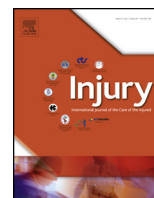




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Management of blunt cerebrovascular injury (BCVI) in the multisystem injury patient with contraindications to immediate anti-thrombotic therapy

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ABSTRACT

Introduction: Practice management guidelines for screening and treatment of patients with blunt cerebrovascular injury (BCVI) have been associated with a decreased risk of ischemic stroke. Treatment: of patients with BCVI and multisystem injuries that delays immediate antithrombotic therapy remains controversial. The purpose of this study was to determine the timing of BCVI treatment initiation, the incidence of stroke, and bleeding complications as a result of antithrombotic therapy in patients with isolated BCVI in comparison to those with BCVI complicated by multisystem injuries.

Materials and methods: This study was a retrospective review of all adult blunt trauma patients admitted to a level 1 trauma center from 2009 to 2014 with a diagnosis of BCVI.

Results: A total of 28,305 blunt trauma patients were admitted during the study period. Of these, 323 (1.1%) had 481 BCEVIs and were separated into two groups. Isolated BCVI was reported in 111 (34.4%) patients and 212 (65.6%) patients had accompanying multisystem injuries (traumatic brain injury (TBI), solid organ injury, or spinal cord injury) that contraindicated immediate antithrombotic therapy. Treatment: started in patients with isolated BCVI at a median time of 30.3 (15, 52) hours after injury in contrast to 62.4 (38, 97) hours for those with multisystem injuries ($p < 0.001$). The incidence of stroke was identical (9.9%) between groups and no bleeding complications related to antithrombotic therapy were identified.

Conclusion: The lack of bleeding complications and equivalent stroke rates between groups suggests that the presence of TBI, solid organ injury, and spinal cord injury are not contraindications to anti-thrombotic therapy for stroke prevention in patients with BCVI.

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Introduction

Although patients with BCVIs comprise only a fraction of the larger trauma population, approximately 1% [1–3] of adult blunt trauma patients, these injuries predispose patients to devastating neurologic sequelae, specifically ischemic strokes. Stroke rates have been found to be as high as 64% and 54% in cases of untreated carotid and vertebral artery injuries, respectively [4]. However, studies within the last decade have shown that rapid screening and diagnosis in conjunction with early antithrombotic treatment

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during a clinically latent period, ranging from 10 to 72 h, can greatly reduce the incidence of BCVI-related stroke to 0.5% [5,6].

The majority of BCVI literature focuses on the diagnosis of BCVI [1,7–14] (angiography versus computed tomographic angiography (CTA)) and appropriate screening criteria [15–17]. Cerebrovascular angiography is viewed as the gold standard for screening potential BCVI patients, however, it is an invasive procedure with its own inherent risk of stroke [7]. As CTA has progressed from single-slice to multi-slice detectors, increasing utilization of CTA as the diagnostic tool for BCVI has occurred secondary to the noninvasive nature of the exam and easy accessibility, allowing rapid diagnosis and more extensive indications for screening [5,7,18]. Multiple treatment modalities for BCVI including anticoagulation therapy (systemic heparin) and antiplatelet therapy (aspirin and clopidogrel) have been shown to be equally effective in preventing ischemic stroke [6].

Current literature does not address the optimal treatment of patients with BCVI and concurrent multisystem injuries, specifically TBI and solid organ injury. In fact, multiple recent studies [2,15,19] conclude that further research is needed to address this patient population. Stein et al [6] suggests that the majority of strokes that occur as a result of BCVI are unpreventable secondary to the inability to initiate treatment with concomitant injuries. Most BCVI studies exclude or do not treat patients with perceived contraindications to antithrombotic therapy, namely traumatic brain injury (TBI) and solid organ injury [2,4,18,20–23], with the exception of Callcut et al [24] who published a retrospective review addressing patients with BCVI and concomitant TBI.

