

TAVR: When Things go Wrong

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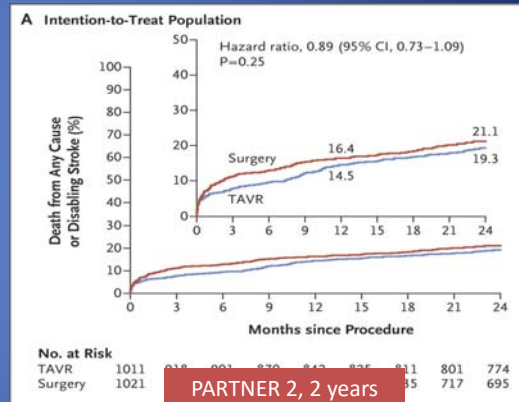
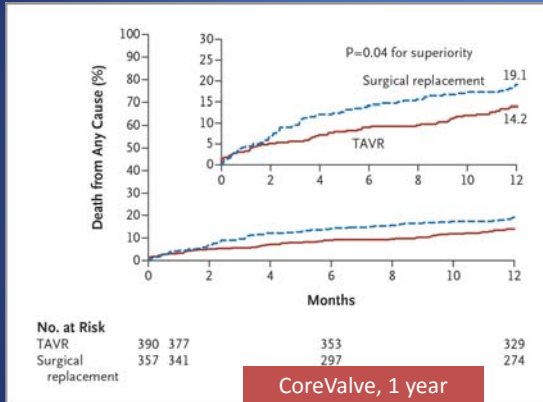
Disclosures

- Academic Echo Core Lab
 - Abbott / St Jude Medical
 - Edwards
 - Medtronic
 - Livanova / Caisson
 - DirectFlow
 - Boston Scientific / Symetis
 - JenaValve
 - Biotronik
 - NeoVasc



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TAVR Compares Favorably to SAVR



Adams et al. NEJM 2014; 370:1790
 Leon M et al. NEJM 2016;374:1609

TAVR - The bar keeps going lower

Inoperable

Extreme Risk

High Risk

Intermediate risk

Low Risk?

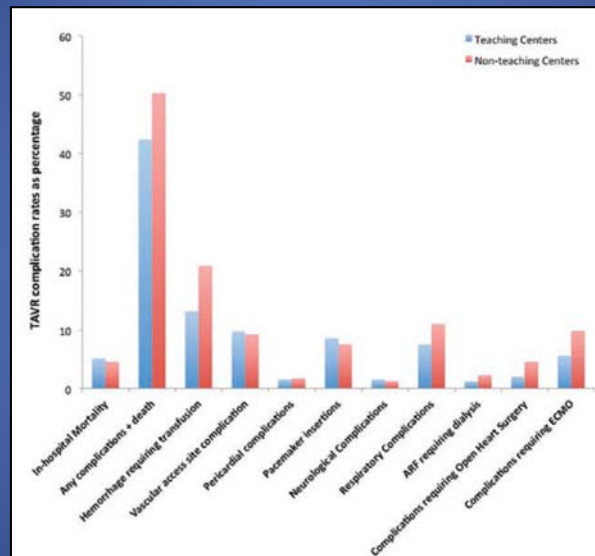
Bicuspid AV

Valve in Valve

Despite all the fantastic results...

Things can go Wrong

TAVR complication rates – US 2012



Pant S et al. J Invasive Cardiol 2016; 28:67

TAVR complication rates – TVT ACC/STS Registry

Table 3. In-Hospital Clinical Outcomes*

Outcomes	Overall (n = 7710)
Death	
From any cause	427 (5.5)
In laboratory/operating room	65 (0.8)
Cardiac arrest	447 (5.8)
Transient ischemic attack	28 (0.4)
Stroke	156 (2.0)
Death or stroke	556 (7.2)
Myocardial infarction	56 (0.7)
New-onset atrial fibrillation	460 (6.0)
Transapical access site complications	61 (0.8)
Renal failure	
Dialysis-dependent	145 (1.9)
Postoperative serum creatinine level ≥ 3 mg/dL ^b	276 (3.8)
Valve Academic Research Consortium major bleeding	267 (3.5)
Multiple transcatheter valves used ^c	221 (2.9)
New permanent pacemaker	509 (6.6)
Intensive care unit duration, median (IQR), h	46 (25-77)
Hospital duration, median (IQR), d ^d	6 (4-10)
Discharge location^d	
Home	4613 (63)
Extended care/transitional care unit/rehabilitation center	2134 (29)
Nursing home	405 (6)
Other	125 (2)

Mod or severe AR = 8.5%
Worsening MR 11%

Mack M et al. JAMA 2013; 310:2069.

TAVR complication rates – meta-analysis 2012

TABLE IV. Additional Complications Reported in Patients Undergoing TAVR

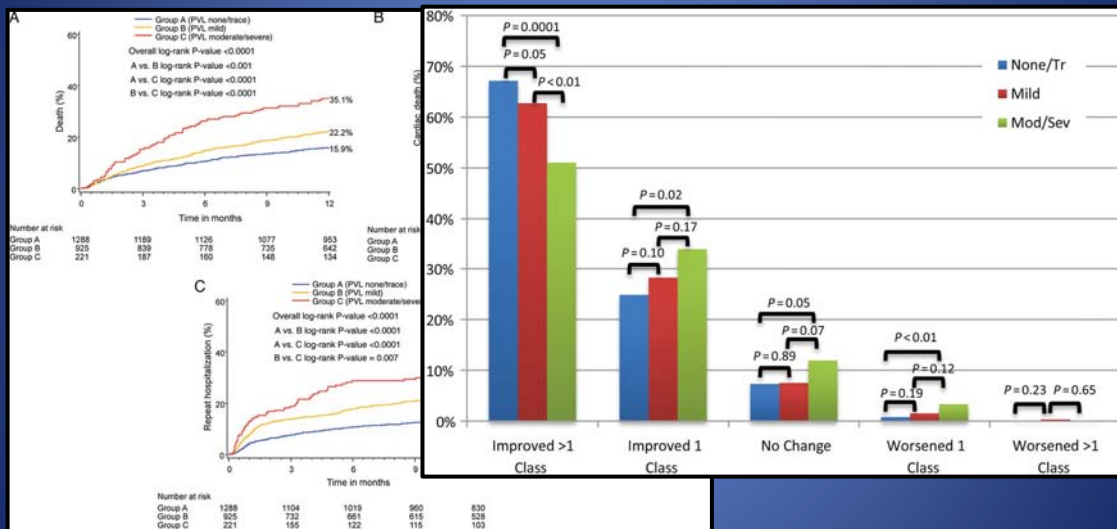
Meta-analysis: TAVR		
Complication	%	6.60%
Major vascular Complication	n/n total	234/3,559
	N studies	6
Cardiac tamponade		1.40%
		6/401
		3
Aortic dissection		0.71%
		9/1,270
		3
Aortic/annular Rupture		0.49%
		4/812
		4
Coronary Obstruction		0.72%
		12/1,675
		4
Myocardial Infarction		0.56%
		5/900
		5
Blood Transfusion		11.60%
		149/1,282
		2
Valve Embolization		0.56%
		10/1,770
		5
Paravalvular aortic regurgitation \geq Moderate		11.6%
		80/692
		7
Endocarditis		0.39%
		2/514
		2

Jilaihawi H et al. Cath and Cardiovasc Interv 2012; 80:128.

What can Go Wrong?

