

Clinical Study

Sizes of the transverse foramina correlate with blood flow and dominance of vertebral arteries

Kadir Kotil, MD^a, Cumhuri Kilincer, MD, PhD^{b,*}

^aAkademik Hospital, T.C. Istanbul Arel University, Nuh Kuyusu Cad. No: 94 Baglarbasi 34664 Uskudar, Istanbul, Turkey

^bNeurosurgery Department, Trakya University Faculty of Medicine, 22030 Edirne, Turkey

Received 2 March 2013; revised 2 June 2013; accepted 14 July 2013

Abstract

BACKGROUND CONTEXT: Knowing the side of the dominant vertebral artery (VA) may be of utmost importance if the VAs are at risk during spine surgery. Determination of the size of VAs is obtained by using Doppler ultrasonography or angiography. Because VA is the main anatomic structure occupying the transverse foramina (TF), it may be assumed that size of TF and blood flow of VAs should be proportional.

PURPOSE: To investigate if there is a correlation between the sizes of TF and the flow of VAs and determine the diagnostic accuracy of measuring TF to predict dominant side of VA. The specific hypothesis was that the larger side of TF corresponds to the side of the dominant VA.

STUDY DESIGN: This is a morphologically based, prospectively designed, single-center study. Thirty patients (14 male, 16 female) who were treated for degenerative spinal pathologies were included. Patients with cervical fractures, occluded VA, prominent degenerative changes affecting TF, deformity, or previous cervical instrumentation were excluded from the study.

OUTCOME MEASURES: In all patients, computed tomography of the cervical spine and Doppler ultrasonography of VAs were obtained for morphometric analysis.

METHODS: Axial computed tomography cuts at the C6 vertebral level were taken. Two measurements were performed for each foramen: its right to left width and its anteroposterior depth. Blood flow volumes of bilateral VAs were measured using color Doppler.

RESULTS: Diameters of TF ranged between 2.2 and 7 mm, and its width was generally slightly larger than the depth. Transverse foramina were always asymmetric, with no right or left side preference. There was a strong correlation between TF diameters and blood flow of VAs. Between TF width and VA blood flow, the Pearson correlation coefficient was 0.59 ($p=.001$) for right side and 0.72 for left side ($p<.0001$). The side of the larger TF matched with the side of dominant VA in 28 of 30 cases (93.3%) ($p<.0001$). The agreement between the dominant VA and the larger side of TF was almost perfect (Kappa=0.087, $p<.0001$).

CONCLUSIONS: There was strong correlation between TF diameters and VA blood volume. Our results suggest that TF diameter of C6 level can be used to predict the side of the dominant VA reliably. © 2014 Elsevier Inc. All rights reserved.

Keywords:

Cervical vertebrae; Color Doppler ultrasonography; Diagnostic imaging; Sensitivity and specificity; Vertebral artery

Introduction

The diameters of the vertebral arteries (VAs) are often unequal, and the left VA is frequently larger than the right VA [1]. Recent studies have suggested that inequality of VA blood flows may have certain hemodynamic effects on the vertebrobasilar system [2]. Moreover, knowing the side of the dominant VA may be of utmost importance if VA is at risk during spine surgery.

FDA device/drug status: Not applicable.

Author disclosures: **KK:** Nothing to disclose. **CK:** Trips/Travel: Tasarimmed (B); Fellowship Support: AOCID (B).

The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

* Corresponding author. Department of Neurosurgery, Trakya University Faculty of Medicine, 22030 Edirne, Turkey. Tel.: (90) 284-2355798.

E-mail address: ckilincer@yahoo.com (C. Kilincer)

Determination of the size of VAs is obtained by using Doppler ultrasonography (USG) or some sort of angiography techniques such as digital subtraction, computed tomography (CT), or magnetic resonance angiography. If a clinician wishes to identify the dominant (ie, larger) side of VA, utilization of one of these techniques is necessary.

The transverse foramina (TF) of cervical vertebrae are known to transmit VAs, vertebral veins, and sympathetic nerves. Because VAs are the factors in the formation of TF, and they are the major anatomical structure occupying them, it can be assumed that variations in the presence, size, and course of VAs will affect morphology of TF considerably. In return, morphology of TF can be useful in estimating the morphology of the vessels. A strong correlation between the sizes of TF and VAs could enable the surgeon to predict the calibers of VAs just evaluating TF on CT, without performing additional imaging techniques.

