TAVR 2020:
Where have we come from and why am I doing this? The Sonographer in the Procedure

Karen G. Zimmerman, BS, ACS, RDCS, RVT, FASE

HAWAII
2020

ASE

1

TAVR 2020:
Where have we come from and why am I doing this? The Sonographer in the Procedure

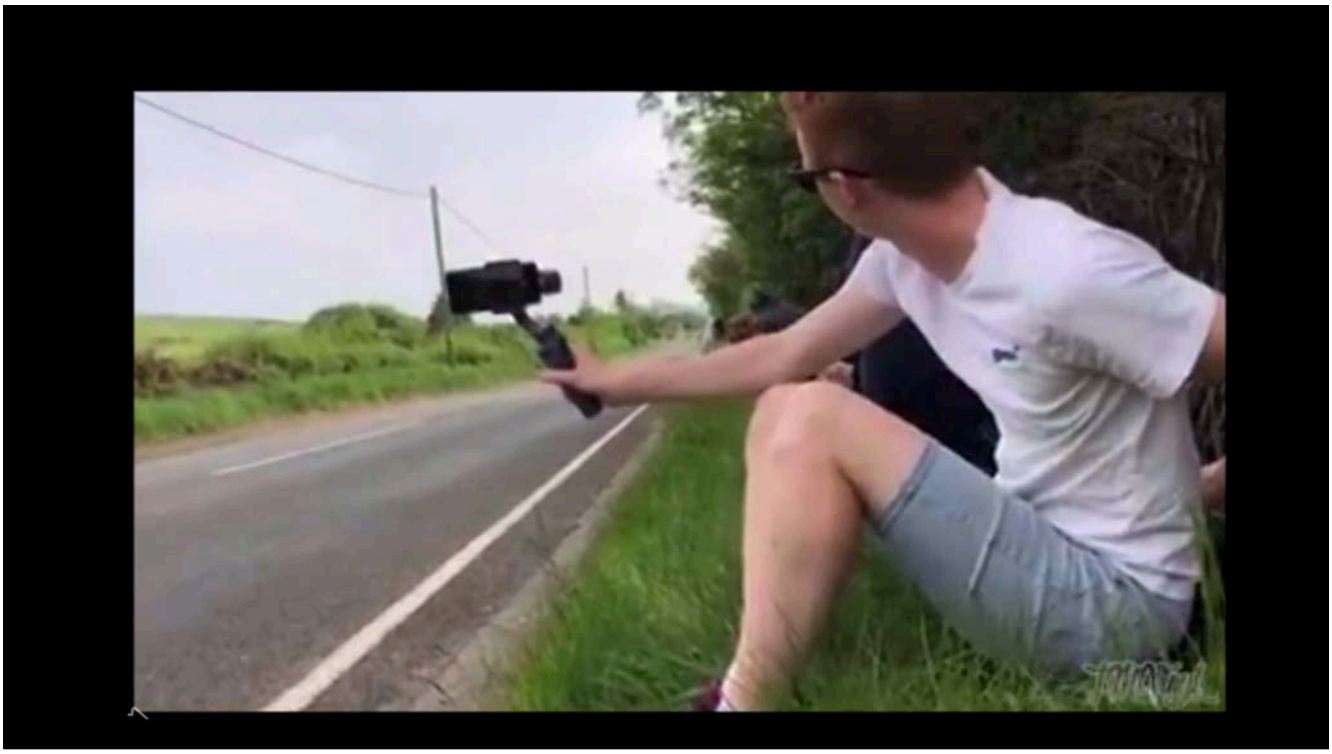
Karen G. Zimmerman, BS, ACS, RDCS, RVT, FASE

Disclosures: I'm a sonographer…how could I have anything to disclose?!

HAWAII
2020

ASE

2



3

Advanced imaging and planning have revolutionized TAVR

Superior outcomes and durability for high-risk severe AS patients

4

TAVR 2020 *Sonographer in the Procedure*

I. Multidisciplinary Heart Valve Team Continuity of Imaging
II. Pre Screening
  I. Key Features of Aortic Stenosis
  II. Valve calcification
  III. Ventricular remodeling
III. Procedural planning
  A. Annulus and prosthetic sizing
  B. Annulus/coronary ostia distance
IV. Procedural guidance
  A. TEE
  B. TTE
  C. Early complications
V. Surveillance studies
VI. Summary

5

Multidisciplinary Team Heart Valve Team

- **Anesthesiologists**
- **Cardiologists**
- **Clinical specialist**
- **Data entry**
- **Interventionalists**
- **Cath lab staff**
- **Surgeons**
- **Sonographers**

6

Multidisciplinary Team Heart Valve Team

- **Vigilant image guidance from pre to intra to post procedural guidance and surveillance**
- **Continuity of Imaging**

7

Sonographer roles in the Heart Valve Team

- Continuity of Imaging (pre, intra, post echos)
- Before and after images for patients
- Gathering data which is changing the future of intervention (AI, strain)
- Educator of Imaging team (training with physicians to understand imaging needs to take back to imaging team and service line)
- Data elements for TVT registry
- New protocols with new advances in technology (low flow, low EF, stress echos)
- New measurements
- MPR, AVA
- Ostial heights
- Valve sizing
- Cropping PVLs
- Cropping for high gradients gradients? LVOT obstruction? Thrombus? Foreign bodies? Where did it go? What is that?!
- New literature (new windows, new rules)
- Strain
- Navigators and fusion leading to confusion
- Connections and confusion (cath lab equipment and slaving)
- We need you in the cath lab, the OR, can you help the anesthesiologist? Call the cardiologists when they get access!
- Are we done yet?!
- New to the radiation world!
- Keys to image guidance!
- Now we need to understand the procedure more, wires, when, access, etc.

8

Important roles of the Sonographer

Continuity of Imaging

- **Preprocedural**
- **Planning**
- **Intraprocedural**
- **Surveillance**

9

Continuity Of Imaging

Definition:

- acquisition of *reproducible complete* datasets
- in the same format
- throughout the patient's continuum of care

10

Consistent, Reproducible, Continuum

It should not matter who is doing the study or where, as long as each study contains a complete reproducible dataset

11

Consistent, Reproducible Imaging is Possible and Necessary!

Data easily analyzed and compared

Decisions regarding therapy and Intervention

Comparison between studies document:

- response to medical management,
- progression of disease
- results from previous intervention

12

Consistent, Reproducible Imaging is Possible and Necessary!

Greatly facilitates outcomes analysis
Clinical research
Machine learning
And patient care

13

TAVR 2020 *Sonographer in the Procedure*

I. Multidisciplinary Heart Valve Team Continuity of Imaging
II. Pre Screening
   I. Key Features of Aortic Stenosis
   II. Valve calcification
   III. Ventricular remodeling
III. Procedural planning
   A. Annulus and prosthetic sizing
   B. Annulus/coronary ostia distance
IV. Procedural guidance
   A. TEE
   B. TTE
   C. Early complications
V. Surveillance studies
VI. Summary

14

#1: Preprocedural study initial TTE by Sonographer

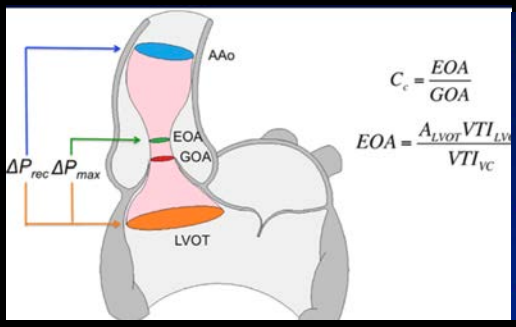
Complete **guideline-directed study including *comprehensive* data on valve hemodynamics and strain**

3D ensures the dataset can be stored for post-acquisition analysis

Same format is used for all subsequent studies

15

Defining Aortic Stenosis

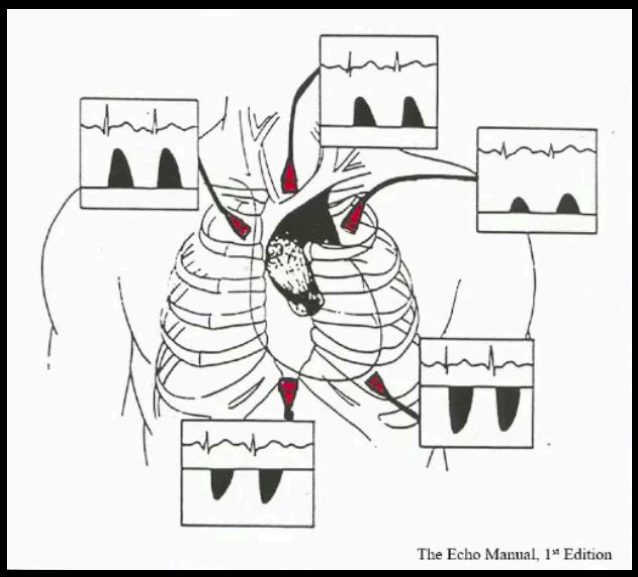


- Gradient
- LVOT diameter
- EOA (echo continuity)
- GOA (cath Gorlin)

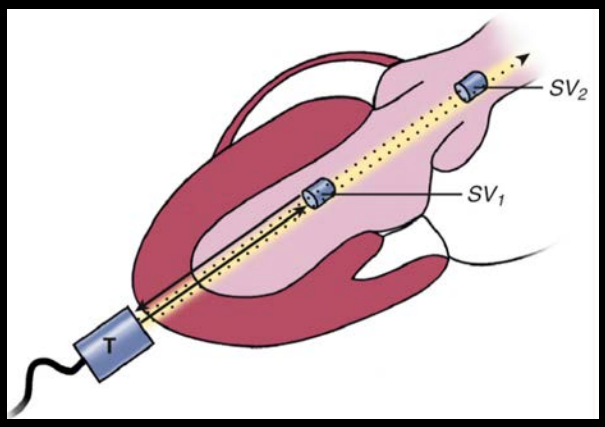
SEVERE AORTIC STENOSIS:
AVA < 1.0 cm^2
Indexed AVA < 0.6 cm^2
Mean transaortic gradient > 40 mm Hg
Peak AV velocity > 4 m/sec

