Coronary anomalies in patients with acquired significant aortic stenosis

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INTRODUCTION

Significant aortic stenosis (AS) is the most common primary valve disease requiring interventional treatment: surgical aortic valve replacement (SAVR), transcatheter aortic valve implantation (TAVI), or balloon aortic valvuloplasty. A proportion of these patients may also require intraprocedural coronary intervention, such as SAVR plus coronary artery bypass grafting (SAVR plus CABG) or TAVI plus PCI (percutaneous coronary intervention), or less frequently, peri-procedural PCI to SAVR. The prevalence of AS is rapidly increasing in Europe and North America due to the aging population.

Anomalous coronary arteries (ACA) represent a heterogeneous group, including their anomalous origins (from the aorta or the pulmonary trunk), course (aneurysms), and termination (fistulae). Anomalous aortic origin of coronary arteries (AAOCA) is a rare finding in invasive coronary angiography (CA) or computed tomography angiography (CTA) examinations. Based on large angiographic studies, the prevalence of AAOCA ranges between 0.9% [1] and 1.3% [2], or 2.3% in CTA studies [3]. Moreover, ACA prevalence may be higher in patients with bicuspid aortic valve (BAV). Very little is known about the coexistence of ACA in patients with significant AS and its relevance to the interventional treatment of significant AS. Existing single reports mainly focus on ACA patients who underwent percutaneous treatment of AS (TAVI or balloon aortic valvuloplasty). Up to 2023, only twenty-four patients with ACA who underwent TAVI were reported [4]. Similarly, around thirty ACA patients who were treated with SAVR for significant AS have been described so far, most of them as single case reports (see Supplementary material, *Table S1*).

AIM

This study aimed to assess ACA types in patients with acquired significant AS and to evaluate the outcome of interventional AS treatment.

METHODS

Individual discharge diagnoses collected in the electronic database from a single high-volume tertiary cardiovascular center were retrospectively screened for the presence of ACA and AS in consecutive patients who were hospitalized from January 2008 to November 2023 for various reasons, mainly cardiovascular. The following keywords with their abbreviations and grammatical variations were used to identify patients with ACA, including "anomalous coronary artery", "anomalous or atypical take-off", "left circumflex coronary artery (LCx) or left coronary artery originating from the right", and "right coronary artery (RCA) originating from the left". Similarly, the following keywords with their abbreviations and grammatical variations were used to

identify patients with AS (who did or did not undergo interventional treatment): "aortic stenosis", "stenosis of the aortic valve", "aortic valve replacement", "trans-catheter aortic valve replacement", and "balloon aortic valvuloplasty". Patient charts and imaging data were reviewed in all identified cases. Demographics, clinical characteristics, and imaging data were collected. Among the patients with AS and ACA, only those with significant AS were selected for further analysis. The requirement for informed consent was waived because of the retrospective nature of the study. Statistics were limited to demographics (sex and age), the number of ACAs, and performed interventional treatments.

RESULTS AND DISCUSSION

Twenty-nine patients, 14 males (48.3%), with significant AS and ACA, were identified. One patient with congenital aortic and subvalvular stenosis was excluded from the study. Demographics and clinical data are presented in Supplementary material, *Table S2*. The median patient age at the time of aortic valve intervention was 68.0 years (interquartile range 15.0). Preinterventional imaging data and interventional data are presented in Supplementary material, *Table S3*. Twenty-three patients underwent CTA, and 17 patients underwent invasive CA.

Types of AS: Fourteen patients (48.3%) presented with BAV.

Types of ACA: The most frequently encountered ACA type was a LCx taking off from the RCA or the right sinus of Valsalva (SoV), (n = 11), followed by a RCA from the left SoV (n = 6), a single coronary artery (SCA) from the left SoV (n = 3), a SCA from the right SoV (n = 1), a left coronary artery (LCA) from the right SoV (n = 3), a RCA from the LCA *via* the collaterals (n = 1; Figure 1), a RCA from above the right SoV (n = 1), a LCA and RCA from above the SoV, mid and distal segments of the left anterior descending coronary artery (LAD) from the RCA (n = 1), an absent LCx (n = 1) and a RCA from the LCA *via* a collateral (n = 1). Three SCA patients were already included in our previous article [5] although without many details about AS.

