

# How to Prevent Acute Kidney Injury in Patients undergoing TAVI?



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# Acute Kidney Injury after TAVI



- Abrupt decrease in renal function within 7days
- Incidence ranging from 5% to 59%:
  - lack of a standard definition
  - different study populations & treatment protocols
- Associated with worse clinical outcomes:
  - 5 ~ 8-fold increase in 30-day mortality
  - >3-fold increase in 1-year mortality



# VARC-2 Stages of AKI



## Stage 1

Increase in serum creatinine to 150–199% (1.5–1.99 × increase compared with baseline) OR increase of  $\geq 0.3$  mg/dL

( $\geq 26.4$  mmol/L) OR

Urine output  $< 0.5$  mL/kg/h for  $> 6$  but  $< 12$  h

## Stage 2

Increase in serum creatinine to 200–299% (2.0–2.99 × increase compared with baseline) OR

Urine output  $< 0.5$  mL/kg/h for  $> 12$  but  $< 24$  h

## Stage 3<sup>b</sup>

Increase in serum creatinine to  $\geq 300\%$  ( $> 3$  × increase compared with baseline) OR serum creatinine of  $\geq 4.0$  mg/dL ( $\geq 354$  mmol/L)

with an acute increase of at least 0.5 mg/dL (44 mmol/L) OR

Urine output  $< 0.3$  mL/kg/h for  $\geq 24$  h OR

Anuria for  $\geq 12$  h

The increase in Cr must occur within 48 h.

The timing for the diagnosis of AKI is extended from 72 h (VARC) to 7 days (VARC 2).

*VARC:*

*Valve Academic*

*Research Consortium*

*Eur Heart J 2012;33:2403*



# Pathomechanisms of AKI during TAVI



- Contrast agent
  - Concomitant drugs
  - Blood loss
  - Rapid pacing with resulting hypotension
  - Embolization during the implantation
  - Postoperative severe inflammatory response syndrome
- } Nephrotoxicity
- } Renal hypoperfusion
- } Direct kidney injury



# Risk Factors for AKI

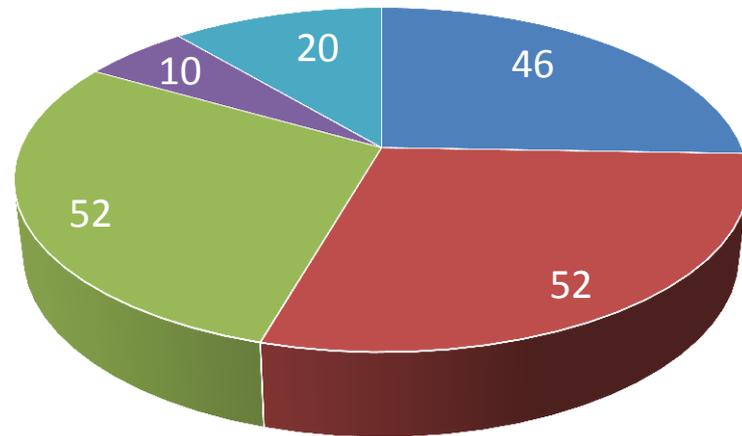


- Previous MI/Low LVEF
- Moderate/severe post AR
- Major bleeding/transfusion
- Hypertension/DM
- PAD
- CKD
- High STS score/Euroscore
- Transapical access
- Volume of contrast medium



# Severance Hospital: CKD in TAVI Patients

- Between July, 2011~ April, 2018:
- Total of 180 patients, mean age 81.6 y.o.
- CKD stage 3~5 (GFR<60 mL/min): 45.6%



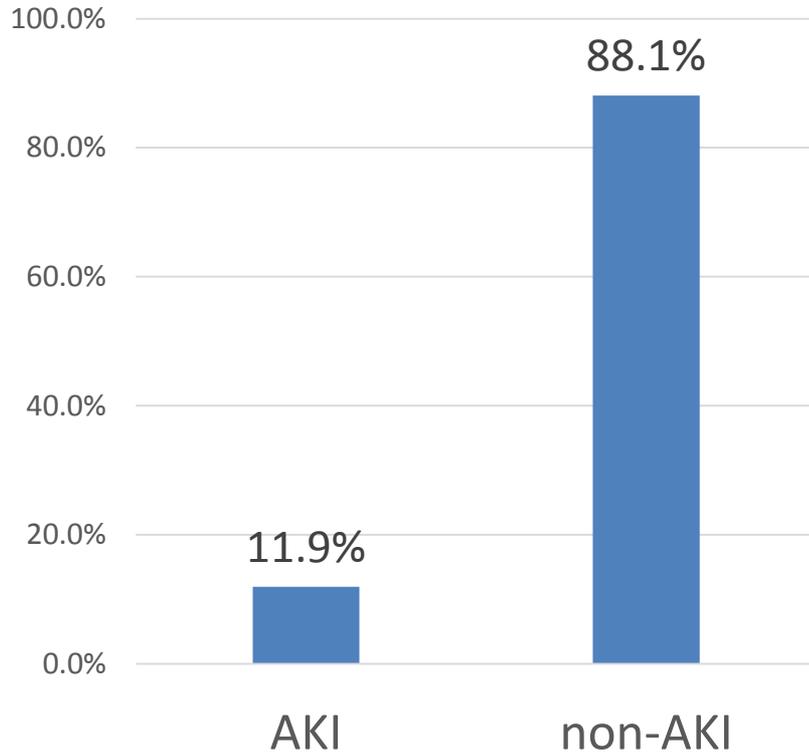
■ Normal ■ CKD 2 ■ CKD 3 ■ CKD 4 ■ CKD 5



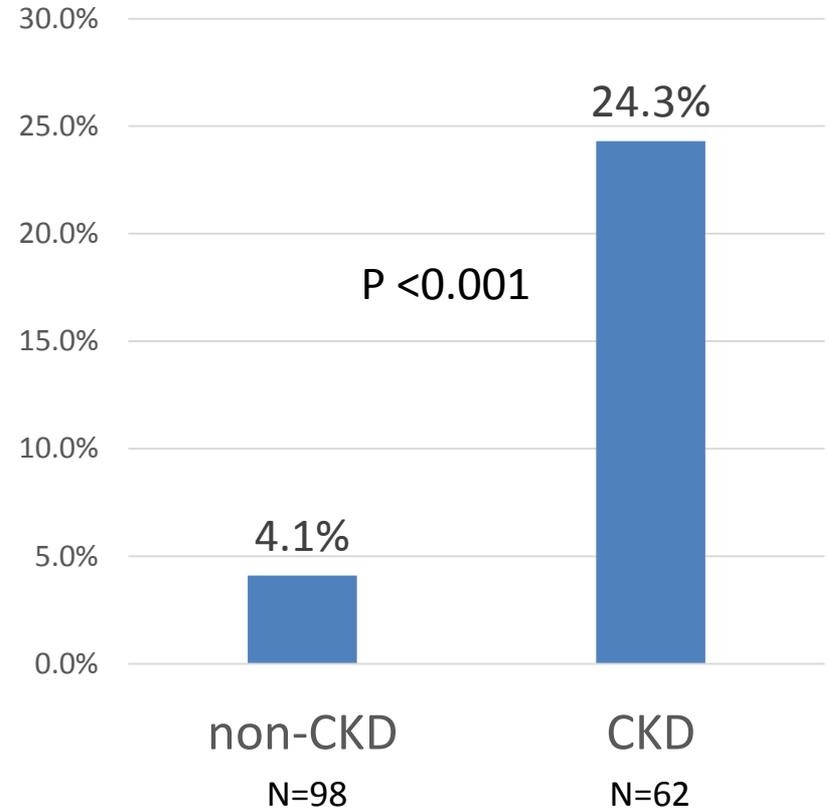
# Severance Hospital: Incidence of AKI after TAVI



Among non-dialysis patients (n=160)



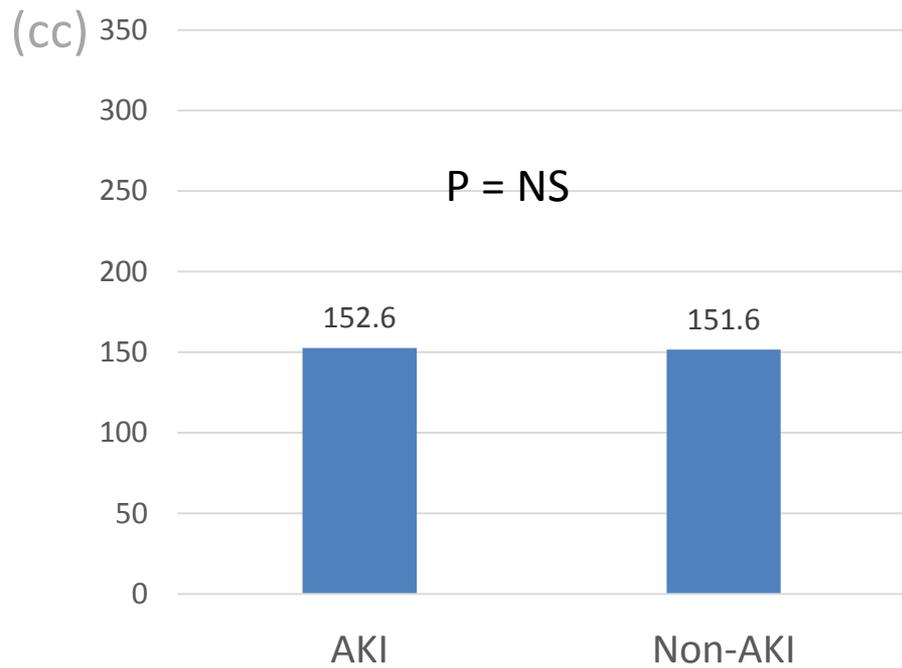
Non-CKD vs CKD (stage≥3)