16

Multiple sites of interrogation is mandatory



Raymond Stainback MD ASE AS Webinar Dec 2019



Otto CM *Textbook of Clinical Echocardiography, 5th ed.* Elsevier 2018

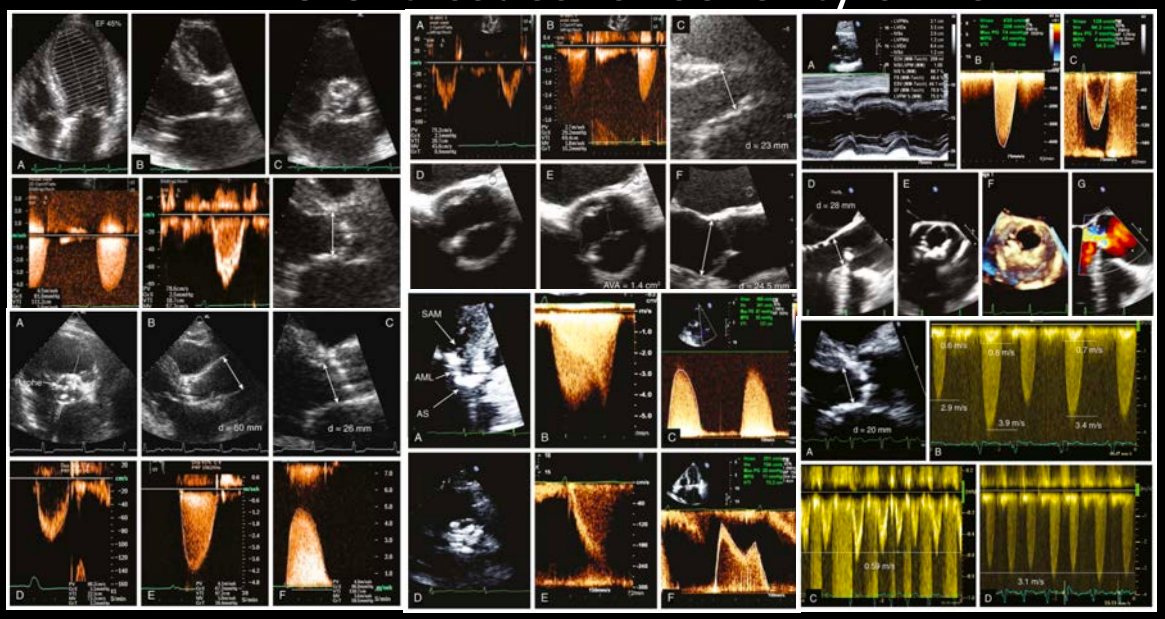
17

TAVR

1. AS in calcific three-leaflet aortic valve
2. Rheumatic AS
3. AS in a Bicuspid aortic valve
4. Combined AS and AR
5. AS with subvalvular obstruction
6. Assessing AS in Atrial Fibrillation

18

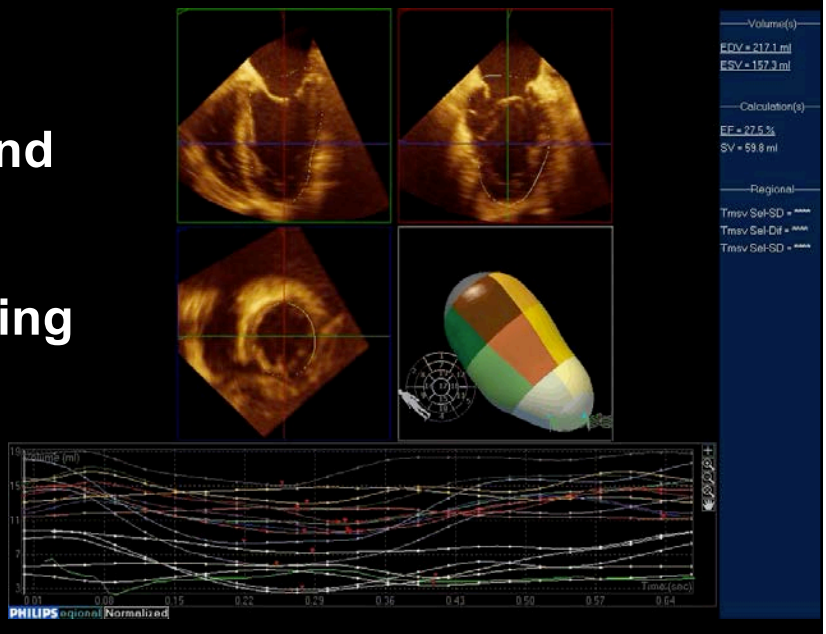
Different issues for severity of AS



N. Jander, J. Minners in Otto's *Practice of Clinical Echocardiography, 5th ed.* Elsevier 2016

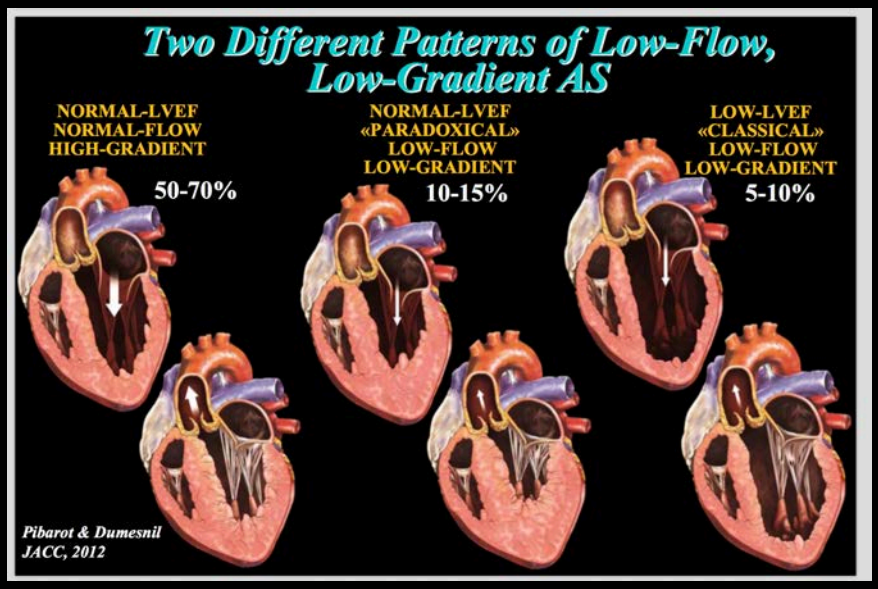
19

3D EF becomes reference for pre and post surveillance providing useful information regarding volume status and remodeling



20

Low Flow, High Flow, No Flow, etc.

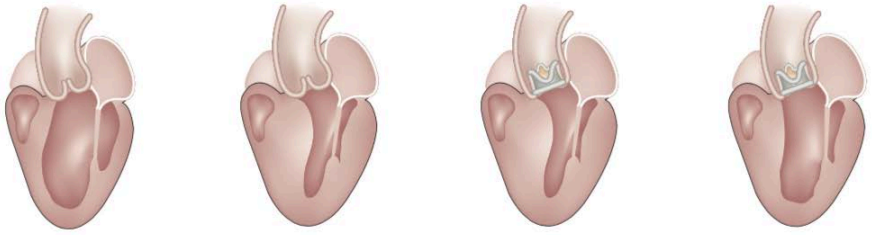


21

Is it the Valve or the Ventricle?

22

Remodeling responses to aortic stenosis



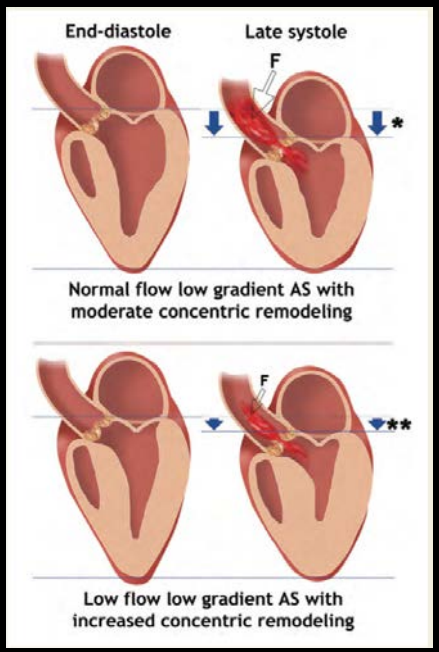
	Mild–moderate aortic stenosis	Severe aortic stenosis	Immediately after AVR	Late after AVR
Histopathology				
LVH	+/++	++/+++	++/+++	++ or +
Fibrosis	+/++	++/+++	++/+++	+/++
Apoptosis	+	++/+++	++/+++	+/++
Echocardiography				
LVEF	Preserved or ↑	N or reduced	Improving	Improved
AVA (cm^2)	1–1.5	<1	2±1	2±1
Mean gradient (mmHg)	25–40	>40	15±5	15±5
E/E' ratio	N or ↑	↑↑	↑/↑↑	N or persistingly ↑

Ozkan, A. et al.Nat.Rev.Cardiol.8,494-501 (2011)

23

Ventricular remodeling for timing of intervention

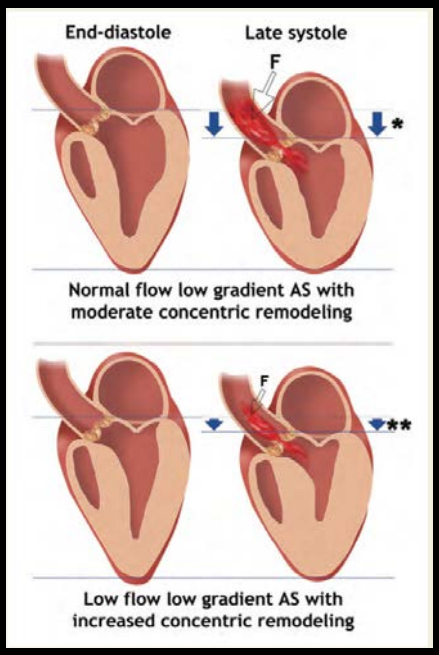
LV walls thicken and mitral annulus tips (twists), as ventricle tries to accommodate and make room for flow..