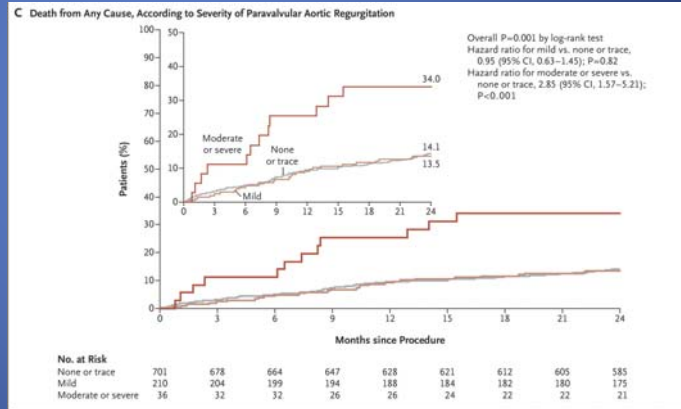
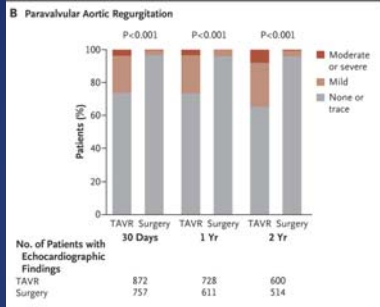
PVL is most common

PVL significance –PARTNER trial



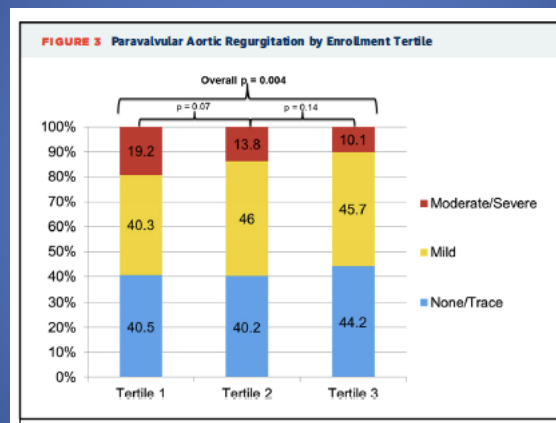
Kodali S et al. Eur H J 2015;36:449

PVL significance – Newer devices PARTNER 2, intermediate risk



Leon M et al. NEJM 2016;374:1609

PVL severity declining overtime (improved practice and devices)



PARTNER Registry
2011-12

Beohar N et al. JACC Intv 2016;9:355

ASE/EAE Guidelines – VARC 2

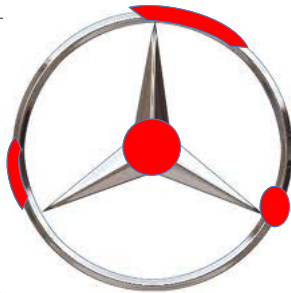
Table 4. Echocardiographic Criteria for Grading PVL per EAE/ASE and VARC-2

Parameter	Mild	Moderate	Severe
EAE/ASE			
Valve structure and motion			
Mechanical or bioprosthetic	Usually normal	Usually abnormal	Usually abnormal
Structural parameters			
Left ventricular size	Normal	Normal/mildly dilated	Dilated
Doppler parameters (qualitative or semiquantitative)			
Jet width in central jets (% diameter); color	Narrow ($\leq 25\%$)	Intermediate (26% to 64%)	Large ($\geq 65\%$)
Jet density: CW Doppler	Incomplete or faint	Dense	Dense
Jet deceleration rate (PHT, ms): CW Doppler	Slow (>500)	Variable (200–500)	Steep (<200)
LV outflow vs. pulmonary flow: PW Doppler	Slightly increased	Intermediate	Greatly increased
VARC-2			
Semi-quantitative parameters*			
Diastolic flow reversal in the descending aorta by pulsed wave	Absent or brief early diastolic	Intermediate	Prominent, holodiastolic
Circumferential extent of PVR (%)	$<10\%$	10% to 29%	$\geq 30\%$
Quantitative parameters*			
Regurgitant volume (mL/beat)	<30 mL	30–59 mL	≥ 60 mL
Regurgitant fraction (%)	$<30\%$	30% to 50%	$\geq 50\%$
EROA (cm ²)	<0.10 cm ²	0.1–0.29 cm ²	≥ 0.30 cm ²

ASE/EAE Guidelines – VARC 2

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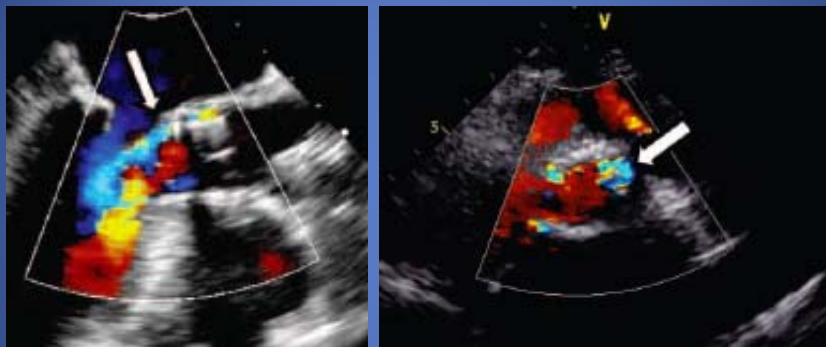


PVL evaluation

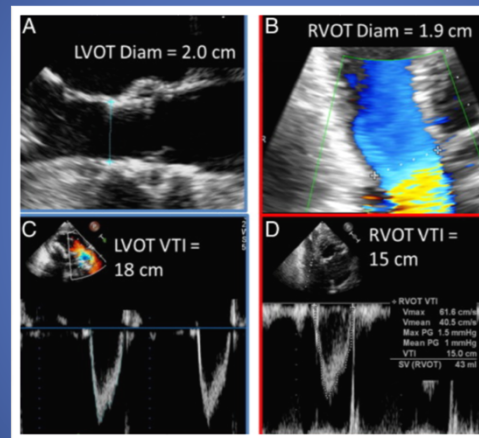
- Color Doppler: SAX
 - PVL lower portion of the stent, % of circumf
 - Central: at the leaflet coaptation point
- Color: LAX
 - Jet width/ratio
 - Vena Contracta
- Regurg volume:
 - $LVOT_{sv} - RVOT_{sv}$
- Flow Reversal in descending aorta