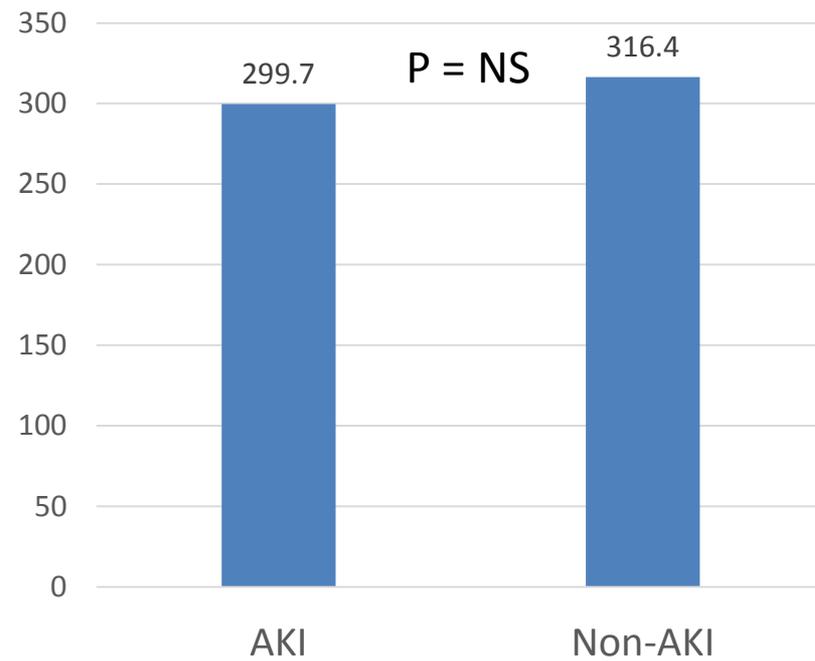
# Volume of Contrast Media



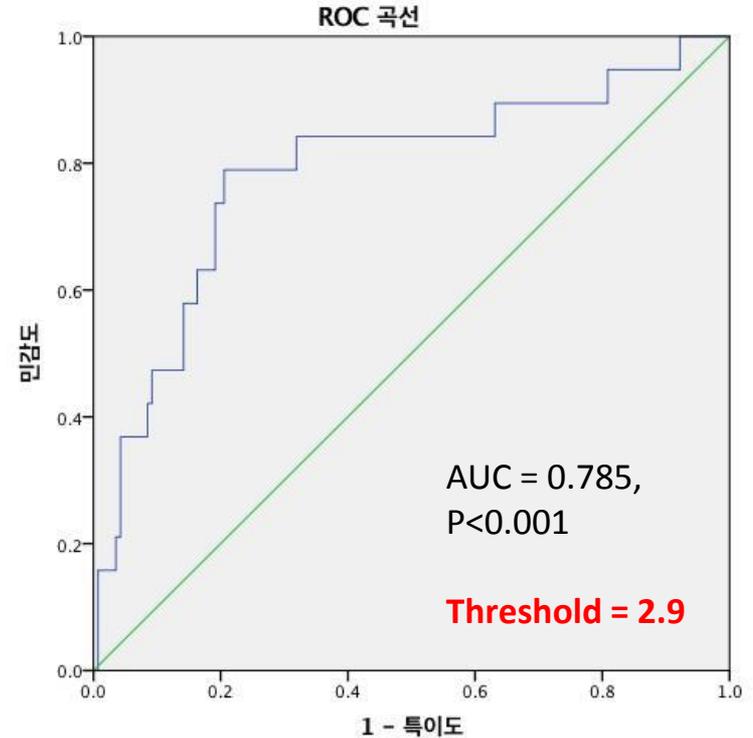
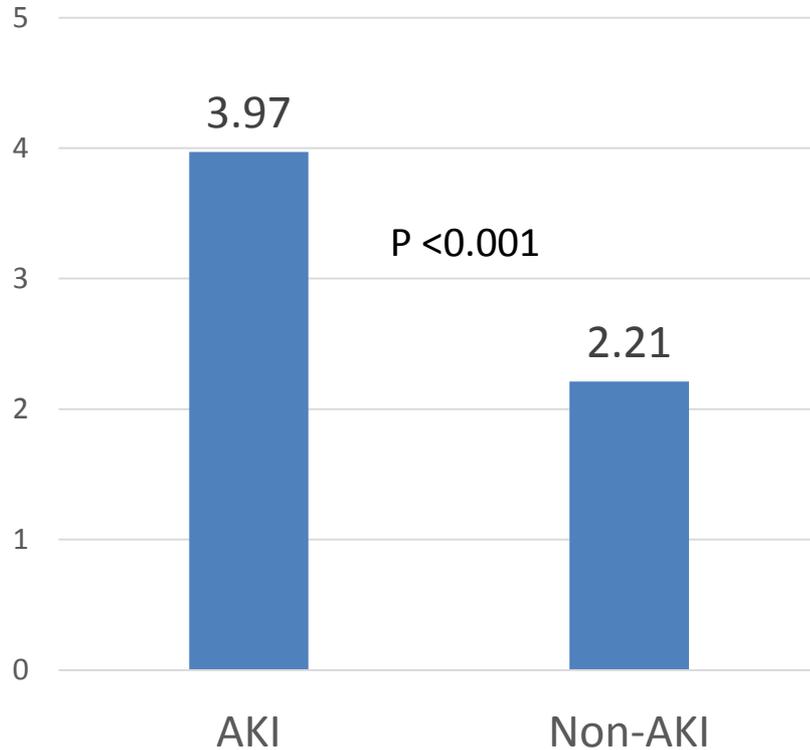
## CM Volume used during TAVI



## CM Volume used perioperatively



# CM Volume-to-CCR Ratio



# Need for Contrast Agents



- Contrast CT: 50 ~ 100 cc
- Coronary angiography: 20 ~ 50 cc
- PCI: 100 ~ 200 cc
- TAVI procedure: 100 ~ 200cc



# Thus,



**we need to reduce the CM volume before  
and during the TAVI procedure especially  
in patients with CKD!**



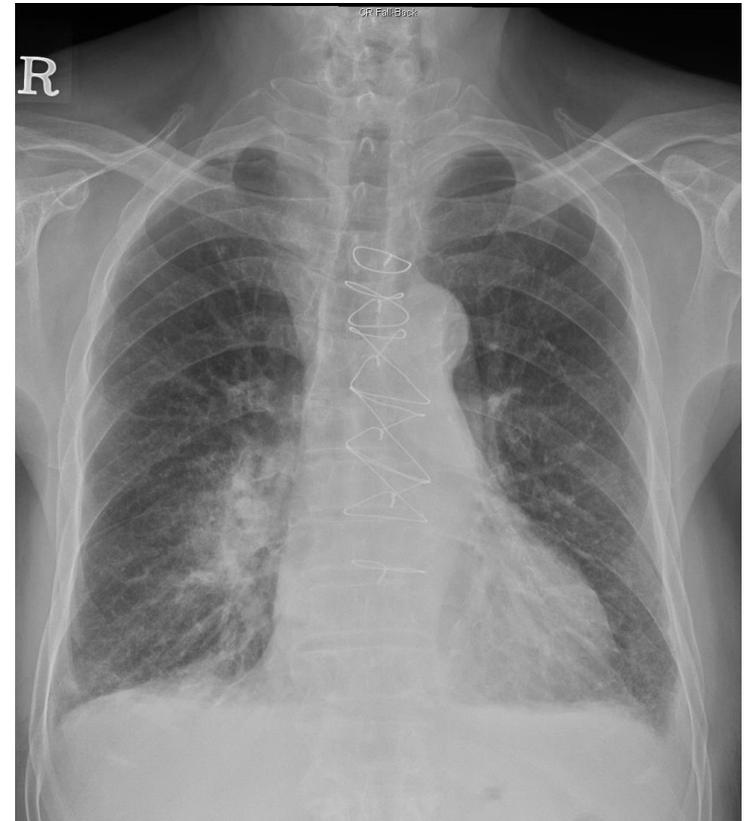


CC: aggravated dyspnea (NYHA III~IV) & generalized edema

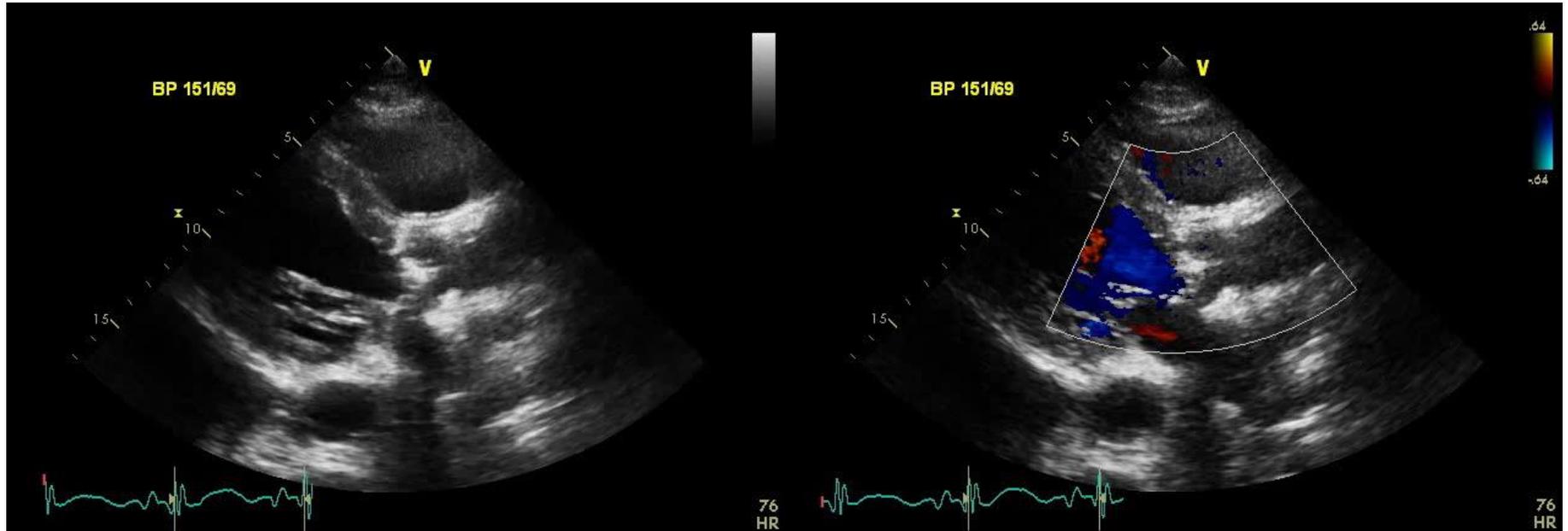
PHx:

