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Pathological and forensic implications of coronary dominance in patients with inferior ST-elevated myocardial infarction

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Abstract: Right and left circumflex coronary artery occlusions cause inferior myocardial infarction. Coronary artery dominance influences the amount and anatomic location of myocardium that is perfused. In patients with acute inferior ST-elevated myocardial infarction (STEMI) the impact ot coronary dominance on atherosclerosis progression is unknown. Our study evaluated the association between coronary dominance and STEMI related artery.
Key Words: coronary dominance, atherosclerosis, acute inferior ST-elevated myocardial infarction.

Knowledge about coronary artery anatomic variats is important in the interpretation and in the treatment of cardiovascular diseases, especially in myocardial infarction. There are 3 types of circulation dominance: right, left, and balanced. In STEMI patients limited information is available regarding the relationship between coronary dominance and prognosis.

Coronary artery dominance seems to be involved in pathophysiology of myocardial infarction. In patients with acute ischemic disease the rheological factors play an important role in relationship between the anatomic coronary variants and the extension of atherosclerotic involvement. The purpose of this study was to identify new aspects of coronary dominance in relation to significant coronary artery disease in inferior STEMI patients.

MATERIALS AND METHODS

The study population included 264 consecutive patients hospitalized with acute inferior STEMI, mostly males [74.6% vs. 25.4% females, $\chi 2 = 64.015$, $p < 0.0001$], mean age 58 (29 to 88) years.

The assessment of the extent of myocardial necrosis was based on the electrocardiogram (ECG) made on admission.

All STEMI patients underwent emergent coronary angiography. Depending on the the origin of the posterior descending artery, there are 3 types of circulation dominance: left, right and balanced. The type of dominance, significant coronary arterial diseases and coronary artery variations were recorded. We correlated angiographic findings of the culprit artery with coronary dominance.

RESULTS

The most frequent localization of myocardial infarction recorded in patients in the study group was the

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infero-postero-lateral (Figure 1), followed in descending order by locations : infero-posterior, inferior, infero-posterior and right ventricular (RV), inferior and RV, infero-postero-lateral and RV, infero-lateral and infero-lateral and RV [24.6% vs.23, 1% vs. 16.3% vs. 12.5% vs. 12.1% vs. 6.4% vs. 4.2% vs. 0.8%, $\chi 2 = 109.394$, $p < 0.0001$]. The RV impairment was recorded only about one third of patients [31.8% vs. 68.2%, $\chi 2 = 34.909$, $p < 0.0001$].

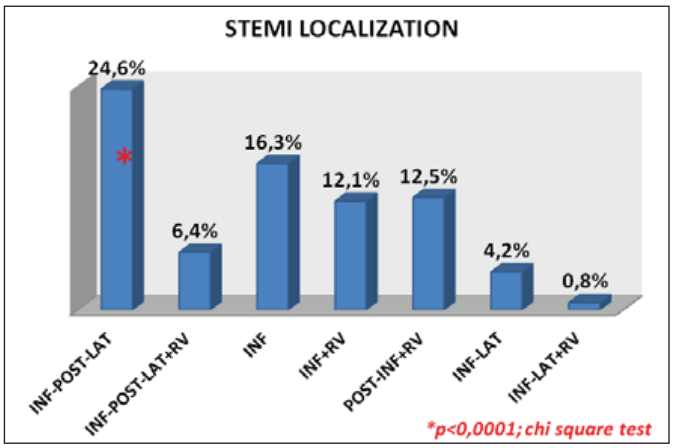

Figure 1. STEMI location in patients study (inf=inferior, lat=lateral, post=posterior, RV=right ventricular).

In study patients diagnostic angiography (Figure 2) indicated right dominance (right. - 90.2% vs. left. - 6.8% vs. codominant - 3%, $\chi 2 = 384.091$, $p < 0.0001$).

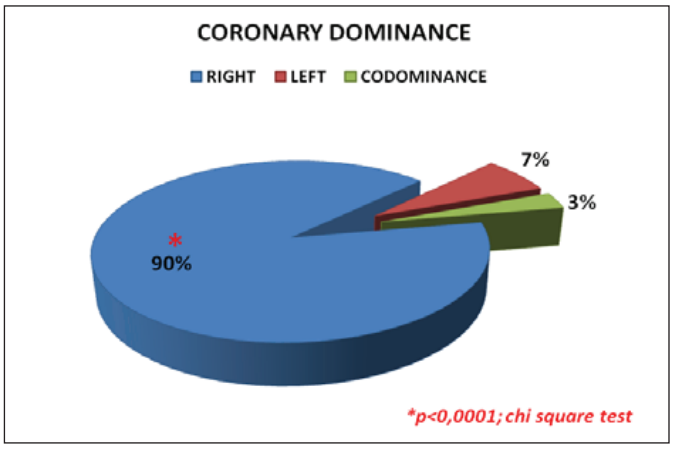

Figure 2. Coronary dominance.

