First implants with new Evolut PRO: advanced sealing for better performance

M.De Benedictis

Ospedale Mauriziano - Torino

ESC Guidelines

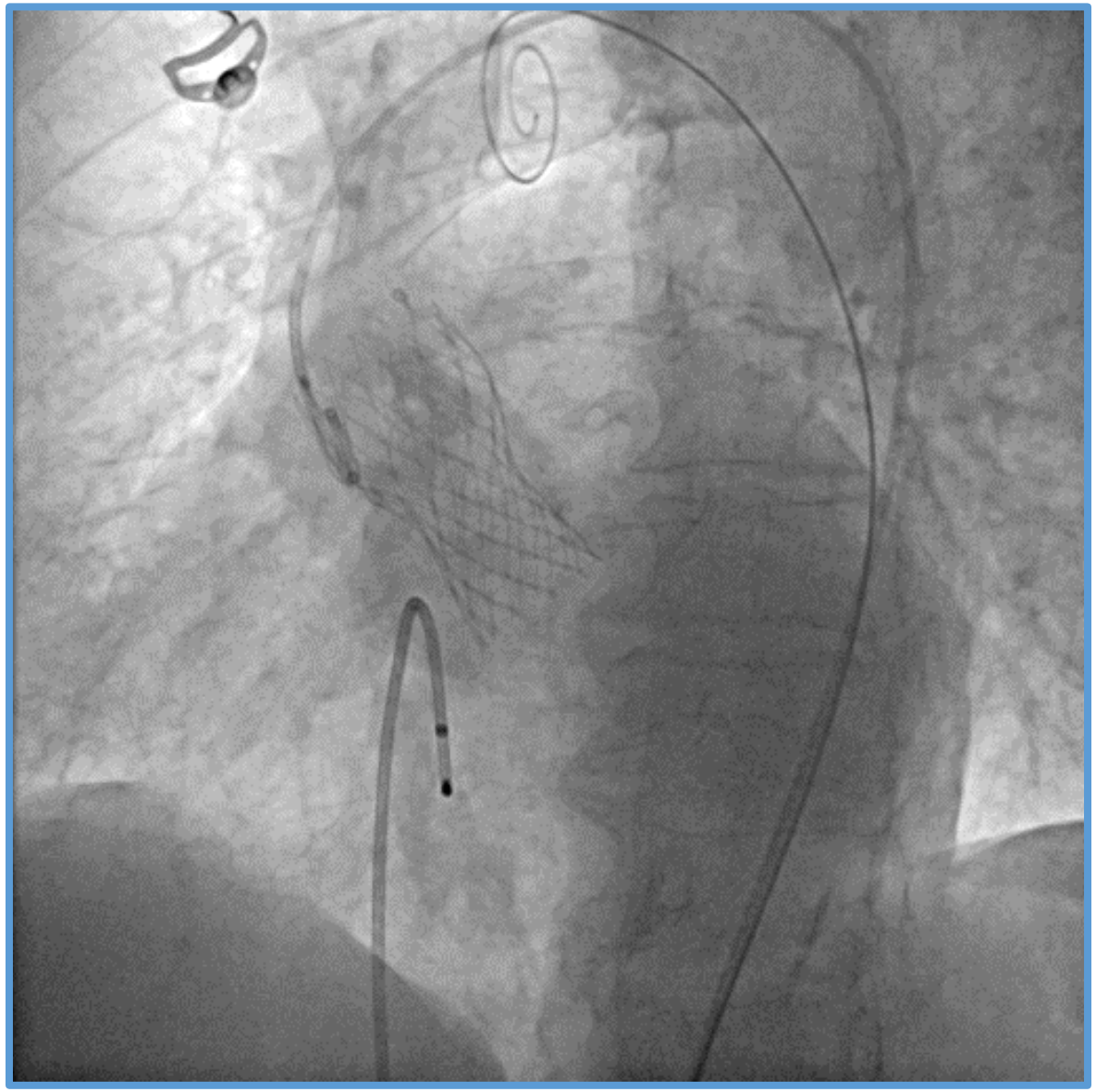
B) Choice of intervention in symptomatic aortic stenosis		
Aortic valve interventions should only be performed in centres with both departments of cardiology and cardiac surgery on site and with structured collaboration between the two, including a Heart Team (heart valve centres).	I	C
The choice for intervention must be based on careful individual evaluation of technical suitability and weighing of risks and benefits of each modality (aspects to be considered are listed in *Table 7*). In addition, the local expertise and outcomes data for the given intervention must be taken into account.	I	C
SAVR is recommended in patients at low surgical risk (STS or EuroSCORE II < 4% or logistic EuroSCORE I < 10%[d] and no other risk factors not included in these scores, such as frailty, porcelain aorta, sequelae of chest radiation).[93]	I	B
TAVI is recommended in patients who are not suitable for SAVR as assessed by the Heart Team.[91,94]	I	B
In patients who are at increased surgical risk (STS or EuroSCORE II ≥ 4% or logistic EuroSCORE I ≥ 10%[d] or other risk factors not included in these scores such as frailty, porcelain aorta, sequelae of chest radiation), the decision between SAVR and TAVI should be made by the Heart Team according to the individual patient characteristics (see *Table 7*), with TAVI being favoured in elderly patients suitable for transfemoral access.[91,94–102]	I	B