**INTEGRATED
APPROACH**

PVL: look in the LVOT/stent transition



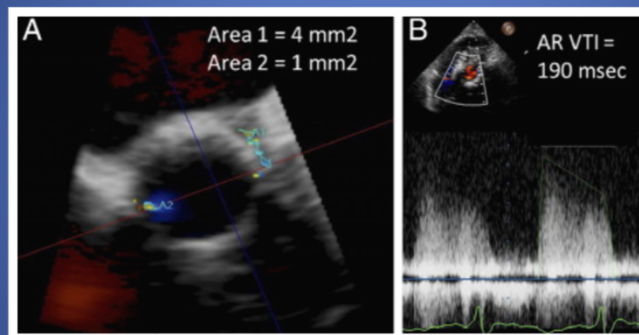
Regurgitant volume Quantification



$$\text{AI R Vol} = \text{LVOT SV} - \text{RVOT SV}$$

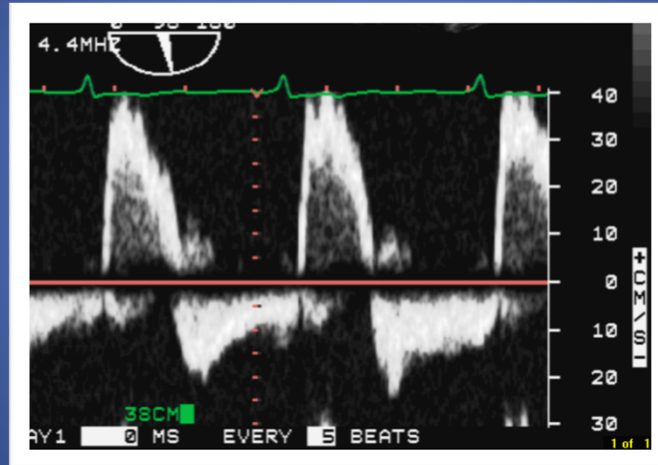
J Am Coll Cardiol. 2013;61(11):1125

3D EROA and RV

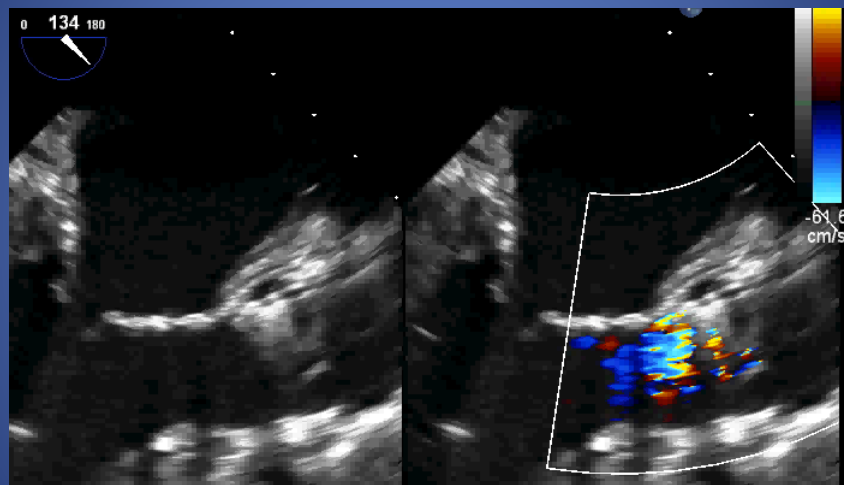


J Am Coll Cardiol. 2013;61(11):1125

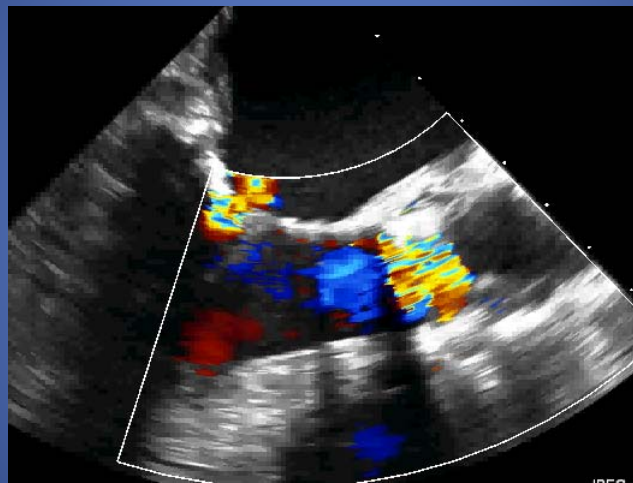
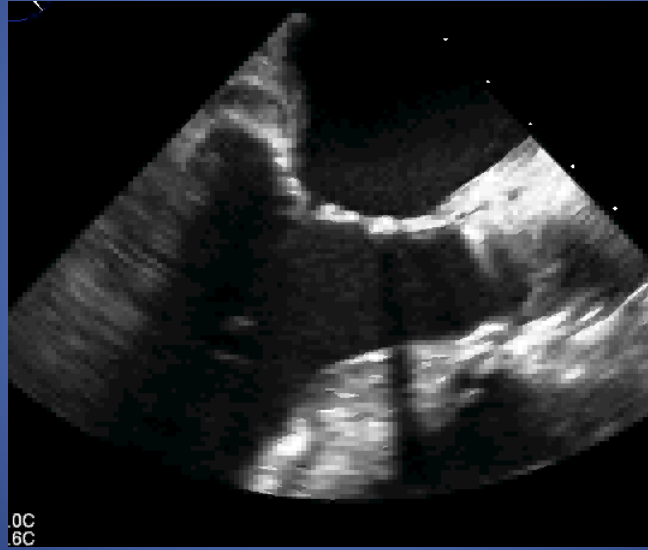
Aortic flow reversal- Desc Aorta



But some cases of AR are not that common



TAVR migration / Dislodgement



Solution: Patient had surgery

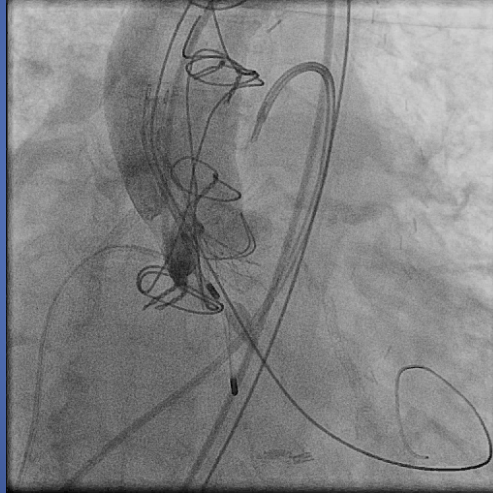
THV migrated to an oblique position,
partially in the Ao root

Bioprosthetic AVR 6 years ago

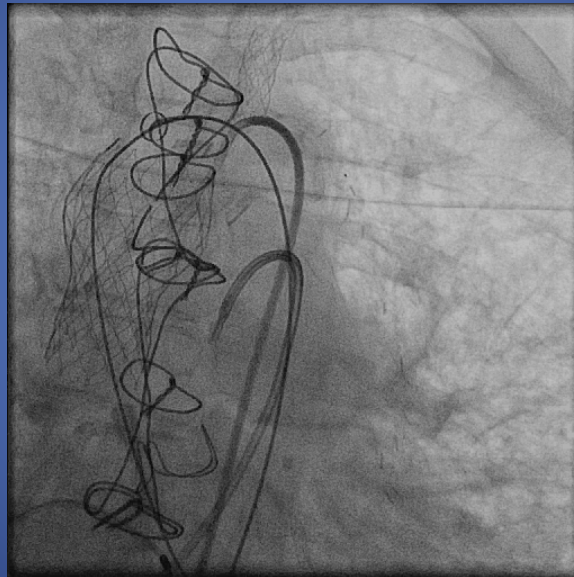
AVR dysfunction with degeneration

Valve in Valve Implant planned

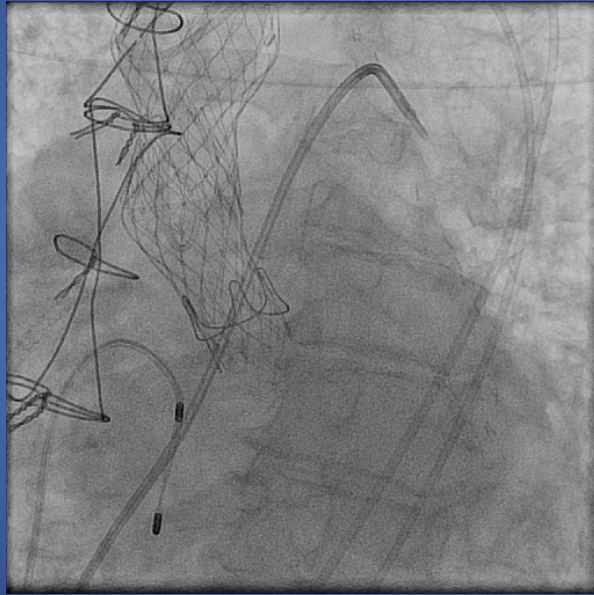
ViV deployment



Valve Embolization



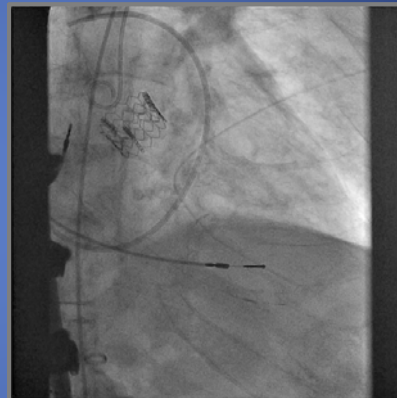
Solution: Second Valve Deployed



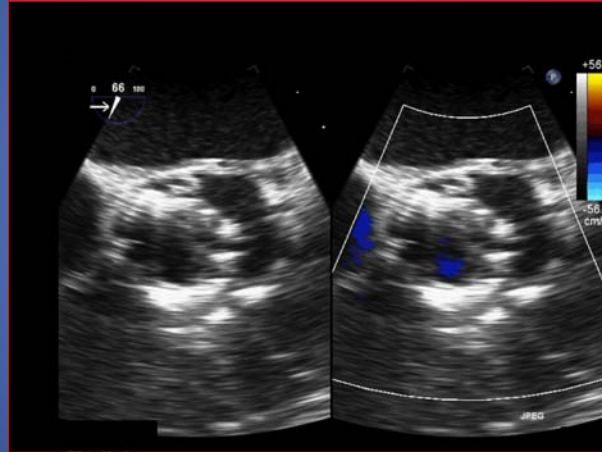
Severe AS, TAVR implanted

Acute cardiogenic shock: BP 170/70 down to 92/32

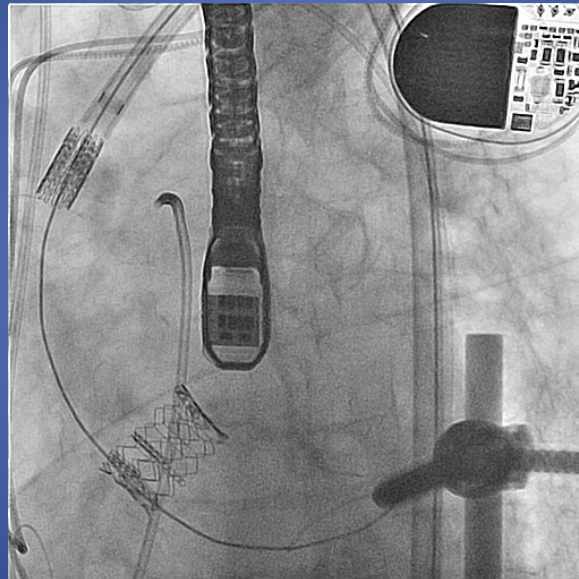
Acute Severe Transvalvular Aortic Regurgitation