Bartel T, Muller S, European Heart Journal((2013)34,1862-1863

24

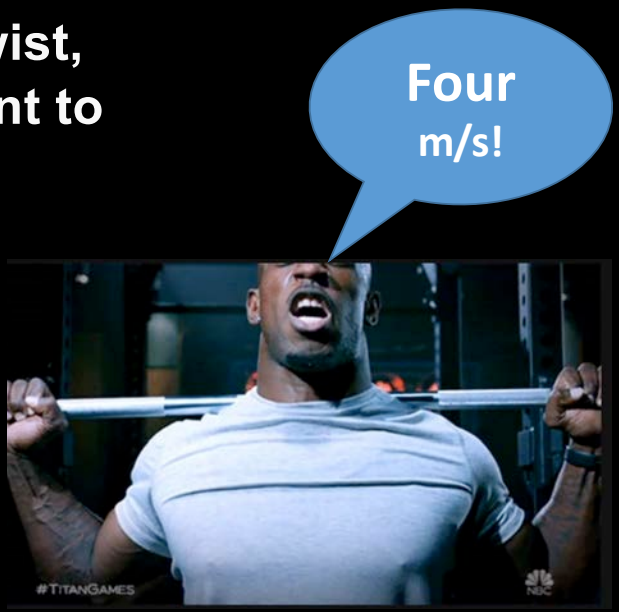
Ventricle works to resolve growing obstruction by doing the "twist and shout"



Bartel T, Muller S, European Heart Journal((2013)34,1862-1863

25

Shouting happens when the ventricle can no longer twist, causing increased gradient to shout!



26

TAVR 2020 *Sonographer in the Procedure*

I. Multidisciplinary Heart Valve Team Continuity of Imaging
II. Pre Screening
   I. Key Features of Aortic Stenosis
   II. Valve calcification
   III. Ventricular remodeling
III. Procedural planning
   A. Annulus and prosthetic sizing
   B. Annulus/coronary ostia distance
IV. Procedural guidance
   A. TEE
   B. TTE
   C. Early complications
V. Surveillance studies
VI. Summary

27

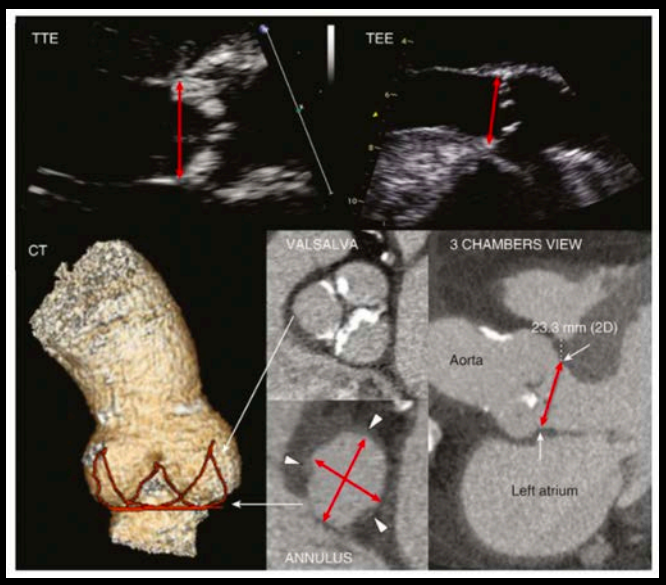
#2: Planning study diagnostic TEE with Cardiologist

Cardiologist establishes diagnosis & initiates therapy

3D dataset acquired and stored for post acquisition analysis

28

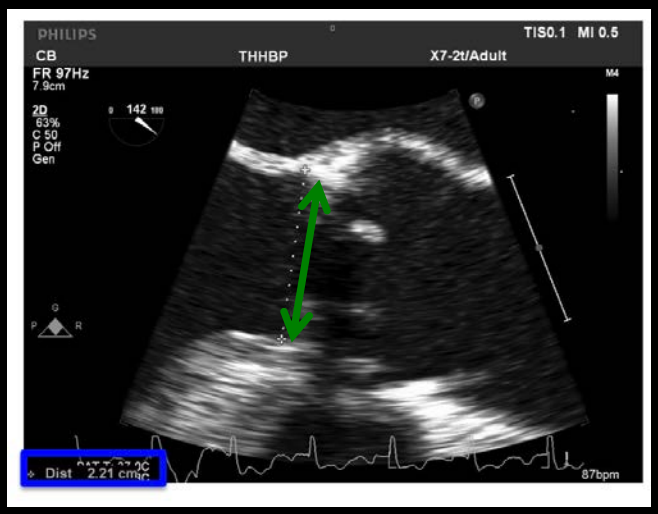
Aortic Annulus measurements: TTE, TEE and CT

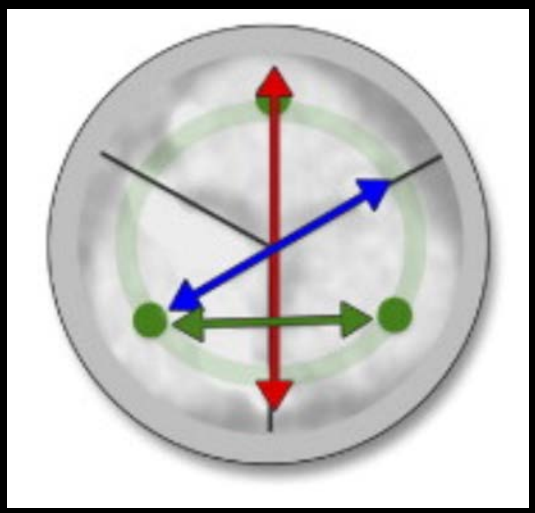


D. Messika-Zeitoun, M. Urena in Otto's *Practice of Clinical Echocardiography, 5th ed.* Elsevier 2016

29

Aortic Annulus is not a 2D structure

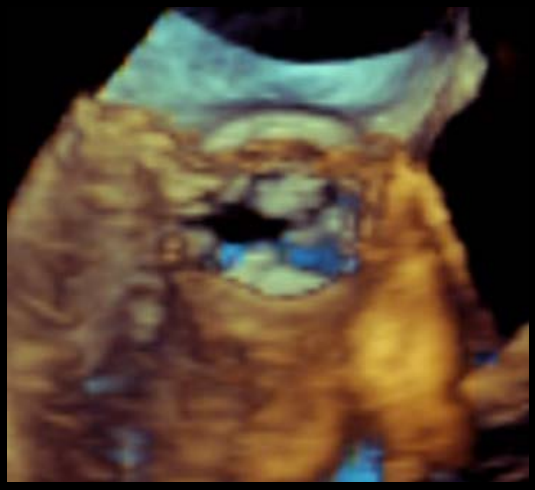


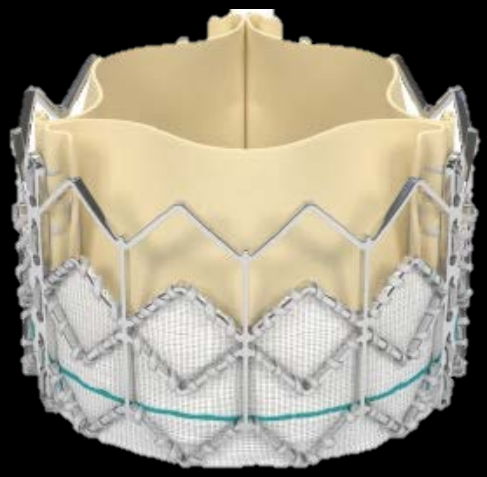


So how are you measuring this diameter?

30

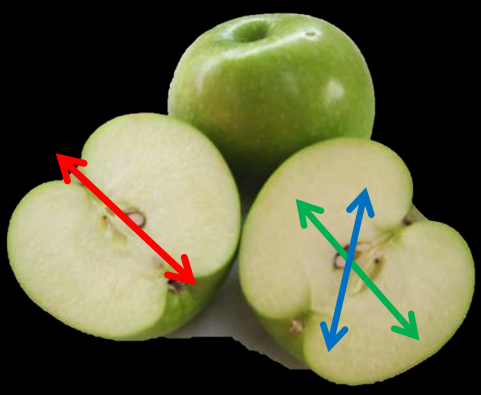
The aortic annulus is also a 3D structure, ... so is the THV

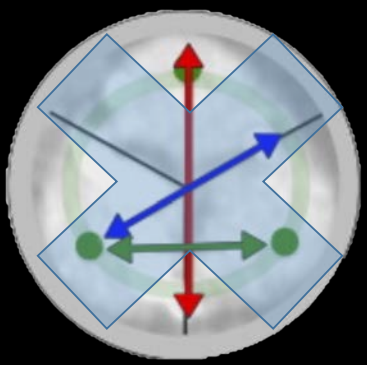


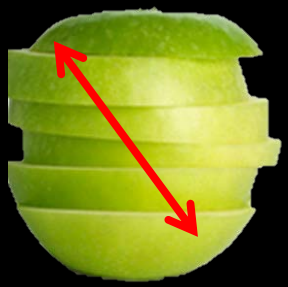


31

The direction of our slice may not even matter anymore, it is just a slice!







