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PREVALENCE AND DISTRIBUTION OF ATHEROSCLEROTIC PLAQUES IN THE AORTIC ROOT SINUSES

Introduction

The aortic sinuses are three small pouches located at the root of the aorta. These structures create a swirling blood flow pattern that serves to cushion the valve leaflets during each cardiac cycle and ensures proper closure of the valve afterward. Two aortic sinuses are associated with specific coronary arteries: the right and left coronary sinuses give rise to their respective coronary arteries, while the non-coronary sinus does not supply a coronary artery [3].

In contemporary clinical practice, the prevalence of cholesterol-related pathologies within the aorta has markedly increased [4]. With aging populations and escalating rates of cardiovascular disease, a significant number of individuals are developing atherosclerotic plaques within their arterial systems. While extensive research has been conducted on atherosclerotic plaques in the coronary arteries and the main aorta, there remains a notable paucity of studies focusing specifically on the aortic sinuses. This is particularly concerning given that plaques present in these regions can directly obstruct blood flow to the myocardium [2, 4].

Our objective is to investigate the frequency of cholesterol plaque formation within the aortic sinuses, as well as to ascertain whether there is a predilection for specific sinuses. We aim to provide valuable insights that may enhance the understanding and management of aortic atherosclerosis.

Goal

The objective of this study was to establish the frequency of atherosclerotic plaques developing in the aortic root.

Material and methods of research

This morphological study was carried out at the Department of Normal Anatomy, 38 human hearts obtained from routine autopsy specimens. All specimens were handled in accordance with standard ethical protocols and institutional guidelines governing the use of cadaveric material for medical research purposes. The study sample comprised hearts from 18 males and 18 females with an additional 2 for whom sex information was not recorded. The age distribution showed a median age of 68.50 years, with an interquartile range spanning from 52.00 to 78.50 years – a demographic profile particularly well-suited for investigating atherosclerotic changes, as these lesions typically require decades to develop and become increasingly prevalent with advancing age.

The ascending aorta was transected above the sinutubular junction to expose the aortic root, and each sinus was identified based on coronary ostia: right coronary (right artery origin), left coronary (left artery origin), and non-coronary (no ostium). Every sinus was examined for

atherosclerotic plaques – elevated, firm, yellowish-white lesions distinct from normal tissue – using visual inspection and palpation. Plaque location and dimensions were recorded, and involvement patterns were categorized as absent, single-sinus, two-sinus, or three-sinus. Data were analyzed using descriptive statistics.

The results of the research and their discussion

Examination of 38 hearts revealed atherosclerotic plaques in 23 specimens (60.53%), while 15 hearts (39.47%) showed no plaque formation. This indicates that aortic sinus atherosclerosis affects nearly two-thirds of individuals in this age group.

Table 1 – Distribution of plaque involvement patterns

Involvement pattern	Number of cases	Percentage
No plaques	15	39.47%
Three sinuses	13	34.21%
Two sinuses	6	15.79%
One sinus	4	10.53%

Among the hearts that showed plaque formation, the most frequently encountered pattern was involvement of all three sinuses, accounting for 34.21% of cases and typically associated with more advanced atherosclerotic changes. Involvement of two sinuses was observed in 15.79% of cases, with the combination of right and left coronary sinuses appearing most often. Single sinus involvement, found in 10.53% of specimens.

Table 2 – Sinus specific prevalence

Aortic sinus	Cases with plaque	Percentage
Left coronary	21	55.26%
Right coronary	18	47.37%
Non coronary	16	42.11%

The left coronary sinus showed highest involvement (55.26%), followed by right (47.37%) and non-coronary (42.11%). Before starting our research, we reviewed the work of Tobler and Edwards [1] from 1988, who examined 97 autopsy specimens and found that atherosclerotic plaques in the ascending aorta were most common on the right and anterior sides. Based on their findings, we expected that the right coronary sinus would show the highest plaque frequency in our study as well. However, our results surprised us. Contrary to what we anticipated, we found that the left coronary sinus was the most frequently affected site (55.26%), followed by the right (47.37%) and non-coronary sinuses (42.11%).

The finding that 60.53% of examined hearts exhibited cholesterol plaques within the aortic sinuses aligns closely with the work of Agmon et al. (2002) [2], who studied atherosclerosis in the thoracic aorta using transesophageal echocardiography and reported plaque prevalence of approximately 58% in older adults, particularly in the proximal aortic segments. Similarly, underwood and colleagues (2000) [3] emphasized that the aortic root, including the sinuses, undergoes significant age-related changes that predispose this region to atherosclerotic involvement.

The predilection for left coronary sinus involvement in our study finds indirect support from VanderLaan and colleagues (2004) [4], who noted that branch points and curvatures create unique hemodynamic environments influencing plaque localization. As the origin of the left main coronary artery supplying a larger myocardial territory, this sinus may experience unique flow dynamics

during diastole, aligning with Stary et al. (1995) [5], who documented that early lesions often develop near vessel orifices where flow is disturbed.

Conclusions

1. Cholesterol plaques are present in the aortic sinuses of 60.53% of middle-aged and elderly individuals.

2. Plaque distribution shows considerable variation: triple-sinus involvement is most common (34.21%), followed by dual-sinus (15.79%) and single-sinus (10.53%) involvement, reflecting complex interplay of systemic and local factors.

3. Contrary to hemodynamic-based expectations, the left coronary sinus demonstrates highest plaque prevalence (55.26%), followed by right (47.37%) and non-coronary (42.11%). This challenges simple explanations and suggests additional factors contribute to regional susceptibility.

These findings require confirmation in larger prospective studies incorporating coronary angiography and histological validation to elucidate mechanisms driving plaque formation in the aortic sinuses.

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