The Role of Multimodality Imaging in Percutaneous Valve Interventions

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Disclosures: None

Overview

1. How did we get here?
2. PARTNERS data
3. Multimodality imaging in patient selection and procedural planning
4. TAVI case
5. Potential complications
6. Lessons learned and future perspectives

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Movement from surgery to transcatheter valve therapies

- Operating room ➔ Cath lab
- General anesthesia ➔ sedation only ➔ no or limited wounds
- Full thoracotomy ➔ off pump
- Cardio-pulmonary bypass

Goal is to improve safety, morbidity and comparable patient outcomes.

This is truly a TEAM work

- **Interventional cardiologist**
- **Cardiac/vascular surgeon**
- **Cardiac Imaging specialist**
- **Cardiac Anesthesiologist**

} Convergence of traditional field domains

- **Nursing lab assistants that can do Cath lab and O.R. jobs**

Equipment needed for Transcatheter Valve Therapies

- **All the features of interventional cath lab (Biplane +/-C-arm with rotational CT)**
- **Imaging equipment (TEE with 3D Multiplane probe and biplane imaging is a must)**
- **Slave monitors – echo and fluoro**
- **Consider a Hybrid room with capabilities of O.R. AND catheterization lab → Equipment ready for cardiac and/or vascular surgery (particularly important for transapical)**

Current State of TAVI

11/02/2011 - FDA approval for inoperable patients ("Cohort B")

2012 - Upcoming in > 400 centers worldwide

In 2011, > 40,000 patients have been treated

Three Transcatheter Aortic Valve Systems available in US

Edwards SAPIEN THV™ | Edwards SAPIEN XT ™ (*) | Medtronic CoreValve ™ (*)

CCF experience

(*) only under Investigational Device Exemption

And the technology continues to evolve…

1989: Porcine tissue | 2002: Equine pericardial tissue | TODAY: Bovine pericardial tissue, ThermaFix™ anti-calcification treatment,

Edwards SAPIEN XT ™

RetroFlex I | RetroFlex 3 | RetroFlex 3 | RetroFlex 3

18F sheath

From TAVI Talk Newsletter (www.edwards.com)

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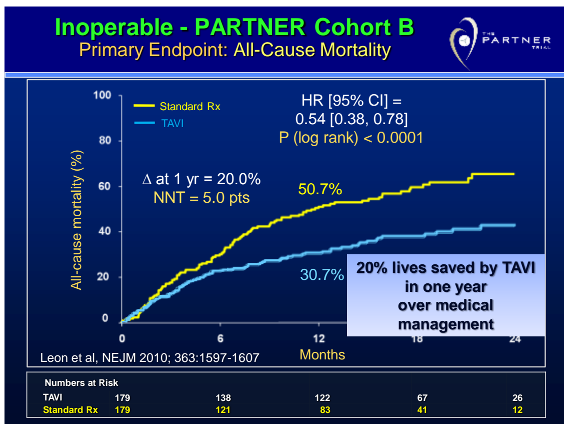
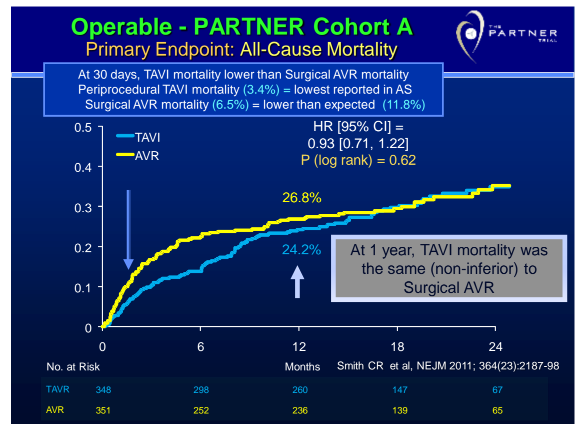
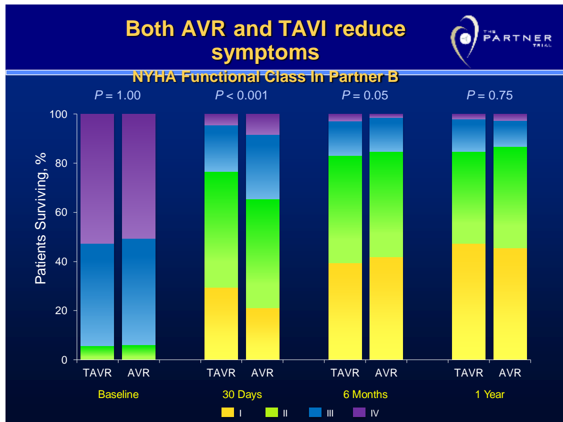
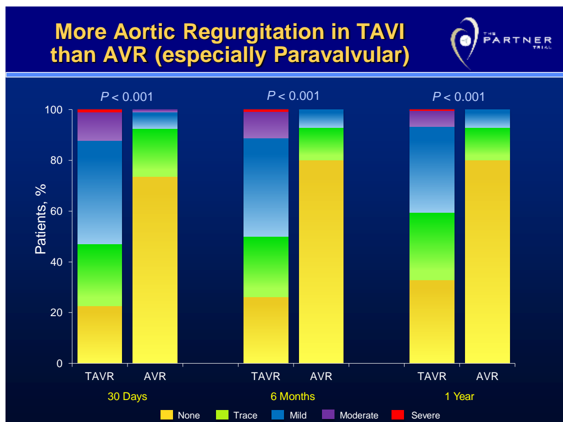






