NOTES ON CASE HISTORY

Blunt Vascular Injuries in Patients with Cervical Spine Fractures: a Cohortclinical Study from Iran

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Study Area: Mashhad, Iran

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Introduction:

Recent reviews have shown that almost 2.4% of patients with blunt cervical traumas suffer from fractures in the cervical vertebrae (Weber *et al.*, 2018). The frequency of blunt traumas to cervical arteries varies in traumatic patients. The lack of alarming symptoms at the exhibition hinders proper diagnosis (Aizpuru *et al.*, 2018). Computed tomography angiography (CTA) is accepted as the method of choice in many emergency departments for evaluating vascular injuries (VIs) in traumatic patients. Till date, a total of 98% concordance has been reported between digital Subtraction Angiography (DSA) and 16-slice CTA scanning (Tso *et al.*, 2017). In addition to arterial involvement, CTA is an effective method for evaluation of the accompanying pathologies in the surrounding tissues (Laser *et al.*, 2015). Blunt VIs have diverse clinical symptoms with poor presentations at admission. Reliable diagnostic technique is necessary for early detection and effective management of these traumas. This study aims to determine the frequency and clinical characteristics of carotid and vertebral artery injuries diagnosed by CTA in patients with cervical spine fractures secondary to blunt traumas.

Case study:

This cross-sectional clinical trial was conducted on adult patients with cervical spine fractures due to blunt traumas (n=106) admitted in Traumatic Emergency Center, Shahid Kamyab Hospital, Mashhad, Iran during May 2014 to April 2016. The main inclusion criterion was the definitive diagnosis of cervical trauma secondary to cervical spine fracture based on the findings from Computed tomography (CT) imaging accompanied by Magnetic Resonance Imaging (MRI). The exclusion criteria were pregnancy, a history of cervical tumors, cervical operations, radiotherapy, or penetrating cervical trauma.

CTA was conducted in patients with evidence of cervical spine fractures, using a standard device (Somatom Sensation 16 Protocol; Siemens, Germany). Bone injuries of

the cervical spine and carotid and vertebral injuries were documented based on the imaging findings. Repeated CTA was performed in all patients with VIs after 7-10 days to evaluate any lesion progression. All the patients were followed-up (mean follow-up: 7.4 mon.; range, 6-12 mon.).

Although DSA is recognized as the gold standard for the diagnosis of VIs, we only used CTA in our study since its sensitivity and specificity are close to DSA for diagnosis of injuries and follow-up of patients. Quantitative data are reported as mean±standard deviation (SD) (range), and qualitative data are presented as frequency.

The characteristics of patients with VIs are summarized in Table 1. The mean initial Glasgow Coma Scale (GCS) score was 13.12±2.89 (range of 7-15). Neurological deficits (33%), Quadripareisis (15.1%), Quadriplegia (9.4%), Hemiparesis (5.7%) and Hemiplegia (2.8%) were reported in patients. Different types of cervical spine injuries were posterior element fracture (41.5%), subaxial subluxation (20.7%), subaxial burst fracture (18%), odontoid fracture (Type-2: 6.6%), Atlanto-axial subluxation (3.9%), subaxial tear-drop fracture (2.8%), Jefferson's fracture (2.8%), Hangman's fracture (2.8%), odontoid fracture (Type-3: 0.9%).

Cervical arterial injury was detected in 6.6% patients, of them 1.9% showed carotid artery involvement and 4.7% with vertebral artery involvement. The carotid artery injury involved occlusion in one patient and dissection in the others (Fig.-1a,b,c). Moreover, vertebral artery injuries included occlusion in three patients (Fig.-2a,b,c) and

Figure-1: Burst fracture of fourth cervical vertebrae in a 33-year-old male (a) with dissection of the left internal carotid artery in axial (b) and coronal (c) computed tomography angiography

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Table 1.Characteristics of the patients with Vis (MVA- Motor Vehicle Accident; *Complication)

Arterial Injury	Sex	Age (y)	GCS	Cause	Neurological Report	Spinal Injury	Complication
Dissection (Carotid)	Male	33	15	MVA	Quadriplegia	C4, burst fracture	-
Occlusion (Carotid)	Male	54	11	Fall	Hemiplegia	C5-6, Subluxation	Ischemia
Dissection (Vertebral)	Male	24	7	MVA	Quadriplegia	C3-4, Subluxation	-
Dissection (Vertebral)	Female	32	9	MVA	None	C2-C3, posterior element fracture	Ischemia
Occlusion (Vertebral)	Male	18	15	MVA	Quadripareisis	C4 posterior element fracture	-
Occlusion (Vertebral)	Male	21	7	MVA	None	C6 posterior element fracture	-
Occlusion (Vertebral)	Male	41	15	MVA	None	Jefferson's fracture	-

Figure-2: Jefferson's fracture in a 41-year-old male (a) with a resultant occlusion in the vertebral artery in the sagittal plane (b) 3D reformatted computed tomography angiography (c).

dissection in two cases. All the patients of VIs were treated with aspirin, with no complications during follow-up.

