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MORPHOLOGICAL VARIANTS OF FENESTRA AND NODULES ON THE AORTIC VALVE LEAFLETS OF HUMANS

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Relevance. Aortic valve nodules are fibrous thickenings located at the midpoints of the semilunar leaflets. They ensure complete valve closure and, together with the semilunar lunulas, form the coaptation area to prevent backflow. Size and integrity variations can indicate underlying valve disease, with enlarged or calcified nodules leading to aortic regurgitation. Fenestrae are small cusp perforations, are normal in small numbers; however, excessive size or quantity weakens cusps, potentially causing regurgitation or prolapse. Rapid fenestrae changes suggest degeneration or stress response. Increased fenestrae near commissures raise tear risks and insufficiency, highlighting the importance of nodule/fenestrae characteristics in maintaining aortic valve function and predicting disease. This study investigates these variations, aiming to provide critical insights for improved diagnostic accuracy and the development of targeted therapeutic interventions in cardiology.

Aim: to establish the range of anatomical variations in aortic valve nodules and fenestrae by characterizing their variant anatomy, nodule location, and frequency of fenestrae occurrence.

Materials and methods. Morphological and morphometric methods were used to evaluate the characteristics of aortic valves in 38 post-mortem human hearts (68,50 [52,00; 78,50] years old). Measurements included lunula lengths (left and right), nodule width, and nodule height. Data were compiled and analysed using Microsoft Excel and Statistica 10.0.

Results and their discussion. The study revealed the following median [IQR] values (in mm): Nodule width (left leaflet: 2.00 [1.00; 3.00], right leaflet: 2.00 [1.00; 4.00], non-coronary leaflet: 2.00 [1.00; 3.00]); nodule height (left: 2.00 [2.00; 3.00], right: 2.50 [2.00; 4.00], non-coronary: 2.00 [2.00; 3.00]); left lunula length (left: 12.50 [11.00; 15.00], right: 13.00 [12.00; 16.00], non-coronary: 14.00 [12.00; 16.00]); and right lunula length (left, right, and non-coronary leaflets: 14.00 [12.00; 16.00], 14.00 [13.00; 16.00] and 14.00 [13.00; 17.00] respectively). Analysis of nodule location (assessed using lunula length differences) showed a tendency for nodules >1mm in the left coronary leaflet to be shifted left (43.75%), while nodules in the non-coronary leaflet were more often shifted right (45.45%). Nodules in the right coronary leaflet were more often in the centre (37.84%). Among cases where nodule shape could be distinguished, the incidence of each shape varied by leaflet. Nodule shape was also qualitatively classified (brush/papillary, round, linear, small protrusion, triangular). In the left coronary leaflet (n=22), nodule shapes were brush/papillary (31.82%), round (27.27%), linear (0%), small protrusion (22.73%), and triangular (18.18%). The right coronary leaflet (n=29) showed the following distribution: brush/papillary (31.03%), round (27.59%), linear (13.79%), small protrusion (17.24%), and triangular (10.34%). The non-coronary leaflet (n=24) had the following shape distribution: brush/papillary (29.17%), round (33.33%), linear (16.67%), small protrusion (12.50%), and triangular (8.33%). In a study of 38 aortic valves, fenestrae (small perforations) were observed in 26.32% of cases. These perforations were not evenly distributed across the leaflets; the left coronary leaflet had the highest incidence (13.16%), followed by the right coronary leaflet (10.53%), and the non-coronary leaflet (4.00%). Among the valves that *did* exhibit fenestrae, the distribution was as follows: 50% had fenestrae in only one leaflet, 20% had fenestrae in two leaflets, and 10% had fenestrae in all three leaflets. The specific leaflet distribution for the remaining 20% of valves with fenestrae was not documented in this study.

Conclusion. Aortic valve leaflets exhibit distinct morphological variations, with nodules shifting left in the left coronary, right in the non-coronary, and centrally in the right coronary leaflet, challenging the traditional midpoint-only view. Brush/papillary and round nodules are prevalent, while linear nodules are absent in the left coronary leaflet. Fenestrae most frequently appear in the left coronary leaflet. These findings enhance understanding of aortic valve structure and may justify diagnostic and therapeutic approaches in cardiovascular research.