- CAD, S/P CABG [12.05.04]
- PAD, diabetic foot, S/P multiple PTA
- S/P Amputation of multiple toes
- CKD, Stage III  
(Cr 1.8 mg/dL, eGFR 36 mL/min)
- HTN / DM / Dyslipidemia

STS score 7.0



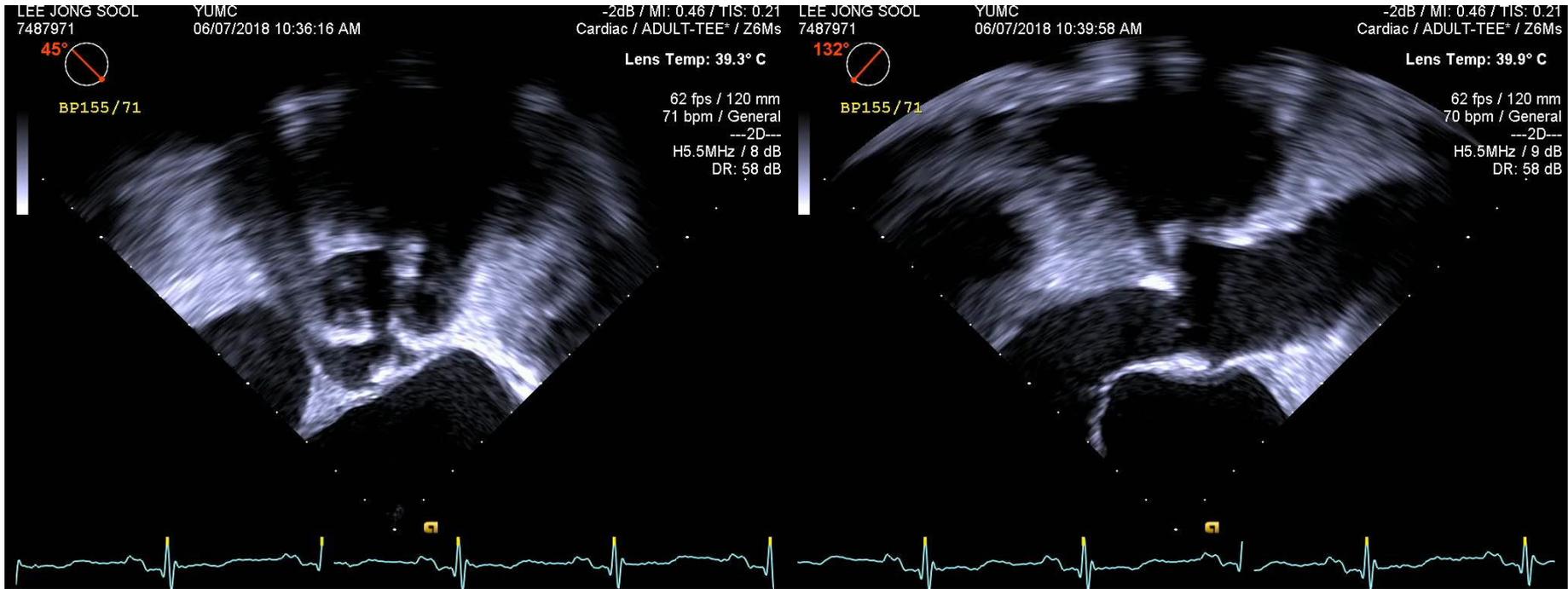
# Pre TTE



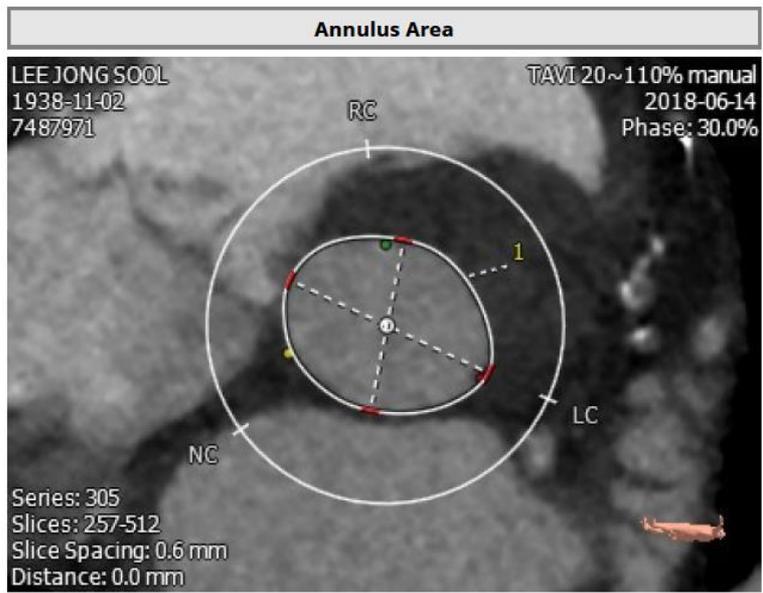
1. Severe AS with moderate AR (G II)
2. AVA : 0.9 cm<sup>2</sup> by C.E, PSPG/MSPG : 74/46mmHg, Peak vel: 4.3m/s
3. RWMA at posterolateral wall of LV
4. LVEF = 55% by biplane



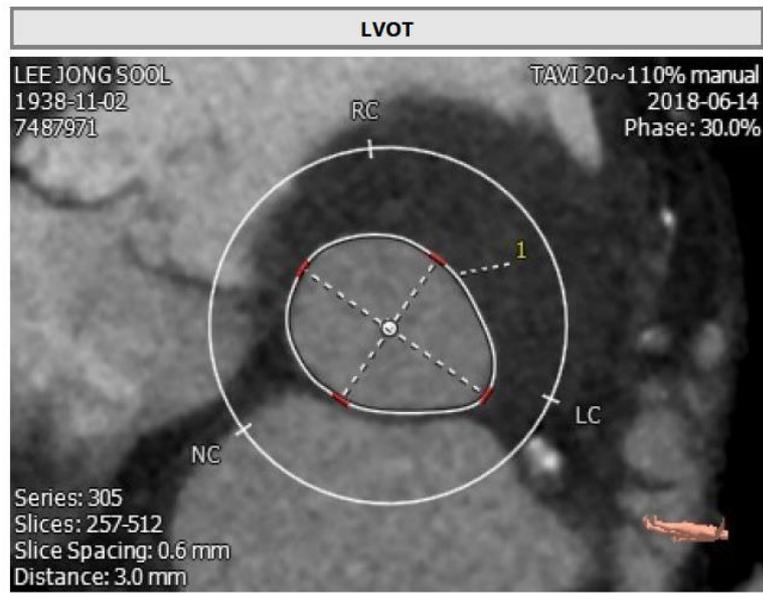
# Pre TEE



# CT Using 50 cc Contrast Dye



ID Type	Label	Value
1	Polygon Min. Ø	24.3 mm
	Max. Ø	30.7 mm
	Avg. Ø	27.5 mm
	Area derived Ø	27.0 mm
	Perimeter derived Ø	27.3 mm
	Area	572.6 mm <sup>2</sup>
	Perimeter	85.8 mm



ID Type	Label	Value
1	Polygon Min. Ø	23.9 mm
	Max. Ø	31.2 mm
	Avg. Ø	27.6 mm
	Area derived Ø	26.8 mm
	Perimeter derived Ø	27.4 mm
	Area	565.5 mm <sup>2</sup>
	Perimeter	86.1 mm

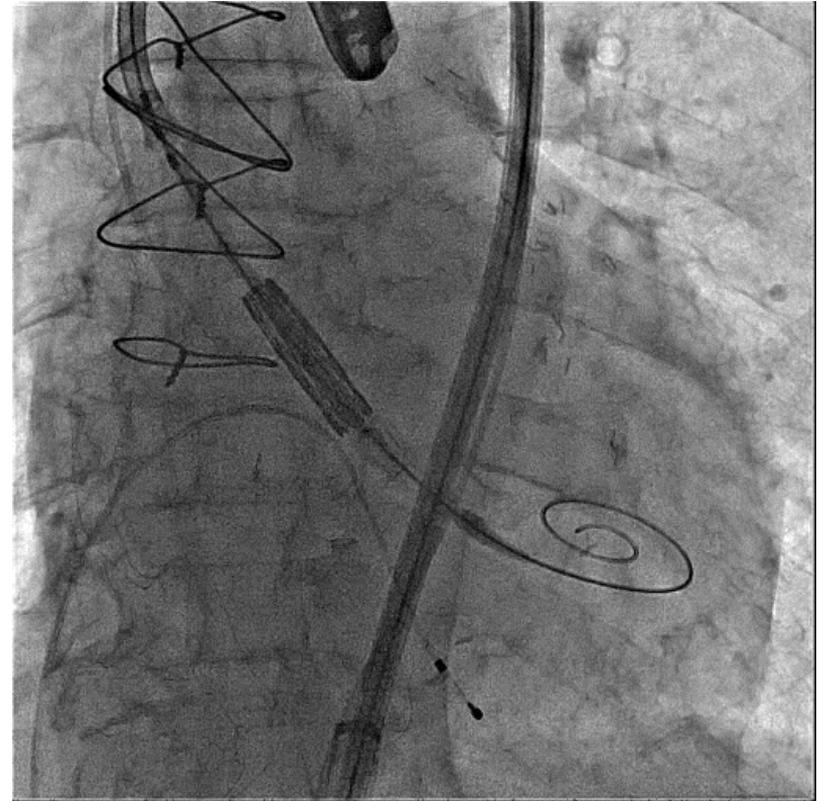
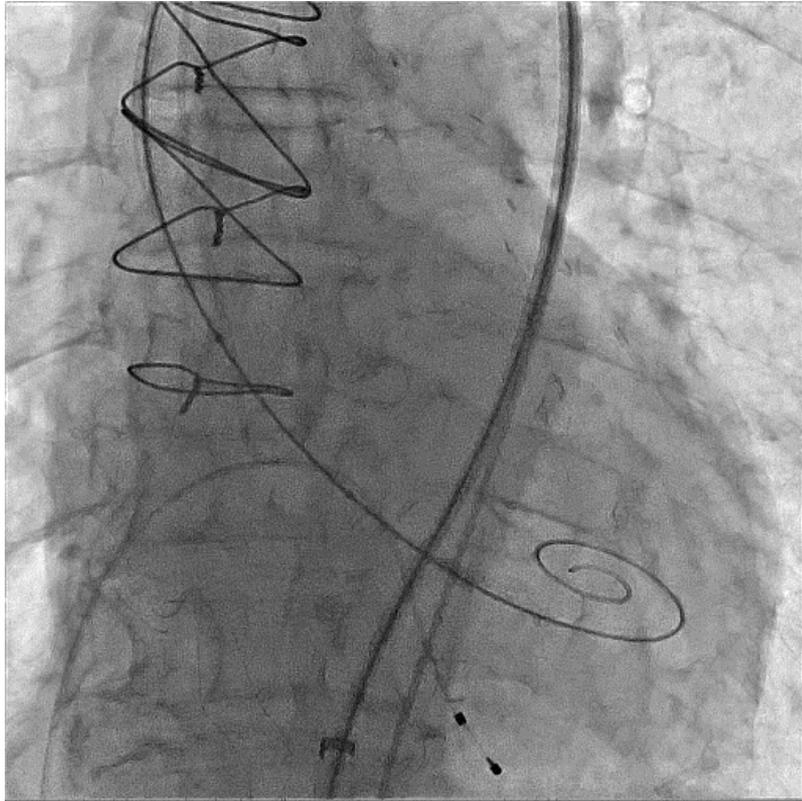
Sapien 3, 29 mm



