Journal of Medical Sciences

ISSN 1682-4474

science alert

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Research Paper

J. Med. Sci., 12 (8): 292-297
15th November, 2012
DOI: 10.3923/jms.2012.292.297

Color Doppler Sonography in Healthy Old Persons, Vertebral Arteries

[1]Abolhassan Shakeri, [2]Masoud Nemati,
[3]Moslem Shakeri and [4]Mohamad Goldust

Recently, color Doppler sonography is widely used in evaluating diseases obstructing brain arteries. This study aimed at providing normal rates of hemodynamic parameters in vertebral arteries of older patients using color Doppler sonography. This prospective study conducted on 31 healthy old people ranges from 60 to 96 years. Angle corrected flow velocities and luminal diameters were measured and waveform parameters calculated in all vertebral arteries. It was possible to visualize V2 Segment in 100% and origin of right VA in 72% and origin of left VA in 59% of them. Mean diameter of right VA was 32.4± 0.56 mm while it was 3.52± 0.67 mm for the left VA. The resistance index in right VA was 0.71±0.08 and it was 0.69±0.06 in the left VA. There was no significant differences between the two sides. Peak systolic velocity was 35.77±12.71 cm sec^{-1} on the right and 36.29±12.71 cm sec^{-1} on the left. Accordingly, no differences were observed between the two sides. This study and its presented reference values can lead to better differentiation between normal and pathologic findings in vertebral arteries among old people. Nevertheless, further studies are needed to determine the normal and pathologic values of vertebral arteries.

Key words: Color doppler ultrasonography, vertebral arteries, old persons

JMS (ISSN 1682-4474) is an International, peer-reviewed scientific journal that publishes original article in experimental & clinical medicine and related disciplines such as molecular biology, biochemistry, genetics, biophysics, bio-and medical technology. JMS is issued eight times per year on paper and in electronic format.

For further information about this article or if you need reprints, please contact:

Mohamad Goldust
Student Research Committee
Tuberculosis and Lung Disease
Research Center Tabriz
University of Medical Sciences

Tel: 00984113368805

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[1,2]Tabriz University of Medical Sciences, Tabriz, Iran
[3]Department of Neurosurgery, Tabriz university of Medical Sciences, Tabriz, Iran
[4]Student Research Committee, Tuberculosis and Lung Disease Research Center, Tabriz University of Medical Sciences

INTRODUCTION

At present, color Doppler sonography is widely used in evaluating diseases obstructing brain feeding arteries such that it is used to screen and evaluate carotid arteries before surgery and has completely replaced carotid angiography in some centers (Goldust *et al*., 2011a,b; Goldust and Rezaee 2013; Hong *et al*., 2011; Lotti *et al*., 2013). Although, vertebral arteries play a significant role in cerebral blood supplying and supply about 30% of brain blood, color Doppler sonography is not widely used in these arteries (Goldust *et al*., 2013a; Mohebbipour *et al*., 2012; Salehi *et al*., 2011; Vaiman *et al*., 2011). This ignorance may result from presenting modern color Doppler sets with more advanced technology have recently provided conditions to appropriately study the vertebral arteries (Fardiazar *et al*., 2013a; Goldust *et al*., 2013b, c; Sato and Sadamoto, 2010). About 25% of cerebral ischemic incidences root in vertebrobasiler system (Goldust *et al*., 2013d, e; Mitrasinovic *et al*., 2010; Vafaee *et al*., 2012). The researches have demonstrated that patients with posterior circulation ischemic incidences have high risk of next attack as well as mortality at acute stage than those with interior circulation incidences (Chen *et al*., 2010; Goldust *et al*., 2012; Sadighi *et al*., 2011). Few studies have already been conducted about vertebral arteries in comparison with carotid arteries which can be attributed to difficulty of surgical techniques in vertebral arteries leading to applying maintaining treatment methods in most centers (Golfurushan *et al*., 2011; Hua *et al*., 2009; Milan *et al*., 2011). Recently, some studies have been conducted on surgical techniques and even percutaneous angioplasty considering vertebral arteries stenosis (Goldust *et al*., 2011a,b; Sadeghpour *et al*., 2011; Wakugawa *et al*., 2009). Therefore, it is necessary to further study normal and pathologic findings of vertebral arteries (Goldust *et al*., 2013f; Qadim and Goldust, 2012; Shakeri and Goldust, 2013). Recently, color Doppler sonography of vertebral arteries has been studied and different parameters have been described in normal arteries (Azimi *et al*., 2013; Nejad *et al*., 2013; Golforoushan *et al*., 2013). But, most studies have been conducted on youths or elders and there is no exact statistics from older than 60 years patients (Nemati *et al*., 2009; Razi *et al*., 2013; Yousefi *et al*., 2013). Considering that brain vascular lesions and the resulted complications often occur in olds, symptomatic atherosclerosis is substantially seen after middle age as well as paying attention to significant changes in brain parenchyma, its general resistance and septum of blood-supplying vessels, it is important to obtain information about normal findings of cerebral vessels in healthy subjects because it can be used as a reference in finding the above-mentioned vascular diseases (Bozgeyik *et al*., 2008; Thomas *et al*., 2009). The aim of this study was to provide normal rates of hemodynamic parameters in vertebral arteries of olds using color Doppler sonography.

