

Variations in Diameters of Vertebro-basilar Tree in Patients with or with No Aneurysm

Anel Mehinovic¹, Eldar Isakovic², Jasmin Delic²

Clinical -University Center of Tuzla, Tuzla, Bosnia and Herzegovina¹
Medical Faculty of Tuzla, Tuzla, Bosnia and Herzegovina²

Corresponding author: Anel Mehinovic, MD. University Clinical Center, Tuzla, Tuzla, Bosnia and Herzegovina.

ABSTRACT

Introduction: The morphological anatomy of the posterior circulation is very complex and variable. Aims of this research were to document the morphological anatomy of the posterior circulation along with variations in the Bosnian population, in patients with or without aneurysm. Measurements of the outer diameters of the vertebral artery, basilar artery and posterior cerebral artery were taken. The second aim was to determine the possible relationship between diameters of the area with subsequent aneurysm formation. **Material and Methods:** The study involved 60 consecutive patients, adults of both sexes, treated in the UKC Tuzla. The patients were divided into two groups. One group consisted of the patients without aneurysm of basilar artery, and the other group of patients with aneurysm. All the 60 patients were treated by means of MRI angiography. **Results:** The mean diameter of the vertebral artery was 2,43 mm; 3,61 mm on the right and 2,83 mm; 3,94 mm on the left. The diameter of the basilar artery varied from 3, 8 mm; 3, 43 mm. The diameter of the posterior cerebral arteries 2, 5 mm; 2,52 mm on the right and 2,46 mm; 2,62 mm on the left. **Conclusions:** We have documented the various morphometry variations as well as the differences of the anatomy in this area in Bosnian population as compared to the medicine literature. **Key words:** vertebro-basilar tree, aneurysms.

1. INTRODUCTION

Arteria vertebralis, branch of subclaviae passes through the openings on lateral extensions of cervical vertebrae and enter the sulcus of arteriae vertebralis at the back arch of the atlas (1, 2). It enters the cranial cavity through the foramen magnum occipitale, merges at a sharp angle with the opposite one, usually below postpontine groove (67%), and form basilar artery (3, 4). After a short course (25–35 mm) at the front of the brain bridge, artery is split into its two terminal branches arteriae posteriores cerebri (5, 6). Vertebral artery diameter ranges from 3.4 mm to 2.9 mm, and of the basilar artery from 3 mm to 7 mm (6, 7).

Aims of this research were to document the morphological anatomy of the posterior circulation along with variations in the Bosnian population, in patients with or without aneurysm. Measurements of the outer diameters of the vertebral artery, basilar artery and posterior cerebral artery were taken. The second aim was to determine the possible relationship between diameters of the area with subsequent aneurysm formation.

2. MATERIAL AND METHODS

The study involved 60 consecutive patients, adults of both sexes, treated in the UKC Tuzla. The patients were divided into two groups. One group consisted of the patients without aneurysm of vertebrobasilar tree, and the other group of patients with aneurysm. Diameters of vertebral, basilar and posterior cerebral artery (0.5 cm above

and below the vertebrobasilar junction, as well as 0.5 cm above and below the basilar bifurcation) were determined for all the examined. The statistical analysis of the data collected by means of the basic tests and descriptive statistics (determination of the measured sizes mean value, standard deviation and standard error), and test of correlation between the measured values in order to determine the correlation coefficient with statistical significance of $p < 0.05$ and Student's t-test to determine the significance of differences of arithmetic means of the values measured.

3. RESULTS

A.vertebralis dextra in the subjects without aneurysm in vertebral- basilar tree, at the site of merging of both vertebral arteries into the basilar artery, had the average value of diameter 2,43 mm, and a. vertebralis sinistra of 2.83 mm. In 46% of the examinees diameters of both a.vertebralis sinistra and a.vertebralis dextra were approximately the same. Caudal part of a. basilaris, at the site of vertebral arteries merging had an average diameter of 3.8 mm, and the rostral part at the site of bifurcation had diameter of 3.43 mm. The initial part of a. cerebri posterior dextrae had an average diameter of 2.5 mm, while the initial part of a. cerebri posterior sinistrae had an average diameter of 2.46 mm.

