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Most common anatomic anomalies of coronary arteries

Alterações anatômicas coronarianas mais frequentes

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ABSTRACT – **Background:** Coronary artery anomalies represent an array of malformations of the vessels responsible for myocardial perfusion, with a prevalence of 1% in the general population. Mostly asymptomatic, they are diagnosed during routine tests. When symptomatic, they are the second major cause of sudden death in young athletes. Our study aimed to assess the most commonly found coronary vessel anatomic anomalies during cardiac catheterization procedures. **Methods:** An analytic cross-sectional study was performed assessing the medical charts of patients submitted to cardiac catheterization during the second semester of 2018. A total of 782 medical charts were analyzed, representing all patients submitted to cardiac catheterization. We performed an epidemiological description of the sample that comprised the following parameters: age, sex, dominance pattern, presence/absence of anomaly and anomaly classification. **Results:** From the charts analyzed, 86 (10.99%) showed anomalies. Fifty-one patients (59.3%) were male and the most frequent anomaly was myocardial bridging of left anterior descending coronary artery, found in 66 patients (88.37% of total anomalies). **Conclusion:** We found a two-fold anomaly prevalence when comparing to data reported in previous studies. Corroborating most studies, we found myocardial bridging of the left anterior descending coronary artery as the most frequent anomaly.

Keywords: Coronary vessel anomalies; Coronary angiography; Cardiac catheterization

RESUMO – **Introdução:** As anomalias coronarianas correspondem a um grupo de malformações nos vasos sanguíneos responsáveis pela irrigação miocárdica, com prevalência de cerca de 1%, cada uma, com relação à população geral. Grande parte é assintomática, tendo diagnóstico a partir de achados em exames casuais. Quando são apresentados sintomas, é a segunda maior causa de morte súbita em jovens atletas. O objetivo deste estudo foi investigar as alterações anatômicas coronarianas mais frequentes em procedimentos de cateterismo cardíaco. **Métodos:** Realizamos um estudo transversal analítico, por meio da avaliação de prontuários de pacientes submetidos a cateterismo cardíaco durante o segundo semestre de 2018. No total, foram avaliados 782 prontuários, sendo incluídos todos os pacientes que passaram por cateterismo cardíaco. Elaboramos o perfil epidemiológico, diferenciando os seguintes dados: idade, sexo, padrão de dominância, presença/ausência de anomalia e tipo. **Resultados:** Dos prontuários analisados, 86 (10,99%) apresentavam alguma anomalia. Eram do sexo masculino 51 pacientes (59,3%), e a anomalia mais frequente foi o trajeto intramiocárdico da artéria descendente anterior, em um total de 66 pacientes (88,37% do total de anomalias). **Conclusão:** Foi encontrado aproximadamente o dobro das prevalências relatadas em outros estudos. O trajeto intramiocárdico de artéria descendente anterior foi a anomalia mais encontrada, concordando com a maioria dos estudos.

Descritores: Anomalias dos vasos coronários; Angiografia coronária; Cateterismo cardíaco

BACKGROUND

Congenital coronary artery anomalies occur when the origin of the coronary at the aorta is not appropriately established and can lead to abnormal origin in the coronary sinus, one coronary becoming a branch of another, or still, the coronary origin in the pulmonary trunk. The anomalous implanting site may or may not result in a symptomatic disorder depending on the conditions to which the anomalous vessel is submmitted.[1,2] According to Angelini et al.,[3] coronary anomaly (CA) is defined as the variation observed in less than 1% of population.

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Cardiac catheterization (CC) has diagnostic (angiography) and therapeutic (angioplasty) goals, and is considered the gold standard to identify coronary artery disease (CAD). Coronary angiography can assess the anatomic-morphologic features of coronary arteries to ascertain the presence of severe obstructive lesions (>50% of stenosis) and the degree of CAD (number of affected vessels), and to assess systolic ventricle function.[4]

The right coronary artery usually originates from the right coronary sinus. The left main coronary artery originates from the left coronary sinus, crosses the pulmonary trunk posteriorly, and bifurcates into left anterior descending and left circumflex arteries.[5] There are also anatomic variations. For instance, in approximately 37% of individuals the left main coronary artery trifurcates into left anterior descending artery, left circumflex artery and ramus intermedius supplying the free lateral wall of the left ventricle. However, these anatomic variants are not described as anomalous, since their incidence in the population is over 1%.[3,6]

The current most accepted classification of coronary anomalies is based on morphology. The anomalies can be of origin and course, intrinsic, and of termination.[3] Some authors include hemodynamic criteria, dividing coronary anomalies into stable and unstable. Hemodynamically, unstable anomalies comprise anomalies of origin with intra-arterial course; and those with anomalous origin, from the pulmonary artery, atresias, and congenital fistulas.[7]

