ΔΙΟΙΣΟΦΑΓΕΙΑ ΥΠΕΡΗΧΟΚΑΡΔΙΟΓΡΑΦΙΑ 3 ΔΙΑΣΤΑΣΕΩΝ

ΣΤΗΝ ΕΚΤΙΜΗΣΗ ΤΗΣ ΑΟΡΤΙΚΗΣ ΣΤΕΝΩΣΗΣ ΓΙΑ ΔΙΑΔΕΡΜΙΚΗ ΑΝΤΙΚΑΤΑΣΤΑΣΗ (TAVI)

Αγγελική Ζαχαράκη
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3D TEE

in patients with contraindications to computed tomography (CT) such as renal dysfunction and known iodinated contrast allergies

Multi-slice detector computed tomography reconstruction of the aortic root and ascending aorta
The aortic root contains at least **3 circular rings** and **1 crown-like ring**

1. **Virtual annulus** formed by the joining basal attachments of the AV leaflets.
2. **Anatomic annulus** formed by the ventriculoarterial junction
3. **Sinotubular junction.**
4. **Crown-like ring** formed by the insertion of the leaflets.
Multidisciplinary approach to transcatheter aortic valve implantation

Selection of patients occurs on the basis of their surgical risk and anatomic suitability.
Imaging for TAVR

Transthoracic echocardiography (TTE)

- Severity and assessment of aortic valve morphology,
- Concomitant valve lesions such as mitral regurgitation,
- Left and right ventricular function,
- Pulmonary artery pressure.
Assess the severity of stenosis
Types of aortic stenosis

- high gradient (velocity > 4 m/s or mean gradient > 40 mmHg) vs. low gradient (mean gradient <40 mmHg)
- normal flow (SVi > 35mL/m²) vs. low flow (SVi <35mL/m²)
- preserved ejection fraction (> 50%) vs. reduced ejection fraction (<50%)
3D ECHO for aortic stenosis severity assessment

- 25% patients reclassified from severe to moderate AS when using 3D TEE planimetered annulus area

2D: Geometric assumption that LVOT is circular

3D: LVOT assumes an elliptical configuration

- Errors in the measurement of the diameter are squared in the process of calculating AVA, leading to an underestimation of up to 13 % for LVOT and 26.3 % for AVA.
Accurate planimetry ofAVA

In 2D methods, it is often difficult to capture the tip of the aortic valve leaflets at the moment of maximal systolic opening; this may lead to overestimation of AVA because of a “funnel” configuration.

Affected by valvular calcification.

3DTEE underestimates the measurement.
TAVI has been cited as a ‘blind’ procedure.
2D/3D TEE evaluation prior to TAVI

- Valve anatomy
  - number of cusps
  - degree of calcification
  - symmetry of calcification

- Aortic annulus diameters, perimeter and area (3D)
- LVOT diameters (3D)
- Distance to coronary arteries (3D)
- Aortic root dimensions (sinus of Valsalva / sinotubular junction / ascending aorta)
- Presence of aortic plaques
- Septal hypertrophy
The annulus size determines the size of the THV that should be used. Aortic annulus perimeter or cross sectional area is superior to annulus diameter.

The intentional oversizing of implants is a recognized strategy to reduce the risk of PVR. Unintentional oversizing increases the risk of rupture of the root, significant conduction disturbances and device underexpansion. Unintentional undersizing Elevated risk of clinically significant PVR and device embolization.
Biplane imaging or three dimensional reconstruction can be used to obtain measurements in the sagittal and coronal planes simultaneously and has become the echocardiographic gold standard for preimplantation assessment of the aortic root.
Aortic annulus measurement

- Ability to measure both the long and short dimensions of the elliptical annulus.
- Measurements are made during mid-systole when root dimensions are maximal and most circular.
- The diameter of the annulus must be measured with disregard for the calcification.
LVOT measurement

LVOT_diam = 2.54 cm
LVOT_area = 5.1 cm²

LVOT_diam = 2.62 cm
LVOT_area = 5.4 cm²

LVOT_diam = 2.62 cm
LVOT_area = 5.6 cm²
Coronary artery height

- It is crucial to know the distance from the basal aortic annulus to the ostia of the left and right coronary arteries and to compare this with the length of the cusps.