MATERIALS AND METHODS

Subjects: In this study, 31 old patients of above 60 years patients underwent duplex sonography of vertebral as well as carotid arteries. The subjects had no clear signs of cerebral arteries disease and insufficiency symptoms of vertebrobasilar. The study was conducted for one year (from May, 2011 to May, 2012) in the radiology ward of Tabriz Imam Reza hospital and sonography center of specialized clinic II of Tabriz University of Medical Sciences. Written consent was obtained from all the patients. This study was approved by ethic committee of Tabriz university of medical sciences.

Methods: Color Doppler sonographies were conducted in a comfortable room with an appropriate temperature and at prostrate position. Joint and interior carotid arteries as well as vertebral arteries of both sides were evaluated by 7.5 MHZ linear probe and using Hitachi set EUB-525. Doppler angle was set less than 60° in all cases. The measured parameters included Passive Systole Velocity (PSV), vascular Resistance Index (RI) and diameter measured and registered at second part of vertebral artery (V_2) and C4-C5 segment. Also, it was tried to evaluate artery origin place as far as possible and measure and register its passive systolic velocity.

Statistical analysis: The obtained data was analyzed using SPSS-16 software. To account for statistical differences in two groups, a chi-square test or Fisher's exact test was used, as appropriate. A p-value of <0.05 was considered significant.

RESULTS

The present study evaluated 62 vertebral arteries of 31 patients. Age range of the subjects varied from 60 to 96 years and their mean age was 69.45±9.69 years. The subjects were consisted of 22 males and 9 females. Age mean of men was 68 ±8.11 and that of the females was 73±12.32 years. The above-mentioned parameters of the second part of vertebral artery have been separately compared in females and males. Vertebral artery diameter was respectively 3.41 and 3.31 mm in males and females and there was no meaningful difference between them.

Table 1: Mean values of study parameters

Variable	Male	Female	p-value
N	22 (70.9%)	9 (29.1%)	
Age (year)	68±8.11	73±12.3	20.54
Vertebral artery diameter (mm)	3.41	3.31	0.32
PSV (cm sec^{-}1)	33.15	43.05	0.008
RI	0.70	0.70	0.86

PSV: Peak systolic velocity, RI: vascular resistance index

Table 2: Different parameter of right and left vertebral artery

Variable	Right	Left	p-value
Diameter (mm)	3.24±0.56	3.52±0.67	0.078
PSV (cm sec^{-1})	35.77±12.71	36.29±12.71	0.24
RI	0.71±0.08	0.69±0.06	0.92

