Morphofunctional aspects of left coronary artery dominance: a case report

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ABSTRACT

Anatomical studies of the coronary arteries began in the eighteenth century. However, the concept of dominance was only established in 1940, being initially purely anatomical. Currently, this concept involves several morphofunctional aspects, being essential for the understanding of the clinical presentations in cardiovascular patients. This article aims to discuss a case of left coronary dominance associated with risk factors such as hypertension, obesity and diabetes, but with less severe clinical presentations than those predicted in the literature, highlighting the importance of knowledge in clinical practice.

Keywords: coronary dominance, heart anatomy, myocardial infarction, coronary circulation

INTRODUCTION

The study and description of the cardiac vessels began with the French physician Raymond de Vieussens, in 1706, with the publication of “Nouvelles Découvertes sur le Coeur”. The publication was expanded in 1715 in the “Treaty of Heart”, in which the author details the coronary arteries, the pericardium and the muscle fibers of the heart. One year after the report of the anatomy of coronary vessels, Adam Thebesius portrayed the first anomaly in the coronary anatomy when reporting a case of the only heart-nourishing vessel. In 1747, Winslow described communications of the interventricular branches at the apex of the heart. This subject was neglected due to the lack of practical application of these studies together with the difficulty in examining corpses, due to multiple restrictions. The interest only returned when the relationship between atherosclerosis and cardiac vessels was established [1-4].

Two centuries after the publication of the first report, this subject sparked interest when, in 1931, a group led by Ehrich conducted anatomical and histological studies describing the pathways of the coronary arteries and morphological changes due to age. They observed that right coronary artery, in some cases was small and ended at the posterior surface between the right margin and the crux cordis, while in other cases the right coronary artery was longer and ended at the left margin [1].

With the end of the restrictions in dissections and well established medical correlations, Rosthoi injected contrast material into the ascending aorta of a rabbit, obtaining partial opacification and observing for the first time the coronary circulation in a living mammal. In 1945, the Swedish Radner also made great progress in the angiographic study with the application of Egas Moniz techniques, obtaining total opacification of the coronary arteries. Sporadic interventions in the coronary arteries are performed between 1962 and 1967, and a pioneer intervention was the use of the saphenous vein for the treatment of coronary obstructions performed in 1967 by René Favaloro [5-7].

Parallel to coronary angiography in the 1940s, Schlesinger introduced the concept of coronary dominance. The concept brought by the author is based on the artery supplying the crux...
Left coronary dominance

cordis, stating that there are three types of dominance: left, right and balanced. According to his criteria, left dominance is determined when the posterior interventricular branch originates from the circumflex artery; right dominance is given when the right coronary artery originates branches to the left ventricle; and balanced when the right and left coronary arteries reach the crux cordis, not surpassing it, and the posterior interventricular branch is originated from the right coronary artery [1, 7-10].

The concept that was closely linked to the origin of the posterior descending artery (also known as the posterior interventricular branch) was updated, requiring the determination of the dominance to elucidate the origin of the posterolateral artery. However, current literature still needs to evaluate the length of the right and circumflex arteries, as well as the relationship with other marginal branches, the presence of the artery at the apex of the heart and the length of the anterior descending artery (even if the anterior interventricular branch) [1, 7-10].

The right dominance is the most prevalent in the population, being present in 75% of the cases, while left dominance is present in approximately 15% of the reports, being indirectly related to a higher preponderance of deaths in cases of acute myocardial infarction and atherosclerosis. The other 10% of hearts exhibit balanced dominance [1, 7-9].

In this scenario, sparing liver surgery has been a consensus among the various centers [3-6]. In addition to reducing the possibility of liver dysfunction, it also increases the chance of future new resections in case of recurrences, which occur between 60-70%. However, in certain situations parenchymal sparing surgery may be challenging in view of the location of metastasis, such as, for example, in between the confluence of the hepatic veins.

A study carried out by Abu-Assi et al. in a retrospective analysis of 767 patients detected 80.9% of right coronary dominance and 8.6% of left dominance, while 10.5% of cases were of balanced dominance. Mortality was observed for right, left and codominance, respectively, of 7.1%, 36.4% and 13.8%. The same study demonstrated a large association of left dominance with mortality, showing a hazard ratio of 1.76. In addition to the risk of death, an association with reinfarction was also observed [11].

As such, the present work aims to analyze the morphofunctional aspects of left coronary dominance and its relationship to ischemic myocardial cardiopathy in a patient with metabolic syndrome.

CASE REPORT

A 52 years old patient presented to our service. He referred smoking and sedentary habits, along with diabetes, hypertension. He weighted 113 kg and had a 175 cm height (BMI of 36.96 - grade II obesity). Due to his condition and blood workup, he was promptly diagnosed with metabolic syndrome.

During a routine cardio test, the patient had a heart rate of 162 bpm, a cardiac output of 22.87 (ref. 17.66) and maximum blood pressure of 240x80 mmHg.

The ECG during exercise revealed a ST segment depression of 1.0 to 1.5 mm in D2, D3, aVF, V4, V5, V6. Stress images showed alterations equivalent to 8.8% of left ventricular muscle mass, 5.9% being of ischemic pattern. There was evidence of transient perfusion deficit (ischemia) in a discrete degree at the apex and a persistent perfusion deficit in the mid-basal extension of the inferior wall. During coronary exploration, lesions were found compromising 50% of the origin of the circumflex artery, 40% of the middle third and 90% of the distal third; a 20% lesion was identified in the distal third of the left coronary trunk; of 50% of the marginal branch of the circumflex artery and diffuse atheromatosis with lesions of 70% in the middle third of the anterior descending artery.