CA can also be classified as benign or malignant, according to the likelihood of eliciting coronary disease, and, additionally coursing asymptomatically throughout several years, progressing to a sudden event during stress, massive physical effort, or even without a clear cause. As a consequence, CA are considered the second major cause of sudden death in young athletes and can also be associated with acute myocardial infarction (MI) and/or arrhythmia in this specific population.[8]

Ischemic myocardial injuries are usually associated with adult patients. However, in the presence of malignant CA, even the pediatric population can present myocardial ischemic injury, for instance a coronary artery with anomalous origin from the aorta. Thus, CA are among the major differential diagnoses for dilated cardiomyopathy in the pediatric population. Its early diagnosis can be identified by tricuspid valve papillary muscle ischemia on echocardiography. [9]

Studies have shown that patients with CA require dedicated management and surgical risk stratification. Noninvasive imaging tests, complementing invasive tests help identify additional features associated with high risk. However, coronary anomalies are usually diagnosed after a coronary artery event, and there is no screening method with a feasible cost-benefit ratio. Besides, the pathophysiological correlation between CA and coronary artery events is still not clear, corresponding to an epidemiological description.[10,11]

The objective of the study was to study the most common anatomical anomalies observed during cardiac catheterization procedures.

METHODS

A cross-sectional descriptive study analyzed the medical charts of patients admitted to the Coronary Care Unit of the Cardiology Department of *Hospital da Cruz Vermelha Brasileira* - Paraná unit, in the city of Curitiba, to be submitted to cardiac catheterization after diagnosis of acute MI, from July 2018 to December 2018. We included patients with acute MI submitted to cardiac catheterization. No patient was excluded from the study because all patients admitted to the Coronary Care Unit of the hospital had an acute MI. Thus, we assessed all patients admitted and separated those with coronary anomalies.

The sample comprised 782 medical charts and the following data were collected: age, sex and type of anatomic anomaly. Statistical analysis of all data was performed using the chi-square test. We checked with the cardiology care team the reports of cardiac catheterizations of patients admitted to the Coronary Care Unit during one month.

Finally, we searched the PubMed® database for studies assessing the prevalence of coronary anomalies in order to compare them with the results obtained in our study.

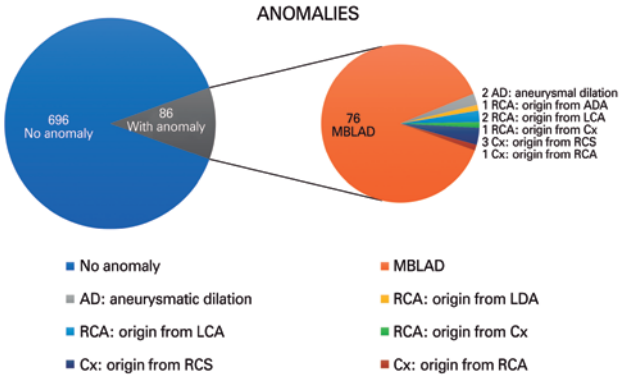
The study was analyzed and approved by an Research Ethics Committee (opinion number 3.635.671; CAEE: 21854919.6.0000.0093).

RESULTS

During the period of analysis, 782 coronary artery angiographies were performed. Of these, 86 (10.9%) showed coronary anomalies, and 51 (59.3%) of these patients were male. There was no significant statistical difference between sexes for patients showing CA (p=0.746). After excluding myocardial bridging of the left anterior descending coronary artery (MBLAD), three female and seven male patients remained, and no significant statistical difference was found (p=0.427). Forty patients (46.5% of sample) were aged ≥60 years, one (1.1%) was under 30 years, and the mean age was 59.2 years.

Of patients with anomaly, 76 (88.4%) presented MBLAD, accounting for 9.7% of 782 angiograms assessed. Regarding coronary artery dominance, seven patients were left-dominant (8.1%), five co-dominant (5.8%) and the remaining 74 (86%) right-dominant.

Figure 1 shows the results in proportions and table 1 describes the epidemiological pattern of the anomalies found.



MBLAD: myocardial bridging of left anterior descending artery; LAD: left anterior descending artery; RCA: right coronary artery; LCA: left coronary artery; Cx: left circumflex artery; RCS: right coronary sinus.

Figure 1. Proportionality of coronary anomalies.

Table 1. Epidemiologic pattern of coronary anomalies

Anomaly	Dominance (RCA/LCA/ co-dominant)	Female	Male	Total
RCA: origin from LCA	1/1/0	0	2	2
RCA: origin from LDA	1/0/0	1	0	1
RCA: origin from Cx	1/0/0	0	1	1
Cx: origin from RCS	3/0/0	1	2	3
Cx: origin from RCA	1/0/0	1	0	1
MBLAD	66/5/5	32	44	76
AD: aneurysmal dilation	1/1/0	2	0	2

RCA: right coronary artery; LCA: left coronary artery; LAD: left anterior descending artery; Cx: left circumflex artery; RCS: right coronary sinus; MBLAD: myocardial bridging of left anterior descending artery.