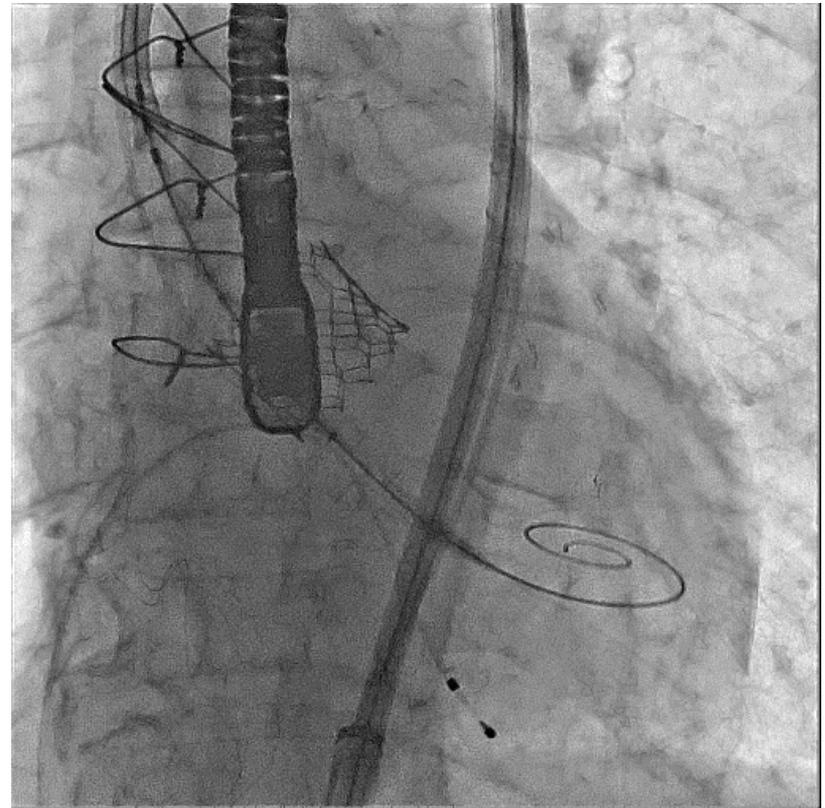
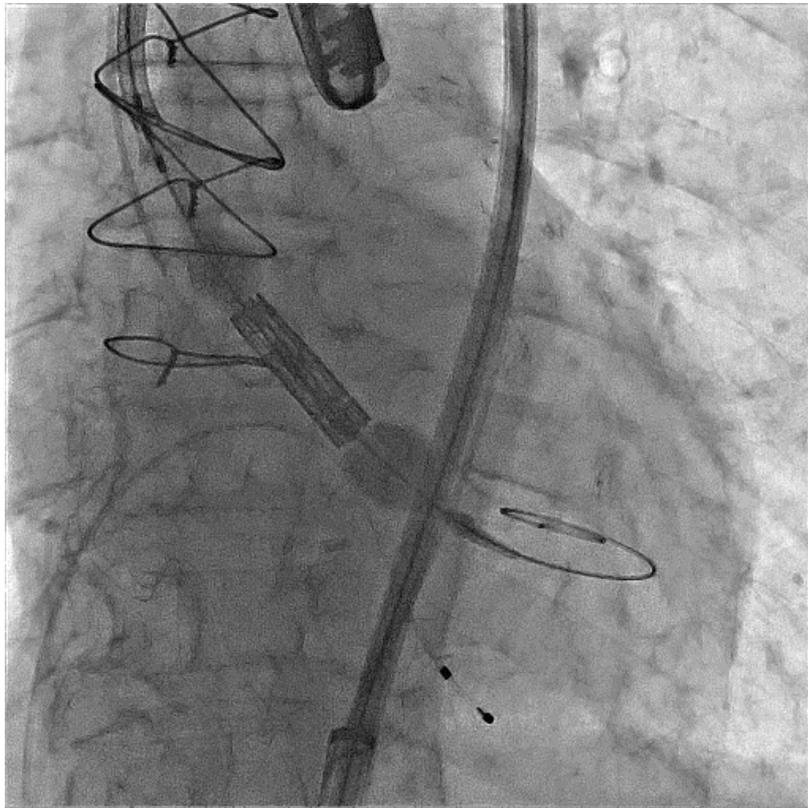
# TAVI Using Contrast Dye <20 cc



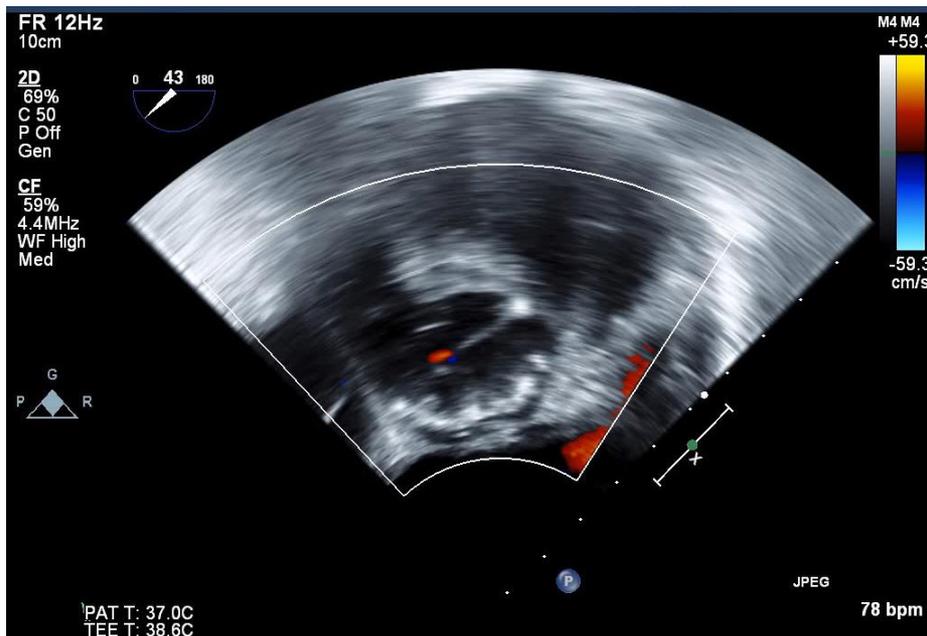
Sapien 3, 29 mm



# TAVI: Sapien 3



# Post TEE

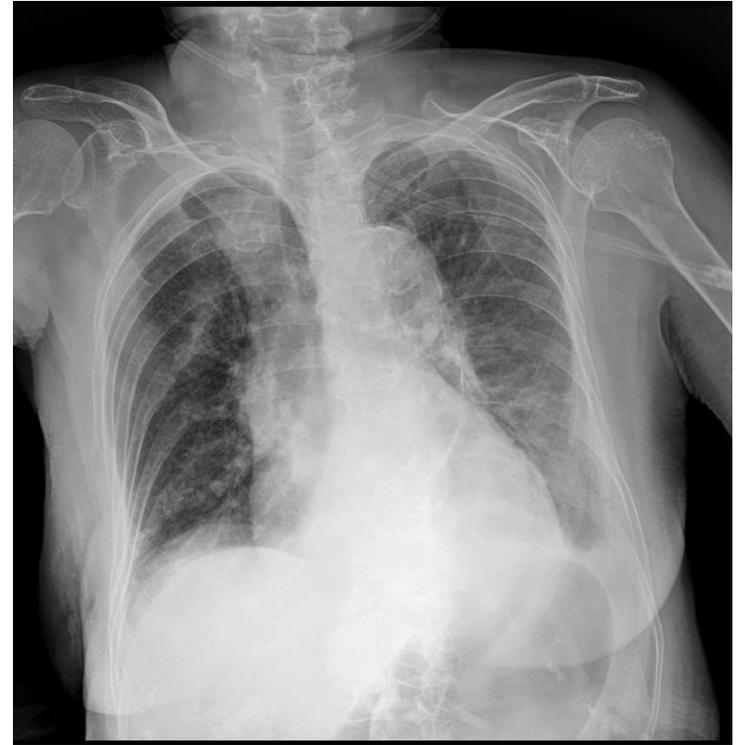


**F/87,** 140.0 cm / 42 Kg / BSA 1.28 m<sup>2</sup>

(LGS #8601573)