In the group of patients with aneurysm of vertebral basilar tree, the average value of diameter, at the site of both vertebral arteries merging into a. basilaris, a.vertebralis dextra had diameter between 3.61 mm, and a.vertebralis

| | | T-test for Independent Samples (sa i bez aneurizme) Note: Variables were treated as independent samples | | | | | | | | | | |
|---------------------|--|--|-----------------|----------|----|----------|--------------------|--------------------|---------------------|---------------------|----------------------|----------------|
| Group 1 vs. Group 2 | | Mean Group 1 | Mean Group 2 | t-value | df | p | Valid N Group 1 | Valid N Group 2 | Std.Dev. Group 1 | Std.Dev. Group 2 | F-ratio Variances | p Variances |
| SA vd vs. BA vd | | 3,613333 | 2,433333 | 4,893803 | 58 | 0,000008 | 30 | 30 | 1,192139 | 0,568321 | 4,400142 | 0,000148 |

| | | T-test for Independent Samples (sa i bez aneurizme) Note: Variables were treated as independent samples | | | | | | | | | | |
|---------------------|--|--|-----------------|----------|----|----------|--------------------|--------------------|---------------------|---------------------|----------------------|----------------|
| Group 1 vs. Group 2 | | Mean Group 1 | Mean Group 2 | t-value | df | p | Valid N Group 1 | Valid N Group 2 | Std.Dev. Group 1 | Std.Dev. Group 2 | F-ratio Variances | p Variances |
| SA vl vs. BA vl | | 3,946667 | 2,833333 | 3,798433 | 58 | 0,000351 | 30 | 30 | 1,396729 | 0,791478 | 3,114202 | 0,003106 |

Table 1 and 2. Differences in average values of diameters of the vertebral arteries in patients with and without aneurysm of vertebral-basilar tree.

| | | T-test for Independent Samples (sa i bez aneurizme) Note: Variables were treated as independent samples | | | | | | | | | | |
|---------------------------------|--|--|-----------------|----------|----|----------|--------------------|--------------------|---------------------|---------------------|----------------------|----------------|
| Group 1 vs. Group 2 | | Mean Group 1 | Mean Group 2 | t-value | df | p | Valid N Group 1 | Valid N Group 2 | Std.Dev. Group 1 | Std.Dev. Group 2 | F-ratio Variances | p Variances |
| SA b kaudalno vs. BA b kaudalno | | 5,083333 | 3,800000 | 4,162886 | 58 | 0,000105 | 30 | 30 | 1,552325 | 0,664364 | 5,459505 | 0,000017 |

| | | T-test for Independent Samples (sa i bez aneurizme) Note: Variables were treated as independent samples | | | | | | | | | | |
|-------------------------------------|--|--|-----------------|----------|----|----------|--------------------|--------------------|---------------------|---------------------|----------------------|----------------|
| Group 1 vs. Group 2 | | Mean Group 1 | Mean Group 2 | t-value | df | p | Valid N Group 1 | Valid N Group 2 | Std.Dev. Group 1 | Std.Dev. Group 2 | F-ratio Variances | p Variances |
| SA b kranijalno vs. BA b kranijalno | | 4,573333 | 3,433333 | 3,847330 | 58 | 0,000300 | 30 | 30 | 1,520194 | 0,568321 | 7,155018 | 0,000001 |

Table 3 and 4. Differences in average values of basilar arteries at caudal and rostral end in subjects with and without aneurysm of vertebral-basilar tree. Kaudalno = caudal; Kranijalno = cranial

sinistra of 3.94 mm. In 40% of respondents diameters of the right and left vertebral artery were approximately the same. Caudal part of a. basilaris, at the site of the vertebral arteries merging, had an average diameter of 5.08 mm, and the rostral part at the site of bifurcation was of 4.57 mm in diameter. The initial part of cerebri posterior dextrae had an average diameter of 2.62 mm, and the initial part of a.cerebri posterior sinistrae had an average diameter of 2.52 mm.

Average diameters of the vertebral arteries (a. vertebralis dextra “vd” and a. vertebralis sinistra “vl”) were statistically significantly higher in the patients with aneurysms of the vertebral-basilar tree (SA) in comparison to the group without aneurysm (BA), (Table 1 and 2).

Average values of diameters in basilar arteries at caudal and rostral end (b caudal & b cranial) were statistically significantly higher in patients with aneurysms of the vertebral-basilar tree (SA) than in the group without aneurysms (BA) (Table 3 and 4).

Average values of diameters of rear cerebral arteries in the group of patients with aneurysm of the vertebral basilar tree, were not statistically significantly different from the average values of diameters of the rear cerebral arteries in the group of subjects without aneurysm.