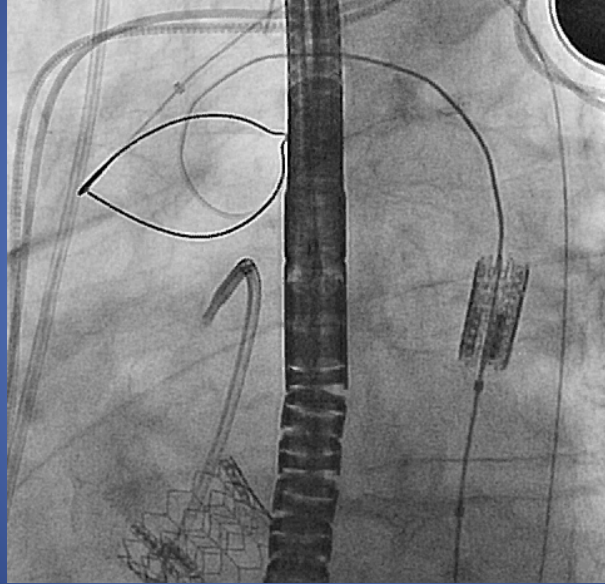
Defective/torn Cusp, failure to close



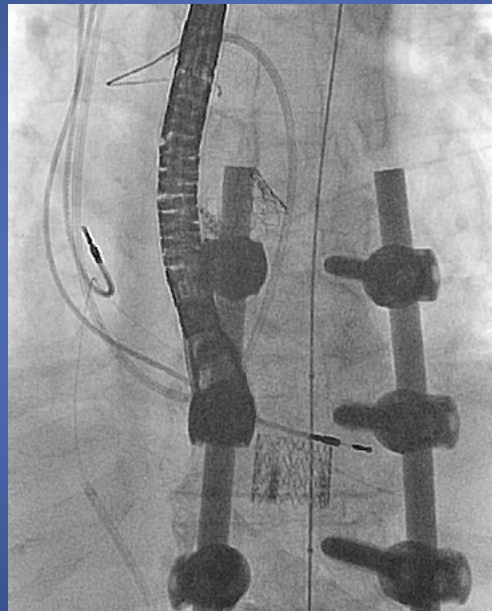
Solution: Valve in Valve



But the device got dislodged from its cath...



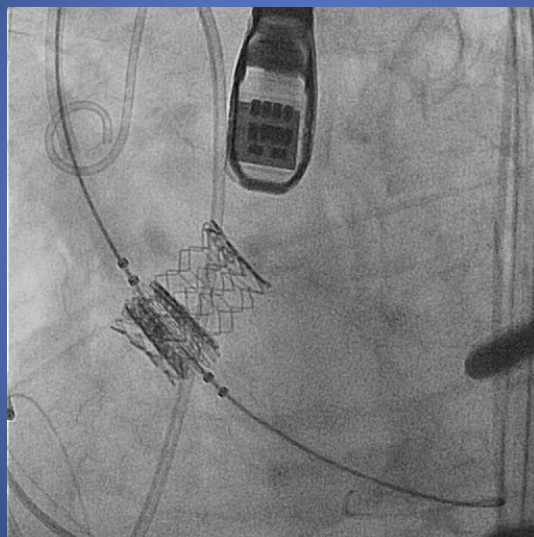
Solution: implant in Desc Aorta



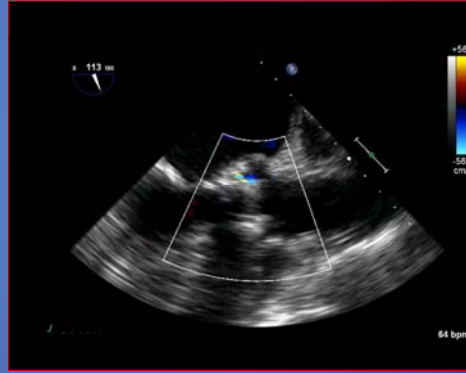
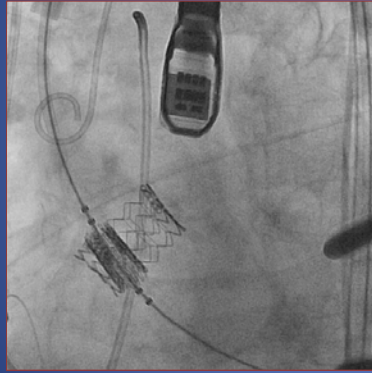
But we are not done yet...

Still have Severe AI

ViV (3rd Valve) implanted



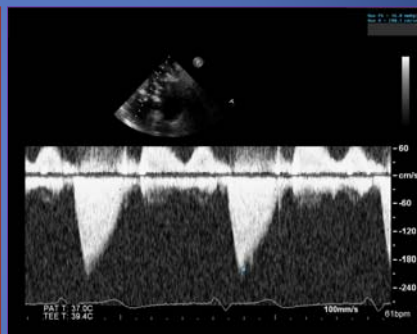
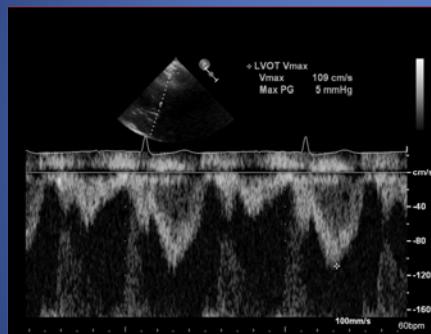
After valve in valve deployment Trace aortic regurgitation



No prosthetic stenosis Dimensionless Index=0.55

- $V1=1.1\text{m/s}$

- $V2=2\text{m/s}$

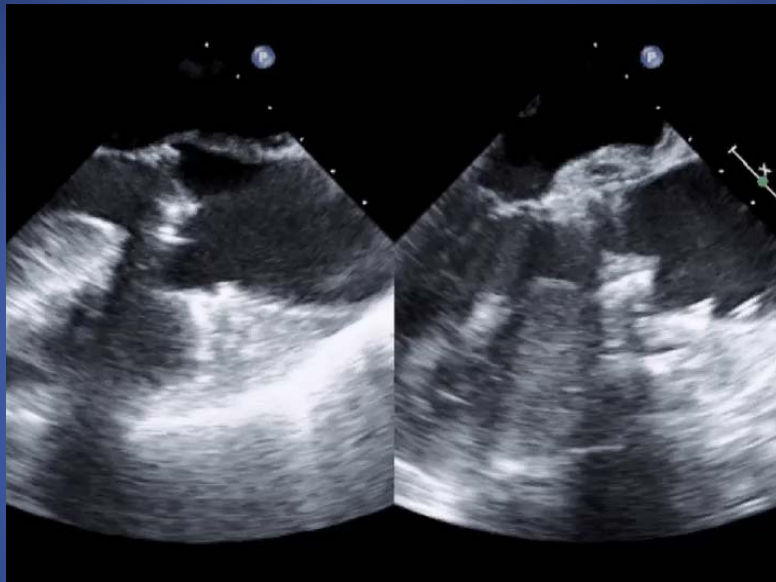
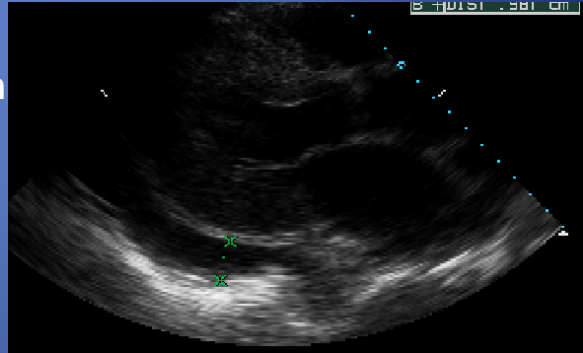


His blood pressure =126/52mmHg

What can Go Wrong?

