Genetical hereditability of vertebral artery diameter and flow parameters

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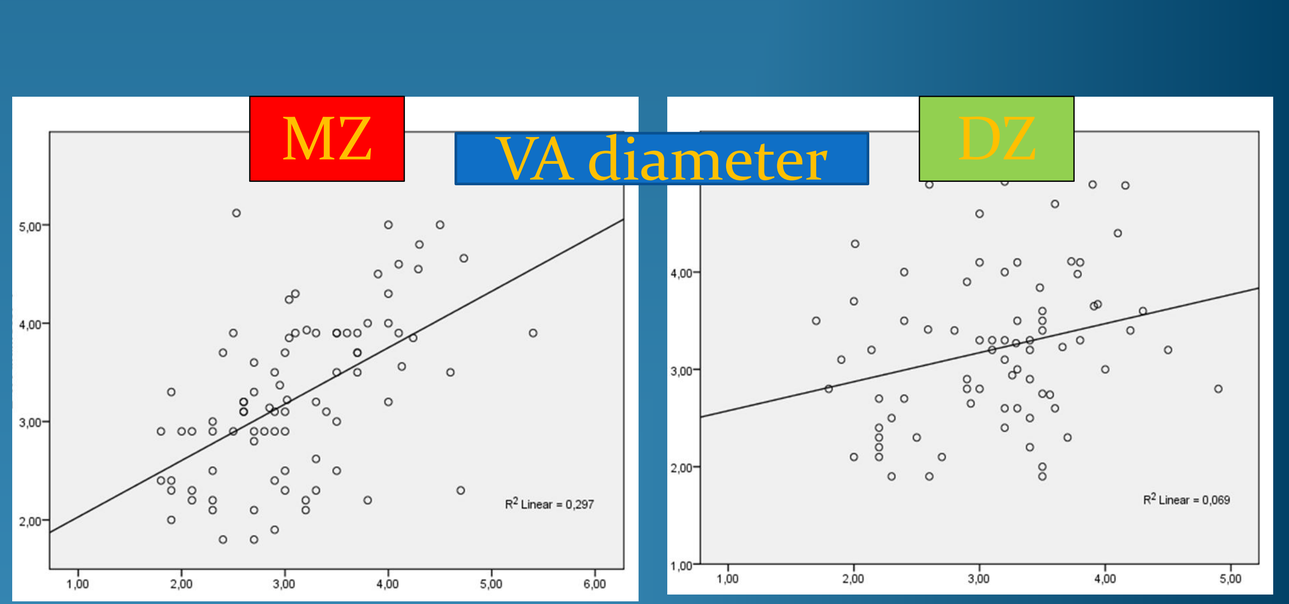
Background. The vertebral arteries (VAs) show considerable variation in length, caliber and vessel course among normal population, in particular VA asymmetry is present in about 75% of subjects and a true congenital VA hypoplasia (diameter <2.5mm) in about 15% of the cases, usually on the right side. According to the international literature, posterior circulation is presumably more vulnerable to ischemia in patients with VA hypoplasia, particularly in those with severe hypoplasia and concomitant atherosclerotic factors. Morever VA hypoplasia has been related to several diseases like migraine with aura and vestibular neuronitis.
The aim of our study was to assess the heritable effects on VA diameter and flow characteristics studied with ultrasonographic techniques.

Methods. One hundred seventy two Italian twins recruited from the Italian Twin Registry from Padua, Perugia and Terni (54 monozygotic /MZ/, 32 dizygotic /DZ/ twin pairs; mean age 50 16 years) underwent a complete ultrasound assessment of their VAs. The ultrasound measurements were performed by B-mode and color Doppler ultrasound with high-frequency linear array (5–10 MHz) transducers. VA diameter was measured bilaterally in the various segments of the entire vessel course, between two echogenic lines representing the intima-media layer of the VA by electronic calipers and their averaged value was used in the statistical analysis. Peak systolic velocity (PSV) and end diastolic velocity (EDV) were assessed in the center of the vessel at V2 segment.

Results:

- Morphological features: The average vertebral artery diameter was 3.2 0.8 mm bilaterally. There was no significant side prevalence of hypoplasic VA detection (19.0% right vs 19.2% left). Hereditability correlation with VA diameter was higher in monozygotic than in dizygotics twins (0.552 vs. 0.229). Age- and sex-adjusted genetic effect accounted for 54.7% (95% CI: 42.2%-69.1%) of the variance of VA diameter, shared environmental effect for 0.0% (95% CI: 0%-0%), and unshared environmental effect for 45.3% (95% CI: 30.9%-57.8%).

- Haemodynamical features: The mean VA PSV and EDV were 44.0 13.4 cm/s and 16.5 7.6 cm/s on the left side, 40.9 12.6 cm/s and 15.5 6.6 cm/s on the right side, respectively. No heritability was found for the PSV of VA, but shared (40.8%;95%CI:28.2%-56.9%) and unshared (59.2%;95%CI:42.8%-71.7%) environmental factors determined the variance. EDV of VA is moderately genetically influenced (42.2%;95% CI:26.3%-59.1%) and also determined by the unshared environment (57.8%; 95% CI: 40.4%-73.7%).



Conclusions. According to our results, the diameter of the VAs is genetically determined, but the influence of environmental remains still important. Different factors influence the PSV and EDV of VAs, which may highlight the complex haemodynamic background of VA flow. These findings support further collaborative initiatives to localize the specific genes and to elucidate whether offsprings of families at risk for VA hypoplasia may benefit from early ultrasound screening due to the higher prevalence of posterior circulation ischaemic events in patients with VA hypoplasia .