- Coronary artery compromise occurring in <1 % of patients in clinical trials.

- Coronary occlusion most commonly affected the left coronary (88.6 %) more commonly in women.

- In 2D-TEE examinations, the distance from the RCA ostium to the annulus can be evaluated.

- There are no 2D planes in which both the left coronary ostium and the leaflet’s hinge line can be visualized.
Coronary artery height

- Height of the leaflets with respect to the coronary ostia

Risk factors for coronary ostial obstruction

- A low lying coronary ostium <10 to 12 mm from the basal leaflet insertion to the coronary ostium
- Mean sinus of Valsalva diameter of <30 mm
- Sinus of Valsalva diameter / annular diameter ratio of <1.25

Potential mechanisms for coronary ostial obstruction

➢ Displacement of native bulky aortic leaflets over the coronary ostium.

➢ Impingement of the coronary ostia by the THV support structure.

➢ Inappropriately high positioning of the sealing cuff of the THV.

➢ Embolization of atheroma, calcium, thrombus, air, or vegetation.

➢ A significantly oversized THV.

➢ Aortic root dissection.
Aortic leaflets

➢ Number of cusps present

➢ The role of TAVI in bicuspid aortic valve (BAV) is uncertain since data on efficacy and safety are limited.

➢ BAV: contraindication to TAVI - poor seating, asymmetrical stent expansion, and/or PAR due to severe distortion of the native valve leaflets.

➢ Growing data from large multicenter registries suggest that outcomes following TAVI in BAV stenosis appear to be quite good.
In a 3D TEE the two nodules are less easily distinguishable because their texture is similar to the surrounding structures.

Calcifications may be recognized with 3D imaging, when they **protrude** into the left ventricular outflow tract or into the aorta.
Concomitant cardiac pathology

Mitral valve leaflets

- Anterior mitral valve morphology is important to characterized in order to avoid unintentional impingement of the anterior leaflet with placement of the THV too low within the ventricle.

- Dense calcification within the aortomitral curtain or mitral annular calcification may increase the risk of paravalvular regurgitation due to asymmetric expansion of the THV.

- Moderate or severe MR is seen in 15 to 48 % of patients undergoing TAVI.
Sinotubular junction and proximal aorta

Small and heavily calcified STJs

- Balloon migration
- Prosthesis patient mismatch
- THV embolization
- Aortic root rupture

Left ventricular outflow tract and septum

Prominent septal hypertrophy

- Challenge to the proper seating of the THV
- Spontaneous repositioning
- Atrioventricular block

Ventricular thrombus

- Contraindication to TAVI
Peri-procedural transesophageal echocardiography during TAVI
Peri-procedural transesophageal echocardiography during TAVI

- Appreciation of how a known balloon size fits into the valve annulus
- Determination of space within the sinuses to accommodate calcified leaflets
- Imaging of coronary ostia to determine risk of obstruction
- Detection of severe regurgitation post-valvuloplasty
Peri-procedural transesophageal echocardiography during TAVI
TAVI complications assessable by peri-procedure TEE

- Aortic regurgitation
- Incorrect prosthesis positioning may lead to embolization
- Myocardial ischaemia- new wall motion abnormality
- Mitral regurgitation
  Damage to the valve leaflets or subvalvar apparatus
  Myocardial ischaemia
  Dyssynchrony secondary to pacing
- Pericardial effusion
  LV or RV perforation
- Unmasked LV dynamic obstruction
  SAM related
  Midventricular
- Aortic dissection or root rupture
Its Completed!!!
Echo Navigator screen image showing a 3D echocardiography image of the aortic valve and a fusion image of echocardiography in 3D and fluoroscopy of the aortic valve during a TAVR procedure
Conclusion

So, going back to our famous archer, we believe William Tell would advise us to trust our MSCT accuracy while keeping a second 3D-TEE arrow to give us alternative options. Both accuracy today and advancement in future options are important, but safety is essential.

- Aortic annulus diameters, perimeter and area (3D)
- LVOT diameters (3D)
- Distance to coronary arteries (3D)
ΕΥΧΑΡΙΣΤΩ ΠΟΛΥ!!!