32

There is another way…

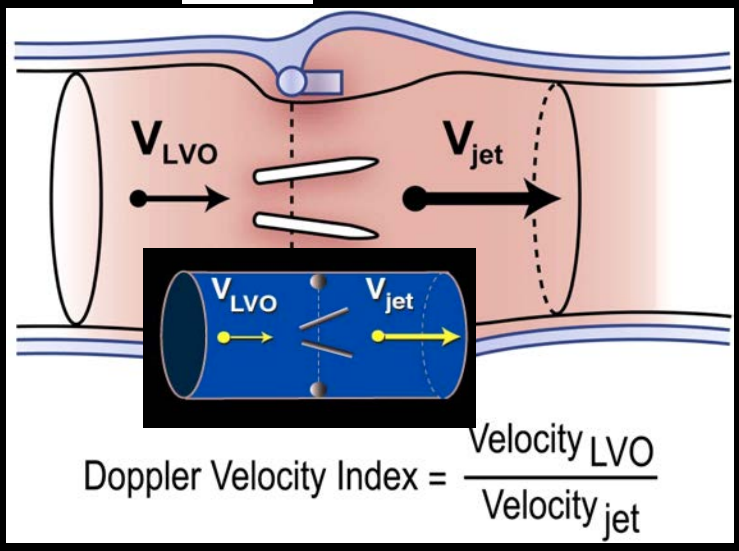
Less prone to error, minimally affected by Cardiac Output

33

***No "hard to see"* LVOT diameter is needed**

34

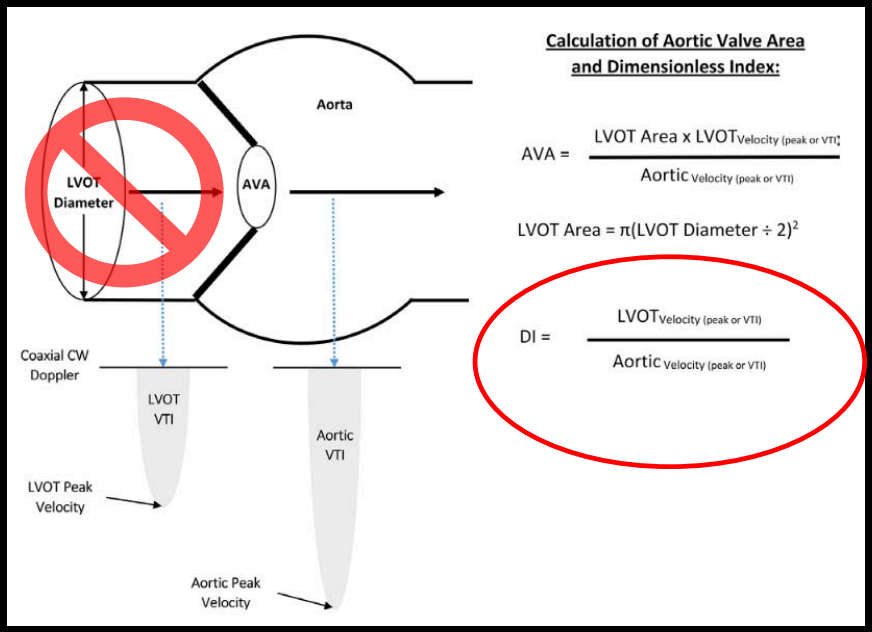
Doppler Velocity Index (DVI) is a **ratio** of flow from **both** sides of the valve



Zoghbi et al JASE 2009 22, 9:975-1014

35

NO LVOT DIAMETER!



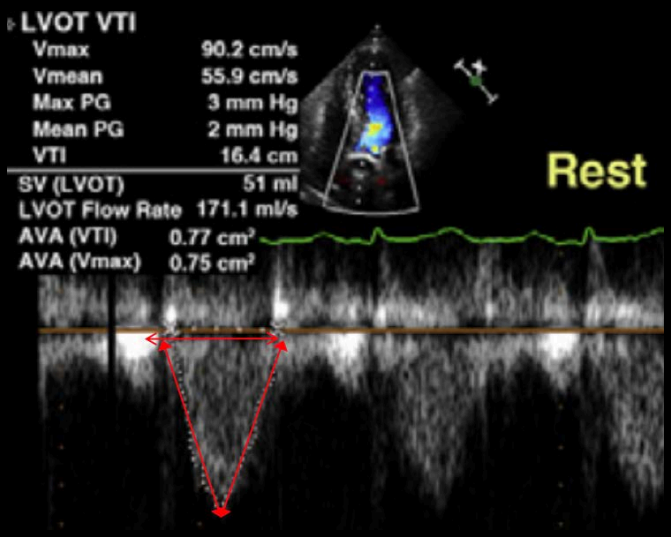
Otto CM. Heart 2019;105:89–91.

36

Transaortic Flow Rate (TFR)

Flow Rate = Stroke Volume/ Systolic Ejection Period (SEP)

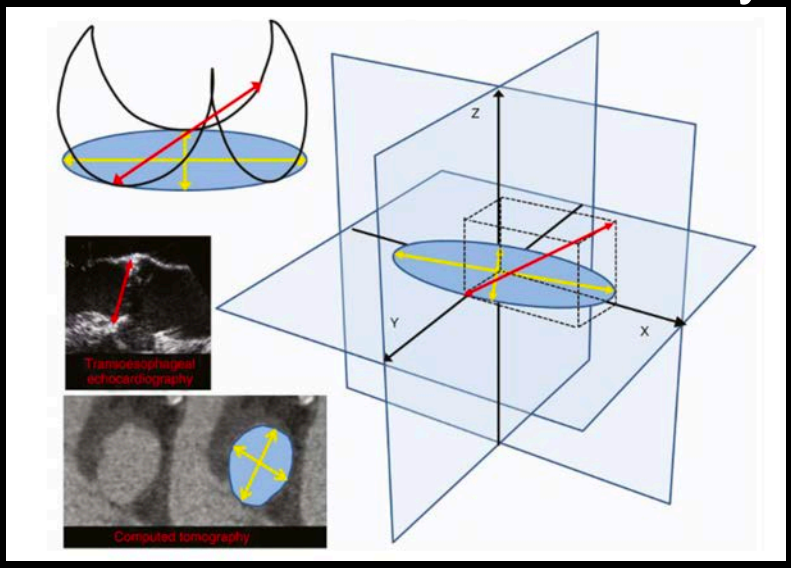
Normal flow rate is determined to be 200 ml/s



Chahal NS et al. JIMG 2015;8:1133-1139

37

3D Aortic Annulus Anatomy

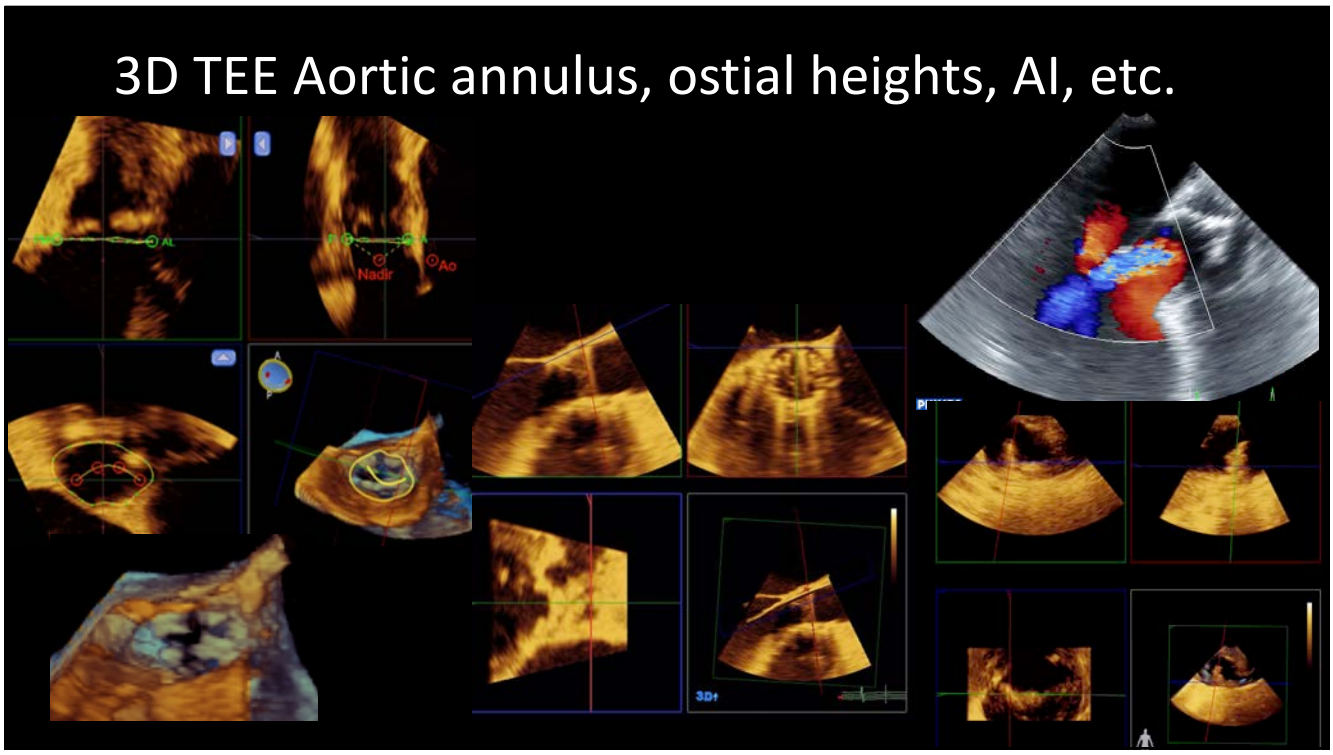


D. Messika-Zeitoun, M. Urena in Otto's *Practice of Clinical Echocardiography, 5th ed.* Elsevier 2016

38

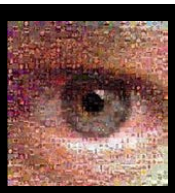

Time to JUMP OUT of the 2D plane!
P
L
R
A

39


3D TEE Aortic annulus, ostial heights, AI, etc.
AL
Nadir
Ao
3D+

40

Image Summaries create a plan



CT	21.5mm	area 3.75-400	(P) 72-74	ov (23)10-4% (26) 42%
3M	22.3mm	area 3.90cm2	(P) 70.7mm	ov (23) 6%
G-Lab	20mm	area 3.27cm2		
MVQ	21.7mm	3.57cm2	(P) 70.7mm	ov (23) 16%

