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MORPHOMETRIC ANALYSIS OF CAROTID ARTERY VARIATIONS IN YOUNG PEOPLE BASED ON ULTRASOUND DIAGNOSTIC DATA

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Relevance. The carotid arteries are two major blood vessels coursing along the anterolateral neck and supply oxygen rich blood to the brain, head and face. A detailed understanding of its normal anatomy is fundamental, yet morphometric variations such as high or low bifurcation and asymmetrical vessel diameter, are common even among healthy young individuals and carry significant surgical implications. Recognizing these variations preoperatively is essential for reducing iatrogenic risks during procedures such as carotid endarterectomy or carotid artery stenting.

Aim: to study and analyze the morphometric features of the carotid arteries using ultrasound diagnostic data.

Materials and methods. A morphometric study was carried out on a group of 17 students (ages 21-24) studying at the Belarussian State Medical University. An ultrasound scan was carried out on each participant. Visualization of vessels was performed using a Mindray DC-70 ultrasound machine (China) with a 5-12 MHz linear sensor and the built-in “Vessels” program. The diameters of the common carotid artery (CCA), internal carotid artery (ICA), external carotid artery (ECA) and carotid bifurcations were measured on both the left and right side, to the accuracy of one decimal place. The level of carotid bifurcation was also estimated relative to the thyroid cartilage. To eliminate inter-observer variability all measurements were carried out by a single trained professional. The software “Analysis Toolpak” was used to carry out statistical analysis.

Results and their discussion. Several anatomical variations were analyzed, and symmetry between the left and right carotid systems were evaluated. The mean common carotid artery (CCA) diameter was larger on the right (6.7mm, SD=0.8) than on the left (6.4mm, SD=0.7). Conversely, the mean internal carotid artery (ICA) and external carotid artery (ECA) were larger on the left side (ICA: 5.1mm, SD=0.6; ECA: 5.2mm, SD=0.8) compared to the right (ICA: 4.8mm, SD=0.5; ECA: 5.1, SD=0.8).

ICA/CCA and ECA/CCA ratios were calculated to infer flow distribution. The ICA/CCA ratio was higher on the left side (0.81, SD=0.12) than on the right (0.73, SD=0.09). Similarly, the ECA/CCA ratio was higher on the left side (0.82, SD=0.11) than on the right (0.77, SD=0.12). These findings suggest a relatively smaller CCA or proportionally larger branch vessels on the left. When comparing ICA/CCA and ECA/CCA ratios on both sides, ECA/CCA ratio was higher, indicating an ECA-dominant carotid system in this cohort.

Participants were classified based on carotid bifurcation level relative to the superior border of the thyroid cartilage, separately for the left and right side. Bifurcation level was categorized into three groups: normal (at the level of the superior border of thyroid cartilage), high (between the superior border of thyroid cartilage and the hyoid bone), low (below the superior border of the thyroid cartilage). On the right side, 4 participants had normal bifurcation, 1 had high bifurcation, and 2 had low bifurcation. On the left side, 1 participant had normal bifurcation, 4 had high bifurcation, and 2 had low bifurcation. Asymmetrical bifurcation levels between the two sides were observed in 3 out of 7 participants (42.9%).

Conclusions. This study identified anatomical variations of the carotid artery among a young and healthy group of participants which helped understand the normal carotid anatomy without preexisting pathology. The observed left-right difference in vessel diameters and ratios may indicate potential hemodynamic consequences particularly relating to wall shear stress. These findings underscore the importance of routine preoperative morphometric assessment, even in young, otherwise healthy populations. These findings should be validated in a larger cohort to better characterize the population-level prevalence and spectrum of carotid bifurcation variations.