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Coronary Artery Anatomical Variations and Palpitations in Libyan Adults Undergoing Coronary Imaging: A Multicentre Retrospective Study

Coronary Anatomical Variation and Palpitations in Libyans

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ABSTRACT: Background: Coronary artery anatomical variations comprise a heterogeneous spectrum of structural configurations involving coronary origin, ostial anatomy, branching, course, and vessel morphology. Although palpitations are reported in patients with selected coronary anomalies, comparative evidence quantifying whether this symptom is more frequent in adults with versus without documented coronary anatomical variation remains limited, particularly in North African clinical cohorts. This study examined and quantified the association between documented coronary anatomical variation and palpitations in a multicentre Libyan coronary-imaging cohort.

Methods: This multicentre retrospective cross-sectional study included 200 adults evaluated at three Libyan cardiac centres. Coronary anatomical variation status and palpitations were obtained from imaging and clinical records. Participants were classified by presence or absence of any documented coronary anatomical variation. Pearson's chi-square test assessed the association with palpitations, and Cramer's V quantified its strength.

Results: Coronary anatomical variation was documented in 87 of 200 participants (43.5%). Palpitations occurred in 17/87 (19.5%) with variation versus 10/113 (8.8%) without ($\chi^2(1)=4.811$, $p=0.028$; Cramer's $V=0.155$). The unadjusted odds ratio was 2.50 (95% CI 1.08–5.79) and the prevalence ratio was 2.21 (95% CI 1.06–4.58).

Conclusions: In this multicentre Libyan coronary-imaging cohort, documented palpitations were more frequent among adults with coronary anatomical variation than among those without documented variation. This study provides a direct quantitative comparison of documented palpitations between Libyan adults with and without coronary anatomical variation, rather than describing symptom prevalence among anomaly cases alone; nevertheless, the small effect size, limited number of events, and cross-sectional design preclude causal or electrophysiological inference. Prospective

phenotype-specific studies incorporating objective rhythm monitoring are warranted.

1. INTRODUCTION

Coronary artery anatomy exhibits substantial variation in origin, ostial configuration, branching pattern, course, length, and vessel morphology. These findings range from relatively common variants to uncommon congenital anomalies with potential clinical consequences [1–7]. The reported prevalence varies considerably according to the anatomical definition applied, the population studied, and the imaging modality used [8–15].

Many coronary anatomical variations are discovered incidentally. However, selected phenotypes can alter coronary haemodynamics, myocardial perfusion, or the relationship between coronary vessels and surrounding structures [1–5]. Myocardial bridging, for example, may influence systolic coronary compression and proximal haemodynamics [16–19], while ectatic or aneurysmal morphology may be associated with altered flow and thrombotic or ischaemic complications [20]. Anomalous coronary origins and selected proximal courses can also have clinical relevance depending on their specific anatomical features [21–23].

Palpitations are a common clinical symptom but are nonspecific and do not by themselves establish an arrhythmia. Their relationship with coronary anatomical variation is therefore uncertain. In symptomatic patients referred for coronary assessment, an observed association between coronary anatomy and palpitations may reflect direct or indirect mechanisms, coexisting coronary disease, referral patterns, or other clinical factors. Consequently, symptom-based associations require cautious interpretation and should not be considered evidence of causality or electrophysiological diagnosis.

The relevant knowledge gap is not simply the scarcity of Libyan data, but the limited comparative evidence quantifying the relationship between coronary anatomical variation and palpitations in adult coronary-imaging cohorts. This distinction is important because describing symptoms among anomaly cases alone cannot determine whether those symptoms are actually more frequent than in comparable patients without a documented variation. Using a multicentre Libyan dataset, the present study therefore compared the prevalence of documented palpitations between adults with and without coronary anatomical variation and quantified the magnitude of the association using complementary relative measures. The study was conducted across Tripoli Medical Center, Benghazi Medical Center, and Tajoura Heart Center, providing clinical imaging data from three major Libyan cardiac centres. The primary objective was to assess the association between binary coronary anatomical variation status and documented palpitations.

2. MATERIALS AND METHODS

2.1 Study design and setting

A multicentre retrospective cross-sectional study was conducted using routine clinical and coronary imaging data from three Libyan centres: Tripoli Medical Center in Tripoli, Benghazi Medical Center in Benghazi, and Tajoura Heart Center in Tajoura. These centres provided a geographically distributed clinical sample from western and eastern Libya within a tertiary cardiac-care setting. The analytical cohort comprised 200 adults who underwent clinically indicated coronary assessment using coronary computed tomography angiography (CCTA) or invasive coronary angiography (ICA).

2.2 Study population

Adults undergoing routine coronary assessment were eligible according to the underlying study protocol. Consecutive eligible cases were identified from radiology/PACS and catheterisation laboratory records. Records with non-retrievable core variables, prior coronary artery bypass grafting before the index imaging, or complex congenital heart disease unrelated to isolated coronary anatomical variation were excluded. The final analytical cohort contained 200 participants.