Concerns: Access, low ostial height

41

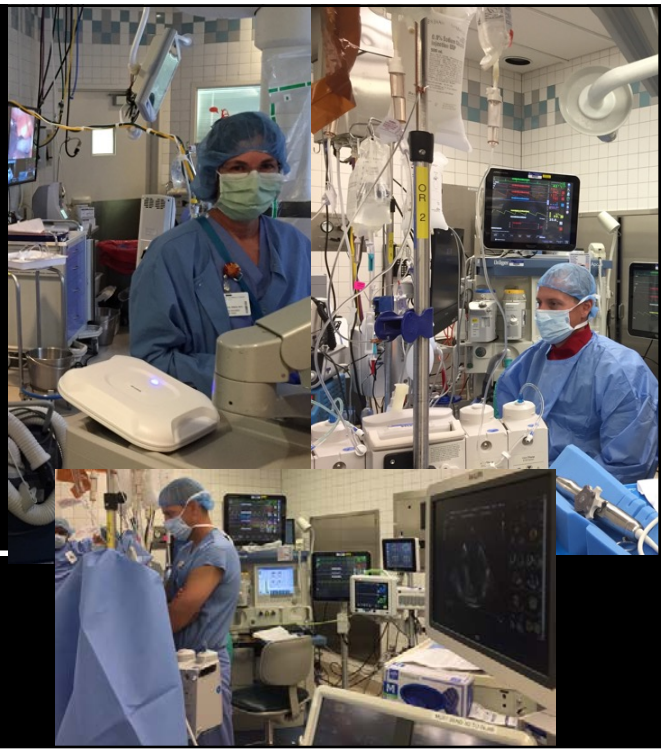
TAVR 2020 *Sonographer in the Procedure*

I. Multidisciplinary Heart Valve Team Continuity of Imaging
II. Pre Screening
   I. Key Features of Aortic Stenosis
   II. Valve calcification
   III. Ventricular remodeling
III. Procedural planning
   A. Annulus and prosthetic sizing
   B. Annulus/coronary ostia distance
IV. Procedural guidance
   A. TEE
   B. TTE
   C. Early complications
V. Surveillance studies
VI. Summary

42

3: Intraprocedural w/ anesthesia/cardiology

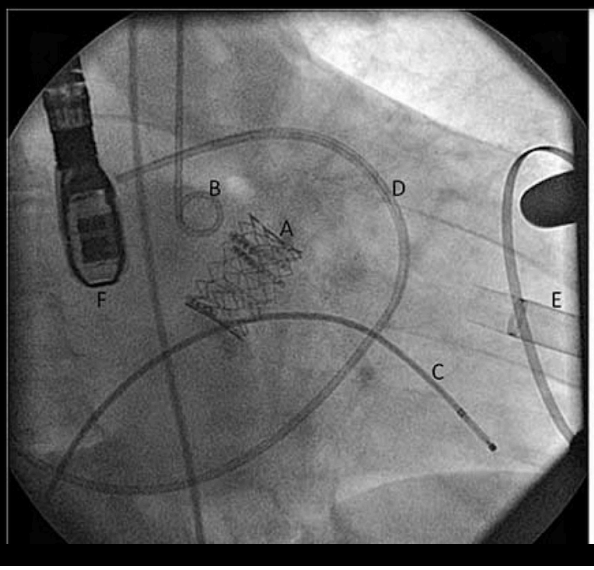
- Hemodynamic management
- Confirm measurements
- Wall motion
- Pericardial effusion
- Image guidance
- 3D real time cropping for PVL
- Or whatever comes up!



43

Sonographer Intraprocedural Imaging Which Wire Where and Why

- Communicator between cath lab/OR staff
- Connections
- Slave monitors
- Barricades
- Probes
- Barricades



A: Implanted Edwards Sapien valve
B:Pigtail catheter in aortic root
C: Percutaneous transvenous pacing wire in right ventricle
D: Swan Ganz catheter
E: Transapical sheath
F: Transesophageal echocardiography probe

44

Sonographer in the procedure

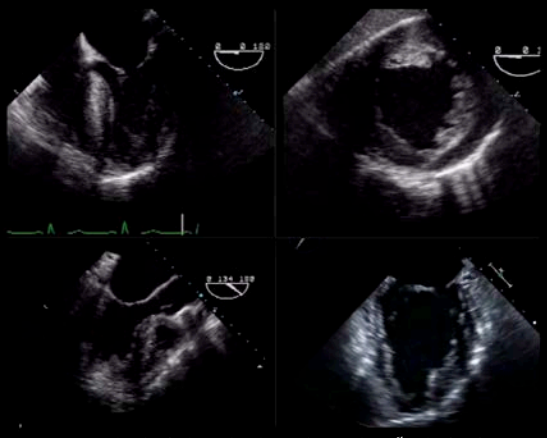
Assists anesthesia/cardiology with pre images and remeasuring to confirm sizing

45

Sonographer in the procedure

4-chamber and SAX views for wall motion evaluation

Long axis-Commissural evaluation of MR/ wall motion

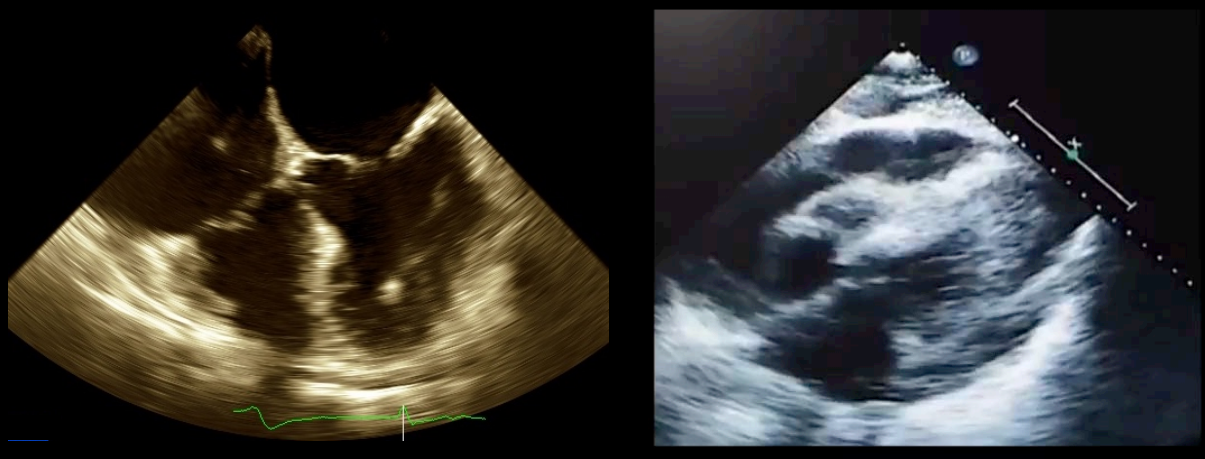


Otto CM *Textbook of Clinical Echocardiography, 5th ed.* Elsevier 2018

46

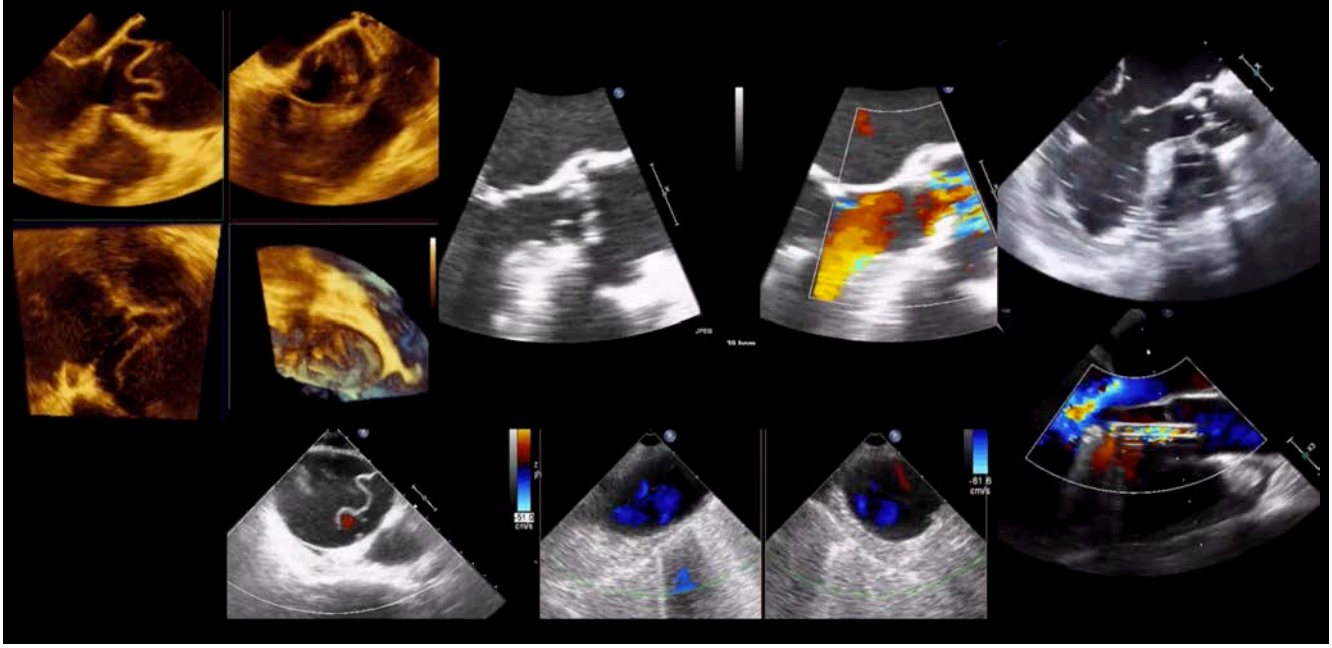
Sonographer in the procedure

Round the world views acquired for checking pericardial effusion and RV/LV function after deployment



47

Anything can happen!



