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Clinical and Epidemiological Characteristics, Trauma Mechanisms, and Outcomes of Blunt Cervical Vascular Injury

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Abstract

Background: Head and neck trauma and its associated injuries contribute substantially to mortality and neurological morbidity. Although relatively uncommon, blunt cervical vascular injury (BCVI) can have severe clinical consequences if not recognized early.

Objectives: This study aimed to assess the clinical and epidemiological characteristics, trauma mechanisms, and clinical outcomes of BCVI among patients admitted to hospitals in Ilam, Iran.

Methods: In this retrospective descriptive study, 88 patients with BCVI admitted to hospitals in Ilam were included. Data were collected using a checklist based on medical records and included demographic characteristics, clinical findings, injured vessel type, trauma mechanism, Glasgow Coma Scale (GCS) score, oxygen saturation, systolic blood pressure, injury severity, and patient outcomes. Vascular injury was defined as any traumatic lesion involving the vertebral artery (VA), common or internal carotid artery (CCA/ICA), or other cervical vascular structures. Data were analyzed using SPSS version 20 with descriptive statistics, including the mean, standard deviation, and frequency distribution.

Results: Among the 88 patients, 34 had a VA injury, 46 had a CCA/ICA injury, and 8 had injuries to other cervical vessels. Motorcycle and bicycle accidents were the most common trauma mechanisms (53.4%), followed by falls from height and car accidents. Overall, 61.4% of patients had moderate injuries, whereas severe trauma was more frequent in the VA injury group. Most patients exhibited physiological instability, with high prevalence rates of a low GCS score (85.2%), oxygen saturation < 90% (96.6%), and systolic blood pressure < 90 mmHg (93.2%). Complete recovery was observed in only 20.5% of patients, and mortality was approximately 31%.

Conclusions: Motorcycle and bicycle accidents were the most common mechanisms of BCVI in this setting. Most patients presented with marked physiological instability on admission, and VA injury was associated with greater trauma severity. These findings underscore the importance of early recognition and prompt clinical assessment in patients with blunt cervical trauma.

Keywords: Cervical Vascular Injury, Head Trauma, Vascular Trauma

1. Background

Sudden incidents and disasters can pose serious threats to human life and cause substantial harm. A major category of such events is traumatic injury, which affects a large proportion of patients presenting to emergency departments. A considerable number of trauma cases result from occupational injuries or traffic accidents (1).

Trauma is one of the leading causes of mortality and disability in both developed and developing countries. Many trauma-related deaths occur because of complications that could be prevented with timely and appropriate intervention. Currently, trauma is a major public health challenge threatening community health.

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The term trauma is used to describe a range of pathological and psychological conditions and refers to any penetrating or blunt injury caused by external factors, including traffic accidents, falls, drowning, and similar events (2, 3).

Head and neck trauma, along with associated injuries, accounts for a high proportion of mortality and neurological deficits. Facial trauma may be accompanied by intracranial, thoracic, abdominal, or limb injuries. Given their high mortality and complication rates, these injuries are of considerable importance and have profound psychological, social, and financial effects on patients and their families. Cervical trauma, if not accurately diagnosed and treated, can result in irreversible spinal cord damage, ultimately causing severe complications such as spinal cord injury, limb paralysis, long-term disability, and prolonged social and psychological burdens (4-6).

BCVI represents one of the most critical forms of cervical vascular trauma. It is associated with serious complications, including disability, stroke, and mortality. As a form of nonpenetrating vascular injury secondary to neck trauma, identifying the profiles of concomitant injuries related to BCVI is essential (7, 8).

The major causes of facial fractures are motor vehicle accidents and interpersonal violence. Traffic accidents are recognized as a leading cause of disability and mortality. In Iran, traffic accidents are the most common cause of injury and the second leading cause of death. Globally, traffic incidents are a major public health concern in both developing and developed countries (9-11).

Trauma can lead to numerous complications. One trauma-related complication is acute respiratory distress syndrome, which results from inflammatory injury to the lungs, impaired gas exchange, hypoxia, and abnormal pulmonary physiology (12, 13).

2. Objectives

This study aimed to assess the clinical and epidemiological characteristics, trauma mechanisms, and clinical outcomes of BCVI in patients admitted to hospitals in Ilam, Iran.

3. Methods

3.1. Study Design and Participants

In this retrospective descriptive study, patients diagnosed with traumatic vascular injury who were admitted to hospitals were included. The inclusion criteria were age 18 - 65 years, admission to hospitals in Ilam Province, confirmed traumatic cervical vascular injury (vertebral artery, common/internal carotid artery, or other cervical vessels) based on the diagnosis by a vascular surgery specialist, and hospitalization between 2019 and 2020.

The exclusion criteria were incomplete patient information according to the researcher-designed checklist, duplicate records, and nontraumatic vascular lesions. Based on these inclusion and exclusion criteria, a total of 88 patients were included in the final data analysis.