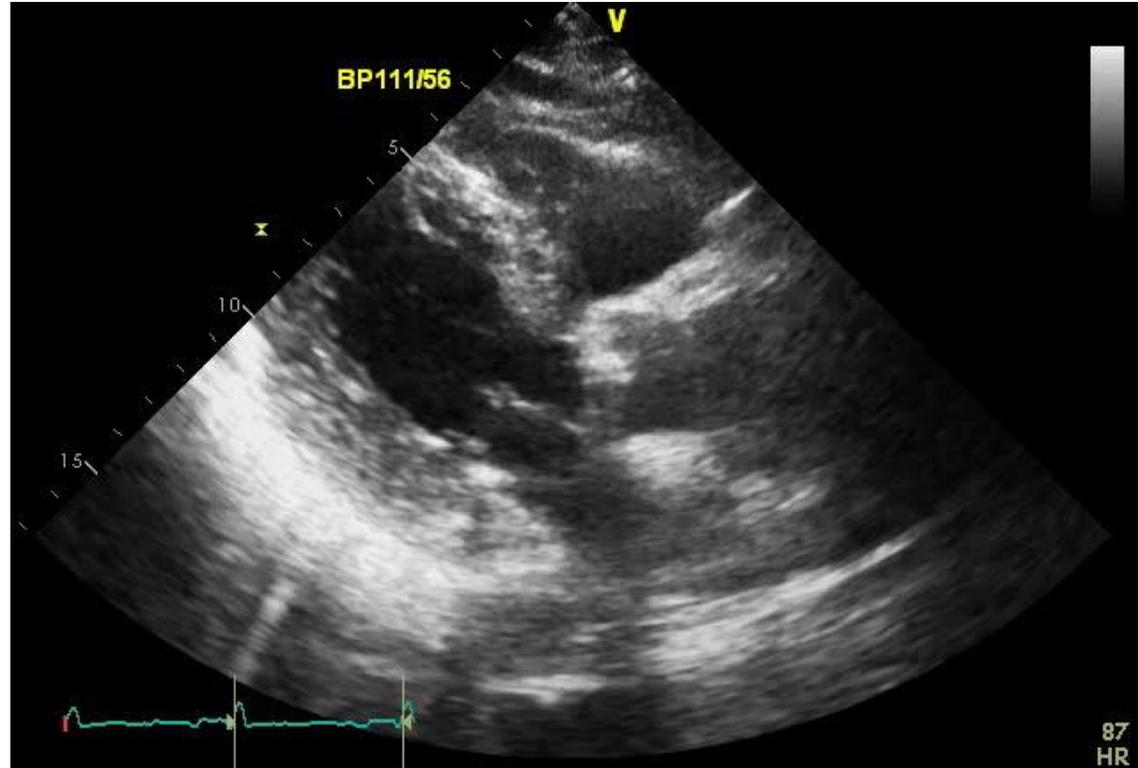
- Lt. femur Fx due to slip down  
=> require OP
- PHx:
  - HTN
  - CKD
  - Osteoporosis, OA
- Lab: Cr 2.5, GFR 18 mL/min  
Hb 8.3
- STS score: 17.1%



# TTE



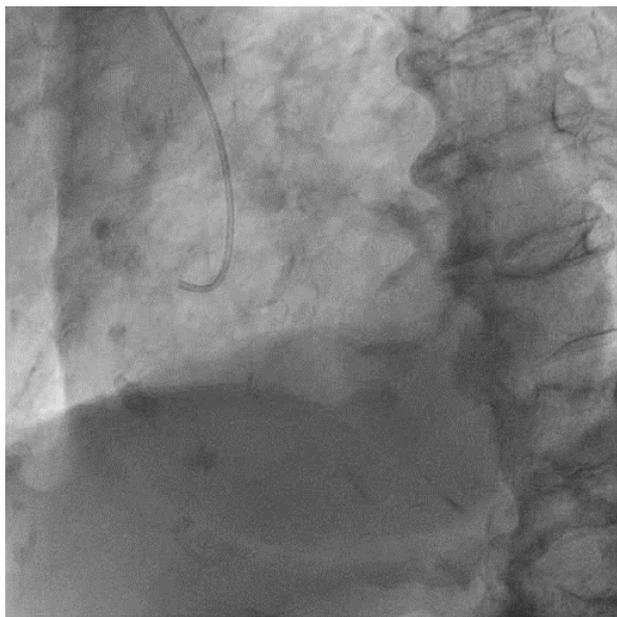
- Severe AS
  - AVA :  $0.79\text{cm}^2$ ,
  - PSPG/MSPG: 84/54 mmHg
- No RWMA
- EF=58%



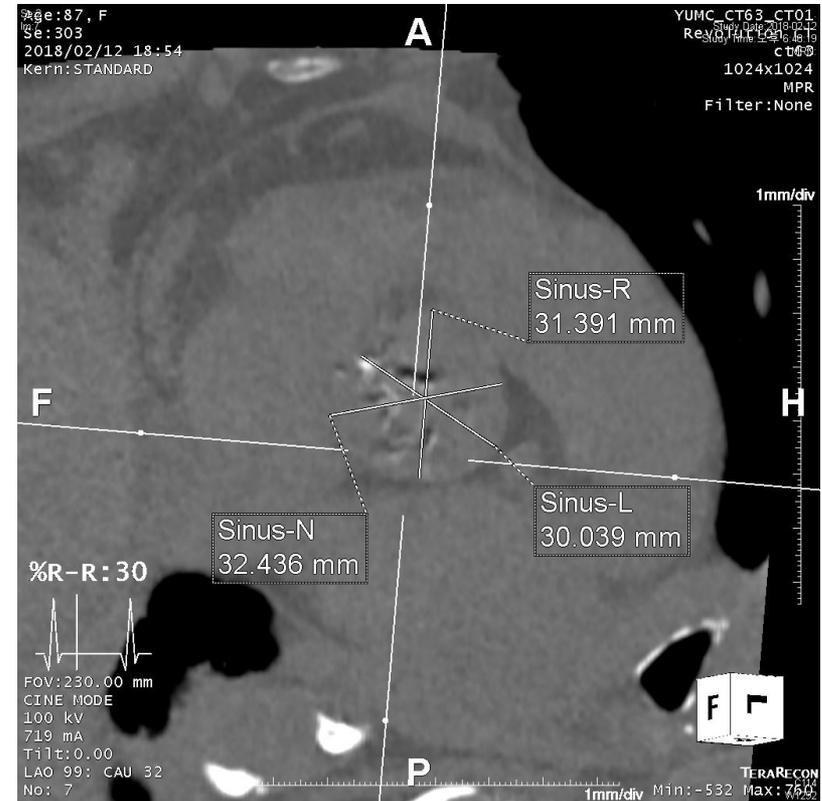
# Coronary Angiogram



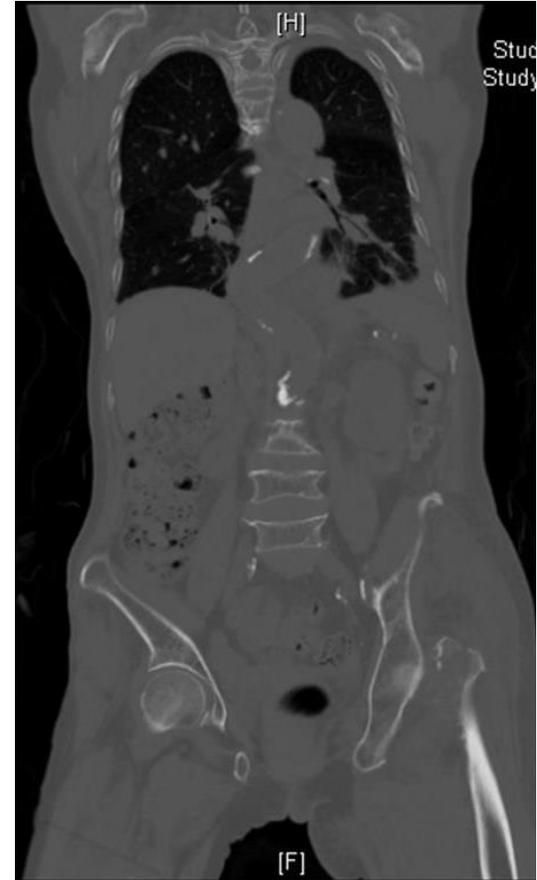
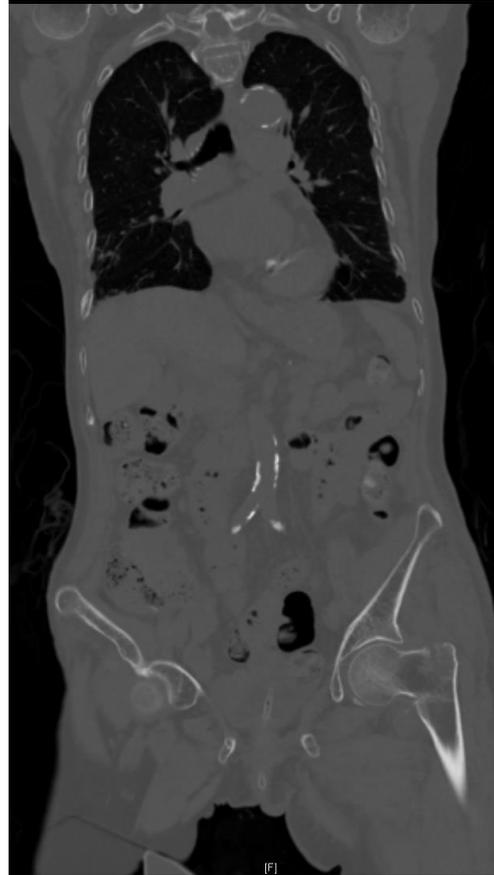
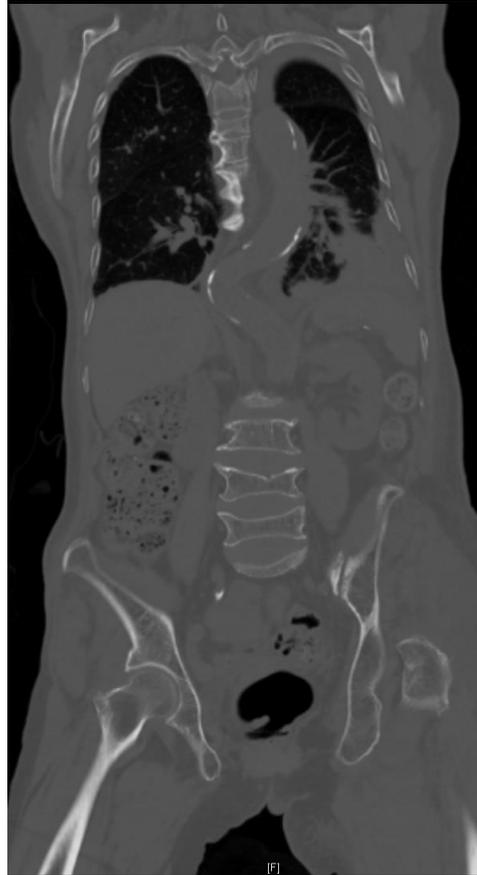
Total contrast volume: < 15 mL