2.3 Coronary anatomical variation

Coronary anatomical variation status was determined from the available imaging and clinical records. The source study encompassed a broad clinical-anatomical spectrum including anomalous origin or ostial variants, branching or length variants, ectasia or aneurysm, myocardial bridging, interarterial or intramural courses, and other documented coronary anatomical/morphological variants. For the present analysis, participants were classified only according to the presence or absence of any documented coronary anatomical variation. Subtype-specific symptom analysis was not performed.

2.4 Outcome definition

The outcome was documented palpitations in the clinical record. Palpitations were treated as a clinical symptom and not as an electrocardiographically confirmed arrhythmia. Coronary anatomical variation status and palpitation status were available for all 200 participants included in the analysis.

2.5 Statistical analysis

Categorical variables were summarized as frequencies and percentages. A 2×2 contingency table (Table 2) was constructed to compare palpitations according to coronary anatomical variation status. Pearson's chi-square test of independence was used to assess the association between CAA status and palpitations, and Cramer's V was reported as a measure of association strength. In addition, the unadjusted odds ratio (OR) and prevalence ratio (PR) for palpitations according to CAA status were calculated directly from the 2×2 table, with 95% confidence intervals derived using the Woolf log method for the OR and a log-transformed method for the PR. Statistical significance was evaluated using a two-sided threshold of $p < 0.05$. The analysis included all 200 participants. No multivariable symptom model or subtype-specific symptom analysis was performed because the available data did not support reliable adjusted or subtype-specific estimates; the OR and PR reported here therefore remain unadjusted for age, sex, or coronary artery disease status.

3. Results

Among the 200 participants, 87 (43.5%) had at least one documented coronary anatomical variation and 113 (56.5%) had no documented variation. Palpitations were recorded in 27 participants (13.5%) overall. Other frequently documented presenting symptoms included chest pain in 191 participants (95.5%) and shortness of breath in 149 (74.5%); cardiogenic shock was recorded in one participant (0.5%) (Table 1).

Palpitations were documented in 17 of 87 participants with coronary anatomical variation (19.5%) compared with 10 of 113 participants without documented variation (8.8%) (Table 2). The association was statistically significant (Pearson $\chi^2(1) = 4.811$, $p = 0.028$) with a small effect size (Cramer's $V = 0.155$).

The unadjusted odds of documented palpitations were 2.50 times higher among participants with coronary anatomical variation than among those without (OR=2.50, 95% CI 1.08–5.79). The corresponding unadjusted prevalence ratio was 2.21 (95% CI 1.06–4.58). These estimates describe an unadjusted cross-sectional association and do not account for potential confounding.

Table 1. Clinical and coronary anatomical characteristics of the study cohort (N=200).

Variable	n	%
Total participants	200	100.0
Any CAA – Present	87	43.5
Any CAA – Absent	113	56.5
Palpitations – Present	27	13.5
Palpitations – Absent	173	86.5
Chest pain – Present	191	95.5
Shortness of breath – Present	149	74.5
Cardiogenic shock – Present	1	0.5

Table 2. Palpitations according to coronary anatomical variation status.

CAA status	No palpitations, n (%)	Palpitations, n (%)	Total
CAA absent	103 (91.2)	10 (8.8)	113
CAA present	70 (80.5)	17 (19.5)	87
Total	173 (86.5)	27 (13.5)	200

CAA, coronary artery anatomical variation. Pearson $\chi^2=4.811$, $df=1$, $p=0.028$; Cramer's $V=0.155$. Unadjusted OR=2.50 (95% CI 1.08–5.79); unadjusted PR=2.21 (95% CI 1.06–4.58).

4. DISCUSSION

This study provides a direct quantitative comparison of documented palpitations between Libyan adults with and without coronary anatomical variation, rather than describing symptom prevalence among anomaly cases alone. Palpitations occurred in 19.5% of participants with a variation and 8.8% of those without, an absolute difference of 10.7 percentage points. The association was statistically significant, although its magnitude was small, as reflected by Cramer's V, and the limited number of palpitation events constrains the precision of this estimate.

The distinction between statistical significance and clinical magnitude is important. The observed OR and PR indicate an unadjusted association, but the study design does not establish that coronary anatomical variation causes palpitations or rhythm disturbance. Palpitations are subjective and heterogeneous, and may occur with or without demonstrable arrhythmia. They may also be influenced by ischaemia, structural heart disease, medications, autonomic factors, anxiety, and other conditions that were not incorporated into an adjusted symptom model.

Nevertheless, biological plausibility exists for selected coronary phenotypes. Myocardial bridging can alter systolic coronary dynamics and local haemodynamics, and has been discussed in relation to ischaemic and rhythm-related manifestations [16–19]. Selected anomalous aortic origins may carry clinical consequences depending on ostial morphology and proximal course [21–23]. Coronary ectasia and aneurysmal disease may also alter coronary flow and coexist with ischaemic or thrombotic processes [20]. These mechanisms are phenotype-specific and should not be generalized to every anatomical variant.