Pericardial Effusion

- TVP perforation
- Annular Disruption



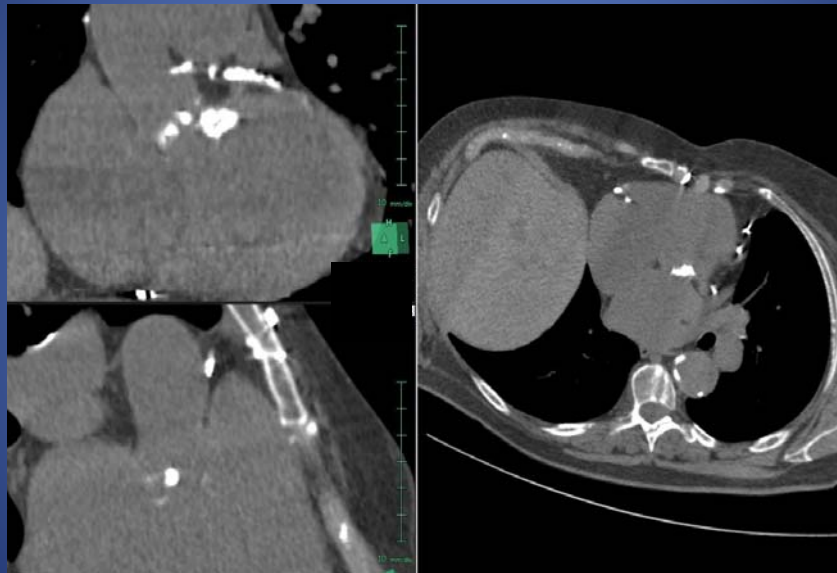
Pre

Post

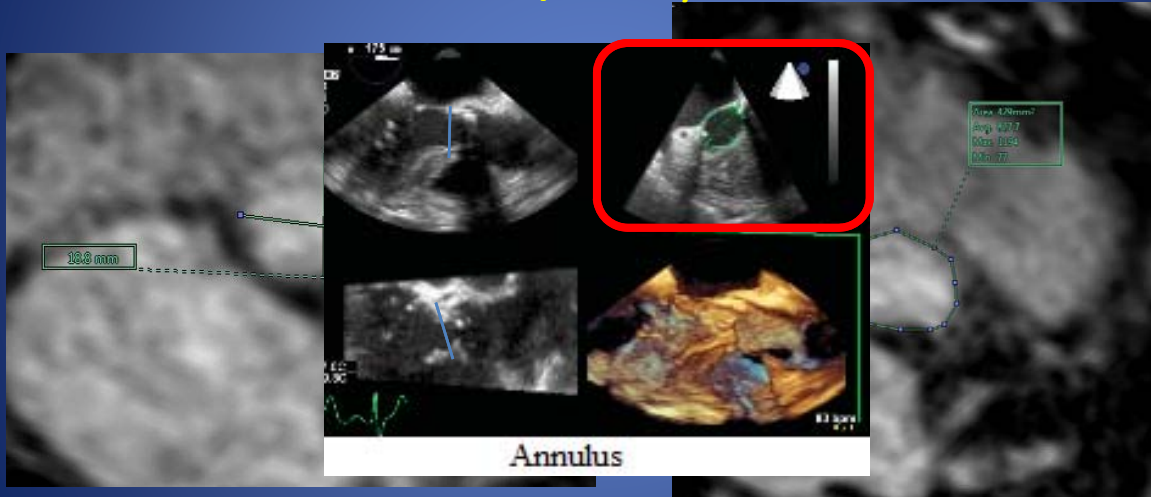


Annular disruption

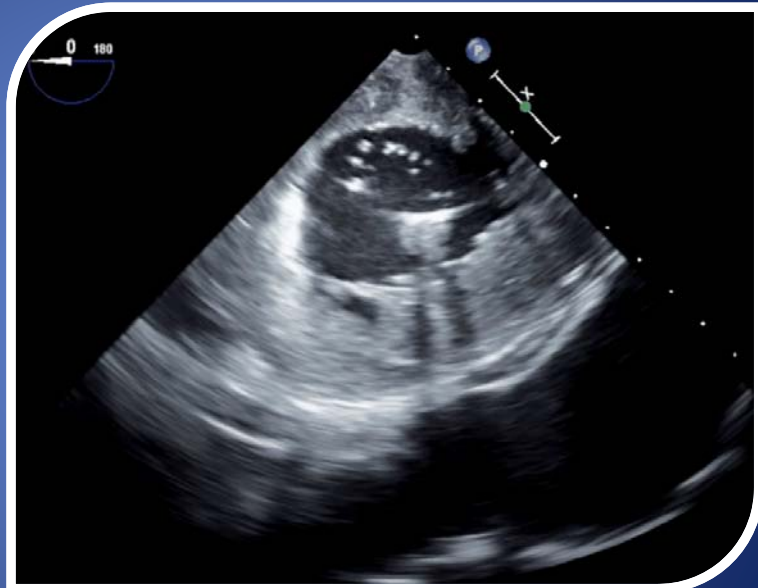
**Annular Calcification –Extension and location
Non- Contrast CT**

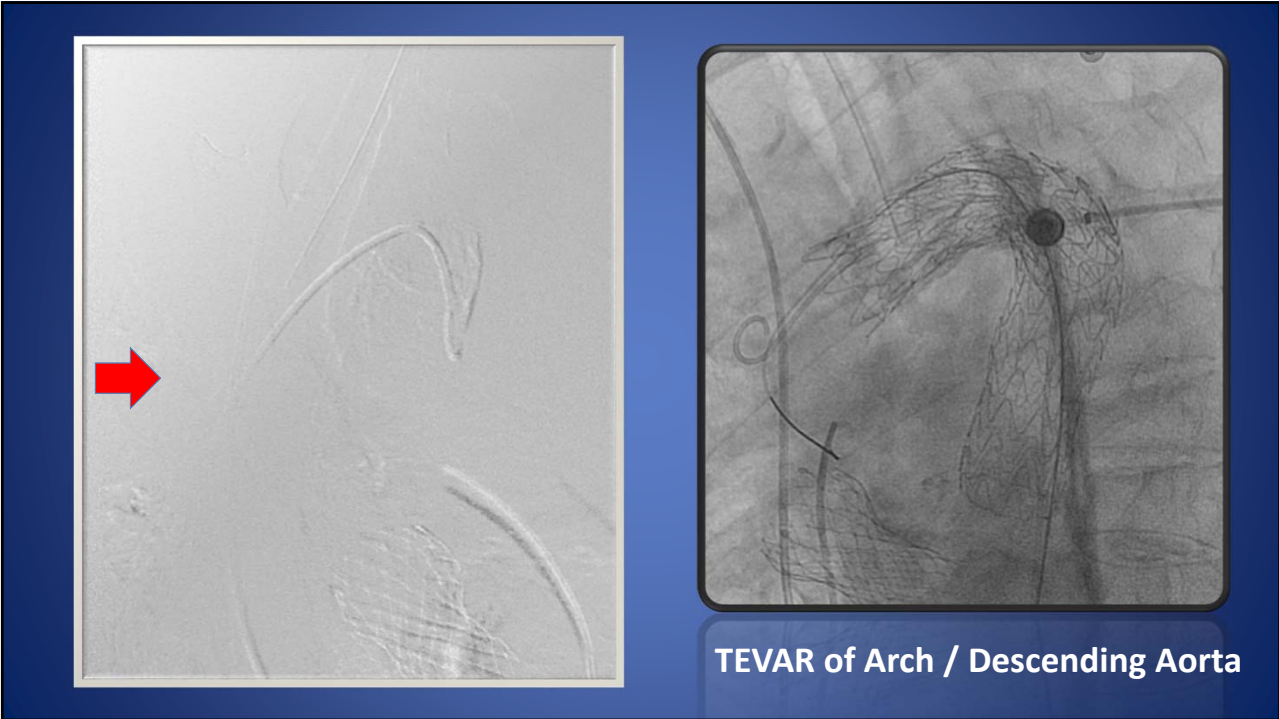
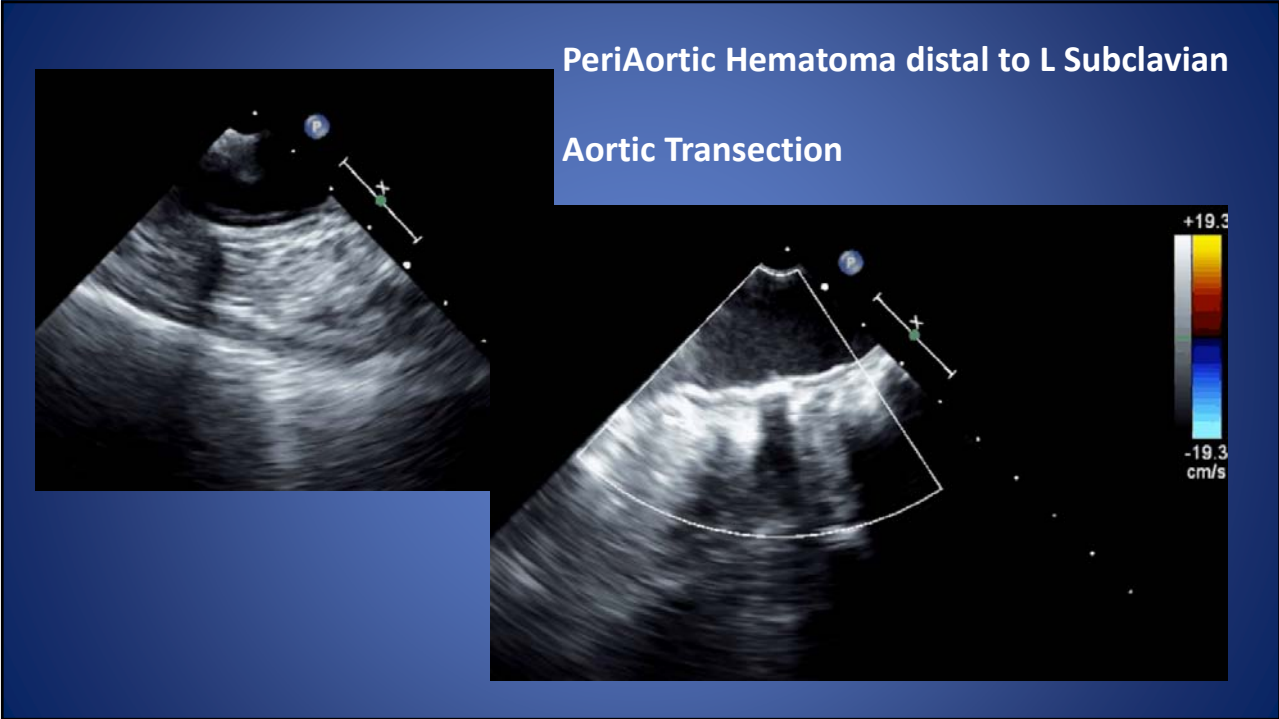


