7 - Title: Associations between Aortic Curvilinearity and Preoperative Abdominal Aortic Aneurysm Outcomes: A Systematic Review

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***Background*:**
Traditional assessments of abdominal aortic aneurysm (AAA) progression have historically relied on maximum aortic transverse diameter as the primary prognostic factor. An emerging body of evidence has demonstrated that characteristics of AAA curvilinearity, encompassing measures of tortuosity, angulation, and curvature, may improve predictions of aneurysm growth and rupture.

Methods/Research Design.
A systematic review was conducted in accordance with PRISMA guidelines. PubMed, Scopus, and Web of Science databases were searched from inception through December 2024 for original research studies investigating relationships between aortic curvilinearity metrics and AAA growth and rupture. 24 studies met inclusion criteria, with quality being assessed using the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool.

***Results (or Preliminary Results, as applicable for a project in progress)*:**
Of the included studies, three groups of curvilinearity approaches were identified: (1) tortuosity indices calculated from centerline length ratios, (2) angulation measurements quantifying vessel orientation changes, and (3) continuous curvature-based metrics assessing local bending. Four studies examined AAA growth, with three demonstrating significant positive associations between curvilinearity and aneurysm expansion. Chandrashekar et al. discovered that a diameter-only predictive model differentiating fast vs. slow growth (AUROC of 0.60) was significantly outperformed by a model combining curvilinearity metrics and diameter (AUROC of 0.80, $p < 0.01$), with Olson et al. finding that higher tortuosity was associated with increased AAA growth ($p = 0.006–0.012$). Among the 20 studies evaluating AAA rupture risk – or peak wall stress as a surrogate metric – 17 demonstrated significant positive associations with greater curvilinearity. Four studies directly compared tortuosity index (TI) with angulation or curvature metrics, with angulation measures and curvature-based indices demonstrating stronger associations with rupture-related outcomes than TI. However, considerable heterogeneity in the definitions of centerline, measurement of endpoints, and computational algorithms restricted direct comparisons across studies.

***Conclusion (or Preliminary Conclusion, as applicable for a project in progress)*:**
This systematic review highlights the growing body of literature detailing curvilinearity as a potent predictor of AAA growth and rupture risk. Our findings support the use of curvilinearity as a metric in AAA risk models, allowing for more individualized clinical management. Further studies of curvilinearity with standardized quantification protocol are warranted to better validate predictive utility and promote clinical adoption.