3.2. Data Collection and Variables

Data were collected using a checklist that included items related to patients' demographic and clinical characteristics and laboratory results. The checklist included the following variables: level of education; occupation; marital status (married or single); sedative consumption; O_2 saturation; respiratory rate; GCS score (< 8, 9 - 12, or 13 - 15); surgery (yes or no); position at the time of the accident (pedestrian, motorcyclist, or car driver); systolic blood pressure (< 90 or > 90 mmHg); Injury Severity Score (ISS) (mild, moderate, or severe); clinical outcome (complete improvement, partial recovery, death, or transfer to a higher-level facility); and trauma mechanism (motorcycle/bicycle accident, car accident, fall from height, simple fall, or other).

In this study, vascular injury was defined as any traumatic lesion involving the VA, CCA/ICA, or other cervical vascular structures.

3.3. Ethical Considerations

The data presented in this study were derived from a medical doctorate thesis. All ethical principles approved by the Research Council of the Faculty of Medicine and the University Research Ethics Committee (IR.MEDILAM.REC.1399.241) were strictly observed. Throughout all stages of the study, patient confidentiality was prioritized, including nondisclosure of information contained in medical records and reporting patient data only in aggregate form.

3.4. Statistical Analysis

Table 1. Demographic and Baseline Clinical Characteristics of Patients with Blunt Cervical Vascular Injury [a]

Variables and Categories	Vertebral Artery (n = 34)	Common/Internal Carotid Artery (n = 46)	Others (n = 8)	Overall (n = 88)
Marital status				
Married	15 (44.1)	18 (39.1)	5 (62.5)	38 (43.2)
Single	19 (55.9)	28 (60.9)	3 (37.5)	50 (56.8)
Education level				
Primary or less	9 (26.5)	13 (28.3)	0 (0)	22 (25)
Secondary	24 (70.6)	27 (58.7)	8 (100)	59 (67)
Academic	1 (2.9)	6 (13)	0 (0)	7 (8)
Occupation				
Employed	18 (52.9)	13 (28.3)	1 (12.5)	32 (36.4)
Unemployed	16 (47.1)	33 (71.7)	7 (87.5)	56 (63.6)
Sedative consumption				
Yes	30 (88.2)	45 (97.8)	7 (87.5)	82 (93.2)
No	4 (11.8)	1 (2.2)	1 (12.5)	6 (6.8)
GCS score				
< 8	28 (82.4)	39 (84.8)	8 (100)	75 (85.2)
9 - 12	6 (17.6)	7 (15.2)	0 (0)	13 (14.8)
13 - 15	0 (0)	0 (0)	0 (0)	0 (0)
O_2 saturation (%)				
< 90	32 (94.1)	45 (97.8)	8 (100)	85 (96.6)
≥ 90	2 (5.9)	1 (2.2)	0 (0)	3 (3.4)
Systolic blood pressure (mmHg)				
< 90	30 (88.2)	44 (95.7)	8 (100)	82 (93.2)
≥ 90	4 (11.8)	2 (4.3)	0 (0)	6 (6.8)

[a] Values are expressed as No. (%).

Data analysis was performed using SPSS software version 20. Descriptive statistical methods, including the mean, standard deviation, and frequency distribution, were used for the analysis.

4. Results

Most patients were single (56.8%), and most had a secondary level of education (67%). A total of 63.6% of the patients were unemployed. Most patients also exhibited physiological instability, with high prevalence rates of a low GCS score (85.2%), oxygen saturation < 90% (96.6%), and systolic blood pressure < 90 mmHg (93.2%). Of the 88 patients evaluated, 34 were hospitalized due to a VA injury, 46 due to a CCA/ICA injury, and 8 due to injuries to other vessels (Table 1).

The most common trauma mechanism was motorcycle/bicycle accidents, accounting for 53.4% of all cases. Falls from height and car accidents were the next most frequent mechanisms. Regarding injury severity, 61.4% of patients had moderate injuries; however, the proportion of severe cases was higher in the VA injury group (Table 2).

The overall rate of complete recovery was low, with only 20.5% of patients achieving full improvement, whereas the mortality rate was high, with approximately 31% of patients succumbing to their injuries, underscoring the severity of the condition (Table 3).

5. Discussion

Vascular injuries can lead to irreversible complications, including limb amputation and death (14, 15). Given the importance of evaluating trauma patients, particularly those with vascular trauma, this study aimed to determine the mechanisms and patterns of BCVI.

