction injuries: a retrospective review of consecutive cases

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Abstract

BACKGROUND CONTEXT: Blunt cerebrovascular injuries (BCVIs) have the potential to cause brain, cerebellar, and/or spinal cord ischemia. Certain subtypes of spine fractures, such as vertebral subluxation, fractures through the foramen transversarium, and C1–C3 fractures have been linked to a higher incidence of BCVI. On the other hand, BCVI in association with craniocervical distraction injuries (CCDs) have been only anecdotally reported.

PURPOSE: We hypothesized that because CCD is also caused by a high-energy hyperflexion/hyperextension distraction mechanism, it could also be associated with a high incidence of BCVI.

STUDY DESIGN/SETTING: Retrospective chart review.

PATIENT SAMPLE: Of 46 consecutive patients with unstable craniocervical dissociations treated operatively at a single Level I trauma center from January 1996 to December 2009, 29 of the 46 had vascular studies that comprised the study sample.

OUTCOME MEASURES: Primary outcomes assessed were BCVI subdivided into blunt carotid artery injuries and/or blunt vertebral artery injuries and classified according to the Biffl criteria. Secondary measures included associated strokes and evidence of emboli on transcranial Doppler.

METHODS: All consecutive patients diagnosed with unstable CCD injuries that were surgically treated at a single Level I trauma center during the period of 1996 to 2009 were identified. Those who were adequately screened with a catheter angiogram and/or computed tomography angiogram of the neck so as to rule out BCVI were included in this study. Electronic medical records were used to determine mechanism, demographics, clinical findings, and transcranial Doppler reports. Angiography and computed tomography angiograms were analyzed to assess for BCVI. If a BCVI was identified, these were classified using the Biffl criteria.

RESULTS: Among the 29 screened patients, 30 BCVIs were identified in 15 patients. According to the Biffl criteria, there were 13 Grade I, eight Grade II, five Grade III, three Grade IV, and one

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Grade V injuries. Three major strokes were diagnosed in those 15 patients with BCVI, as opposed to none among the other 14 patients without BCVI.

CONCLUSIONS: Blunt cerebrovascular injuries were seen in more than 50% of the patients screened, with major strokes occurring in 20% of the patients. We suggest screening for BCVI in all patients presenting with C0–C1 and/or C1–C2 distraction injuries. © 2015 Elsevier Inc. All rights reserved.

Keywords: Blunt vessel injury; Carotid artery; Craniocervical distraction; Atlanto-occipital dissociation; Stroke; Vertebral artery

Introduction

The occurrence of blunt cerebrovascular injuries (BCVIs) is particularly concerning because of the potential deleterious disabilities related to stroke. Recently, screening of certain trauma subpopulations with computed tomography angiograms (CTAs), magnetic resonance angiograms, or angiography has led to early diagnosis and initiation of treatment, with reported decreases in stroke rates [1]. Certain subtypes of traumatic spinal injuries, such as subaxial cervical spine subluxations, C1–C3 fractures, and fractures through the vertebral artery foramen transversarium, have been linked to both vertebral and carotid injuries [2].

With advancements in prehospital and hospital care, the number of surviving patients with craniocervical dissociation (CCD) injuries has been increasing in the past two decades [3]. Although BCVI has been reported anecdotally in patients with craniocervical injuries [4,5], the incidence of blunt vascular injuries in such instances is unknown because of the limited number of cases. Because it is well known that BCVI occurs in association with high-energy hyperextension/flexion injuries [6], we hypothesized that patients with CCD injuries would have a high incidence of BCVI because hyperextension/distraction is the primary force responsible for the CCD. Our goal was to investigate the incidence of BCVI in a series of patients treated in a single Level I trauma institution who presented with unstable craniocervical distraction injuries.

Materials and methods

After obtaining institutional review board approval, all patients diagnosed with unstable CCD injuries that were operatively managed at a single Level I trauma institute from January 1996 to December 2009 were retrospectively identified from a prospectively maintained database. Data on demographics, mechanism of injury, clinical examinations, imaging features, treatment, and outcomes were reviewed and collected from the patient medical records and review of radiographic imaging studies.

Unstable CCDs were defined as injuries with clear disruption of the facet capsules and surrounding stabilizing ligaments and radiographic distraction and/or translation at the craniocervical junction with or without associated fractures of the occipital condyles, C1 ring, or Type I dens

fracture that merited surgical fixation. Distraction injuries at C1–C2 were also included given the injury of the stabilizing ligaments between the dens and cranium as these too are typically included in CCD definitions [3]. Injuries of the craniocervical junction thought to be stable and treated nonoperatively were excluded.

Among the patients with unstable CCDs, all who underwent screening neck CTA and/or a catheter angiography performed to rule out BCVI were included in this study. The current indications for screening for BCVI in our institution are outlined in Table 1. The official neuroradiology readings on the neck CTA and/or catheter angiograms were subdivided into blunt carotid artery injuries (BCIs) and/or blunt vertebral artery injuries (BVIs) caused by a blunt trauma mechanism, and classified according to the Biffel grading (Table 2) [7]. For the purpose of this article, a carotid cavernous fistulae was classified as Grade V.

The presence of additional cervical spine, facial fractures, mandible fractures, skull base fracture, imaging features characteristic of stroke on head computed tomography (CT) and/or magnetic resonance scans, transcranial Doppler (TCD) emboli monitoring recordings, and/or any traumatic brain injury (TBI) resulting in intracranial hemorrhage were also entered in the data set. Because the investigational purpose of the study was purely identification of the incidence of BCVI among patients with craniocervical distraction injuries, no efforts at identifying treatment effectiveness and its relation to outcomes were undertaken.

Results

We identified 46 patients with unstable CCD injuries that were treated surgically at our Level I trauma center during the period of January 1996 through December 2009. There were three patients with primarily C1–C2 distraction injuries and 43 patients with C0–C1 distraction injuries. Twenty-nine of the 46 patients were adequately screened with either neck CTA (28 of 29) and/or catheter angiogram (6 of 29) to assess for BCVIs. Fifteen of the 29 patients (52%) who underwent screening had positive imaging findings for BCVI.

Mechanism of injury was a motor vehicle accident in 24 patients, car versus pedestrian in three patients, snowmobile versus car accident in one patient, and a fall off a two-story height in one patient.

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