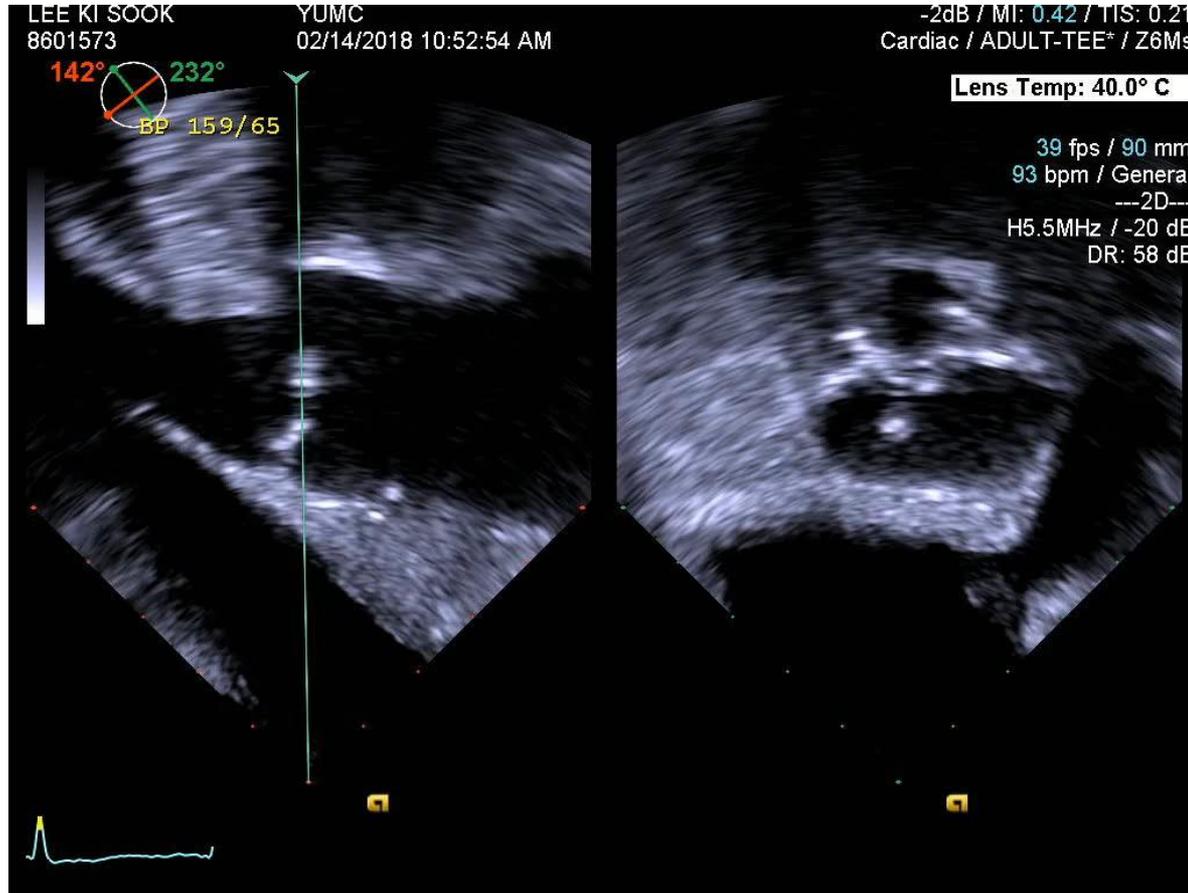
# CT, non-contrast



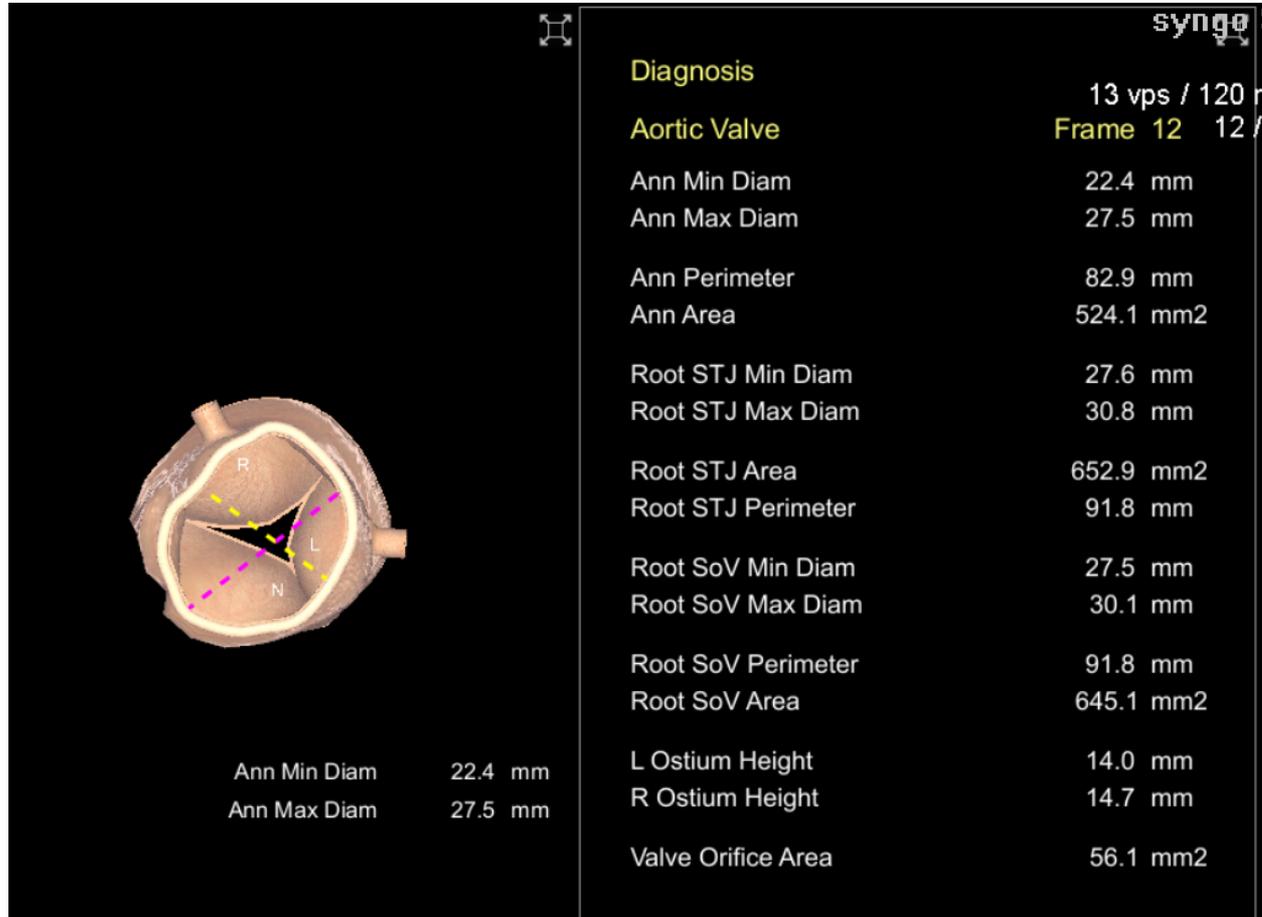
# CT, non-contrast



# TEE



# Measurement by 3D TEE



# Valve Size Selection



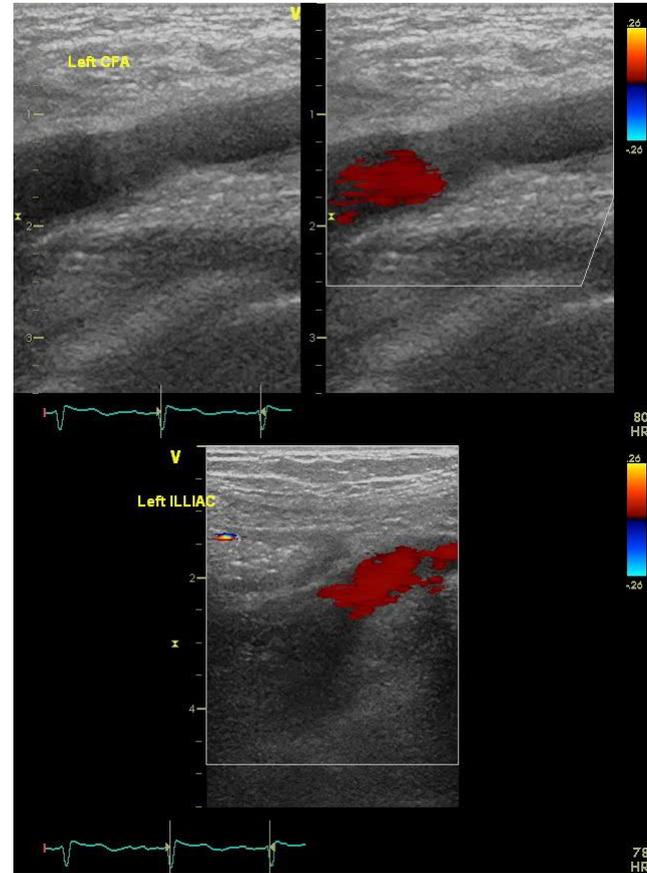
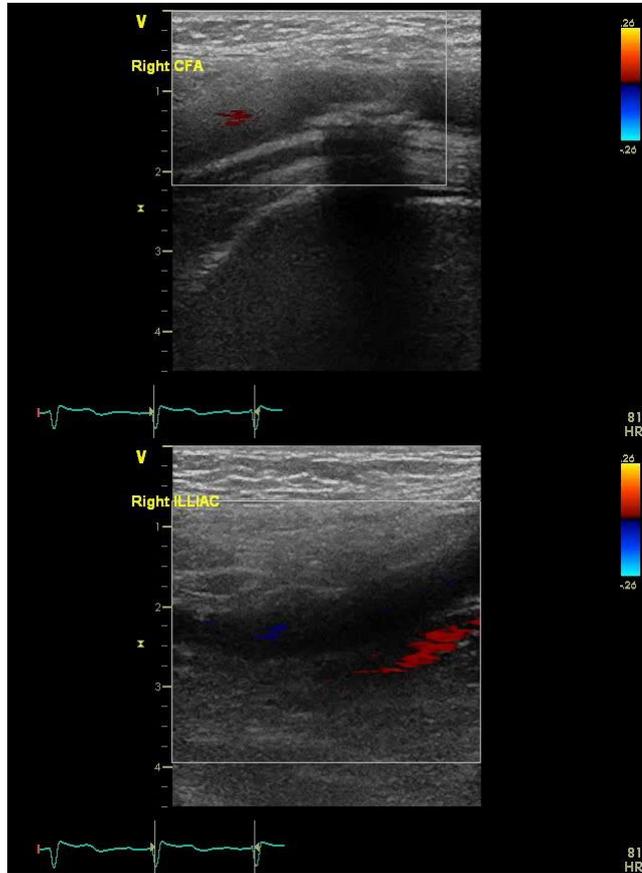
Perimeter by non-contrast CT: 79 mm  
by 3D TEE: 83 mm