PSV: Peak systolic velocity, RI: vascular resistance index

PSV was 33.15 cm sec^{-1} in males and 43.05 cm sec^{-1} in females. The velocity was higher in females and statistically meaningful ($p<0.01$). RI was the same in males and females and equaled 0.70 (Table 1). Second part of the vertebral artery was completely visible in all understudy subjects. Mean diameter of the right vertebral artery was 3.24±0.56 and the left one was 3.52±0.67 mm. The difference between the left and right artery was not statistically meaningful ($p = 0.078$). PSV of the right and left sides was 35.77±12.71 and 36.29±12.71 cm sec^{-1}, respectively. The difference was not statistically meaningful. Additionally, RI of the right vertebral was 0.71±0.08 and of the left one was 0.69±0.06 and the difference was not again meaningful ($p = 0.092$) (Table 2).

DISCUSSION

In a previous study conducted on second part of vertebral artery of 50 patients with mean age of 55.8 years, diameter of the right vertebral artery was measured as 3.44 and that of the left side as 3.71 mm (Seidel and Kaps, 1997) It was almost similar to current study and artery diameter at the left side is a little more than the right side. In that study, PSV of the right and left vertebral artery was, respectively 45.9 and 51.5 cm sec^{-1}. The velocity was a little more than current study. In the above-mentioned study, although PSV which was similar to our study was a little more in the left side, any meaningful difference was not observed between them. In a previous study conducted on 42 patients with mean age of 67 years and without pathological findings in vertebral arteries demonstrated that diameter of right and left vertebral arteries was 3.22 and 3.16 mm, right and left PSV was 46 and 41 cm sec^{-1} and right and left RI was 0.72 and 0.71. Meaningful difference was not observed between two sides considering the above parameters (Hallerstam and Rosfors, 2004). This was in correspondence with current study. In the above-mentioned study, PSV in females was a little more than that of males. The difference was statistically significant and is completely similar to the outcomes resulted from current study. In a previous study, maximum systolic velocity in both sides of artery origin was more than its second part (58 vs. 46 cm sec^{-1}) (Hallerstam and Rosfors, 2004). The difference was statistically meaningful and in correspondence with our study. High velocity observed at vertebral arteries origin likely demonstrates partial narrowness of the arteries at the point separating from subclavian which lead to relative increase of blood circulation velocity there. About 70% of vertebral arteries origin should be observed using advanced color Doppler sonography sets and conducting the sonographies by experts (Wessels *et al*., 2008). In some previous studies, the mentioned statistics is higher than 70% (Nemati *et al*., 2013; Postert *et al*., 1997; Qadim *et al*., 2013; Salehi *et al*., 2013a; Sun *et al*., 2007). Of course, more previous studies have often been conducted on youths and observing their arteries is naturally easier than that of olds having meandered vessels (Daghigh *et al*., 2013; Mysior and Stefanczyk 2007; Pugliese *et al*., 2007; Salehi *et al*., 2013b; Soleimanpour *et al*., 2013). Therefore, we could observe about 60-70% of arteries origin in current study which is about similar to other studies conducted on olds. All studies were the same in one point, i.e., observing left vertebral artery origin is more difficult than the right one (Fardiazar *et al*., 2013b; Ganjpour Sales *et al*., 2013; Salehi *et al*., 2013c). There was the same problem in our study and left artery origin was seen in 59% and the left one in 72% of cases. The difference may root from unnatural separation of the left vertebral artery directly from aorta arc making its observation difficult or impossible (Farhoudi *et al*., 2012; Nourizadeh *et al*., 2013; Salehi *et al*., 2013d; Trattnig *et al*., 1993). Finally, the study may be used as a standard criterion for hemodynamic parameters in vertebral arteries of the olds. It corresponds with few studies having already conducted in this regard (Karzar *et al*., 2012; Seyyednejad *et al*., 2012; Shakeri *et al*., 2013; Tian *et al*., 2006).

CONCLUSION

This study and its presented reference values can lead to better differentiation between normal and pathologic findings in vertebral arteries among old people. Nevertheless, further studies are needed to determine the normal and pathologic values of vertebral arteries.

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