Association between coronary tortuosity and mitral annular calcification

Levent Cerit, Zeynep Cerit

Abstract

Introduction: Coronary tortuosity (CorT) is a common coronary angiographic finding. The aetiology, clinical implication and long-term prognosis are not well clarified. Mitral annular calcification (MAC) is one of the most common cardiac structural abnormalities on echocardiographic examination. MAC and CorT are associated with atherosclerotic risk factors such as advanced age, hypertension, diabetes mellitus, hypercholesterolaemia, female gender and chronic kidney disease. There are few data on the co-existence of MAC and CorT in the literature. This study was conducted with the aim of evaluating the association between CorT and MAC.

Methods: The medical records of consecutive patients who underwent coronary angiography were retrospectively reviewed. The study group consisted of 2 736 patients. Taking into consideration the inclusion criteria, 392 patients with MAC and 687 patients without MAC (control group) were included in the study. Biochemical, clinical and echocardiographic parameters and CorT were evaluated in all patients. CorT was defined as three fixed bends during both systole and diastole, with the angle of each bend 45° or more.

Results: Patients with MAC had a higher prevalence of hypertension, hyperlipidaemia, female gender, MAC and advanced age. On univariate analysis, advanced age, hypertension, female gender, hyperlipidaemia and MAC were associated with CorT. On multivariate analysis MAC, advanced age and hypertension were independent predictors for CorT (OR 2.167, 95% CI: 1.436–4.283, \( p < 0.001 \); OR 1.243, 95% CI: 1.243–3.674, \( p < 0.001 \); OR 2.358, 95% CI: 1.864–4.681, \( p < 0.001 \), respectively).

Conclusion: In our study, we found a significant relationship between MAC and CorT.

Keywords: mitral annular calcification, coronary tortuosity, hypertension, female gender, ageing

Mitrail annular calcification (MAC) is a chronic, progressive process, characterised by calcium deposition on the mitral valve annulus. The incidence of MAC is 2.7% in the general population older than 50 years. MAC is a chronic degenerative process, and the prevalence of MAC is increasing in the developed world due to the growing population of elderly patients, and risk factors such as hypertension (HT), hypercholesterolaemia (HL), diabetes mellitus (DM), female gender and chronic kidney disease. MAC has been shown to be a predictor of systemic atherosclerosis, cardiac arrhythmias, conduction abnormalities and vascular diseases such as coronary artery disease (CAD) and stroke. Severe MAC is related to the severity of calcium deposition in the coronary vasculature.

Coronary tortuosity (CorT) is a common coronary angiographic finding. It is defined as three fixed bends during both systole and diastole in at least a single epicardial artery, with each change in the vessel direction a 45° bend. Clinical studies have demonstrated that CorT is associated with ageing, HT, HL, atherosclerosis and DM.

The association between MAC and CorT has not been studied. In the light of this knowledge, we aimed to determine the relationship between the CorT and MAC.

Methods

The study group consisted of 2 736 consecutive patients who underwent coronary angiography after to a positive treadmill test. A retrospective evaluation of consecutive patients undergoing coronary angiography was performed. Stable angina was defined as discomfort in the chest, back, jaw, shoulder or arm, typically elicited by exertion or emotional stress, and relieved by rest or nitroglycerin.

All patients enrolled in the study underwent coronary angiography as a result of chest pain and objective signs of ischaemia during treadmill exercises. Taking into consideration the inclusion criteria, 392 patients with MAC and 687 patients without MAC (control group) were included in the study. We excluded patients with severe coronary artery disease (left main coronary artery and proximal left anterior descending artery > 50%, other coronary arteries > 70% blockage) and previous myocardial infarction.
The data of patients were retrospectively analysed for demographic features and echocardiographic parameters, including ejection fraction, MAC, biochemical parameters, and CorT. The study was approved by the local ethics committee.

All patients underwent transthoracic echocardiography using a Vivid S5 (GE Healthcare) echocardiography device and Mass S5 probe (2–4 MHz). Standard two-dimensional and colour-flow Doppler views were acquired according to the guidelines of the American Society of Echocardiography and European Society of Echocardiography.8 The ejection fraction was measured according to Simpson’s method. We evaluated MAC, best achieved on short-axis views of the mitral valve (parasternal short axis at the base on transthoracic echocardiography).

All patients underwent elective coronary angiography according to the Judkins technique. Angiograms were reviewed by at least two non-blinded reviewing cardiologists. The left anterior descending coronary artery (LAD), the left circumflex coronary artery (LCX) and the right coronary artery (RCA) were observed at various angulations. CorT was evaluated at special angulations, the LAD was assessed in the right anterior oblique view with cranial angulations, and the LCX in the left anterior oblique view with caudal angulations. The RCA was evaluated in the right anterior oblique view. CorT was identified by three or more bends (defined as a ≥ 45° change in vessel direction) along the main trunk of at least one artery, present both in systole and in diastole.

Patients with DM were identified on admission as those with documented DM using either oral hypoglycaemic agents or insulin treatment. HL was defined as total cholesterol level at least 200 mg/dl (5.18 mmol/l) or using antihyperlipidaemic therapy on admission. HT was defined as blood pressure above 140/90 mmHg or using antihypertensive therapy on admission.