Valve Size Selection	CoreValve <sup>®</sup> Evolut <sup>®</sup> R			
				
Size	23 mm	26 mm	29 mm	34 mm
Annulus Diameter	18-20 mm	20-23 mm	23-26 mm	26-30 mm
Annulus Perimeter†	56.5-62.8 mm	62.8-72.3 mm	72.3-81.7 mm	81.7-94.2 mm
Sinus of Valsalva Diameter (Mean)	≥ 25 mm	≥ 27 mm	≥ 29 mm	≥ 31 mm
Sinus of Valsalva Height (Mean)	≥ 15 mm	≥ 15 mm	≥ 15 mm	≥ 16 mm

†Annulus Perimeter = Annulus Diameter x  $\pi$



# Duplex US for Evaluation of Vascular Access



# Sheath Insertion



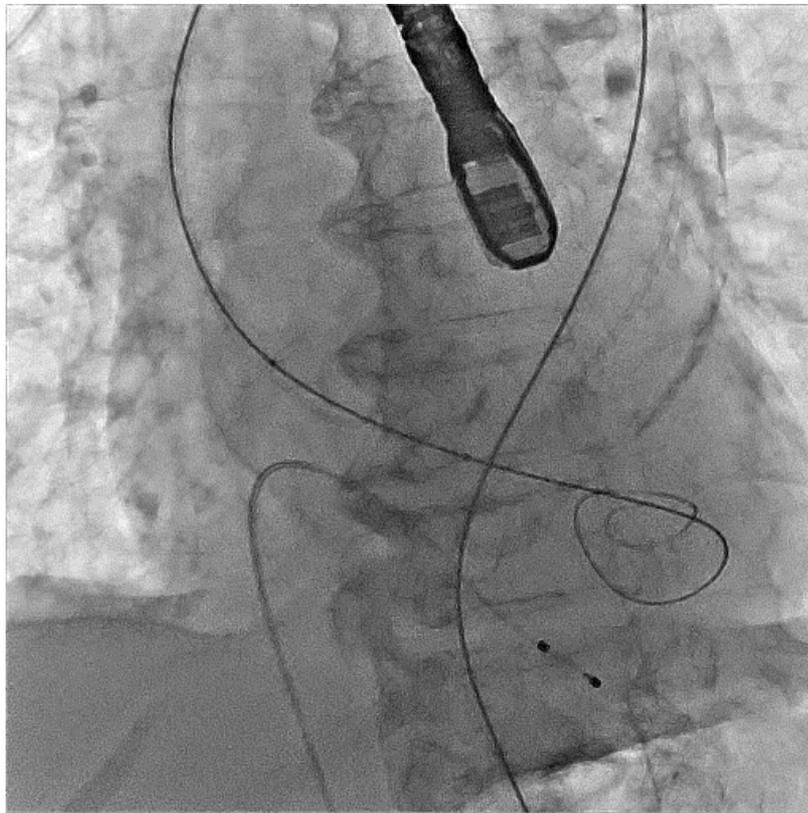
18F sheath



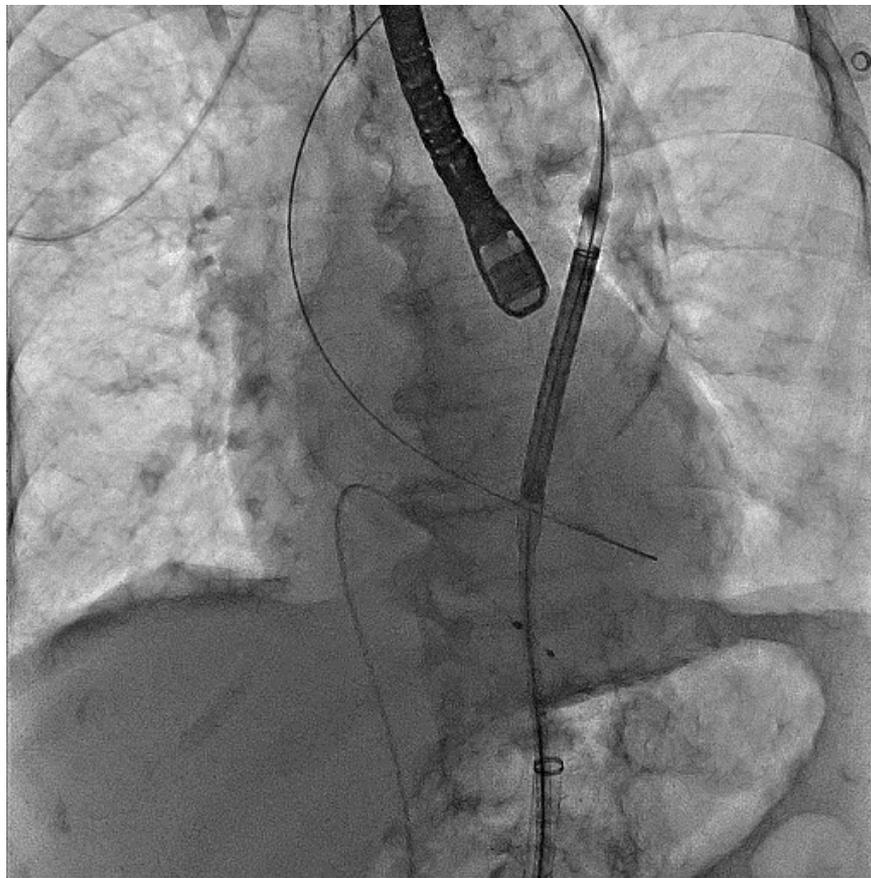
# Predilatation



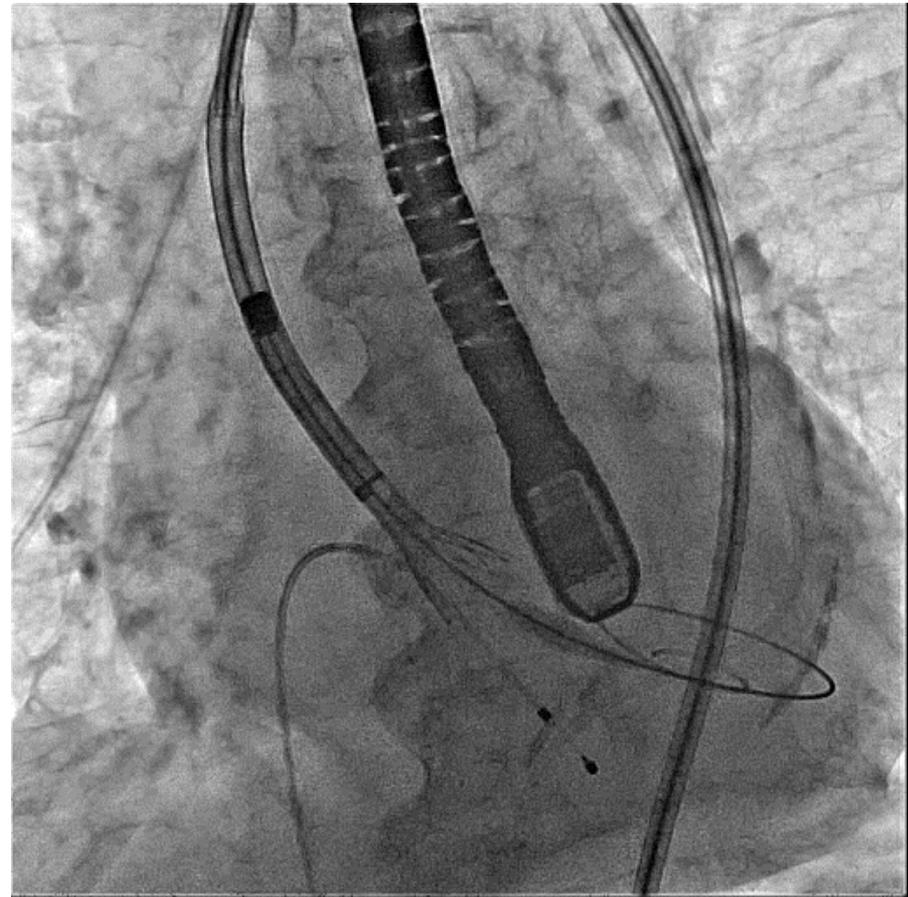
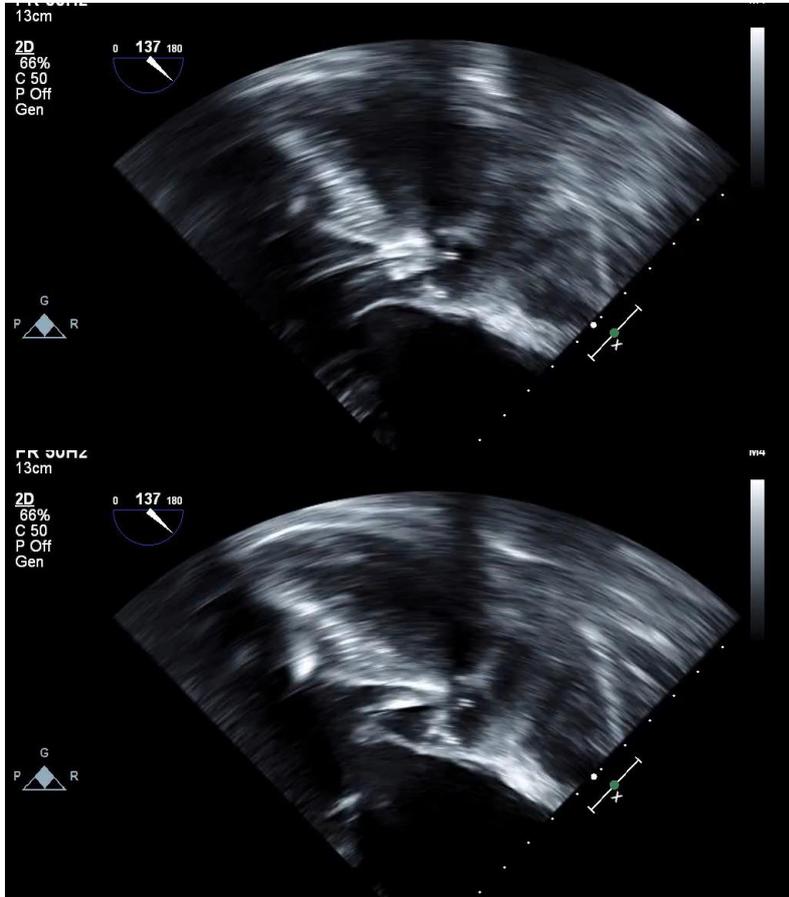
Z-med balloon  
23 x 40 mm