The angiographic findings (Figure 3) indicated extent of vessel involvement (normal coronary-2,7% vs. single-vessel, 36.7% vs. bicoronarian 33.3% vs. tricoronarian 27.3%, $\chi 2 = 75.182$, $p < 0.0001$) with a single critical stenosis (mode = 1, median = 2, minimum = 0, maximum = 9). The presence of diffuse coronary atheromatosis was recorded in only less than 3% of patients in the study.

The culprit infarct artery (Figure 4) in most cases was the right coronary : anterior descending artery (AVA) - 7.9% vs. circumflex artery (CxA) -27.4% vs. right coronary artery (RCA) - 64.7%, $\chi 2 = 125.738$, $p < 0.0001$.

Most patients in which angiographic examination revealed the presence of right coronary

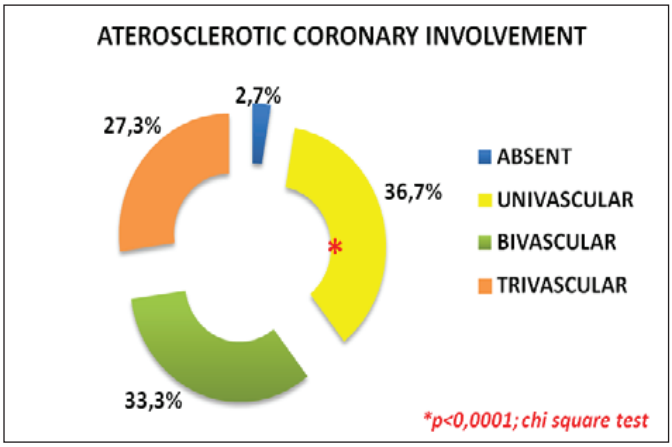

Figure 3. Aterosclerotic coronary involment.

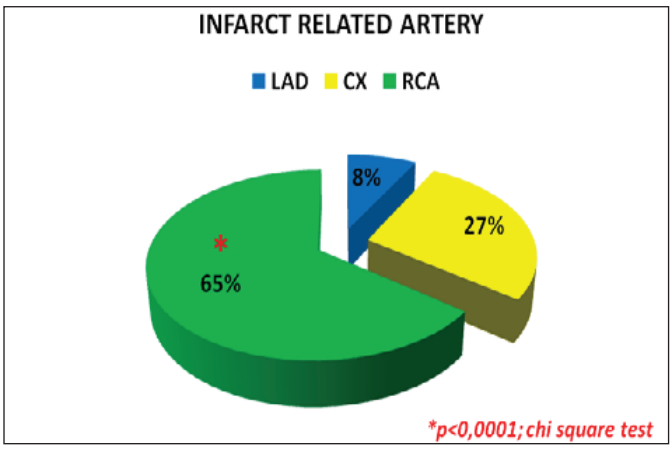

Figure 4. Infarct related artery.

dominance (Figure 5) were in the group with posterior inferior infarction (15.5% vs. 4.6% vs. 22.3% vs. 6.7% vs. 23.9% vs. 13.5% vs. 12.6% vs. 0.8%, $\chi 2 = 89.126$, $p < 0.0001$) and the highest proportion of patients with left dominance was recorded in infero-postero-lateral infarction [22,25 vs. 0% vs. 44.4% vs. 5.6% vs. 16.7% vs. 5.6% vs. 5.6% vs. 0%, $\chi 2 = 12.667$, $p = 0.027$] and the presence of circulation codominance was recorded in similar proportions (25% vs. 0% vs. 50% vs. 0% vs. 12.5% vs. 0% vs. 12.5% vs. 0% vs. $\chi 2 = 3$, $p = 0.392$).

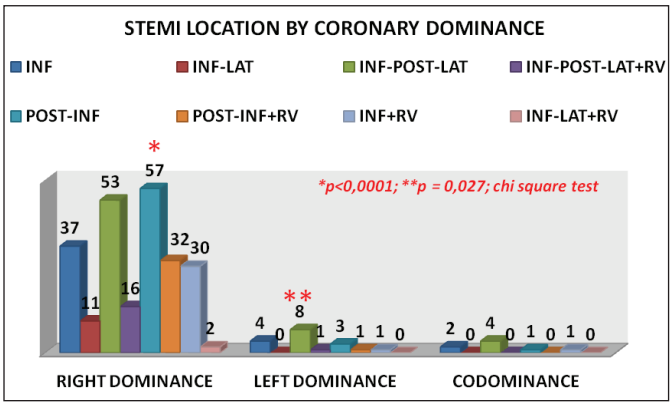

Figure 5. STEMI location by coronary dominance (inf=inferior, lat=lateral, post=posterior, RV=right ventricular).

