Single coronary artery with double coronary courses: Tips and tricks

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ABSTRACT

Congenital coronary artery anomalies are uncommon and the vast majority is diagnosed incidentally during coronary angiogram or necropsy. A single coronary artery is one of the most rarely seen coronary artery anomalies. Determination of its course (inter-arterial, intra-septal, pre-pulmonic or retro-aortic) is very important regarding its clinical significance. Avoiding the misdiagnosis of an unsuspected anomalous coronary artery is critical to the patient and it is always the angiographer’s responsibility to accurately define the origin and course of the vessel. Cardiologists should be aware of simple clues in order to easily identify coronary anomalies.

Keywords:
Coronary angiography
Coronary anomaly
Single coronary artery

A 65-year-old female patient referred to our hospital with the complaints of atypical chest pain but mild apical ischemia on nuclear stress testing. She had no significant medical history and physical examination was unremarkable. Electrocardiographic and echocardiographic findings were unrevealing. No origin of the coronary ostium arising from the left sinus Valsalva (LSV) could be imaged by the conventional coronary angiography (Video 1, http://e-coretvasa.cz/suppl/2019-4-439-1.avi). A single coronary artery (SCA) originating from the right sinus of Valsalva (RSV) with a pre-pulmonic left anterior descending artery (LAD) and a retro-aortic left circumflex artery (LCX) was detected (Fig. 1, Video 2 http://e-coretvasa.cz/suppl/2019-4-439-2.avi and Video 3 http://e-coretvasa.cz/suppl/2019-4-439-3.avi). Categorization of solitary ScA based on anatomy can be either classified as anomaly of the abnormal “origin” or as anomaly of normal “course” by the scheme propo-
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In current case, the LAD and LCX had separate origins from the proximal part of the normally located RCA (Video 2 http://e-corevasa.cz/suppl/2019-4-439-2.avi). In general, this anomaly has no clinical significance unless atherosclerotic coronary artery disease superimposes. However, both LAD and LCX’s courses are important. When the LAD and/or LCX originate from the proximal RCA or right sinus of Valsalva (RSV) (type II or type III), these anomalous vessels take 1 of 4 aberrant pathways to reach its proper vascular territory. These 4 pathways are as follows:

- **In type I**, there is a solitary dominant artery. The vessel follows the course of normal left or right coronary artery with a continuation into the missing artery’s territory (R-I type as solitary dominant right coronary artery [RCA], and L-I type as solitary dominant left coronary artery).

- **In type II**, one coronary artery arising from the proximal portion of other normally located opposite coronary artery.

- **In type III**, the both LAD and LCX arise separately from the proximal part of a normal RCA. There is an absence of the left main coronary artery (LMCA).

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**Fig. 1** – Left anterior oblique (LAO) and right anterior oblique (RAO) angiogram shows single coronary artery with prepulmonic left anterior descending (LAD) artery and retroaortic circumflex artery. Ao – aorta.

<table>
<thead>
<tr>
<th>Type</th>
<th>Definition</th>
<th>Course</th>
<th>Curvature of long LAD</th>
<th>Clues</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Anterior to the right ventricular outflow tract</td>
<td>Pre-pulmonic (known as subaortic or aorticopulmonary)</td>
<td>Antero-cranial convex</td>
<td>If the first branch arising from the long LAD is not the aorta or interventricular septum</td>
</tr>
<tr>
<td>B</td>
<td>Between the aorta and pulmonary trunk</td>
<td>Interarterial (known as pre- or postaortic)</td>
<td>Postero-cranial convex</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Cristal, coursing through the crista supraventricularis portion of the intraventricular septum</td>
<td>Intra-septal (known as subaortic or subpulmonic or septal)</td>
<td>Antero-caudal concave</td>
<td>If the first branch arising from the long LAD is not the aorta</td>
</tr>
<tr>
<td>D</td>
<td>Dorsal or posterior to the aorta</td>
<td>Retroaortic (known as subaortic or interventricular)</td>
<td>Postero-caudal concave</td>
<td>Aortic root sign or Paget’s sign</td>
</tr>
</tbody>
</table>

**Table 1** – The subtypes depending on the aberrant pathways to reach its proper vascular territory of the anomalous LAD.
type D (Dorsal or Posterior to the aorta- “retroaortic course” with posterocaudal concave curvature and the “aortic root” or Page’s sign).

Of the 4 pathways of the anomalous course of coronary arteries, only inter-arterial variant is considered dangerous, and is associated with exertional angina, syncope, and sudden cardiac death. In current coronary anomaly was classified as type III SCA with a pre-pulmonic LAD and a retro-aortic LCX according to Lipton’s scheme of classification.

Since even experienced angiographers have difficulty finding and delineating the true course of some anomalous vessels, a thorough method is required before making a definitive diagnosis. The course of the anomalous coronary can invasively be identified by angiography after insertion of a catheter into the pulmonary artery and another into the aorta,6 by the “dot and eye method”4 in coronary angiography or noninvasively by computed tomography angiography.10 In 1985, Ishikawa et al.3 followed by Serota et al.4 in 1990 proposed a series of coronary angiographic criteria intended to define the relationship, along the initial course, between the anomalous vessel and the aorta and the pulmonary artery. These authors attempted to identify the different courses on the basis of the orientation of the “loop” formed by the anomalous coronary artery with the rest of the coronary tree1 or by applying the concept of the “dot” (visualization of the contrast column of the coronary artery anomaly which, because of the turn it makes, adopts the morphology of a dot).4 In a 30º right anterior oblique (rAo) view, before turning to the apex at the midseptum, the LAD will pass left and upward (forming the upper half of the “eye” – anterocaudal concave loop-curvature) in an intra-septal course. In case of an inter-arterial course the vessel will describe a cranial posterior loop before turning anteriorly towards the anterior interventricular sulcus in a RAO or LAO views (posterocranial convex curvature). The intra-septal course is also favored by the presence of phasic systolic compression of this segment similar to a myocardial bridge and proximal branching into septals. It is important to define the branching of an aberrant long LAD correctly as a septal artery (in always intra-septal course) or a conus artery (pre-pulmonary course) despite both may have anterocaudal curvature-loop. In current case, the conus artery was an important clue for the pre-pulmonic LAD course (Video 2 http://e-corevasa.cz/suppl/2019-4-439-2.avi). Recognition of this variant and differentiation among the possible courses of the ectopic branch is essential for patient management. For all artery pathways that travel behind the aorta, the RAO projection during aortography or coronary angiography will visualize the artery on end and appear as a radio-opaque “dot” posterior to the aorta. Although the most important point for anomalous courses of coronary arteries is identifying the benign posterior or malignant anterior “dots” in the RAO view; this method was not useful in current case due to double separate courses of the SCA (Video 3). There was not another associated cardiac anomaly or coronary obstructive lesions. Cardiologists should be aware of simple clues in order to easily identify coronary anomalies.

Conflict of interest
There are no any potential conflicts of interest, including related consultancies, shareholdings, and funding grants.

Appendix A. Supplementary data
Supplementary material related to this article can be found, in the online version, at doi: https://doi.org/10.1016/j.crvasa.2018.07.007.

References