48

TEE vs Conscious Sedation

Advantages and Disadvantages

Advantages	Disadvantages
Comprehensive preprocedural assessment	General anesthesia
Procedure guiding	Semiinvasive
Rapid and accurate assessment of procedural results and complications	Risk of oropharyngeal and gastroesophageal complications
Higher imaging resolution than TTE	
No interference with interventional or surgical management of complications	

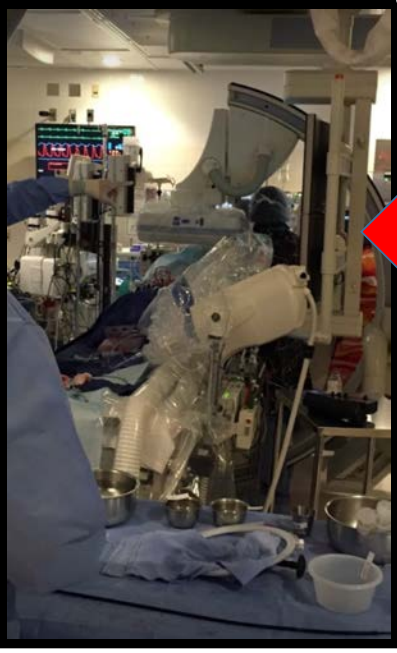
D. Messika-Zeitoun, M. Urena in Otto's *Practice of Clinical Echocardiography, 5th ed.* Elsevier 2016

49

You simply cannot see well enough without TEE!

50

You simply cannot see well enough without TEE!



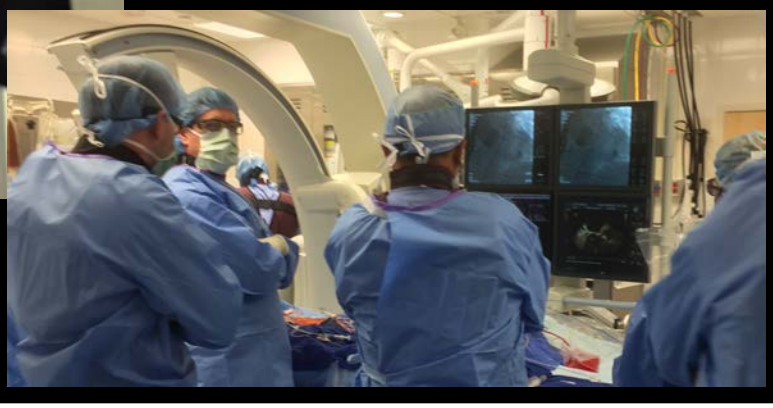
51

Sonographer in the procedure

Image acquisition with sonographer straddling C-arm is horrible at best!

52

Basically, do you want to see or not?



53

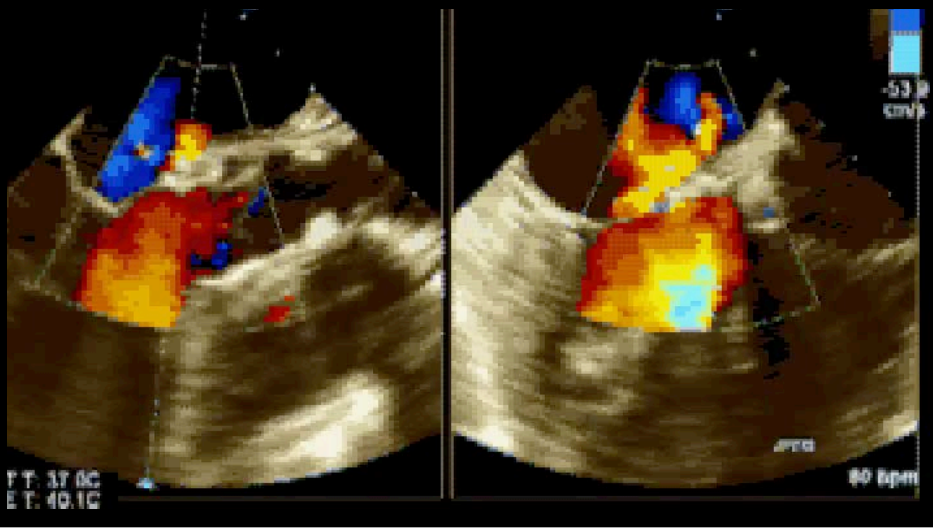
Complications

1. Paravalvular Leak
2. Annular rupture
3. Pericardial tamponade
4. Low positioning
5. Incomplete deployment
6. Acute mitral regurgitation
7. Valve thrombosis

54

Sonographer in the procedure

Paravalvular Leaks

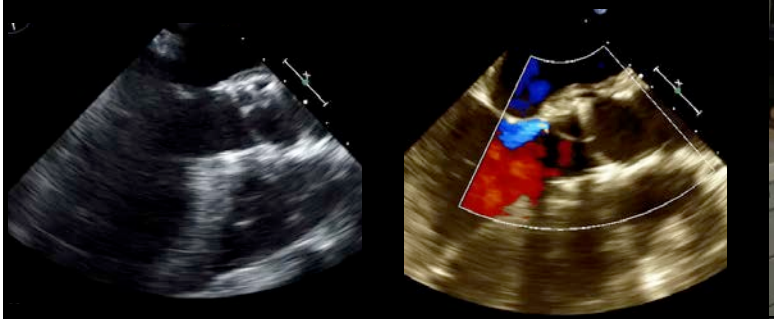


55

Post-deployment Assessment (Real-time Cropping)

Is it fixed or not?!

Imager must be accurate, brave & fast!



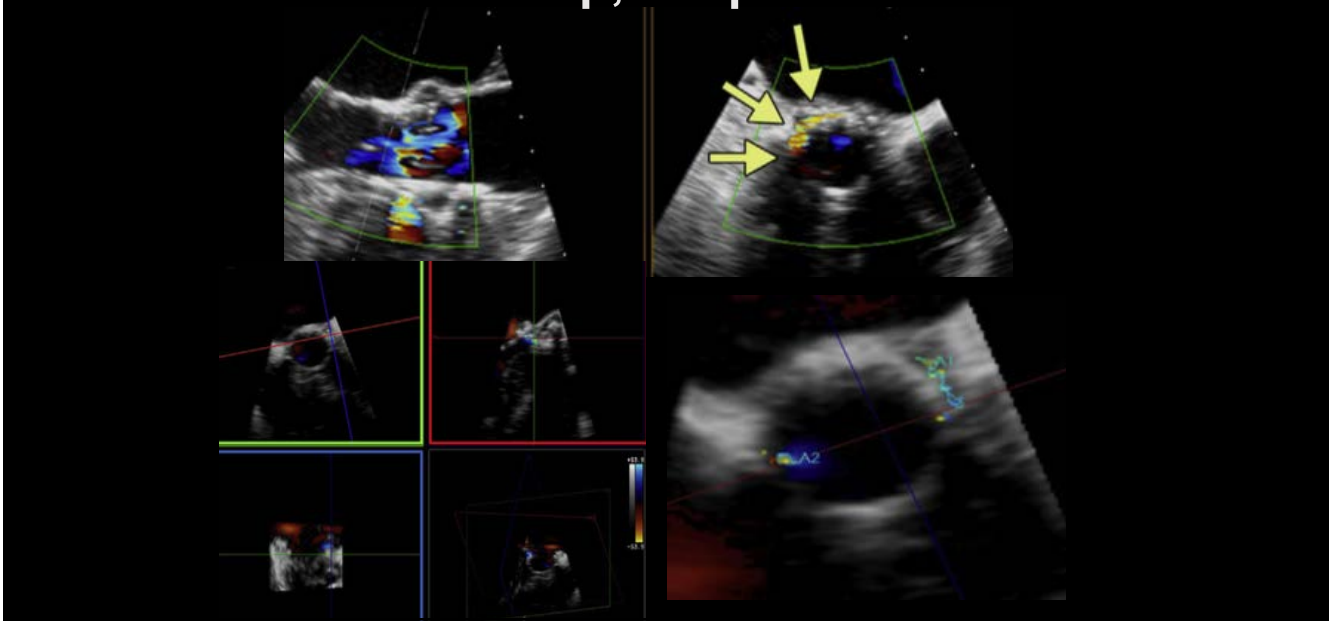
56

Sonographer in the procedure

Not afraid to show the truth!