Statistical analysis

Statistical analysis was performed using the SPSS (version 20.0, SPSS Inc, Chicago, Illinois) software package. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were expressed as a percentage (%). The Kolmogorov–Smirnov test was used to evaluate the distribution of variables. The Student’s t-test was used to evaluate continuous variables showing normal distribution, and Mann–Whitney U-test was used to evaluate variables that did not show a normal distribution.

To identify predictors of CorT, the following variables were initially assessed in a univariate model: age, HT, female gender, DM, HL and MAC. Significant variables in univariate analysis were then entered into a multivariate logistic regression analysis using backward stepwise selection. A p-value < 0.05 was considered statistically significant.

Results

The prevalence of MAC was found in 14.3% in the study group. The MAC and control groups comprised 392 and 687 patients, respectively. The demographic characteristics of both groups are summarised in Table 1.

There was no significant difference between the groups regarding current smoking and DM (32.1 vs 29.9%, p = 0.762; 27.0 vs 29.4%, p = 0.684, respectively) (Table 1). There was a significant difference between the groups regarding age, HT, HL, female gender and CorT (71.6 ± 8.2 vs 61.4 ± 7.4 years, p < 0.001; 72.4 vs 44.5%, p < 0.001; 40.3 vs 28.2%, p < 0.001; 68.6 vs 41.7%, p < 0.001; 23.9 vs 12.1%, p < 0.001, respectively) (Tables 1, 2).

There was no significant difference between the groups regarding biochemical parameters such as levels of urea, creatinine, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, total cholesterol and triglycerides (Table 2).

The results of univariate analysis are presented in Table 3. On univariate analysis, advanced age, HT, female gender, HL and MAC were associated with CorT (Table 3). On multivariate analysis, MAC, advanced age and HT were independent predictors for CorT (OR 2.174, 95% CI: 1.637–4.253, p < 0.001;...
OR 1.938, 95% CI: 1.362–3.463, p < 0.001; OR 2.068, 95% CI: 1.539–3.861, p < 0.001, respectively) (Table 4).

Discussion

This study revealed that advanced age, HT and MAC were associated with CorT. To the best of our knowledge, our study is the first to evaluate the association between MAC and CorT. Our results may be related to the fact that both MAC and CorT have the same predisposing factors, such as advanced age, HT, DM, HL, female gender and smoking.17

CorT is a common coronary angiographic finding. It is generally attributed to age-dependent pathological changes of the elastic material in the vessel, and elongation and dilatation of the arteries, with left ventricular hypertrophy due to HT.18

The aetiology and clinical importance of CorT are unclear. Arteries may become tortuous due to reduced axial strain and hypertensive pressure in an elastic cylindrical arterial model. Therefore CorT might be one of the forms of artery remodelling induced by hypertension due to increased coronary pressure and blood flow.

CorT was positively correlated with essential HT,14,15 female gender and advanced age.14 Our results are consistent with previous studies where HT was independently associated with CorT. Chiha et al.3 reported that women had more severe CorT, and only age was associated with the presence of tortuosity. Similar to a previous study,14,15 we found that advanced age was independently associated with CorT.

Women with suspected ischaemic chest pain undergoing invasive coronary angiography were found to have less extensive CAD. Women displayed a greater symptom burden and a higher rate of functional disability compared to men, but presented with a lower prevalence of obstructive CAD and more microvascular dysfunction.16 Furthermore, despite the lower prevalence of obstructive disease, women displayed evidence of ischaemia on functional assessments such as pressure wire studies, myocardial perfusion imaging and magnetic resonance imaging.14,15 These findings suggest that different pathophysiological mechanisms may be responsible for chest pain in females compared to males, and that traditional risk factors and standard diagnostic techniques may play an alternative role. Consistent with a previous study,12 we found that female gender was a major predictor of CorT.

MAC has been related to the severity of calcium deposition in the coronary vasculature.17-19 It has been associated with atherosclerosis in the coronary and carotid arteries and the aorta.20-22 HT is a major cardiovascular (CV) risk factor and has been independently associated with MAC.18,21

Qasim et al.24 reported that the association between HT and MAC on univariate analysis may be confounded by other CV risk factors. Female gender has been associated with the presence of MAC.24,25 Bhatt et al.26 reported that female gender was an independent predictor of MAC. MAC has been consistently linked with age and is considered a marker of senile degenerative changes in the heart.24,25,27-29

The present study was the first to evaluate the relationship between CorT and MAC. In our study, there was a significant association between MAC and CorT. Higher incidence of co-existence of MAC and CorT may be associated with both having the same predisposing factors, including HT, HL, female gender and advanced age. Further prospective and randomised studies with a larger number of patients are needed on this subject.

Our study has some limitations, first, the retrospective study design and second, the small sample size.

Conclusion

To the best of our knowledge, this study is the first to evaluate the relationship between CorT and MAC. We found a strong association between CorT and MAC. Further prospective, randomised studies with a larger number of patients are required to confirm the results obtained in this small study.

References