Valve Hemodynamics are slightly better after TAVI than AVR

	30 Days			1 Year		
Finding	*TAVR*	*AVR*	*p =*	*TAVR*	*AVR*	*p =*
AVG – mmHg	9.9 ± 4.8	10.8 ± 5.0	0.04	10.2 ± 4.3	11.5 ± 5.4	0.008
AVA - cm²	1.7 ± 0.5	1.5 ± 0.4	0.001	1.6 ± 0.5	1.4 ± 0.5	0.002
LVEF - %	55.5 ± 11.4	56.0 ± 11.4	0.63	56.6 ± 10.5	57.1 ± 10.3	0.64



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Multimodality Imaging for TAVI

- Preprocedural (patient selection and planning)
  - Echocardiography (TTE, TEE w/ 3D)
  - CTA
- Intraprocedural
  - Fluoroscopy
  - TEE
- Post procedural
  - Echocardiography

Pre Procedural Assessment

- **Echocardiography**
  - Does the patient have severe AS?
  - Gradients, Aortic Valve area
  - Valve morphology, calcification, degree of AR
  - Annular diameter and calcification
    - TTE vs TEE vs TEE with 3D
  - LV function, LVH, Septal Bulge, Cavity Size
  - Associated MR, presence/extent of MAC

Annular Size

- Importance
  - Fundamental part of the continuity equation
  - Selection of the optimal valve size
  - Undersizing of the prosthesis may lead to dramatic events such as valve embolization or severe paravalvular leaks. Oversizing can lead to central AR or annulus rupture.

EDWARDS SAPIEN THV SIZE

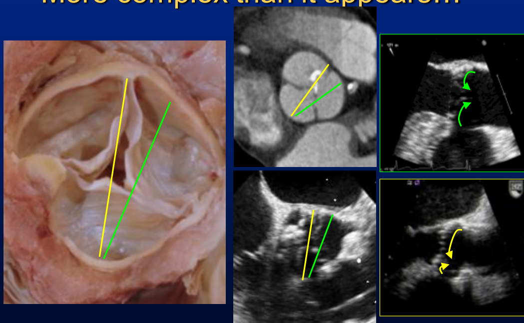
Annular size	Prosthesis size	Prosthesis Length
18-21mm	23 mm	14 mm
22-25 mm	26 mm	16 mm

MEDTRONIC CORE VALVE (*)

Annular size	Prosthesis size
20-23 mm	26 mm
24-27 mm	29 mm

(*) Height and Width of the sinuses and the AscAo diameter should be carefully measured.
If AscAo>45mm and/or aortic annular diameters <20 or >27 mm, this device should not be implanted.

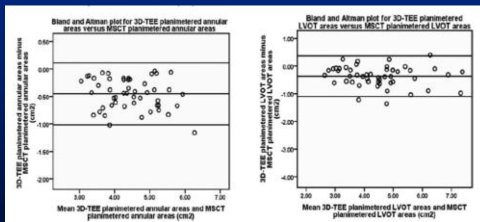
The "correct" measurement of the annulus
More complex than it appears…



CT and 3-D Echo: 3-D Datasets

Schoenhagen P, et al. European Heart Journal Eur Heart J. 2009 Sep;30(17):2079-86.