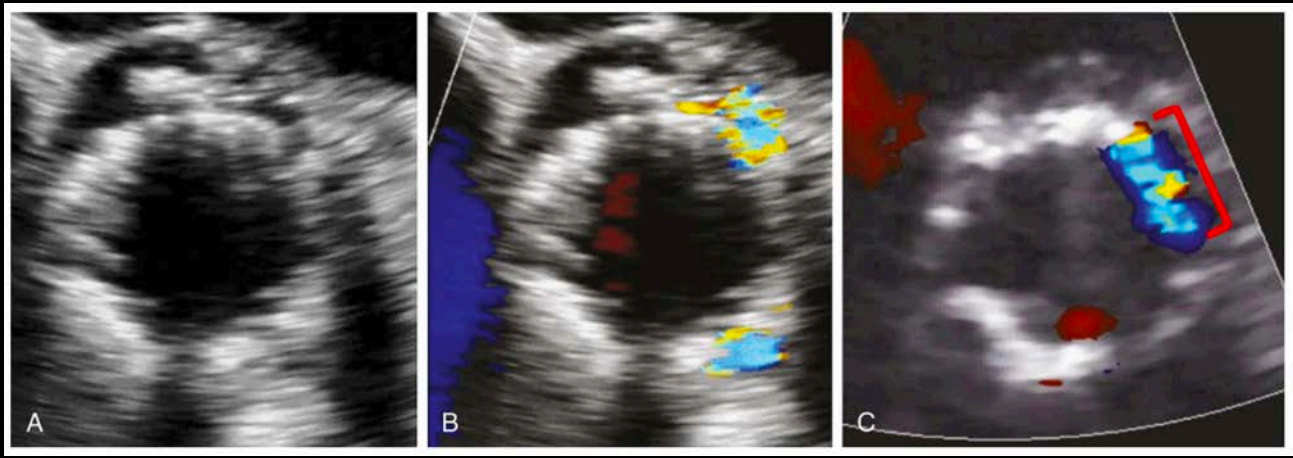
57

Intraprocedural Imaging PVL: 2D vs. 3D Chop, Crop and Roll!



58

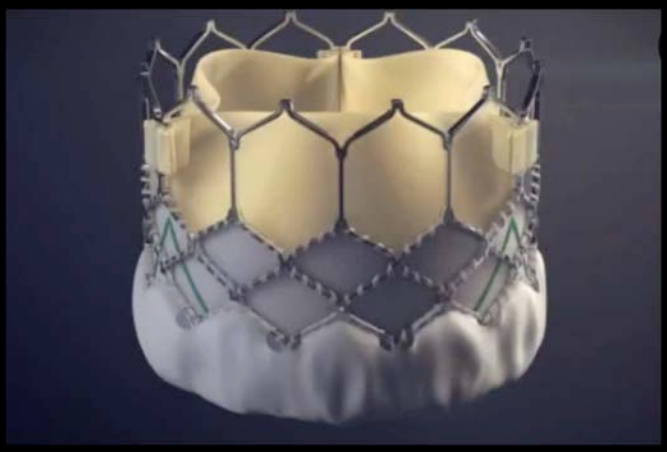
Paravalvular Leak



D. Messika-Zeitoun, M. Urena in Otto's *Practice of Clinical Echocardiography, 5th ed.* Elsevier 2016

59

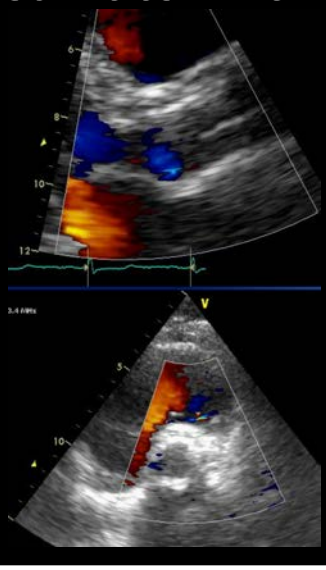
However our occurrences of PVLs has become less, partly since Edwards put a skirt on it!



Edwards SAPIEN 3 transcatheter heart valve/ Edwards Lifesciences

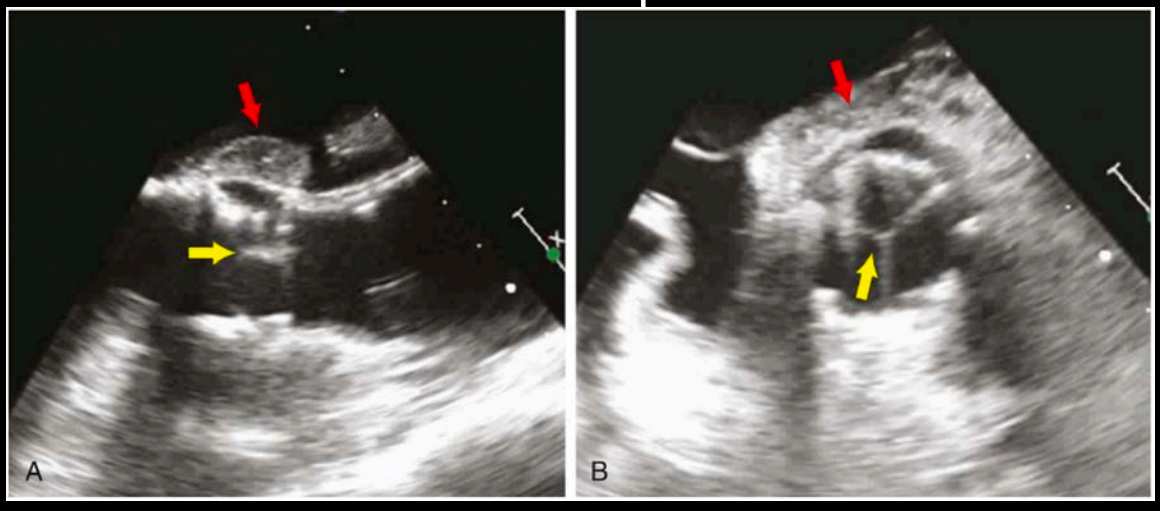
60

Atypical inconsistent jet shape and direction: How many? From where? Truly can't tell from surface…



61

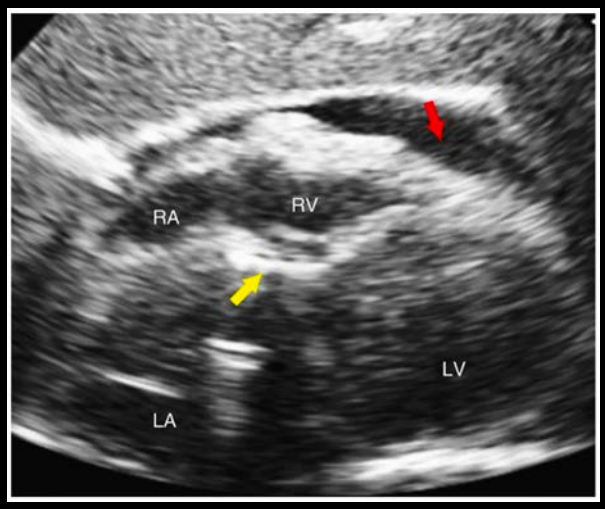
Complications
Annular rupture



D. Messika-Zeitoun, M. Urena in Otto's *Practice of Clinical Echocardiography, 5th ed.* Elsevier 2016

62

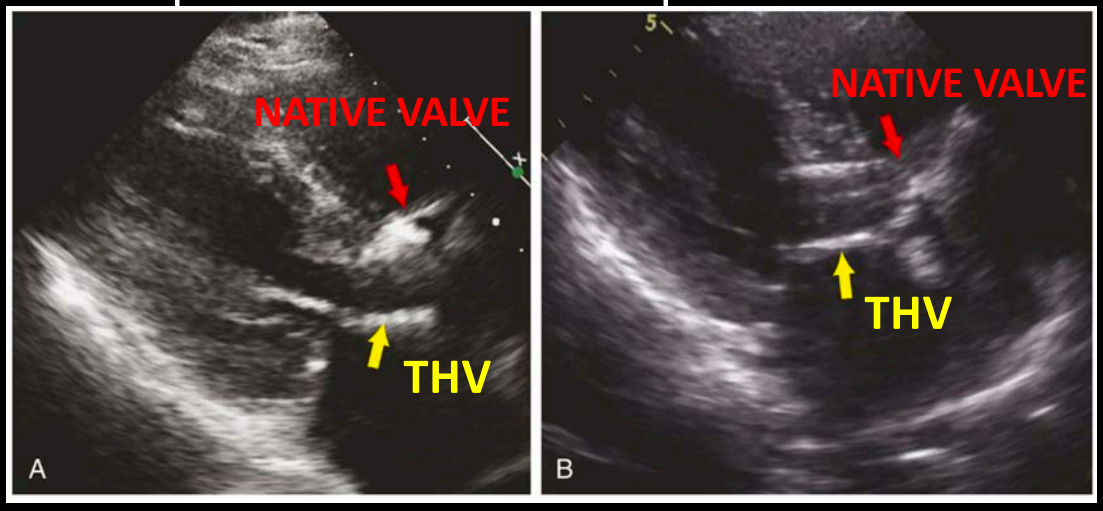
Complications
Pericardial tamponade



D. Messika-Zeitoun, M. Urena in Otto's *Practice of Clinical Echocardiography, 5th ed.* Elsevier 2016

63

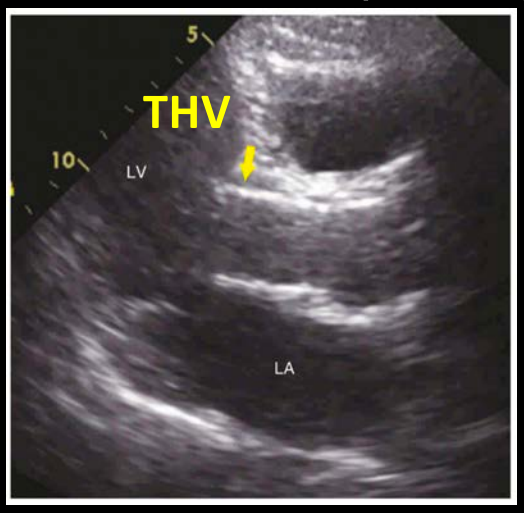
Complications
Low positioned balloon-expandable valve



