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ORIGINAL ARTICLE**Clinical Trials Study**

- 813 Delineation of epicardial stenosis in patients with microvascular disease using pressure drop coefficient: A pilot outcome study

Hebbar UU, Effat MA, Peelukhana SV, Arif I, Banerjee RK

Observational Study

- 822 Endothelin-1 activation in pediatric patients undergoing surgical coarctation of the aorta repair

Frank BS, Urban TT, Tong S, Cassidy C, Mitchell MB, Nichols CS, Davidson JA

META-ANALYSIS

- 830 Erythropoietin therapy after out-of-hospital cardiac arrest: A systematic review and meta-analysis

Chaudhary R, Garg J, Krishnamoorthy P, Bliden K, Shah N, Agarwal N, Gupta R, Sharma A, Kern KB, Patel NC, Gurbel P

CASE REPORT

- 838 Artefactual angulated lesion on angiography: A case report and review of literature

Edroos SA, Sayer JW

- 842 Successful recanalization of long femoro-crural occlusive disease after failed bypass surgery

Korosoglou G, Eisele T, Raupp D, Eisenbach C, Giusca S

- 848 Transposition of the great arteries - a phenotype associated with 16p11.2 duplications?

Karunanithi Z, Vestergaard EM, Lauridsen MH

LETTERS TO THE EDITOR

- 853 Transcatheter aortic valve implantation operators - get involved in imaging!

Brinkert M, Toggweiler S

ABOUT COVER

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Transcatheter aortic valve implantation operators - get involved in imaging!

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Abstract

Pre-procedural planning is the key element of trans-

catheter aortic valve implantation (TAVI). Multislice computed tomography of the chest, abdomen and pelvis with the ability to perform a 3-dimensional reconstruction has become the cornerstone of pre-procedural planning. We would like to encourage TAVI operators (interventional cardiologist and surgeons) to get involved in imaging. All TAVI operators should know how to assess the annulus, the annular root, and the iliofemoral access. We strongly believe that this will improve outcomes of this evolving procedure.

Key words: Aortic stenosis; Transcatheter aortic valve implantation; Transcatheter aortic valve replacement; Imaging; Computed tomography

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Core tip: We have noticed that only a minority of interventional cardiologists and cardiac surgeons routinely look at their patients MDCTs and know how to perform a three dimensional multiplanar reconstruction. With this editorial, we would like to encourage all transcatheter aortic valve implantation (TAVI) operators to get involved in cardiac imaging. We do believe that this will improve outcomes. In case a complication occurs, TAVI operators will be more likely to understand the nature of the complication and learn from it. And this again will lead to improved outcomes in future.

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TO THE EDITOR

Transcatheter aortic valve implantation (TAVI) is now routinely performed in inoperable, high-risk, and

