Supplementary material

Krzyżewski RM, Kliś KM, Kwinta BM, et al. Possible association between β-blocker use and a risk of intracranial aneurysm rupture. Pol Arch Intern Med. 2024; 134: 16642. doi:10.20452/pamw.16642

Tortuosity measurements

For each patient we also obtained their DSA imaging data prior to any surgical or endovascular interventions. Based on such data, we extracted curve representing course of aneurysm feeding artery and other mentioned arteries, using previously described methods[12]. Then, for extracted curve we measured five tortuosity descriptors: Relative Length (RL), Sum of Angle Metrics (SOAM), Product of Angle Distance (PAD), Triangular Index (TI) and Inflection Count Metrics (ICM). We measured in total tortuosity of 611 arteries (188 ACAs, 83 MCAs, 230 ICAs and 110 BAs). All tortuosity descriptors were normalized to lie within 0-10 range.

First of them is Relative Length (RL), defined as:

$$RL = \frac{l}{l_c}$$

where l_c is the curve length and l is the length of the straight line between the start and end points of the curve. Next is Sum of Angle Metrics (SOAM), for which we divide curve into subcurves of equal length. Then for each subcurve we calculate supplementary of the angle between lines connecting its centre and ends. SOAM is defined as:

$$SOAM = \frac{\sum_{i=1}^{n}(180° - \varphi_i)}{l_c}$$

where φ indicates measured angles and n is these angles count. Third descriptor is Product of Angle Distance (PAD), defined as:

$$PAD = \frac{SOAM}{RL}.$$

Fourth is Triangular Index (TI), for which curve is again divided into equal subcurves. Then a triangle is built with vertices on each end of the subcurve and in its middle point. TI defined as:

$$TI = \frac{\sum_{i=1}^{n}\frac{a_i + b_i}{c_i}}{n}$$

where n is the number of subcurves, a and b are sides of triangles and c is its base. Last of the tortuosity descriptors is Inflection Count Metrics (ICM), defined as:

$$ICM = \frac{n_I * l_c}{l}$$

where n_I represents the number of the curve's inflection points.