Annular Dimensions and device size selection Non- Contrast MRI (alternative to contrast CT/3D TEE)



- Hypotensive & Hypoxic
- Immediately post TAVR
- Required Intubation
- Emergent TEE w pleural effusion





What can Go Wrong?

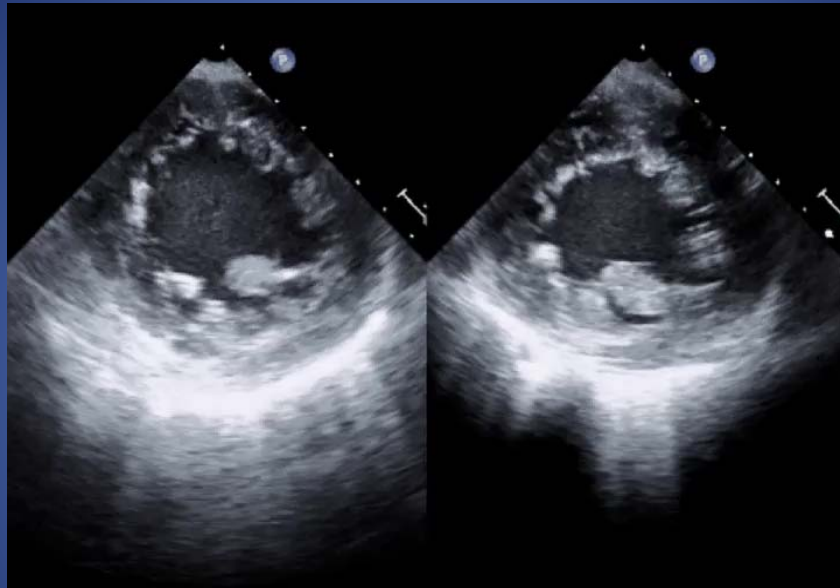
Coronary Ischemia



Baseline

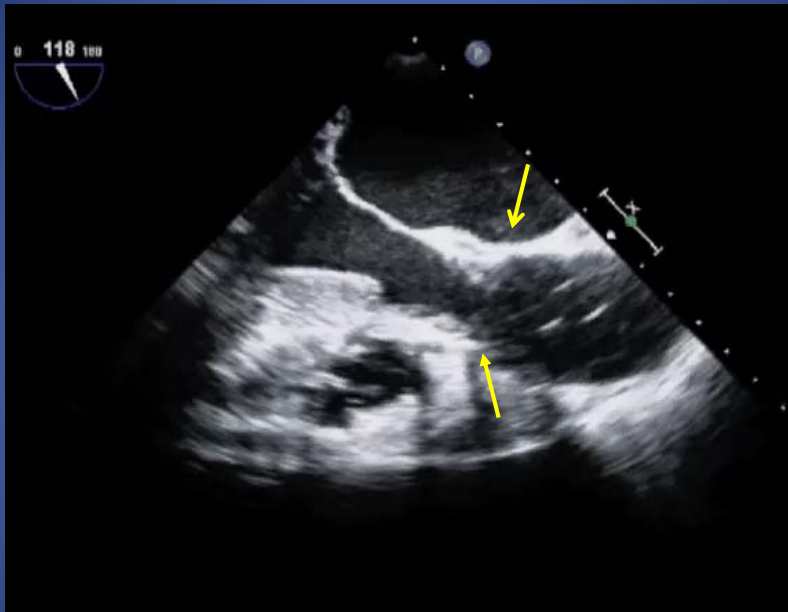
Post-deployment

Courtesy of Dr S Goldstein

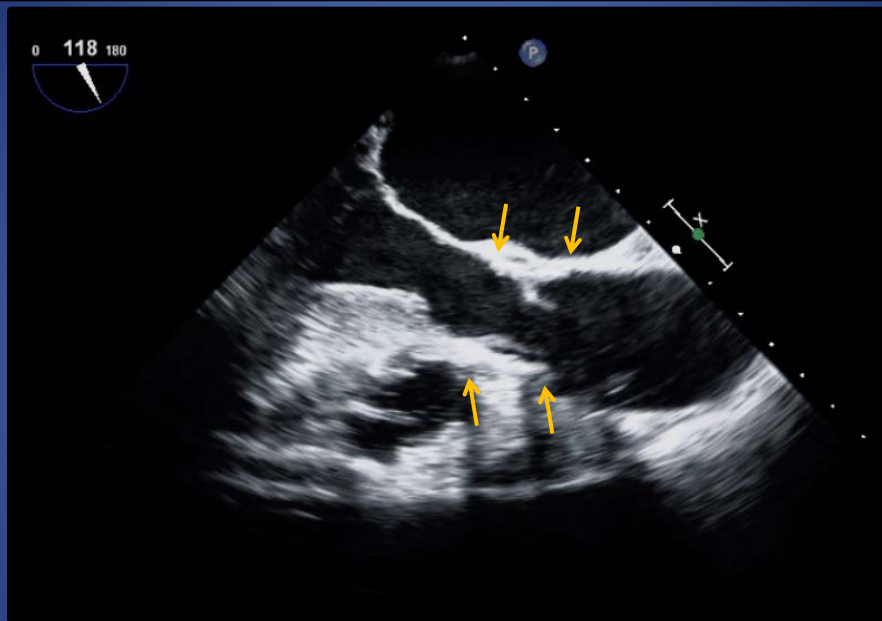


Baseline

Post-deployment



Prosthesis too "high" (ie too aortic)