3D TEE improves the accuracy



Ng et al. Circ Cardiovasc Imaging 2010;3;94-102

CLEVELAND CLINIC CT SCAN PROTOCOL

Siemens Definition Flash (Dual Source – 2x128 MDCT, high pitch, prospectively triggered) - Temporal resolution = 83 ms

or Philips Brilliance iCT 256-slice scanner = 135 ms

Mode = spiral, gated
(synchronized to heart beat)

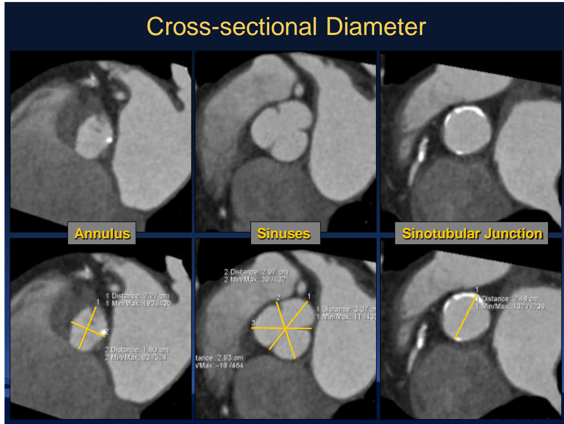
minimal slice thickness = 0.75 mm

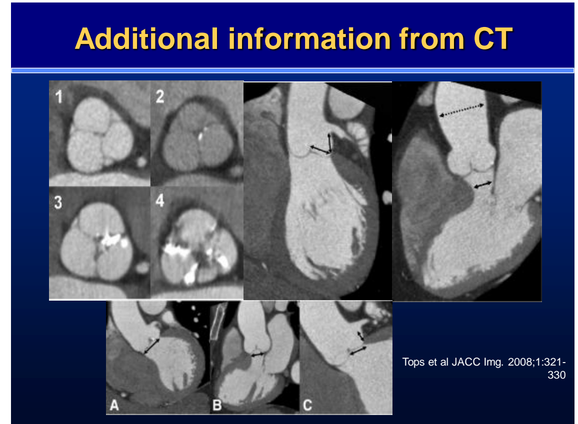
Mode = spiral, non-gated

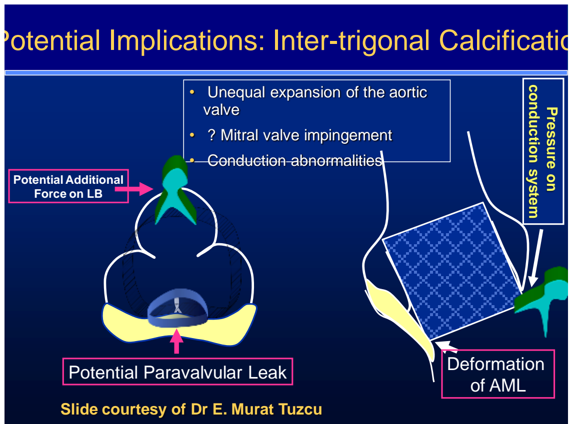
slice thickness = 3 mm

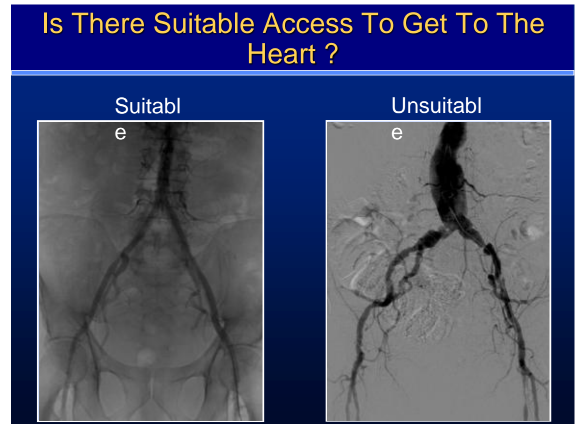
Inclusion criteria: stable sinus rhythm

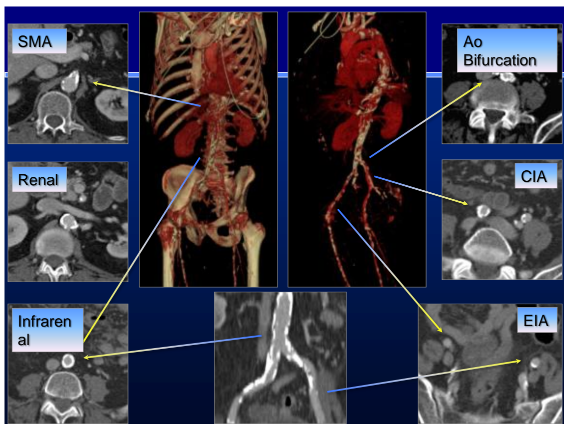
80-150 ml iodinated contrast-material

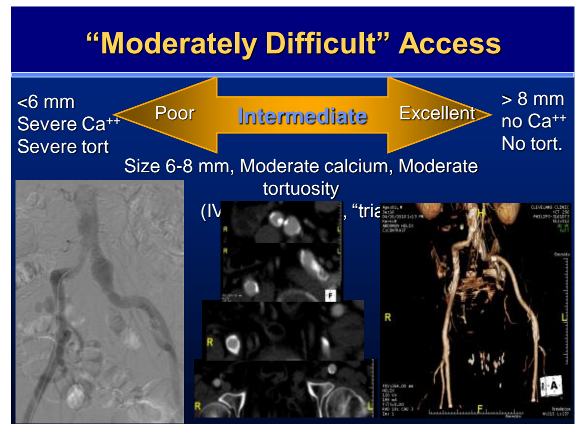

Cross-sectional Diameter
Annulus
Sinuses
Sinotubular Junction


Additional information from CT
1
2
3
4
A
B
C
Tops et al JACC Img. 2008;1:321-330

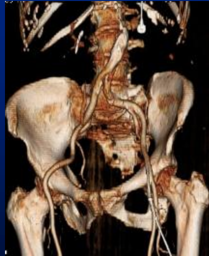

otential Implications: Inter-trigonal Calcificati
Unequal expansion of the aortic valve
? Mitral valve impingement