Coronary circulation with an obstructive triarterial pattern was identified. Ventriculography showed preserved ventricular contractility. Percutaneous transluminal angioplasty was performed with a pharmacological stent implant (Resolute Integrity™, 3.0 x 12 mm) in the marginal branch of the circumflex artery and a pharmacological stent (Endeavor Resolute®, 3.0 x 15 mm) in the circumflex artery.

One year later, a segmental lesion was identified in 90% of the circumflex artery, and
segmental mid-distal lesion was found in 80% of the posterior interventricular branch. Coronary angiography did not show obstruction. Percutaneous transluminal angioplasty was performed with a pharmacological stent implantation (Resolute Integrity™, 2.25 x 22 mm).

**DISCUSSION**

The coronary arteries present a large number of anatomical variations, making it impossible to describe a universal pattern and making it necessary to perform coronary angiography examinations to determine anastomoses before performing a surgical intervention [1].

The anatomical knowledge, in the current integral perspective of health, is necessary for the understanding of the diverse clinical manifestations of ischemic heart disease. Knowledge of coronary arteries and dominance has become imperative. It is necessary to determine the number of branches, location and irrigated portion. This information influences the therapeutic preference, as well as cardiac surgeries, hemodynamic procedures, and helps to treat arrhythmias resulting from coronary occlusions, thus allowing the professional to decide for minimally invasive or conservative treatment, according to the associated risk. Coronary artery bypass surgery, for example, should certainly be preceded by minute analyzes of angiographies that determine the pattern of dominance and its impact on the clinical picture [1, 12].

The heart is vascularized by the left coronary artery, which originates the anterior interventricular branch (gives origin to the septal branches; the circumflex artery (gives origin to the lateral branches and terminates at the cardiac apex); and the right coronary artery, which originates atrial and ventricular branches, the atroventricular branches, the right marginal artery, the posterior interventricular artery and the posterior septal branches, ending in the diaphragmatic surface of the heart [1].

In the pattern of left dominance, the left coronary trunk is seen originating from the left aortic sinus, passing posterior to the pulmonary trunk, following a craniocaudal path, giving rise to the anterior descending artery and the circumflex artery. The anterior descending artery will continue to the left atrium until it reaches the anterior interventricular sulcus. The circumflex, in turn, passes beneath the left atrium, reaching the left atrioventricular sulcus, originating the posterior descending artery and, in exceptional cases, the terminal branch that reaches the crux cordis. As such there is a massive dependence on the cardiac muscle tissue of the left coronary artery [2, 13].

Left coronary dominance can be further subdivided into three subgroups determined by Didio and Wakefield in 1975. In subgroup I, the right and left coronary arteries reach the crux cordis and terminate with parallel posterior interventricular branches. The subgroup II is characterized by irrigation of the left ventricle and interventricular septum by the left coronary artery, with only one posterior interventricular branch originating from the circumflex branch, originating from the left coronary artery. Subgroup III occurs when the left coronary artery originates the right posterior ventricular branches, vascularizing the left ventricle, the entire interventricular septum area and part of the posterior wall of the right ventricle [12]. In Brazil, however, no publications were found corroborating or using the classification.

It was observed that the patient presented an anterior descending artery that exceeded the apex of the heart, while the diaphragmatic face being irrigated by branches of the circumflex artery, posterior descending artery and marginal artery (Figure 1).
Left coronary dominance

This arterial pattern allows identifying the pattern of left coronary dominance, which irrigates the left inferior and posterolateral side of the left ventricle. Together with the new criteria established by the literature, especially the number of branches and their length it is possible to determine this pattern.

In the imaging studies, the patient presented several arterial ramifications, which is known to be a protection factor in relation to ischemic complications. Left dominance influenced the absence of symptoms of ischemic heart disease and the detection of electrocardiographic changes only in effort, even in the cases of major obstructions.

The case presented herein does not configure the majority of cases described in the literature, as most of the patients present a less complex ischemia, higher mortality and more severe conditions for the pattern of left dominance. This dominance is also known as the pattern of the sudden death artery, since there is a large portion of the heart dependent on a single vessel and patients with this pattern are more prone to have atherosclerosis [2].

CONCLUSION

The morphofunctional aspect is essential to understand the patient's condition and its prognosis. The case illustrates the influence of anatomy in the practice of medical practice as related and essential subjects. It also allowed discussion of the classic concept of coronary dominance and its modern perspectives.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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REFERENCES

RESUMO

Aspectos morfofuncionais da dominância coronariana esquerda: relato de caso

O estudo da anatomia das artérias coronárias se iniciou no século XVIII, entretanto, o conceito de dominância só foi estabelecido em 1940, sendo inicialmente puramente anatômico. Atualmente este conceito envolve diversos aspectos morfofuncionais, sendo essencial para a compreensão das apresentações clínicas de pacientes cardiovasculares. Este artigo se objetiva por discutir o quadro de paciente cardiopata, com dominância esquerda, portador de fatores de risco, como hipertensão, obesidade e diabetes, porém, com apresentações clínicas menos graves do que as previstas na literatura, ressaltando-se a importância do conhecimento anatômico na prática clínica.

Palavras-chave: dominância coronariana, anatomia do curacao, infarto do miocárdio, circulação coronariana