The proportion of patients with right coronary dominance (Figure 6) was statistically significantly higher in the group in which the culprit artery was the

right coronary (AVA - 90% vs. CxA - 75.4% vs. RCA - 96.3%, $\chi 2 = 138.775$, $p < 0.0001$), whereas in the group of patients in whom the infarct artery was the circumflex showed a statistically significantly higher proportion of patients with left coronary dominance (AVA - 5% vs. CxA - 18.8% vs. RCA - 1.8%, $\chi 2 = 14.588$, $p = 0.001$) and presence of coronary codominance being recorded statistically similar proportions to the three groups of patients (AVA - 5% vs. CxA - 5.8% vs. RCA - 1.8%, $\chi 2 = 1.750$, $p = 0.417$).

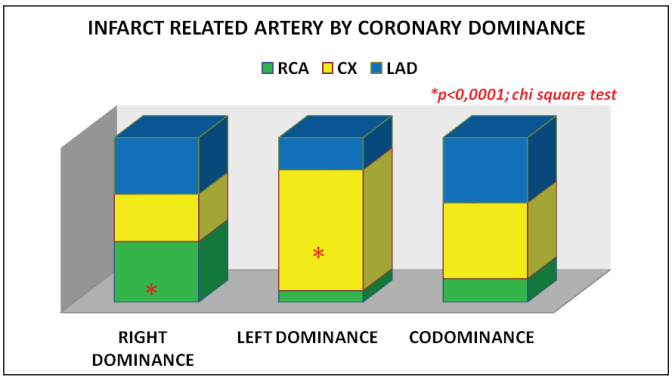

Figure 6. Infarct related by coronary dominance.

In patients with associated RV infarction (Figure 7) was recorded a statistically significantly higher proportion of right coronary dominance (87.9% vs. 95.2%, $p < 0.0001$) and in those without ECG signs of right ventricular myocardial damage was recorded a statistically significantly higher proportion of left coronary dominance and cominance (left dominance - 8.3% vs. 3.6%, $p = 0.005$, codominance - 3.9% vs. 1.2%, $p = 0.034$, binomial test).

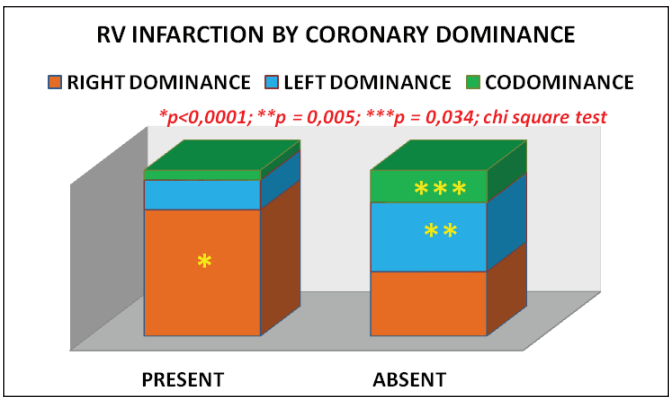

Figure 7. RV infarction by coronary dominace.

DISCUSSIONS

There are variations in the anatomy of the coronary arteries in patients with left, right or codominant circulation. The dominance of right circulation is common in about 87-89% of the general population. The rate of the dominance of left circulation for the general population is about 7-8% and the rate of codominance in the general population is around 4% [1].

Our study indicated that in our population of patients with inferior STEMI, right dominant circulation is more common than in the general population - right dominance was identified in 90.2% of patients, left dominance in 6.8% and 4% codominant.

Limited information is available regarding the relationship between coronary vessel dominance and prognosis. The influence of anatomical variations in STEMI patients is not clear.

The proportion of patients with right coronary dominance was statistically significantly higher in the group where the infarct-related artery was the right coronary artery, while the group of patients in which the infarct-related artery was the circumflex showed a statistically significantly higher proportion of left coronary dominance and the presence of coronary codominance was recorded in statistically similar proportions to the three coronary.

The association between coronary dominance and STEMI related artery has not been mentioned so far in various published studies. Rheological factors seem also to be involved in the coronary pathogenesis of myocardial infarction.

The explanation could be the character of the dominant coronary blood flow, which is strong and generates a high pressure in the coronary wall, enough to represent the initiation signal of atherosclerosis. Intimal damage is related to shear stresses because endothelial cell damage occurs at high shear rates.

A recent study showed that coronary artery dominance has an impact on coronary blood flow volume in the left circumflex and right coronary arteries [2]. Locally hemodynamic flow variations could be associated with progressive atherosclerosis.

In a autopsy cohort slightly higher risk of mortality in case of left versus right coronary artery occlusion has been reported [3]. At the same time, in patients with significant coronary artery disease referred for computed tomography coronary angiography the presence of a left dominant system was identified as an independent predictor of all-cause mortality [4]. Increased mortality in acute coronary patients with left dominance has also been reported in a large angiography study [5].

But only the extent of coronary atherosclerosis does not depend on the type of dominant coronary circulation [6]. The relationship between coronary vessel dominance and prognosis appears to occur in patients with acute coronary syndrome.

CONCLUSIONS

Our study indicates the association between coronary dominance and culprit related artery in inferior STEMI patients. Understanding coronary artery variations has a great clinical importance in the interpretation of angiography findings and in planning the treatment of cardiovascular ischemic diseases.

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