ESC Guidelines

	Favours TAVI	Favours SAVR
Clinical characteristics		
STS/EuroSCORE II <4% (logistic EuroSCORE I <10%)[a]		+
STS/EuroSCORE II ≥4% (logistic EuroSCORE I ≥10%)[a]	+	
Presence of severe comorbidity (not adequately reflected by scores)	+	
Age <75 years		+
Age ≥75 years	+	
Previous cardiac surgery	+	
Frailty[b]	+	
Restricted mobility and conditions that may affect the rehabilitation process after the procedure	+	
Suspicion of endocarditis		+

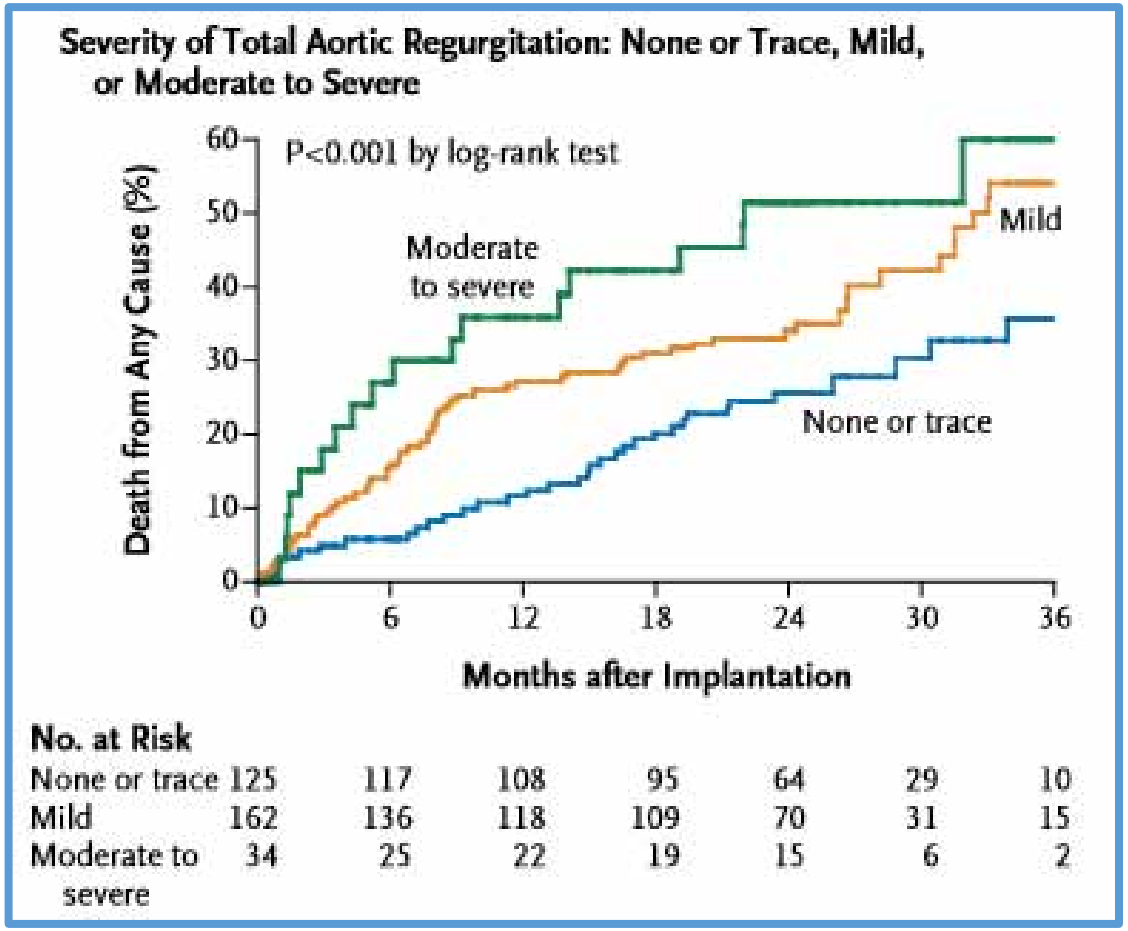
Anatomical and technical aspects		
Favourable access for transfemoral TAVI	+	
Unfavourable access (any) for TAVI		+
Sequelae of chest radiation	+	
Porcelain aorta	+	
Presence of intact coronary bypass grafts at risk when sternotomy is performed	+	
Expected patient–prosthesis mismatch	+	
Severe chest deformation or scoliosis	+	
Short distance between coronary ostia and aortic valve annulus		+
Size of aortic valve annulus out of range for TAVI		+
Aortic root morphology unfavourable for TAVI		+
Valve morphology (bicuspid, degree of calcification, calcification pattern) unfavourable for TAVI		+
Presence of thrombi in aorta or LV		+