DISCUSSION

The prevalence of coronary artery anomaly is a subject of intense debate, for there is no clear definition for what can or cannot be considered an anomaly. Several studies only consider anomalies of origin and course, based on the Angelini et al. classification[3], or only disregard MBLAD as anomaly.[12-19]

In addition, there are studies that use their own classification,[20-23] making it challenging to compare data unless one performs a re-analysis of the results using the same classification.

We chose the Angelini et al. classification[3] since we consider it the most comprehensive as compared to other established classifications[24,25] that have been used in previous studies.[26-29] The prevalence of anomalies in our study was 10.9% (86/782), of which 78 were intrinsic anomalies and the remaining eight (1.02%) were anomalies of origin and course. We did not find anomalies of termination or of anastomosis.

Overall, we analyzed 19 articles addressing the prevalence of CA that were performed between 1956 and 2016, four in the United States, six in Europe, four in Asia and five in the Middle East. The prevalence found in each study is described in figure 2. Several classifications of CA were used: nine studies used Angelini et al.[3], but five modified the classification; six proposed their own classification and four used the Yamanaka and Hobbs classification[25].

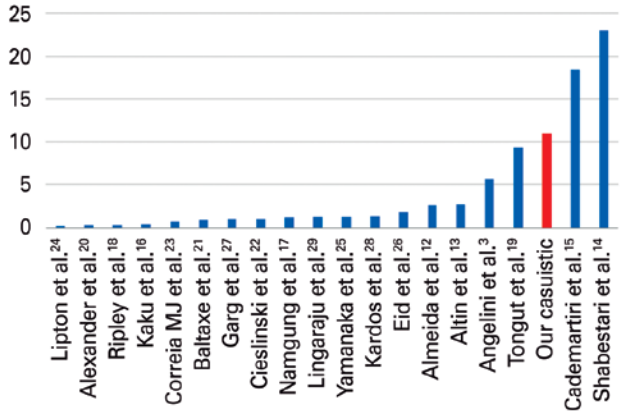


Figure 2. Prevalence of coronary abnormalities.

Yamanaka and Hobbs' classification[25] was the second most used classification. It differs from the classification proposed by Angelini et al.[3] because it does not classify CA in groups, but describes each anomaly, and eliminates the possibility of including new anomalies not previously described. Probably, that explains why the studies that have used this classification have reported a lower mean prevalence.[25]

Shabestari et al.[14] reported a prevalence of 23%, the highest described. The study assessed a sample of 2,697 individuals and was performed in Iran, in 2012, using the classification of Angelini et al.[3] The study by Lipton et al.[24] reported the lowest prevalence, assessed a sample of 438 individuals and described a prevalence of 0.2%. It was performed at former Yugoslavia, in 1979, presently Serbia, using a classification designed by the auhors.[14,24]

According to previous publications, our sample showed higher occurrence of intrinsic anomalies, with MBLAD accounting for most of this CA type. Prevalence of anomalies of origin and of course was 1.02%, similar to what has been reported in other studies.[14, 19]

MBLAD, a 9.7% prevalence in our study, was considered a normal anatomic variant in other studies. When this anomaly is excluded, the prevalence of CA found in our study decreases to 1.27%, showing that, when such anomaly is considered, the result of the study can change. Given the

range of values for the prevalence of this anomaly in all studies analyzed, including ours, it was not possible to estimate whether the results corresponded to the prevalence in the general population. This indicates the importance of using a single CA classification by all researchers.

However, it is unclear why the prevalence of anomalies was higher in our study when compared to other similar studies. The main hypothesis is that there is a higher prevalence of CA in the Brazilian population, but this hypothesis is still difficult to confirm, since studies of this type in Brazil are scarce.

To better elucidate this issue, further research is desirable in other Brazilian centers. On the other hand, anomaly diagnostic tests (cardiac catheterization and coronary angiography) are expensive and invasive and are, therefore, used only in patients with significant cardiovascular events. Therefore, all studies performed for CA detection may not reflect the actual prevalence of these anomalies in the general population.

CONCLUSION

In our single center study, carried out for 6 months, the prevalence of coronary anomalies was higher than in most published studies, with more than half anomalies in males, and myocardial bridging of the left anterior descending artery being the most frequent anomaly. Among prevalence studies, those that used the Angelini et al. classification or a variation of it had a higher proportion of CA, mainly related to the incidence of myocardial bridging of the left anterior descending artery, when it was considered. Multicenter studies are needed to establish a general prevalence in the population.

SOURCE OF FINANCING

None.

CONFLICT OF INTEREST

The authors declare there are no conflicts of interest.

CONTRIBUTION OF AUTHORS

Conception and design of the study: LDSS; data collection: DDBS, LDSS, LBS; data interpretation: ACR; writing of the text: DDBS, LDSS, LBS; approval of the final version to be published: ACR.

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