Right coronary artery anomaly originating in the contralateral sinus of Valsalva interpreted by the angiographic rapid identification method

Fernando Roberto de Fazzio, Fernando Matheus, Carlos M. Campos, Adriano Ossuna Tamazato, Gabriel Dodo Buchler, Santiago Raul Arrieta, José Mariani, Pedro A. Lemos

Serviço de Hemodinâmica e Cardiologia Intervencionista, Instituto do Coração, Faculdade de Medicina, Universidade de São Paulo, São Paulo, SP, Brazil.

ABSTRACT

Background: This study aimed to determine the correspondence between the anterior dot sign at the angiography and the malignant interarterial course, defined by the gold standard coronary angiography (angio-CT), in individuals with right coronary artery originating in the contralateral sinus of Valsalva.

Methods: This was an observational, retrospective, and single-center study. All individuals who had both coronary angio-CT and invasive coronary angiography (ICA), and a diagnosis of right coronary artery anomaly originating in the contralateral sinus of Valsalva were screened. ICA images were retrieved and analyzed for angiographic findings, searching for the presence of the anterior dot sign, characteristic of the interarterial course.

Results: Between January 2010 and April 2015, 1,410 patients who underwent angio-CT and ICA were identified. Of these, 13 patients (0.92%) had a diagnosis of right coronary anomaly originating in the contralateral sinus of Valsalva. The mean age was 59.6 ± 18.3 years, and 61.5% were males. In all 13 cases, the right coronary artery originating in the left coronary sinus showed an interarterial course (between the aorta and the pulmonary trunk) at the angio-CT. In all cases with appropriate acquisition (9/13), the ICA showed the presence of the anterior dot sign.

Conclusions: The presence of the anterior dot sign at the ICA confirmed the interarterial course of the right coronary artery originating in the contralateral sinus of Valsalva.

© 2017 Sociedade Brasileira de Hemodinâmica e Cardiologia Intervencionista. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Anomalia da artéria coronária direita com origem no seio de Valsalva contralateral interpretada pelo método de identificação rápida angiográfico

RESUMO

Introdução: O objetivo deste trabalho foi determinar a correspondência entre o sinal angiográfico dot anterior e o trajeto interarterial maligno, definido pelo padrão-ouro por meio de angiotomografia coronária (angio-TC), em indivíduos com coronária direita com origem no seio de Valsalva contralateral.

Métodos: Estudo observacional, retrospectivo, unicêntrico. Foram rastreados todos os indivíduos que possuíam simultaneamente angio-TC de coronárias e angiografia coronária invasiva (CINE), e que tinham diagnóstico de anomalia da artéria coronária direita com origem no seio de Valsalva contralateral. As imagens de CINE foram recuperadas e analisadas para avaliação dos achados angiográficos, buscando-se presença do sinal dot anterior, característico do trajeto interarterial.

Resultados: Entre janeiro de 2010 e abril de 2015, foram identificados 1.410 pacientes que possuíam angio-TC e CINE. Destes, 13 pacientes (0,92%) apresentaram o diagnóstico de anomalia da coronária direita com origem no seio de Valsalva contralateral. A idade média foi de 59,6 ± 18,3 anos, e 61,5% eram do sexo masculino. Em todos os 13 casos, a artéria coronária direita com origem no seio coronário esquerdo apresentava trajeto interarterial (entre a aorta e o tronco pulmonar), pela angio-TC. Em todos os casos com aquisição apropriada (9/13), a CINE apresentava o sinal do dot anterior.

Conclusões: A presença do sinal dot anterior à CINE confirmou o trajeto interarterial da artéria coronária direita com origem no seio de Valsalva contralateral.

© 2017 Sociedade Brasileira de Hemodinâmica e Cardiologia Intervencionista. Este é um artigo Open Access sob a licença de CC BY-NC-ND (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Introduction

Coronary artery course anomalies occur in less than 1% of the population. In most cases, the presence of anomalies does not correspond to clinical manifestations or major prognostic implications. However, the subgroup of patients with anomalous coronary arteries originating in the contralateral sinus of Valsalva and with an interarterial course (coronary trajectory between the aorta and the pulmonary trunk) appears to be more prone to arrhythmias, myocardial infarction, syncope, and sudden cardiac death. In the United States, this condition is the second leading cause of sudden cardiac death among young athletes and the leading cause among military recruits. Although it is difficult to estimate its exact prevalence, published data suggest that the incidence of this malignant anomaly ranges from 0.1 to 1.07%. It is estimated that the right coronary anomaly originating in the contralateral sinus of Valsalva is 6 to 10-fold more common than that of the left coronary artery, also being more prevalent among the Japanese.

In the past, angiographic methods were proposed to allow the diagnosis of such origin and course anomalies. The so-called dot-and-eye method assumed that contrast-enhanced radiographic impressions in the right anterior oblique view ("dot" sign), when present at the anterior or posterior border of the aorta, respectively diagnosed the interarterial or retroaortic course of the coronary vessel. Similarly, the eye-shaped image could determine the pre-pulmonary and septal courses.

However, after the advent of coronary angiography (angio-CT), this method has become more prominent in this scenario, and it is the exam of choice for the precise definition of the origin and course of coronary anomalies.