D. Messika-Zeitoun, M. Urena in Otto's *Practice of Clinical Echocardiography, 5th ed.* Elsevier 2016

64

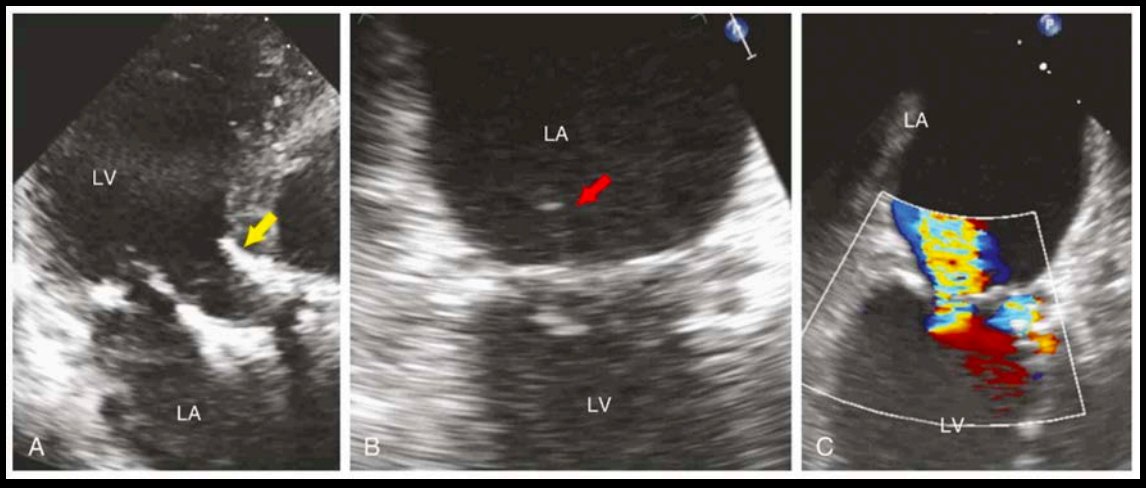
Complications
Low positioned self-expanding valve



D. Messika-Zeitoun, M. Urena in Otto's *Practice of Clinical Echocardiography, 5th ed.* Elsevier 2016

65

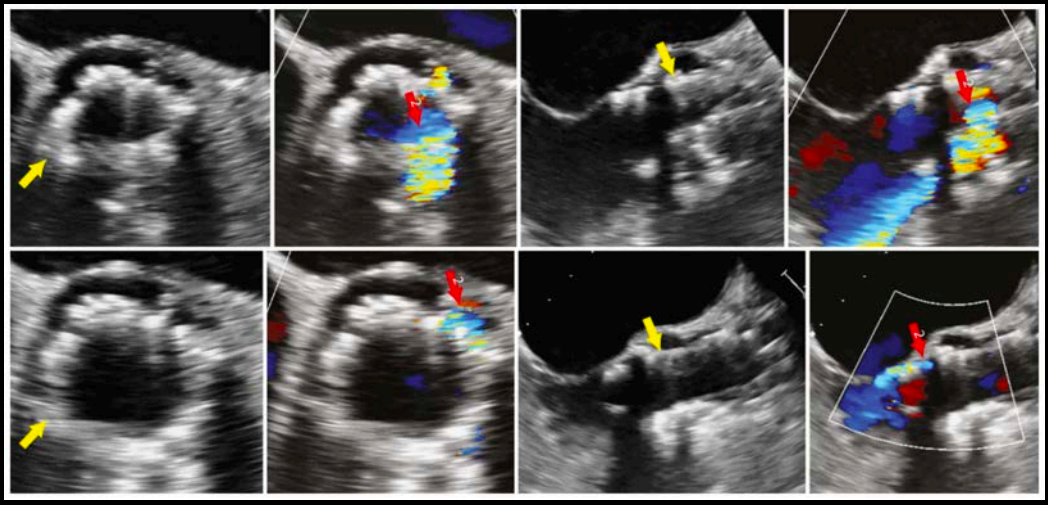
Complications
Acute traumatic MR



D. Messika-Zeitoun, M. Urena in Otto's *Practice of Clinical Echocardiography, 5th ed.* Elsevier 2016

66

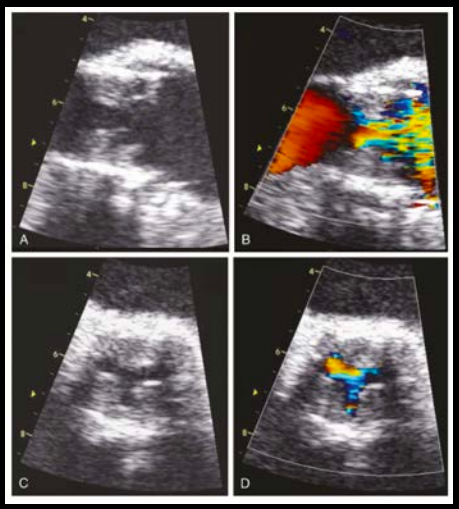
Complications
Incomplete deployment of a self-expanding valve



D. Messika-Zeitoun, M. Urena in Otto's *Practice of Clinical Echocardiography, 5th ed.* Elsevier 2016

67

Complications
Valve thrombosis



D. Messika-Zeitoun, M. Urena in Otto's *Practice of Clinical Echocardiography, 5th ed.* Elsevier 2016

68

TAVR 2020 *Sonographer in the Procedure*

I. Multidisciplinary Heart Valve Team Continuity of Imaging
II. Pre Screening
   I. Key Features of Aortic Stenosis
   II. Valve calcification
   III. Ventricular remodeling
III. Procedural planning
   A. Annulus and prosthetic sizing
   B. Annulus/coronary ostia distance
IV. Procedural guidance
   A. TEE
   B. TTE
   C. Early complications
V. Surveillance studies
VI. Summary

69

4: Surveillance studies

- **Follow up studies are performed the same as the initial study**
- **Include complete data sets stored for future evaluation**
- **Additional focus on procedural results**
  - Views for repair stability
  - Post deployment diameter carried throughout
  - Gradients
  - Volume status
  - TVT data entry

70


Success of TAVR is
the
Continuity of Imaging
Medicine
Radiology
Surgery
Cardiology
Anesthesia

71


It takes many eyes to create a successful team
Karen G. Zimmerman BS, ACS, RDCS, RVT, FASE

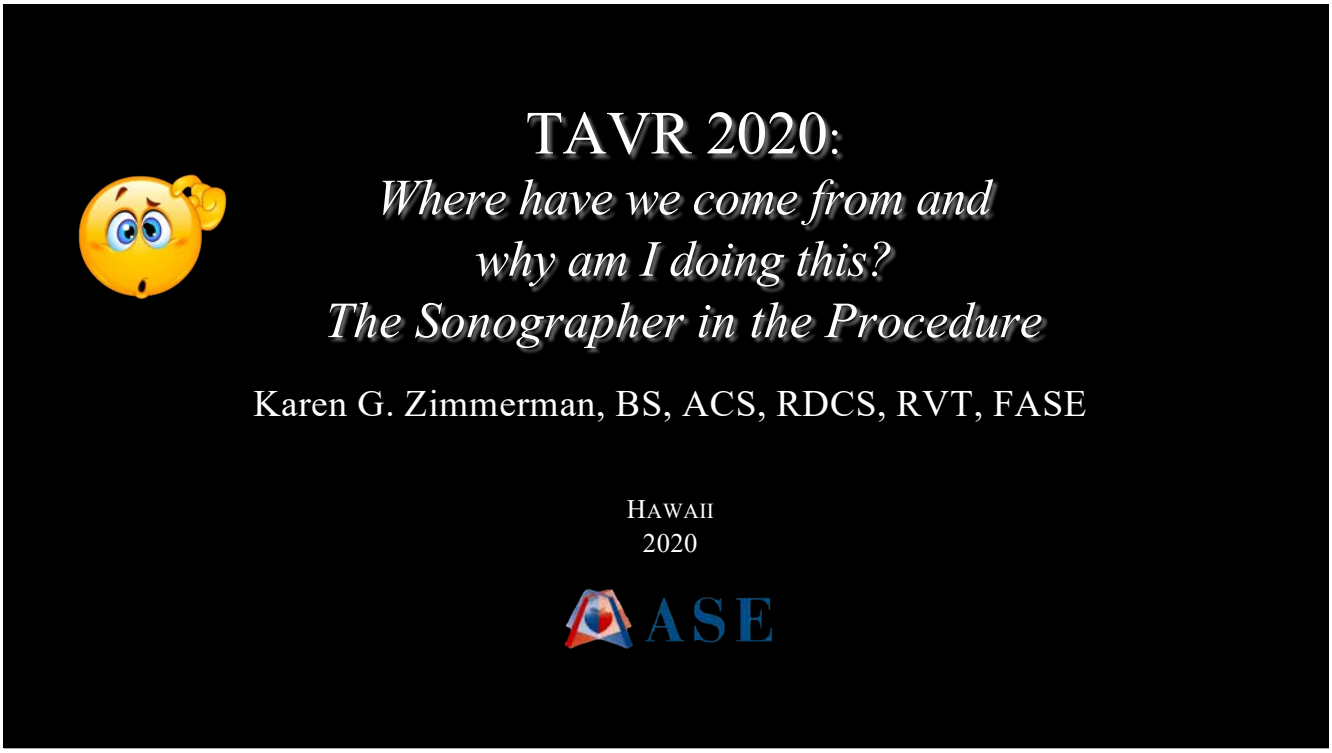
72

Thank you!

73

Welcome to Echo Hawaii 2020

74


TAVR 2020:
Where have we come from and
why am I doing this?
The Sonographer in the Procedure
Karen G. Zimmerman, BS, ACS, RDCS, RVT, FASE
HAWAII
2020
ASE

75