Management guidelines have been delineated for isolated cases of BCVI. Given the high-energy transfer mechanisms of injury, however, the majority of patients with BCVIs present with concomitant multisystem injuries that initially contraindicate the initiation of antithrombotic therapy [2,19]. While proper treatment must be carefully considered given the potential risk for bleeding complications associated with antithrombotic therapy, the delayed initiation of such treatment due to concurrent injuries may leave patients vulnerable to ischemic cerebral crises. Optimal treatment strategies have yet to be identified for patients with BCVIs and concurrent severe injuries. The purpose of this study was to determine the timing of BCVI treatment initiation, the incidence of stroke, and bleeding complications as a result of antithrombotic therapy in patients with isolated BCVI in comparison to those with BCVI complicated by multisystem injuries.

Materials and methods

Study setting

The Texas Trauma Institute at Memorial Hermann Hospital is an American College of Surgeons-verified Level I trauma center in Houston, Texas and serves as the primary teaching facility for the University of Texas Medical School at Houston.

Selection of participants

Following approval from the Institutional Review Board at the University of Texas Medical School at Houston, we conducted this single-center retrospective study utilizing electronic medical records and the trauma registry from Memorial Hermann Hospital (MHH). All adult (≥ 16 years of age) blunt trauma patients admitted between August 2009 and January 2014 with a BCVI diagnosis were included in this study. Exclusion criteria include lack of BCVI on neurosurgical review of CTA, penetrating mechanism of injury, and remote history of injury.

Definitions

BCVI and BCVI related strokes were determined via review of CTA, CT and MRI reports and confirmed by independent neurosurgical review of the relevant studies. We also evaluated the time of injury, BCVI diagnosis, treatment, and incidence of stroke. Time of injury was defined as time of arrival to the Emergency Department (ED) for non-transferred patients and time of first imaging study at outside hospital for transferred patients. Time of first imaging study was readily available electronically and eliminates inconsistencies with pre-hospital documentation and time of transfer. Time of CTA neck acquisition was used as time of BCVI diagnosis. Time of treatment is the time of first antithrombotic or therapeutic anticoagulant medication administration, and time of stroke was the time of radiographic diagnosis of stroke (time of CT or MRI of the brain).

BCVI diagnosis and CTA protocol

BCVI was diagnosed by CTA neck on one of two CT scans during the study period. We utilized a Siemens 40-slice multi-detector CT (MDCT) in the emergency department and a Siemens 64-slice MDCT outside of the ED. CTA protocol (weight based IV contrast) and indications for CTA remained unchanged throughout the study period.

BCVI screening and treatment guidelines

Our institution has trauma management guidelines for BCVI that are regularly updated based on available literature. Patients were screened for BCVI based on the Denver screening criteria for BCVI [6]. The treatment guidelines during the study period suggested antithrombotic therapy within 72 h of TBI with stable head CT and within 48 h of stable hemoglobin and hematocrit (H&H) for solid organ injury. We typically start ASA 325 mg in the absence of stroke symptoms and a heparin infusion without bolus (goal aPTT 40–50) in the presence of stroke symptoms or in patients perceived to have a high risk of bleeding complications (at attending discretion).

Statistical analysis

Two sets of statistical comparisons were evaluated for this study. The first compared our isolated BCVI and multisystem injury groups while the second compared patients with and without BCVI related strokes. Fisher's exact statistical analyses were used to identify differences between all categorical data (presented as frequencies and percentages), while Mann-Whitney statistical analyses were used to evaluate differences between all continuous data (presented as medians and 25th and 75th percentiles). Negative values were assigned for 9 patients (2.8%) when patients were diagnosed with a stroke prior to BCVI diagnosis. These patients were excluded from statistical analysis regarding timing of BCVI diagnosis and stroke but included in all other statistical analyses. For patients with multiple BCVIs, the highest grade BCVI as determined by the Denver Grading Scale, was used for statistical analyses given that higher grades of injury have been associated with a higher risk of stroke [5]. Statistical comparisons with p -values of <0.05 were accepted as significant and all analyses were performed using STATA (version 12).

Results

Comparison of Isolated and Multisystem BCVIs: Of the 28,305 total adult blunt trauma patients admitted during the study period (Fig. 1), 344 BCVI patients were identified in the trauma registry.

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