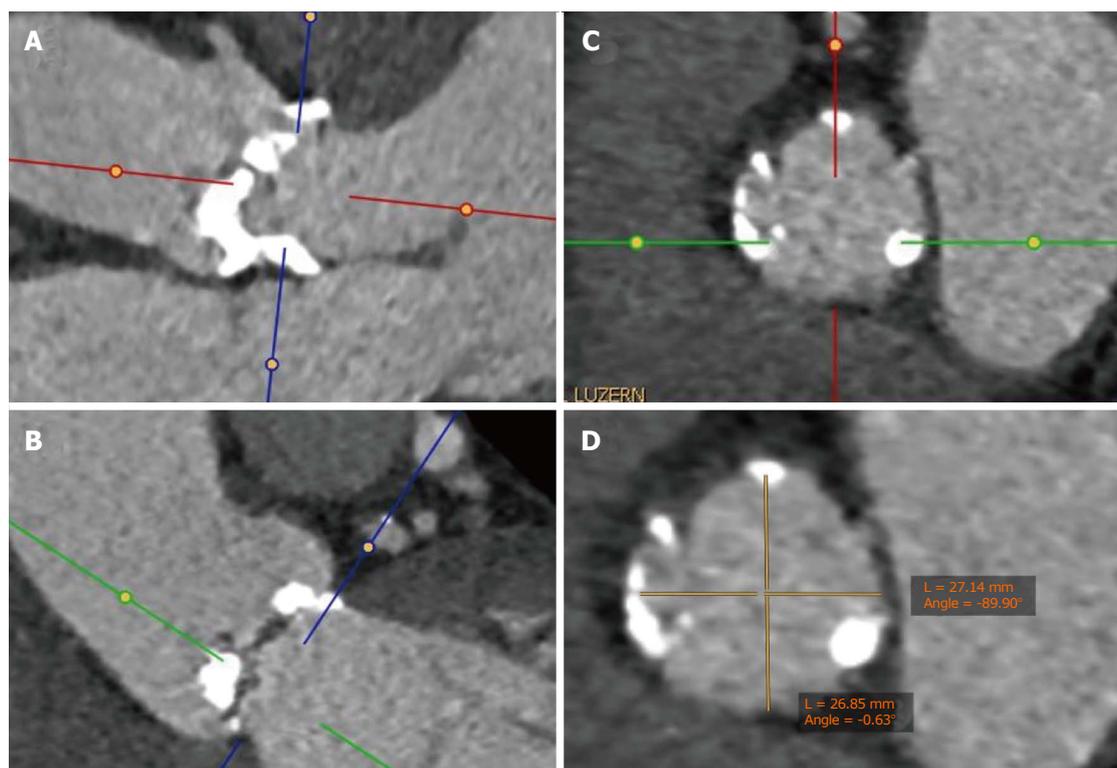


Figure 1 Example of a multiplanar reconstruction of the aortic annulus. A and B: Double-oblique MSCT images at the basal insertion of the calcified native cusps; C: Double-oblique reconstruction at the level of the aortic annulus. The aortic valve leaflets are just barely visible at the level of the ventriculoarterial junction; D: Measurement of the short and long diameter at the level of the aortic annulus. MSCT: Multislice computed tomography.

intermediate risk patients with low mortality- and complication rates^[1,2]. Some of the key elements contributing to these impressive results are pre-procedural patient evaluation by the multidisciplinary HeartTeam, and pre-procedural imaging^[3,4].

The important role of multislice computed tomography (MSCT). MSCT of the chest, abdomen and pelvis with 3-dimensional reconstruction has become the cornerstone of pre-procedural planning. MSCT is now routinely performed to assess the aortic annulus, the distance between the aortic annulus and the coronary ostia and the suitability for the transfemoral access^[3,5]. Nowadays matured post-processing imaging software is widely available to perform these measurements automatically and create standardized reports^[6]. However, automatic measurements may not include the degree and distribution of calcification and may not take into account all aspects of the anatomy. Most of the TAVI operators rely on such reports or on numbers and measurements reported by the radiologist^[7-9]. Therefore, we would like to encourage all TAVI operators to get involved in imaging and learn how to perform a 3-dimensional multiplanar reconstruction.

Choosing the valve type and size. It has been shown that left ventricular outflow tract (LVOT) calcification is associated with an increased risk for annular rupture during TAVI with balloon-expandable prostheses^[10]. Extensive calcifications at the native aortic valve may increase the risk for paravalvular regurgitation or need for a permanent pacemaker^[11,12]. As an interventional

cardiologist or cardiac surgeon, we can easily perform multiplanar reconstructions of the aortic annulus not only to measure the dimensions of the annulus but also to get an impression of the distribution of calcification of the valve leaflets and the LVOT (Figure 1)^[13]. Based on all information including the annular perimeter, area, distribution of calcification and anatomy of the aortic root, valve type and size can be chosen more specifically as part of a patient tailored therapy (Figure 2).