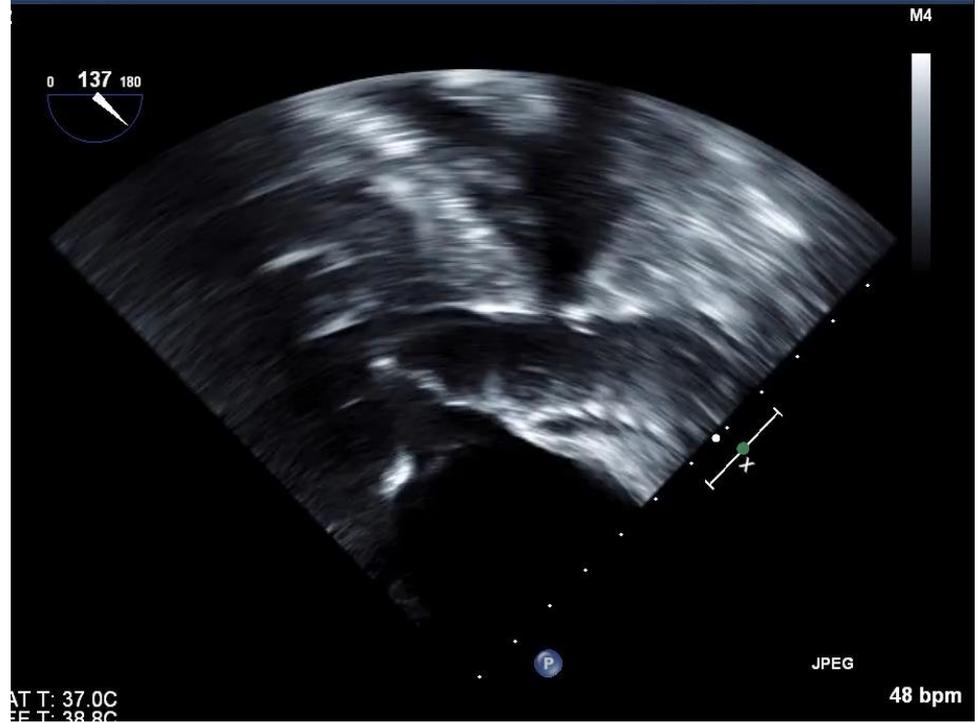
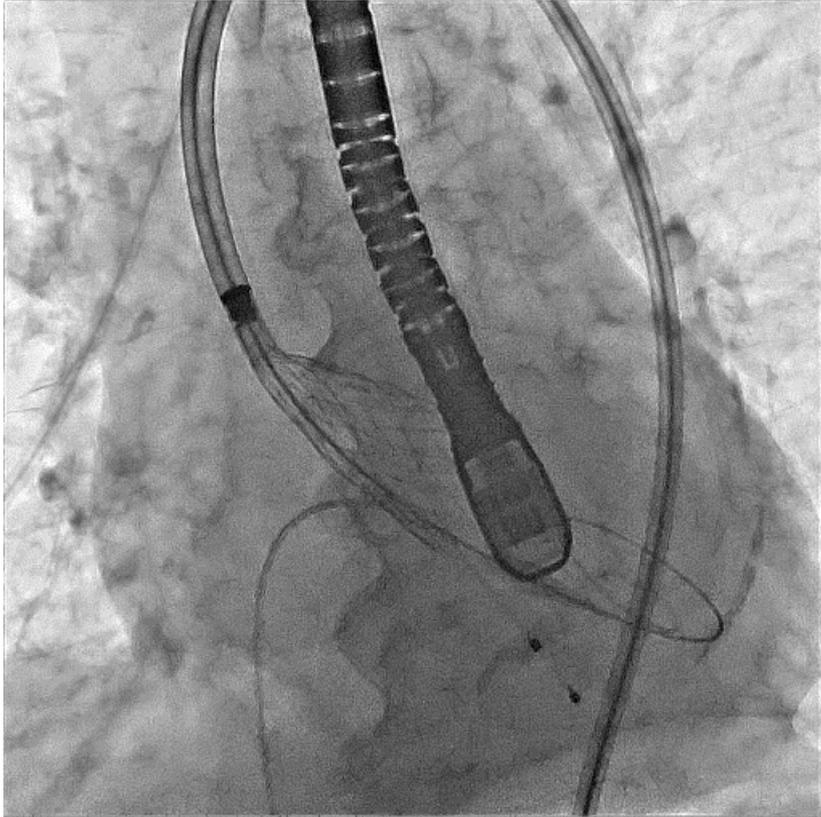
# Evolut R 29 mm



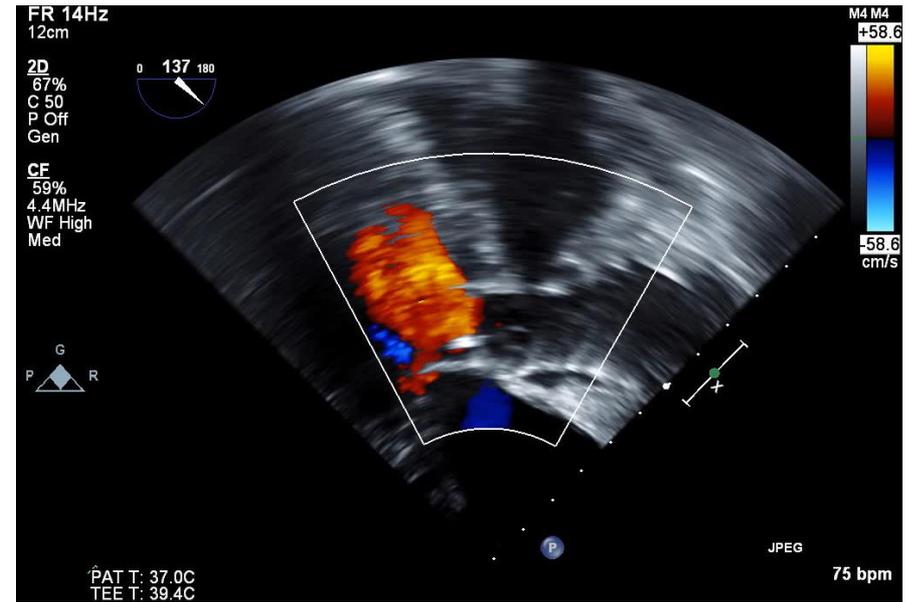
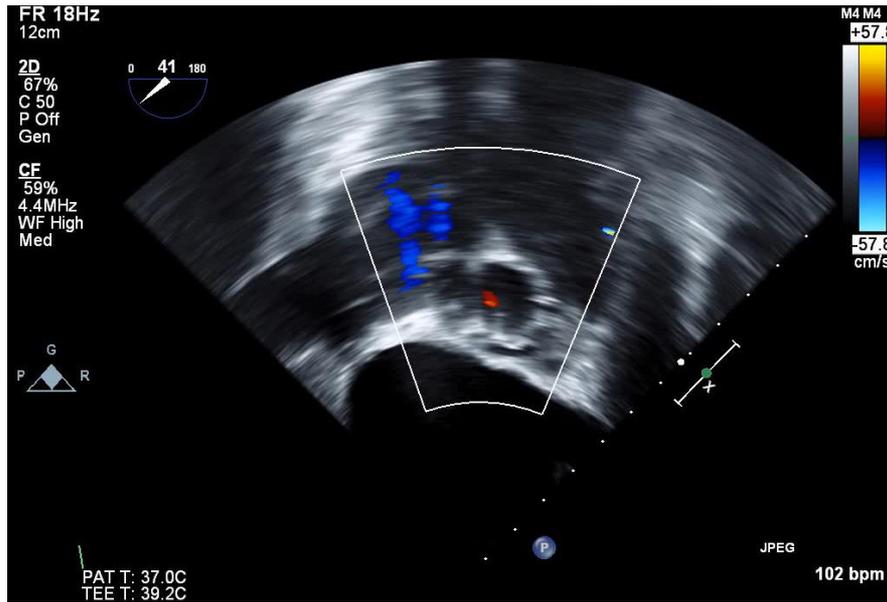
# TEE-guided TAVI: Zero Contrast



# TEE-guided TAVI



# TEE after Valve Implantation



# Progress after TAVI



- Post TAVI
  - Day #1: Transferred to GW without complication
  - Day #13: OS surgery
  - Day #22: discharged from hospital
- Renal function at discharge:
  - Cr 2.5 => 2.13 mg/dL,
  - eGFR 22 mL/min



# Take Home Messages



- CKD is frequently present in patients undergoing TAVI.
- AKI occurs not infrequently after TAVI and is associated with worse clinical outcomes.
- Contrast volume is a known risk factor for AKI.
- Thus, preprocedural evaluation and TAVI procedures using minimal contrast medium is important to reduce the risk of AKI in patients with CKD.
- Furthermore, maintaining stable hemodynamics and avoiding complications are essential to prevent AKI during the TAVI.



**Thank You for Your Attention!**