Contemporary literature increasingly emphasizes detailed anatomical characterization rather than treating all coronary variants as a uniform clinical entity [1–5]. This is especially relevant when symptoms are considered. A symptom such as palpitations cannot establish the physiological significance of a coronary configuration, and objective rhythm documentation would be required to determine whether a reproducible electrophysiological phenotype exists.

The clinical context of the present cohort also requires caution. Participants were referred for coronary assessment at tertiary cardiac centres, and chest pain and shortness of breath were highly prevalent. The findings therefore reflect a symptomatic coronary imaging population rather than the general Libyan population. Similarly, the 43.5% frequency of any documented coronary anatomical variation derives from a broad clinical-anatomical definition and should not be compared directly with prevalence estimates restricted to rare congenital coronary anomalies [6–15,21–25].

Despite these limitations, the study contributes multicentre imaging-based evidence from Libya, a population under-represented in the coronary anatomy literature. The observed symptom association provides a focused hypothesis for future prospective investigation. Studies incorporating standardized anatomical classification, electrocardiography or ambulatory rhythm monitoring, and adjustment for age, sex, coronary artery disease, cardiovascular risk factors, and medication use would help determine whether the present finding is reproducible and clinically meaningful.

4.1 Strengths and Limitations

Strengths include the multicentre design, imaging-based identification of coronary anatomical variation, and complete data for the principal 2×2 analysis. The study also reports both relative measures of association and an effect-size estimate rather than relying on the p value alone.

Several limitations should be recognized. The retrospective cross-sectional design precludes temporal and causal inference. The cohort was drawn from tertiary cardiac centres and is not representative of the general population. Palpitations were obtained from clinical documentation and were not equivalent to an ECG-confirmed arrhythmia. Coronary anatomical variation was analyzed as a binary exposure, so potentially important differences among specific phenotypes could not be evaluated in relation to palpitations. No multivariable symptom model was available to adjust for potential confounders. Finally, only 27 participants had documented palpitations, which limits precision and the complexity of analyses that can be supported by the dataset.

4.2 Clinical Implications

The findings do not support using the presence of a coronary anatomical variation as a diagnostic explanation for palpitations. Rather, they suggest that documented palpitations may merit objective rhythm assessment when clinically indicated, while the anatomical finding should be interpreted according to its specific morphology and established clinical context. Prospective integration of detailed coronary anatomy with ambulatory rhythm monitoring would be more informative than symptom status alone.

5. CONCLUSION

In this multicentre cohort of 200 Libyan adults undergoing coronary assessment at Tripoli Medical Center, Benghazi Medical Center, and Tajoura Heart Center, palpitations were documented in 19.5% of participants with coronary anatomical variations compared with 8.8% of those without documented variations. The association was statistically significant but small in magnitude ($\chi^2(1)=4.811$, $p=0.028$; Cramer's $V=0.155$). This study provides a direct quantitative comparison of documented palpitations between Libyan adults with and without coronary anatomical variation, rather than describing symptom prevalence among anomaly cases alone, though the findings remain unadjusted and do not establish that coronary anatomical variation causes rhythm disturbance. Prospective phenotype-specific studies incorporating relevant confounders and objective rhythm monitoring are required to determine whether this signal corresponds to a reproducible electrophysiological phenotype.

Ethics Approval

Ethical approval for the underlying study was obtained from the Lincoln University College Research Ethics Committee (LUC-REC), Malaysia (approval reference LUC-REC/2024/078; 20 May 2024). The investigation was retrospective and used previously collected clinical and imaging information. Data were anonymized before analysis.

Informed Consent

The study used retrospective, de-identified records, and the requirement for written informed consent was waived.

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Disclosure Statement

The authors declare no conflict of interest.

Declaration of Generative AI Use

ChatGPT (GPT-5.6 Sol, OpenAI) was used during manuscript preparation solely to assist with language refinement, clarity, and editorial improvement. The authors reviewed and revised the output, confirmed the originality and accuracy of the manuscript, and take full responsibility for the integrity of the content, including the accuracy of the references. The authors also confirmed the suitability of the tool for this use in accordance with its applicable terms. Generative AI was not used to generate or modify the study data, research results, or clinical images.

Data Availability Statement

The study used retrospective clinical and imaging records that are not publicly available because of ethical, institutional, and patient-confidentiality restrictions. Anonymized data may be considered for reasonable research requests subject to applicable ethical approval and authorization from the relevant institutions.

Author Contributions

Yaseen Ahmad Muhammad Wafi: Conceptualization, methodology, investigation, data curation, formal analysis, interpretation of findings, and preparation of the original manuscript. Emad Mohamed Nafie Abdelwahab: Supervision, methodological guidance, interpretation of findings, critical review, and manuscript revision. Lubna Shirin: Supervision, clinical and anatomical interpretation, critical review, and manuscript revision. Mohammed Shahjahan Kabir: Supervision, methodological guidance, critical review, and manuscript revision. All authors reviewed and approved the final manuscript.

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