Assessment of the coronary artery height. The "Instructions for use" of different valves include specific recommendations for the minimal coronary artery height. However, the risk for coronary obstruction is greatly increased in patients with bulky atheroma or calcifications at the tip of the leaflets, a smaller sinus of valsalva diameter, narrow sinotubular junction and different patient characteristics like female gender or patients with previous surgical bioprosthesis^[14]. Measuring the coronary artery height with MSCT is a great screening tool, but "virtual implantation" by the operator comparing the length of the leaflets with the distance between annulus and coronary ostia and also assessing the distribution of calcifications may allow much better risk stratification (Figure 3). Radial strength depends largely on the valve type. Whereas the widely used balloon-expandable valves consist of cobalt chromium, self-expanding valves are composed of nitinol thus applying less radial force to the tissue^[14]. Accordingly, a self-expandable and retrievable valve might be preferable in patients at risk for coronary obstruction. Moreover, in case of borderline

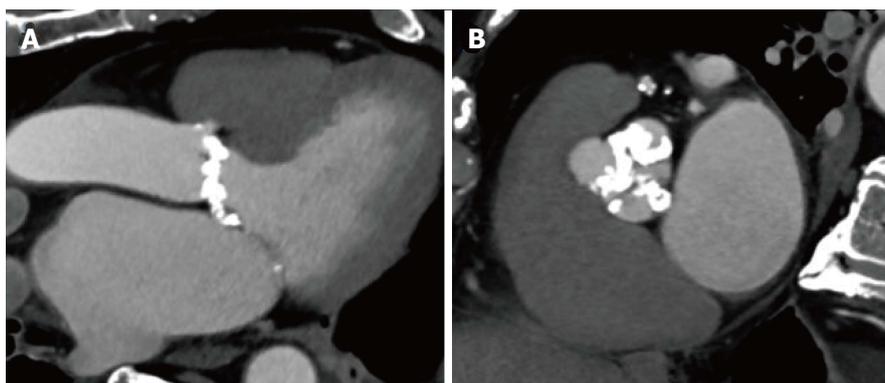


Figure 2 Cardiac multislice computed tomography showing a patient with heavy calcifications extending into the left ventricular outflow tract and a shallow sinus. This anatomy is associated with increased risk for annular rupture in patients undergoing TAVI with a balloon expandable valve. A: Three chamber view of the heart showing a patient with heavy calcification extending from the aortic annulus into the LVOT and a shallow sinus; B: Short axis view of the aortic valve showing heavy calcified aortic leaflets. LVOT: Left ventricular outflow tract; TAVI: Transcatheter aortic valve implantation.

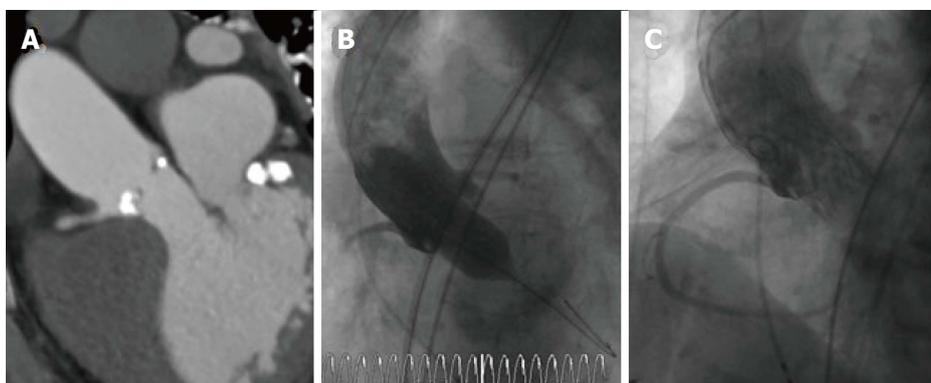


Figure 3 Patient undergoing transfemoral transcatheter aortic valve implantation with a very low ostium of the right coronary artery. A: Patient with a very low ostium of the right coronary artery but potentially a large enough sinus valsalva for TAVI; B: Balloonvalvuloplasty with simultaneous injection of contrast media to estimate the risk for coronary obstruction; C: Successful implantation of an Evolut R. Supraannular injection shows a patent right coronary artery. TAVI: Transcatheter aortic valve implantation.