Discussion:

Incidence of arterial injuries in patients with cervical spine trauma ranges from 0.1% to 28.9% in different studies (Alterman *et al.*, 2013). It has been shown that vertebral subluxations fractures of the upper cervical vertebrae and fractures of posterior elements with concomitant involvement of the foramen transversarium occur in over 90% of patients with cervical artery injuries (Nagasawa *et al.*, 2017; Burks *et al.*, 2018). The most common vertebral involvement in the present study was the fracture of posterior elements with the involvement of the foramen transversium, followed by subluxation and burst fractures. Differences in the incidence rate of arterial injuries could be attributed to the different methodologies and inclusion criteria with other studies. The incidence rate of carotid and vertebral injuries in patients with cervical spine traumas increases when concomitant cervical spine fractures are present (Alterman *et al.*, 2013; Shahan *et al.*, 2016). Although DSA is the gold standard for detecting injuries of cervical arteries, in practice, it cannot be applied in most traumatic cases due to its invasiveness (Aizpuru *et al.*, 2018). Therefore, this modality has been replaced by other less invasive techniques, such as magnetic resonance angiography, duplex ultrasound, and CTA in most trauma centers. Although mild VIs are occasionally missed by CTA, most cases resolve spontaneously (Tso *et al.*, 2017). The mortality rate was reported 0-18% in symptomatic patients (Mitha *et al.*, 2013), while our finding showed 1.9% of patients had brain ischemia and 0% mortality. Our finding showed the most common types of Arterial injuries were occlusion type (4 cases) and dissection types (3 cases)

supporting the finding of Aizpuru *et al.* (2018).

Conclusively, the rate of cervical artery injuries in patients with cervical spine fractures was 6.6% in our series, which is higher than most of the previous reports. The higher incidence of these injuries in our study could be related to the selection of patients with cervical spine fractures. However, according to the findings, diagnostic investigation of VIs with CTA is necessary in patients with cervical spine fractures.

References:

- Aizpuru, M., Poirier, M.V., Benarroch-Campel, J. (2018): Vertebral artery injury: an update on screening, diagnosis and treatment. *Current Surg. Rep.*, 6:22.
- Alterman, D.M., Heidel, R.E., Daley, B.J., Grandas, O.H., Stevens, S.L., Goldman, M.H. & Freeman, M.B. (2013): Contemporary outcomes of vertebral artery injury. *J. Vasc. Surg.*, 57(3):741-746.
- Burks, J.D., Conner, A.K., Briggs, R.G., Bonney, P.A., Smitherman, A.D., Baker, C.M., Glenn, C.A., Ghafil, C.A., Pryor, D.P., O'Connor, K.P. & Bohnstedt, B.N. (2018): Blunt vertebral artery injury in occipital condyle fractures. *J. Neurosurg. Spine*, 29(5):500-505.
- Laser, A., Kufera, J.A., Bruns, B.R., Sliker, C.W., Tesoriero, R.B., Scalea, T.M. & Stein, D.M. (2015): Initial screening test for blunt cerebrovascular injury: validity assessment of whole-body computed tomography. *Surgery*, 158(3):627-635.
- Mitha, A.P., Kalb, S., Ribas-Nijkerk, J.C., Solano, J., McDougall, C.G., Albuquerque, F.C., Spetzler, R.F. & Theodore, N. (2013): Clinical outcome after vertebral artery injury following blunt cervical spine trauma. *World Neurosurg.*, 80(3-4):399-404.
- Nagasawa, D.T., Bui, T.T., Lagman, C., Lee, S.J., Chung, L.K., Niu, T., Tucker, A., Gaonkar, B., Yang, I. & Macyszyn, L. (2017): Isolated transverse process fractures: a systematic analysis. *World Neurosurg.*, 100:336-341.
- Shahan, C.P., Magnotti, L.J., Stickley, S.M., Weinberg, J.A., Hendrick, L.E., Uhlmann, R.A., Schroepel, T.J., Hoit, D.A., Croce, M.A. & Fabian, T.C. (2016): A safe and effective management strategy for blunt cerebrovascular injury: avoiding unnecessary anticoagulation and eliminating stroke. *J. Trauma Acute Care Surg.*, 80(6):915-922.
- Tso, M.K., Lee, M.M., Ball, C.G., Morrish, W.F., Mitha, A.P., Kirkpatrick, A.W. & Wong, J.H. (2017): Clinical utility of a screening protocol for blunt cerebrovascular injury using computed tomography angiography. *J. Neurosurg.*, 126(4):1033-1041.
- Weber, C.D., Lefering, R., Kobbe, P., Horst, K., Pishnamaz, M., Sellei, R.M., Hildebrand, F., Pape, H.C., TraumaRegister DGU. (2018): Blunt cerebrovascular artery injury and stroke in severely injured patients: an international multicenter analysis. *World J. Surg.*, 42(7):2043-2053.