Among the 88 evaluated patients, 34 were hospitalized due to VA injury, 46 due to CCA/ICA injury, and 8 due to injuries involving other vessels. In the meta-analysis by Karimian et al. in Iran, which reviewed 16 published articles including 1500 patients, the pooled

Table 2. Trauma Mechanisms and Injury Severity Score in Patients with Blunt Cervical Vascular Injury [a]

Variables and Categories	Vertebral Artery (n = 34)	Common/Internal Carotid Artery (n = 46)	Others (n = 8)	Overall (n = 88)
Trauma mechanism				
Motorcycle/Bicycle accident	20 (58.8)	26 (56.5)	1 (12.5)	47 (53.4)
Car accident	5 (14.7)	8 (17.4)	1 (12.5)	14 (15.9)
Fall from height	8 (23.5)	8 (17.4)	3 (37.5)	19 (21.6)
Simple fall	1 (2.9)	3 (6.5)	2 (25)	6 (6.8)
Other	0 (0)	1 (2.2)	1 (12.5)	2 (2.3)
Injury Severity Score (ISS)				
Mild	2 (5.9)	7 (15.2)	1 (12.5)	10 (11.4)
Moderate	18 (52.9)	30 (65.2)	6 (75)	54 (61.4)
Severe	14 (41.2)	9 (19.6)	1 (12.5)	24 (27.3)

[a] Values are expressed as No. (%).

prevalence of lower-limb vascular injury was 54.8% (95% CI, 41.1 - 73.8), and the prevalence of upper-limb vascular trauma was 31.5% (95% CI, 17.7 - 49.7). Additionally, the reported rates were 22% for fasciotomy, 12.3% for mortality, and 8.8% for amputation (16). In the study by Shibata et al., among 454 evaluated patients, 105 were hospitalized due to CCA/ICA injury, 262 due to VA injury, and 87 due to other causes (17).

The trauma mechanisms indicated that 53.4% of patients were injured in motorcycle/bicycle accidents, 15.9% in car accidents, 21.6% in falls from height, and 6.8% in simple falls. In the study by Sarafi et al. on penetrating abdominal trauma, 13.8% of injuries were due to traffic accidents, 43.1% to stab wounds, 24.1% to firearm injuries, and 19% to other causes. Regarding injured body regions, 6.9% of patients had chest injuries, 13.8% had pelvic or spine injuries, 15.5% had head, neck, and face injuries, and 10.3% had extremity injuries (18). In the study by Yadollahi et al., involving 193,306 trauma patients, traumatic accidents accounted for 46.7% of cases, penetrating trauma for 4.5%, falls for 27.1%, and assault-related injuries for 13.2% (19).

In our study, the overall mortality rate was 30.7%. In the study by Shibata et al., the overall mortality rate was 24%; however, when stratified by injury type, mortality was 45% in patients with CCA/ICA injury, 16% in patients with VA injury, and 26% in the other groups (17). In the study by Barbati et al., mortality within the first 24 hours was 18.2% in patients with isolated arterial injury, 21.7% in patients with isolated venous injury, and 32.7% in patients with combined arterial and venous injuries. Hospital mortality was 28% for isolated arterial injury and 33.2% for isolated venous injury (20).

5.1. Limitations

This study is limited by its retrospective design, single-center setting, and reliance on medical records. In addition, the lack of standardized imaging and multivariable analysis limits the generalizability of our results.

5.2. Conclusions

Motorcycle and bicycle accidents were the most common mechanisms of BCVI in this setting. Most patients presented with marked physiological instability on admission, and VA injury was associated with greater trauma severity. These findings underscore the importance of early recognition and prompt clinical assessment in patients with blunt cervical trauma.

Footnotes

AI Use Disclosure: The authors declare that no generative AI tools were used in the creation of this article.

Authors' Contribution: M. K., M. B., F. R., and S. E. conceived and designed the study, performed the study, collected the data, discussed the results, and supervised, directed, and managed the study. All authors reviewed and approved the final manuscript and agreed to be accountable for all aspects of the work.

Conflict of Interests Statement: The authors declare no conflict of interest.

Table 3. Clinical Outcomes of Patients with Blunt Cervical Vascular Injury [a]

Variables and Categories	Vertebral Artery (n = 34)	Common/Internal Carotid Artery (n = 46)	Others (n = 8)	Overall (n = 88)
Clinical outcome				
Complete improvement	5 (14.7)	10 (21.7)	3 (37.5)	18 (20.5)
Partial recovery	7 (20.6)	21 (45.7)	3 (37.5)	31 (35.2)
Death	11 (32.4)	14 (30.4)	2 (25)	27 (30.7)
Transferred to higher-level facility	11 (32.4)	1 (2.2)	0 (0)	12 (13.6)

[a] Values are expressed as No. (%).

Data Availability: The dataset presented in the study is available on request from the corresponding author during submission or after publication.

Ethical Approval: Ethical approval for this study was obtained only after clearance and approval from the Ethics Committee of Ilam University of Medical Sciences (IR.MEDILAM.REC.1399.241).

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