The aim of the current study was to investigate if there is a correlation between the sizes of TF and VAs and determine the diagnostic accuracy of measuring TF to predict dominant side of VA. The specific hypothesis was that the larger side of TF corresponds to the side of the dominant VA.

Methods

This is a morphologically based, prospectively designed, single-center study. Thirty patients (14 male, 16 female) who were treated for degenerative spinal pathologies between January 2009 and January 2011 were included in the study. Ages varied between 23 and 55 years (mean, 39 years). Patients with cervical fractures, occluded VA, prominent degenerative changes affecting foramina, deformity, or previous cervical instrumentation were excluded from the study. Informed consent regarding the interventions and the study was obtained from all the patients.

In all patients, CT of the cervical spine and Doppler USG of VAs were obtained as a part of routine investigation of the patient's spinal condition (neck/arm pain or

a previously documented degenerative cervical spine disorder) and preoperative planning. Axial CT cuts were taken using Toshiba Aquilion 64 (Toshiba Medical Systems, Tokyo, Japan) with a slice thickness of 0.5 mm. Two measurements were obtained for each TF by the primary author using screen images (Fusion PACS; Merge eMed, Milwaukee, WI, USA): its width (maximum right-left diameter) and its depth (maximum anteroposterior diameter). C6 level was measured in all patients for consistency.

Blood flow volume of bilateral VAs were measured using color Doppler by an experienced radiologist with either a Logiq 7 or Logiq 9 system (GE Healthcare, Milwaukee, WI, USA). Because Doppler USG is accepted as the reference standard, side of the higher VA blood flow was accepted as the dominant side. Measurements of TF sizes and blood flow of VAs were performed and recorded separately at different times, and the investigators were blinded to each other's results.

The Figure demonstrates how the measurements were done in an illustrative case.

The Pearson correlation test was used for the evaluation of correlation between TF diameters and blood flow of VAs. The agreement between the side of larger TF and dominant VA was evaluated with kappa statistics. Analyses were performed with an SPSS ver.13 statistical software package (SPSS Inc., Chicago, IL, USA). A p value of $\leq .05$ was considered significant.

Results

All measurements of TF diameters and VA blood flow volumes are presented in Table 1. Their means, standard deviations, and range values are presented in Table 2. As depicted in Table 2, mean values of TF sizes (width and depth) and blood volumes of VAs showed no difference between right and left sides. The dominant VA side was the left side in 16 cases and right side in 14 cases.

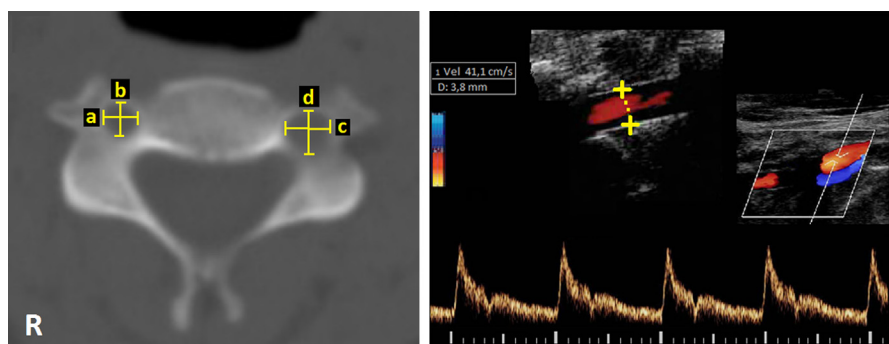


Figure. Transverse foramen diameters and blood flow volume measurements of vertebral artery in an illustrative case (Patient 12). (Left) Axial computed tomography cut taken from C6 level shows that the width of the right TF (a) is 4.9 mm; depth of the right TF (b) is 4.3 mm; width of the left TF (c) is 6.1 mm; depth of the left TF (d) is 6.1 mm. (Right) Color Doppler imaging shows measurement of blood flow volume. To do this, the luminal diameter of the artery (mm) was measured on a B-mode image. Then, blood flow (mL per minute) was calculated automatically by the machine by multiplying this diameter by the time-averaged velocity. It is 98 mL/min on the right side and 156 mL/min on the left side.

Download English Version:

<https://daneshyari.com/en/article/4097768>

Download Persian Version:

<https://daneshyari.com/article/4097768>

[Daneshyari.com](https://daneshyari.com)