Conduction abnormalities
Pressure on conduction system
Potential Additional Force on LB
Potential Paravalvular Leak
Deformation of AML
Slide courtesy of Dr E. Murat Tuzcu

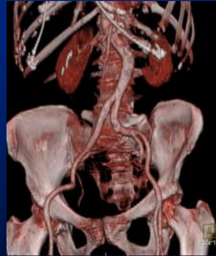

Is There Suitable Access To Get To The Heart ?
Suitable
Unsuitable


SMA
Renal
Infrarenal
Ao Bifurcation
CIA
EIA


"Moderately Difficult" Access
<6 mm
Severe Ca++
Severe tort
Poor
Intermediate
Excellent
> 8 mm
no Ca++
No tort.
Size 6-8 mm, Moderate calcium, Moderate tortuosity

Contrast Sparing CTA

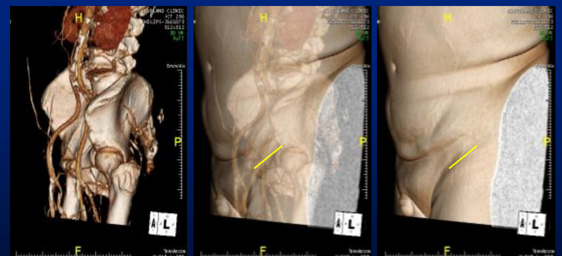




- 5F pigtail in abdominal aorta
- Mix 20cc contrast + 60 cc saline
- Inject at 4 cc/sec for 10 seconds

90 cc IV Contrast

Common Femoral Artery Imaging

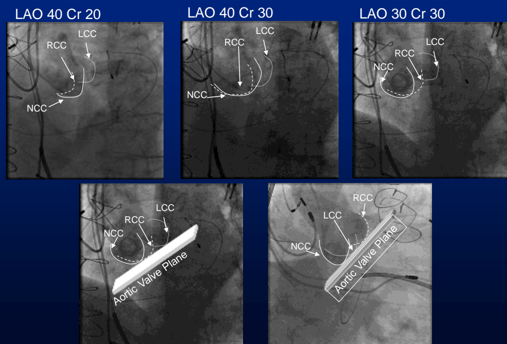


Precise planning for the “skin entry” and anticipation of the “de

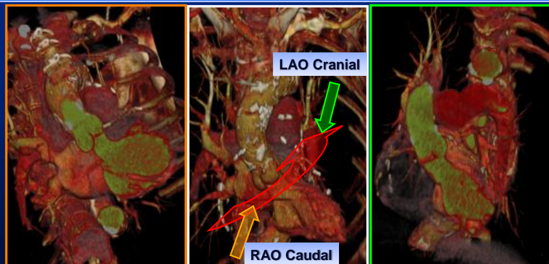
Role of CT in TAVI Procedural Guidance

- **Pre procedural selection of angiographic planes**
  - Important to coaxial positioning of the valve
  - Perpendicular to valve annulus
  - Decrease contrast utilization