4. DISCUSSION

Pai et al., 2007 in their research show the values of vertebral artery diameters ranging from 3.4 mm to 2.9 mm, and the basilar from 3 mm to 7 mm. Yung et al., 2003, also measured the average value of diameters of a. vertebralis

on the left $4:37 \pm 1.21$ mm; on the right $3:22 \pm 1.64$ mm), the average value of the diameter of a. basilaris at caudal end (4.45 ± 1.28 mm) and average values of diameters of a. cerebri posteriors (left $2.62 \pm 1:36$ mm, and the right $2.61 \pm 1:22$ mm). Nishijima, 1994 (8) shows the average maximal and minimal external diameter of a. basilaris of 3.93 ± 0.76 mm and 3.14 ± 0.58 mm, which is slightly different from the values in our study, especially for diameters in responders with aneurysm of a. basilaris.

In our study, diameter of the right vertebral artery ranged from 2 mm–4 mm, and 1 mm to 4 mm of the left vertebral artery in the patients without aneurysm, whereas in the patients with aneurysm of the right vertebral artery diameter varied from 2 mm–7.6 mm and of the left one from 2 mm–8.1 mm. Basilar artery diameter at caudal end varied from 3 mm–5 mm, and at rostral end of 2 mm–4 mm in patients without aneurysm, while in patients with aneurysm it varied from 2.8 mm–9.9 mm at caudal and of 2.3 mm–8.7 mm at rostral end.

According to the authors Shoja et al. (9) a.vertebralis dextra and a. vertebralis sinistra are in almost 60% of cases of different diameters. The results of our study are nearly identical to results of the authors mentioned, either in the subjects with or without basilar aneurysm.

5. CONCLUSION

Average values of the measured parameters of vascular geometry of vertebrobasilar tree showed statistically significant differences and higher values in the group of patients with aneurysm compared to those without

aneurysm in the vertebral-basilar tree, of all the values measured, except diameters of rear cerebral arteries. This means diameters of vertebral arteries at the site of merging into the basilar artery, as well as the basilar artery diameters at both ends are in average statistically significantly higher in patients with aneurysm.

CONFLICT OF INTEREST: NONE DECLARED

REFERENCES

1. Krmptić-Nemanić J. Anatomija čovjeka (V ed). Medicinska naklada: Zagreb, 1993.
2. Perović D, Anatomija čovjeka (IV ed). Medicinska knjiga. Beograd-Zagreb, 1964.
3. Frick H, Leonhardt H, Starckl D, Spezielle Anatomie II. Georg Thime Verlag: Stuttgart-New York, 1992.
4. Songur A, Gonul Y, Ozen OA, Kucuker H, Uzun I, Bas O, Toktas M. Variations in the intracranial vertebrobasilar system. *Surg Radiol Anat.* 2004; 30(3): 257-264.
5. Schulte-Altendorneburg G, Droste DW, Popa V, Wohlgenuth WA, Kellermann M, Nabavi DG, Csiba L, Ringelstein EB, Visualization of the basilar artery by transcranial color-coded duplex sonography: comparison with postmortem results. *Stroke.* 2000; 31(5): 1123-1137.
6. Pai BS, Varma RG, Kulkarni RN, Nirmala S, Manjunath LC, Rakshith S, Microsurgical anatomy of the posterior circulation. *Neurol India.* 2007; 55(1): 31-41.
7. Yang H, Liu J, Wang JC, Liu CX, Sun YZ, Han GQ, Gao FY, Kang CS, Wang HZ, Zhang JH. Anatomical study and three dimensional image characteristic analysis of basicranial artery and its clinical significance. *Zhonghua Yi Xue Za Zhi.* 2003; 83(1): 13-17.
8. Nishijima Y. Anatomical analysis of the basilar artery and its branches with special reference to the arterial anastomosis, and its course and distribution on the pontine ventral surface. *Nippon Ika Daigaku Zasshi.* 1994; 61(6): 529-547.
9. Shoja MM, Tubbs RS, Khaki AA, Shokouhi G, Farahani RM, Moein A. A rare variation of the vertebral artery. *Folia Morphol.* 2006; 65(2): 167-170.

instructions for the authors

All papers need to be sent to: Editorial board of the journal "Medical Archives (Med Arh)", electronically over the web site www.scopemed.org. Every sent article gets its number, and author(s) will be notified if their paper is accepted and what is the number of paper. Every correspondence will use that number. The paper has to be typed on a standard format (A4), leaving left margins to be at least 3 cm. All materials, including tables and references, have to be typed double-spaced, so that one page has no more than 2000 alphanumeric characters (30 lines) and total number of used words must not to be more than 3,500. Presenting paper depends on its content, but usually it consists of a title page, summary, text references, legends for pictures and pictures. type your paper in MS Word and send it on a diskette or a CD-ROM, so that the editing of your paper will be easier.