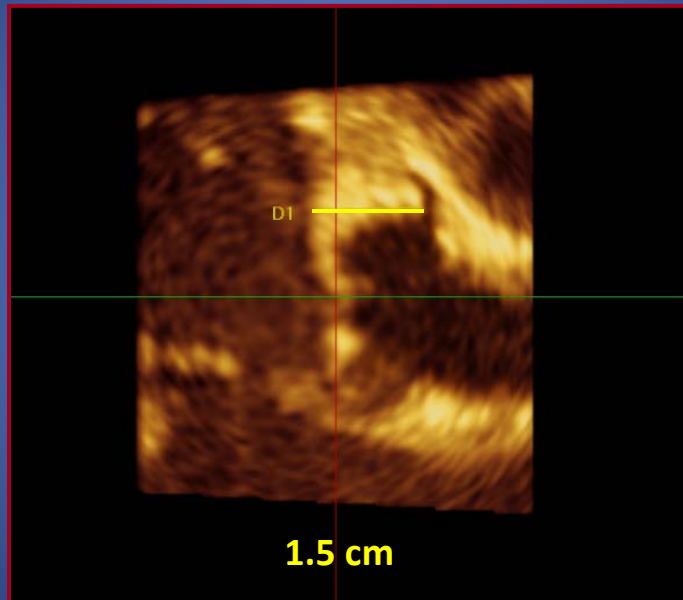
Prosthesis too "high" (ie too aortic)



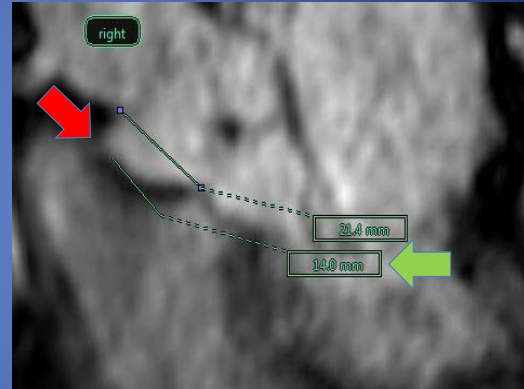
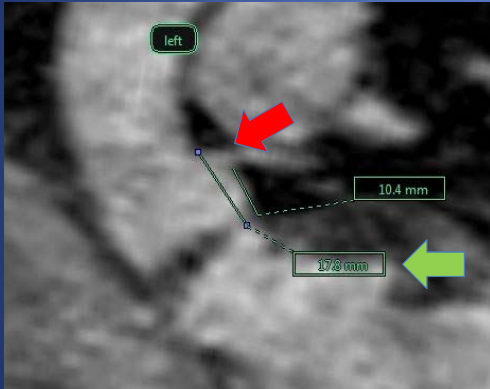
Note prosthesis at level of L-coronary

Distance to L-Main

Distance from Annulus to L-coronary

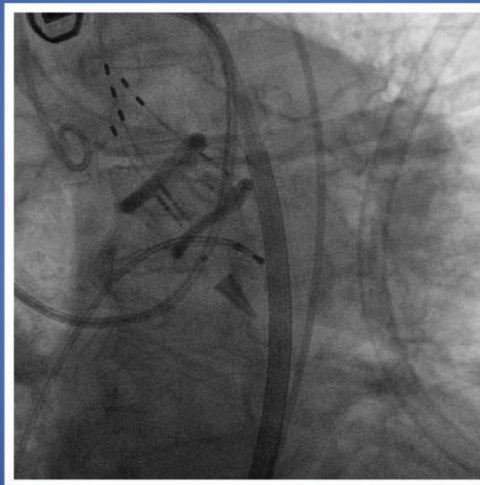


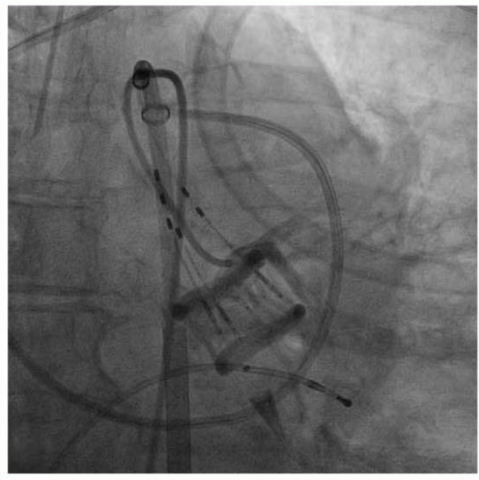
Coronary Height

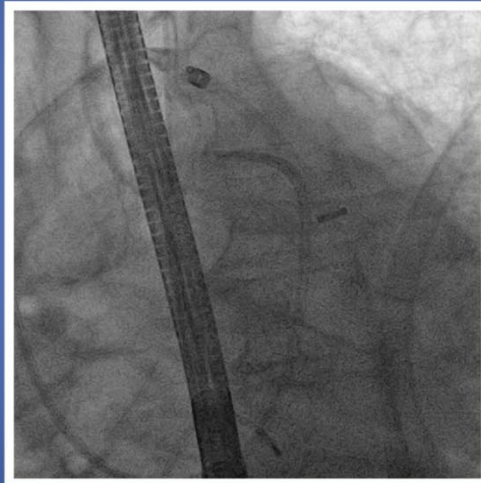


Measure from annulus (projected stent position)

Importance of Retrievable Devices







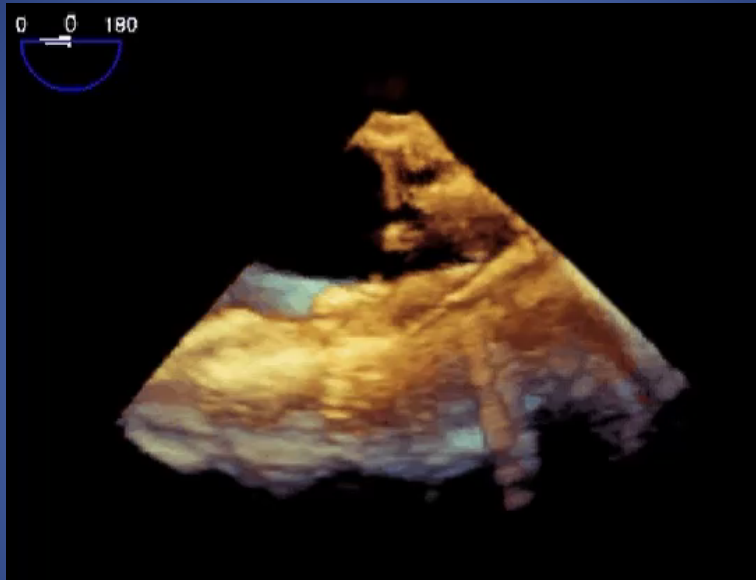
What can Go Wrong?

Sources of embolism !

