Ultra-low Contrast Dose CTA for TAVR Planning with a Total Dose of 20cc Contrast in a Patient with Renal Insufficiency

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Clinical History
An 82-year-old male presented with two weeks of dyspnea at rest and exertion, and orthopnea and lower extremity edema. Physical examination revealed a grade 3 out of 6 systolic ejection murmur, crackles at both lung bases and distended jugular venous pressure. His presentation was consistent with acute diastolic heart failure in the setting of severe aortic stenosis (AS). He was overweight and weighed 189 pounds, with a body-mass index of 27.8 kg/m². Transthoracic echocardiography demonstrated a peak trans-aortic valve gradient of 63 mm Hg and a calculated aortic valve area of 0.5 square cm by the continuity equation, consistent with critical AS. He was referred to our center for consideration of transcatheter aortic valve replacement (TAVR) after he was deemed at high surgical risk given multiple comorbidities including acute on chronic renal insufficiency, with a 30-day mortality of at least 14% based on the Society of Thoracic Surgeons (STS) score.

Findings
Ultra-low dose protocol high-pitch dual-source computed tomography angiography was performed with a total dose of 20 mL contrast to evaluate the aortoiliac vessels for access planning. This confirmed suitable vascular sizes and angulation for the delivery sheath system, with a minimal luminal diameter of 8mm on left side and 8mm on the right. The aortic annulus and proximal aortic root were assessed concurrently via transthoracic echocardiography (not shown) as well as CTA, to determine the annular size for TAVR device sizing, and to ensure adequate coronary ostial height. Preoperative invasive coronary angiography was also performed to exclude the presence of significant epicardial coronary stenosis.

Discussion
TAVR has revolutionized the care of the non-operable patient with critical aortic stenosis by allowing a durable minimally invasive repair (1). The procedure is preferably performed via a transfemoral approach, which is contingent upon suitable aortic root and annular dimensions, and several other parameters. Because the delivery sheath system is large, the aortoiliac vessels must be screened to ensure adequate vascular diameters between at least one common femoral artery and the entire route to the aortic annulus. CTA has evolved into a valuable tool for obtaining these measurements prior to the TAVR procedure (2). In patients with renal insufficiency, CTA can be performed with ultra low contrast dose technique via contrast dilution and rapid scanning, if equipment and operator experience allows (3). In this case, minimizing the contrast dose was essential given the concomitant renal insufficiency and the planned intervention necessitating further contrast administration.
Figure 1: The heavily calcified, elliptical aortic annulus is visualized with the use of a 3D workstation which allows accurate biplanar, area, and circumference measurement of the annulus size (2). This anatomic assessment confirmed the measurements provided by echocardiography, which is the first-line tool for aortic stenosis imaging. Echocardiography offers repeatable, physiologic assessments, and transesophageal echocardiography is mandatory for intraoperative TAVR procedural guidance.

Figure 2: 3D volume rendered images allow rapid depiction of characteristics of the aortoiliac vessels that may render the TAVR procedure challenging (such as tortuosity or kinking of vessels, severe or circumferential vascular calcifications). This patient’s aortoiliac morphology was amenable to transfemoral TAVR access.

Figure 3: Adequate opacification of the aortoiliac vessels was achieved even with an ultra-low dose of contrast, thus allowing centerline extraction by the 3D workstation for accurate measurements of short axis diameters.

REFERENCES