Interventions

The most commonly performed procedures were SAVR--only (n = 15), followed by SAVR plus CABG (n = 5): in two patients, their vein grafts were anastomosed to non-ACAs, in the third patient, the left internal artery mammary (LIMA) was anastomosed to the LAD, and a saphenous vein graft (SVG) was anastomosed to the anomalous RCA, in the fourth patient the SVG was anastomosed to the anomalous RCA and in the fifth patient the LIMA was anastomosed to the LAD. Four patients underwent SAVR with supracoronary prostheses. The remaining patients underwent another interventional treatment, and one patient was treated conservatively. In-hospital course data were available for 28 patients (one patient was operated on 38 years earlier). Three in-hospital deaths occurred: one patient died due to aortic rupture during TAVI, one patient died due to multi-organ dysfunction after SAVR, and one patient died due to decompensated heart failure after rescue balloon aortic valvuloplasty. Additionally, one patient required a re-thoracotomy due to post-operative bleeding. Follow-up for the remaining 10 patients ranged between 1 month and 30 years.

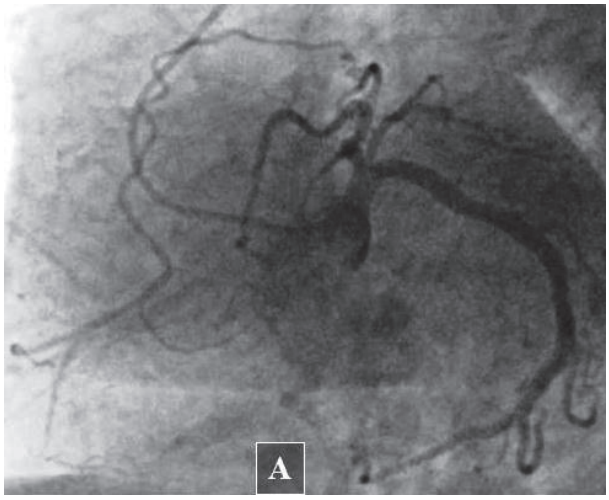

Figure 1. Coronary angiography. A right coronary artery taking off from the left coronary artery *via* a collateral (patient no. 6)

Previous descriptions of patients with AS and concomitant ACA were confined only to single reports and frequently had no follow-up (Supplementary material, *Table S1*). Our cohort represents a systematic analysis of such patients who were identified among all hospitalized patients over fifteen years in a large cardiovascular center. Most of our patients with AS and ACA were treated surgically, but caution is also advised with percutaneous treatment [6].

Firstly, the most common ACA type was a LCx from the RCA or from the right SoV, which is in line with observations from the general population and previous case reports on AS patients. As ACA may pose difficulties in imaging by CA and even be missed, CTA may be indispensable in dubious cases.

Secondly, in one of our patients (no. 4), ACA was anastomosed during SAVR, namely the RCA originating from the left SoV, with a course between the aorta and the pulmonary trunk. Still, moderate systolic compression of ACA, especially non-LCA ACA, may raise doubts about the need for anastomosis. There are no studies assessing the role of fractional flow reserve or intravascular ultrasound in such cases.

Thirdly, the presence of ACA may make the SAVR procedure more difficult [7]. Undetected ACA poses a risk of complications during SAVR, such as a) inadequate infusion of cardioplegia solution, b) iatrogenic ACA injury during aortotomy, or c) ACA compression by the valve prosthetic ring [8]. As a consequence, these complications may lead to intra-procedural myocardial infarction. Even separate ostia of the left anterior descending coronary artery and the LCx (and absent left main coronary trunk) make the infusion of cardioplegia more difficult. For example, Wa-

riishi reported on a patient in whom SCA was suspected before SAVR [9]. However, a high posterior take-off of the RCA was detected only at aortic closure. As a consequence of insufficient supply of cardiogenic solution at the RCA, ventricular fibrillations frequently occurred after cardiopulmonary bypass, and percutaneous cardiopulmonary support was required [9].

Finally, some patients could benefit from using a sutureless valve, not only to minimize the risk of ACA occlusion by the suture [7], but also to reduce cardiopulmonary bypass, cross-clamp, and whole procedure duration.

Limitations

This is a retrospective analysis. The relatively small number of patients limited statistical analyses. We cannot rule out that some patients with significant AS and ACA were missed.

CONCLUSIONS

Detailed pre-interventional work-up is critical. An individualized approach in dubious cases is advisable.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/polish_heart_journal.

Article information

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