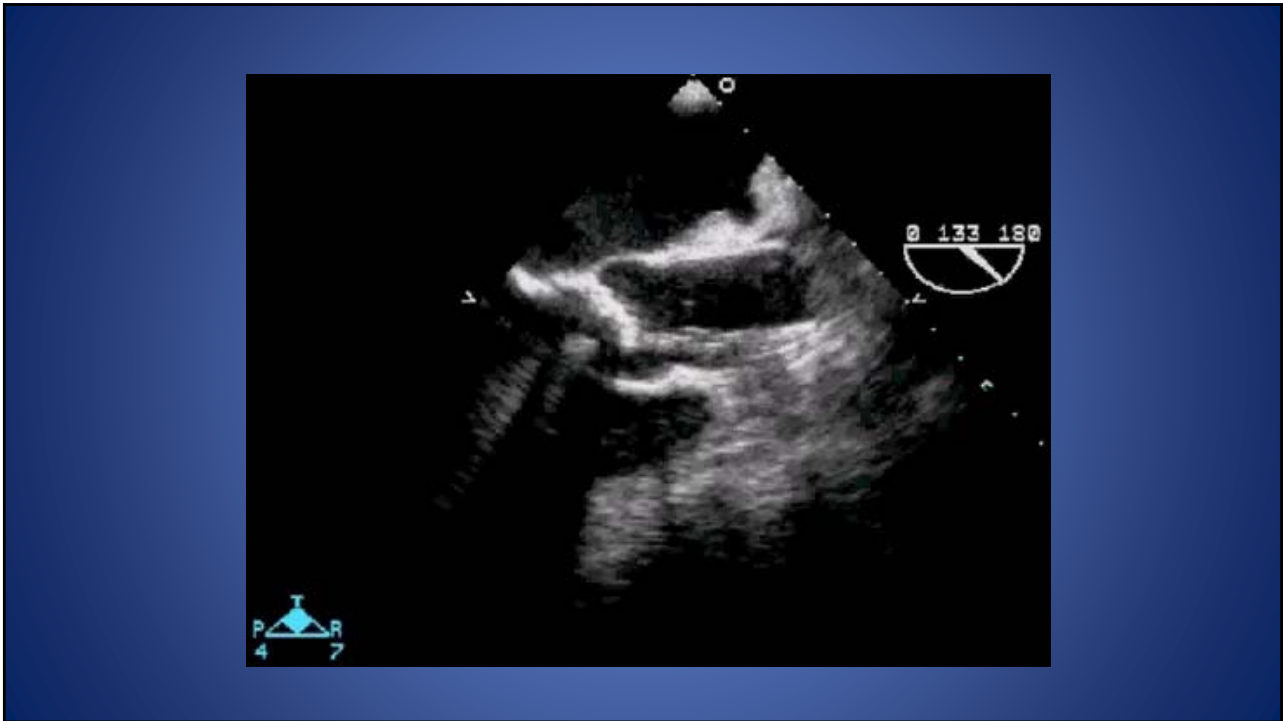
Aorta - Atheroma

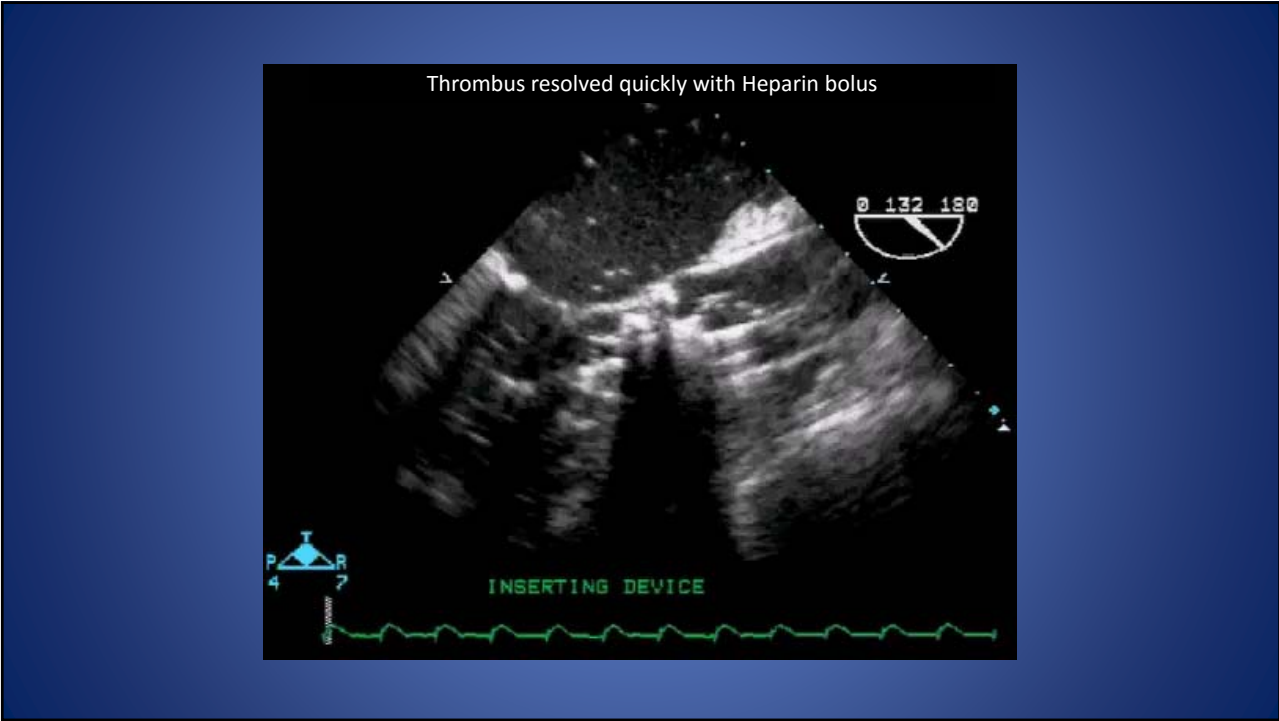
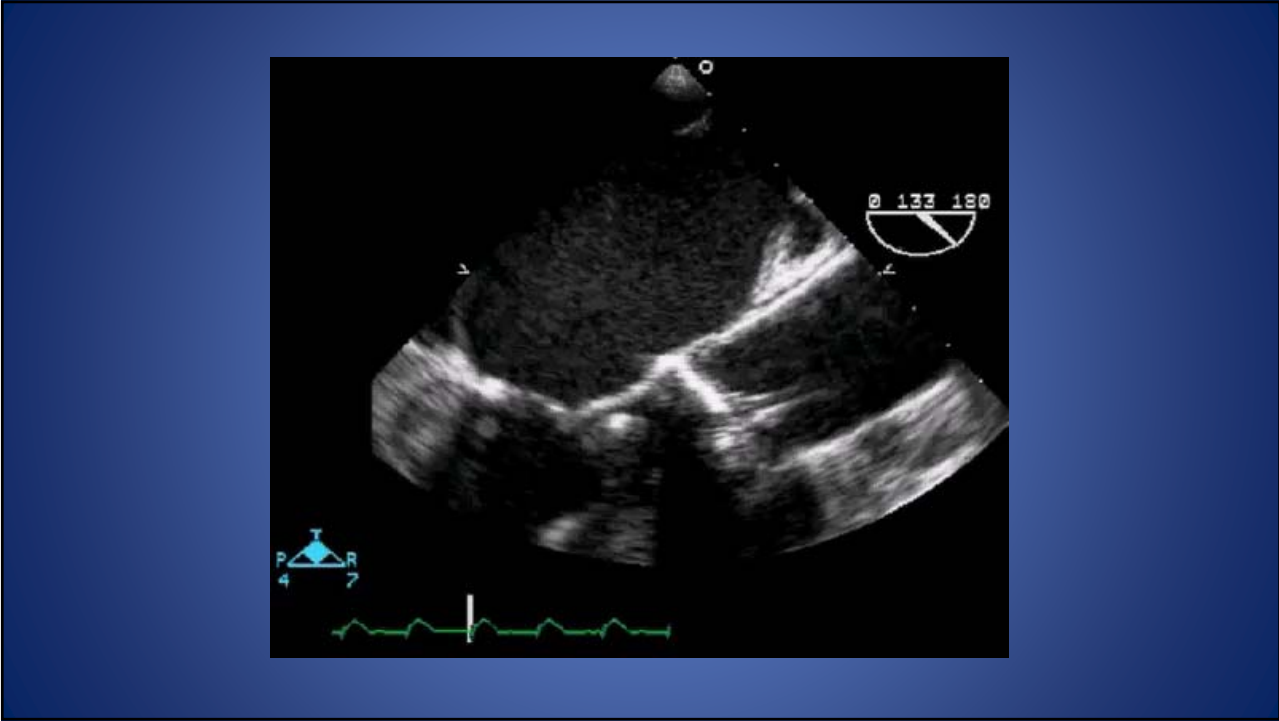


Courtesy of Dr S Goldstein



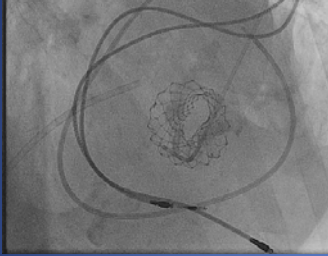
Thrombi on Catheters/Wires





Other things can go wrong

Underexpanded TAVR



Pseudo Aneurysm



Degeneration

Summary

- Despite overwhelming success, TAVR procedures still come with complications:
 - Shock, Stroke
- Look for:
 - Pericardial Effusion – Annular disruption or LV laceration
 - Coronary obstruction or embolization
 - Acute Mitral Regurgitation
 - Aortic Regurgitation / PVL
 - Valve embolization
 - Cath Thrombosis
 - Severe Atherosclerosis

Summary

- Complications are rare but best evaluated with TEE
- Escalate to TEE whenever complications are suspected