Selection of Fluoroscopic Projections



CT Scan: Definition of Aortic Plane



Kurra et al, JACC Cardiovasc Interv. 2010;3(1):105-1

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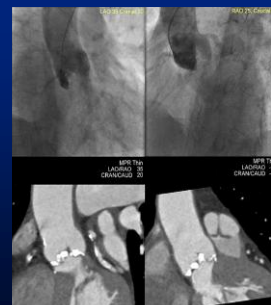
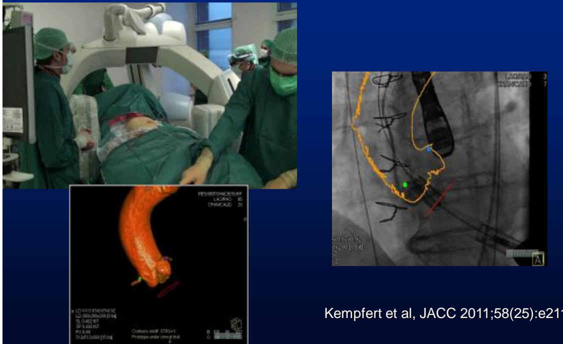


Kurra et al, JACC Cardiovasc Interv. 2010;3(1):105-1

Intraprocedural role of DynaCT in TAVI



Kempfert et al, JACC 2011;58(25):e211

Goals of Intra-procedural guidance by TEE in TAVI

1. Sizing the LVOT diameter – choose size of prosthesis
2. Guiding placement of transcatheter wire (mostly fluoro)
3. Positioning the crimped valve within the annulus
4. Assessing the position of the valve after expansion
5. Quantitating post implantation regurgitation
6. Looking for hemopericardium
7. Looking for new wall motion abnormalities
8. Documenting TAVI gradient

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Potential complications related to Valve Positioning

- Too ventricular ⟷ Usually related to calcification of the annulus/root → AR !!
  - Mitral valve impingement
  - Overhanging of native leaflets
  - Leak from above the skirt
- Too aortic
  - Embolization
  - Coronary obstruction
  - Inadequate apposition
  - Central leak

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Lessons Learned in the Cath Lab – Part 1

- The success of percutaneous valve program is absolutely dependent on, and starts with the patient selection
  - HIGHLY selected patients!
- Pre-procedural strategic planning.
- Antecipate potential intraprocedural complications.
  - Communicate clearly
  - Timely management when it occurs

Lessons Learned in the Cath Lab – Part 2

- Use the standardized vocabulary and anatomy between interventionalist and echocardiographer
  - Rely upon internal anatomic landmarks
- Allow interventionalist to do “drive” and ask for additional images when needed.
- Know what views to use for each step of the procedure. Don’t need to be creating beautiful pictures throughout, but be practical and objective.

Lessons Learned in the Cath Lab – Part 3

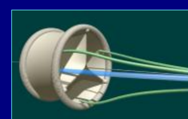
- Mutual collaboration and team work also with radiology (lots of these pts have extra-cardiac findings!)
- Interventionalists must master the disease and can’t afford not to be an imager.
- Huge synergy between these fields is leading to further developments in imaging and device technology. (a win-win situation)

Future Perspectives

- Long-term durability? (Max 4 yrs). Waiting SOURCE and PARTNER registry data
- Now with the commercial THV system, are the results going to be consistent with PARTNERS?
- Is transapical really the best approach with unsuitable femorals?
- Anticoagulation and peri-procedural Afib management
- Learning curve from interventionalist
- Ongoing PARTNERS II Cohort A for pts with severe AS and STS > 4.

Transcatheter Percutaneous AVR: Next Generation Devices

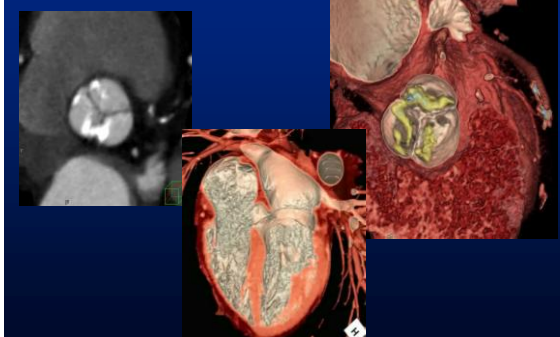
AorTx

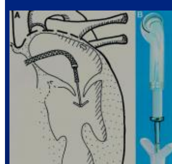

DirectFlow

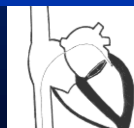
Sadra

- Lower profile
- Repositionable
- Less paravalvular AR

Fusion of 3D Dataset with Function and Deformational Imaging




TransSeptal Clip Repair for MR


Percutaneous closure of peri-prosthetic leak

Transcatheter Valve Procedures represent a fast growing field!

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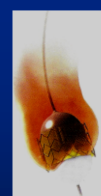
Transcatheter AVI