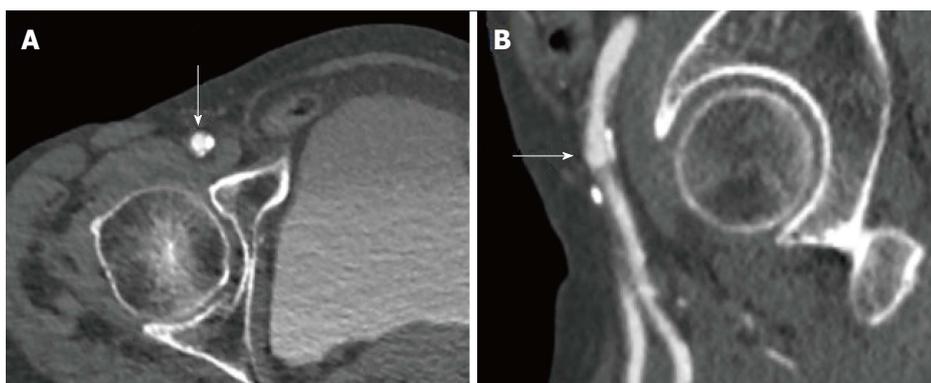


Figure 4 Multislice computed tomography showing calcified right common femoral artery in a patient undergoing transfemoral transcatheter aortic valve implantation. A: Right common femoral artery with an arrow pointing at the ideal puncture site above the calcification; B: Right common femoral artery with an arrow pointing at the ideal puncture site above the height of bifurcation of the common femoral artery in relationship to the femoral head.

anatomy, balloonvalvuloplasty with simultaneous contrast media injection may allow to estimate the risk for coronary obstruction during valve deployment. In patients considered at high risk for coronary obstruction placing a coaxial guiding catheter extension such as the GuideLiner catheter (Cascular Solutions Inc., Minneapolis,

MN, United States) in the coronary artery during valve deployment may allow emergent percutaneous coronary intervention.

Choosing the ideal puncture site. Finally MSCT is routinely used to evaluate size, tortuosity and calcifications of the iliofemoral arteries and to determine

the feasibility of transfemoral access^[15]. MSCT provides detailed information about the height of the bifurcation of the common femoral artery in relationship to the femoral head. Furthermore, it allows visualization of the inferior epigastric artery which is located within the inguinal ligament. Finally, MSCT shows the extent of calcification at the level of the potential puncture site (Figure 4). Knowing your patients anatomy allows to perform a precise puncture under fluoroscopy guidance thus minimizing the risk for vascular injury^[16,17].

How to get involved in imaging, and why? Potential TAVI candidates are discussed by the interdisciplinary HeartTeam consisting of non-invasive cardiologists specialized in cardiac imaging, interventional cardiologists and cardiac surgeon to define the best treatment option for the individual patient. Evaluation of associated comorbidities that may limit the life expectancy or the recovery after the procedure is of particular importance. Results from pre-procedural invasive angiogram, echocardiogram and MSCT are reviewed for each patient. We would like to encourage all TAVI operators to review their patients MSCT again immediately before the procedure. Look at the iliofemoral access to choose the better side with less calcification or tortuosity, and choose the ideal puncture site. Then, perform a three dimensional multiplanar reconstruction of the annulus, measure the annular diameters, perimeter, and the area. Look for calcification at the level of the annulus, but also at the level of the LVOT. Finally, review the root and the coronary arteries. With routine, this can be performed in 2-3 min in most patients. There are two potential advantages of being able to analyze your patient's images. First, you may improve your patient's outcomes. Second, if you have a complication, you are more likely to understand it and learn from it. And this will again lead to better outcomes in the future.

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