Title page. Every article has to have a title page with a title of no more than 10 words: name(s), last and first of the author(s), name of the institution the author(s) belongs to, abstract with maximum of 45 letters (including space), footnote(s) with acknowledgments, name of the first author or another person with whom correspondence will be maintained.

Summary. The paper needs to contain structured summary, 200 words at the most. Summary needs to hold title, full name(s) and surname(s) of the author(s) and coauthor(s), work institution, and all essential facts of the work, introduction, formulation of problems, purpose of work, used methods, (with specific data, if possible) and basic facts. Summary must contain the review of underlined data, ideas and conclusions from text. Summary must have no quoted references. Four key words, at the most, need to be placed below the text.

Central part of the article. Authentic papers contain these parts: introduction, goal, methods, results, discussion and conclusion. Introduction is brief and clear review of the problem. Methods are shown, so that interested reader is able to repeat described research. Known methods don't need to be identified, they are cited (referenced). If drugs are listed, their generic name is used, (brand name can be written in brackets). Results need to be shown clearly and

logically, and their significance must be proven by statistical analysis. In discussion, results are interpreted and compared to the existing and previously published findings in the same field. Conclusions have to give an answer to author's goals.

References. Quoting references must be on a scale, in which they are really used. Quoting most recent literature is recommended. Only published articles, (or articles accepted for publishing), can be used as references. Not published observations and personal notifications need to be in text in brackets. Showing references must be as how they appear in the text. References cited in tables or pictures are also numbered according to the quoting order. All references should be compiled at the end of the article in the Vancouver style or PubMed style (i.e. www.scopemed.org).

Statistical analysis. Tests used for statistical analysis need to be shown in text and in tables or pictures containing statistical analysis.

Tables and pictures. Tables have to be numbered and shown by their order, so they can be understood without having to read the paper. Every column needs to have a title, every measuring unit (SI) has to be clearly marked (i.e. preferably in footnotes below the table, in Arabic numbers or symbols). Pictures also have to be numbered as they appear in the text. drawings need to be enclosed on a white or tracing paper, while black and white photos have to be printed on a radiant paper. Legends (e.g. next to pictures and photos), have to be written on a separate A4 format paper. All illustrations, (pictures, drawings, diagrams), have to be original, and on their backs contain, illustration number, first author's last name, abbreviated title of the paper and picture at the top. It is appreciated, if author marks the place for the table or picture.

Use of abbreviations. Use of abbreviations have to be reduced to a minimum. Conventional units can be used without their definitions. Supplement. If paper contains original contribution to a statistical method or author believes, without quoting original computer program, that paper's value will be reduced. Editorial staff will consider possibility of

publishing mathematics /statistic analysis in extension.

Important policies. Any practice of plagiarism will not be tolerated regarding submitted articles. Non-identifiable quoted parts of the articles from other authors are known act of plagiarism if it is not cited or referencing in appropriate places in the article. Adverent practice of plagiarism will abort reviewing process or article submission. Author(s) may suggest or exclude peer-re-viewers for their articles but Editorial Board has the right to reject their(s) opinions or suggestions according to copyright Assignment form signed by authors before reviewing process. Authors must respect guidelines and rules of ICMJE, WAME, cOpE, E A SE, linked on www.avicenapublisher.org.

Authorship. All individuals listed as authors should qualify for authorship and should have participated sufficiently in the work to take public responsibility for appropriate portions of the content and follow the next conditions: a) substantial contributions to the conceptions and design, acquisition of data, or analysis and interpretation of data; b) drafting the article or revising it critically for important intellectual content; c) final approval of the version to be published (all co-authors must sign copyright Assignment form downloaded from www.avicenapublisher.org). All other contributors to the article's subject who does not qualify for authorship should be listed in acknowledgement section. for all relevant information about authorship follow ICMJE guidelines.

Conflict of interest. All authors must make a formal statement at the time of submission indicating any potential conflict of interest that might constitute an embarrassment to any of the authors if it were not to be declared and were to emerge after publication. Such conflict of interest might include, but not limited to, share holding in or receipt of grant or consultancy free form a company whose product features in the submitted manuscript or which manufactures a competing product. All authors must submit a statement of conflict of Interest to be published at the end of their article (conflict of Interest: NONE DECLARED).