Interestingly, there are no conclusive studies in the literature to date that validate the traditional angiographic dot-eye method versus the current gold standard, coronary angio-CT. Such validation is clinically relevant, since in a significant number of cases the diagnosis of coronary anomaly occurs incidentally during cardiac catheterization (invasive coronary angiography - ICA), without previous diagnosis or suspicion. The main objective of this study was to determine the correspondence between the anterior dot angiographic pattern and the interarterial course defined by coronary angiography in individuals with right coronary artery originating in the contralateral sinus of Valsalva.

Methods

This was an observational, retrospective, single-center study carried out in a high-complexity, tertiary Cardiology service. The research was based on database analysis and chart review.

Study population

The database of the Cardiology Service of Instituto do Coração of the Hospital das Clínicas de Medicina of Universidade de São Paulo (USP) was searched with the assistance of the Medical and Hospital Information Unit, and all individuals who simultaneously had angio-CT and ICA with a diagnosis of anomalous right coronary artery originating in the contralateral sinus of Valsalva at the angio-CT were selected.

Data collection and image analysis

All reports and original images of angio-CT were retrieved and reviewed to confirm the anomalous coronary artery origin and course, and new reconstructions were performed when necessary. All ICA images were retrieved and analyzed to evaluate the angiographic findings. Particularly, as previously described by Serota et al., angiographic projections in the right anterior oblique view were carefully analyzed to assess the presence of the anterior dot sign, characteristic of the interarterial course (Figure 1).

Results

Between January 2010 and April 2015, 1,410 patients who underwent to angio-CT and ICA were identified. The individual evaluation of each of the charts, through the electronic medical record system, resulted in the selection of 13 patients (0.92%) with a diagnosis of anomalous right coronary artery originating in the contralateral sinus of Valsalva.

Of the 13 patients that comprised the present study population, 8 (61.5%) were males and 12 (92.3%) were Caucasian. The mean age was 59.6 ± 18.3 years, ranging from 27.9 years to 95.1 years.

In all 13 cases, the right coronary artery originating in the left coronary sinus presented an interarterial course (between the aorta and the pulmonary trunk) at the angio-CT. Of these, four cases did not have ICA with ventriculography or aortography in the right anterior oblique view. In the remaining nine cases, in which such projections were systematically performed, the anterior dot was present.

Of the total number of patients, six (46.2%) remained in clinical treatment, two cases (15.4%) underwent percutaneous coronary intervention with stent implantation, one case (7.7%) was treated surgically with reimplantation of the right coronary artery, and four cases (30.8%) were submitted to surgical revascularization with grafting to the right coronary artery (Figure 2).
The terminology “origin” might have been used in an inappropriate way, since more recent studies on coronary embryology report the ingrowth theory, in which the coronary artery would develop from a tangle of epicardial vessels, and its proximal portion would fuse in the peritruncal ring. However, as observed in the present study, most individuals with right coronary artery originating in the left sinus have an interarterial course. The main high-risk characteristics of this type of anomalous coronary course are lateral luminal compression of the intramural portion of the anomalous vessel, coronary compression between the aorta and the pulmonary artery, slitlike orifice, and origin with acute exit angle. Furthermore, these arteries have an intramural course (defined histologically by the coronary artery sharing the same media with the aorta, without adventitia interposition). Although established, the explanation of a scissors-like mechanism, created by the close proximity of the aorta and pulmonary artery, especially during exertion, is still controversial.

Several risk stratifications have been suggested, including non-invasive assessment using provocative stress tests (myocardial scintigraphy, echocardiography), analysis of angiotomographic anatomic criteria, or even through measurements obtained by the intravascular ultrasound (IVUS) and fractional flow reserve (FFR) values associated with dobutamine infusion; however, all methods present limitations.

Although the surgical treatment for the correction of coronary artery anomalies with an interarterial course is almost a consensus among specialists, even without specific guidelines to guide such management, the best way of managing cases of malignant coronary anomalies is not well defined, especially in asymptomatic individuals. Among the several surgical techniques the unroofing procedure can be highlighted representing the strategy of choice when there is an intramural component of the initial course; reimplantation; coronary artery bypass grafting surgery using venous or arterial grafts; pulmonary artery translocation; and the creation of a new ostium.

Conservative treatment is recommended by some authors in situations of negative results in provocative tests after drug treatment implementation (commonly with beta-blockers). More recently, percutaneous coronary intervention has been presented as an alternative technique to the limitations and risks of the surgical procedure, with good results described in the short-term follow-up.

The use of drug-eluting stents and a careful selection of the guidecather, together with other devices that provide greater therapeutic support, and a IVUS-guided procedure, can contribute to maintain long-term success.

Study limitations

This was an observational, pioneering study analyzing a series of cases with a rare coronary anomaly using two methods of cardiovascular imaging. However, its retrospective nature, based on database information and patient files, as well as the small number of patients, does not allow drawing definitive and comprehensive conclusions on the subject, and further studies with a larger number of individuals are required.

Conclusions

The presence of the anterior dot sign on the coronary angiography confirmed the interarterial course of right coronary arteries originating in the contralateral sinus of Valsalva. This angiographic sign can be a valuable tool for the rapid identification of this course, considered to be high risk and often underestimated in daily clinical practice.
Sources of funding

None to be declared.

Conflicts of interest

The authors declare no conflicts of interest.

References