Paravalvular leak: Defining the problem



Impact on prognosis – Sapien Valve

High risk patients (PARTNER Trial)

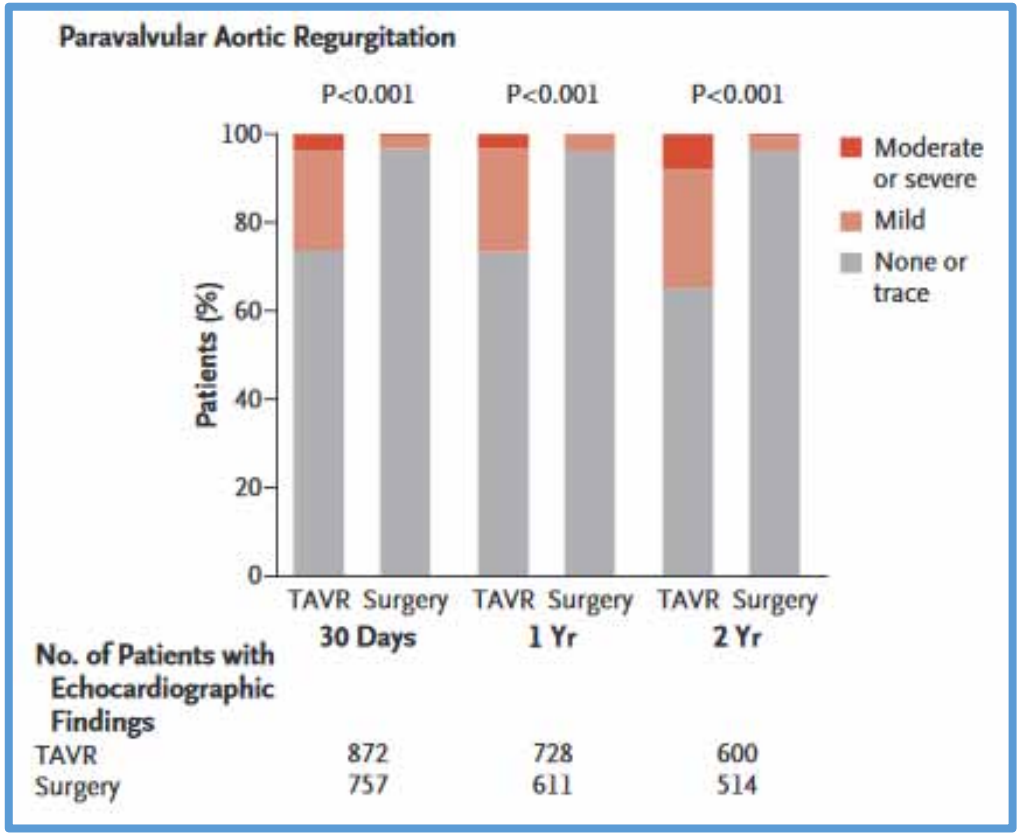


- Mild, moderate, or severe vs. none or trace after TAVR was associated with increased late mortality (hazard ratio, 2.11; 95% CI, 1.43 to 3.10; P<0.001). Even mild aortic regurgitation was associated with an increased rate of late deaths.
- Moderate or severe paravalvular aortic regurgitation was more common after TAVR than after surgical replacement :7.0% vs. 1.9% at 1 year, 6.9% vs. 0.9% at 2 years(P<0.001 for both comparisons).

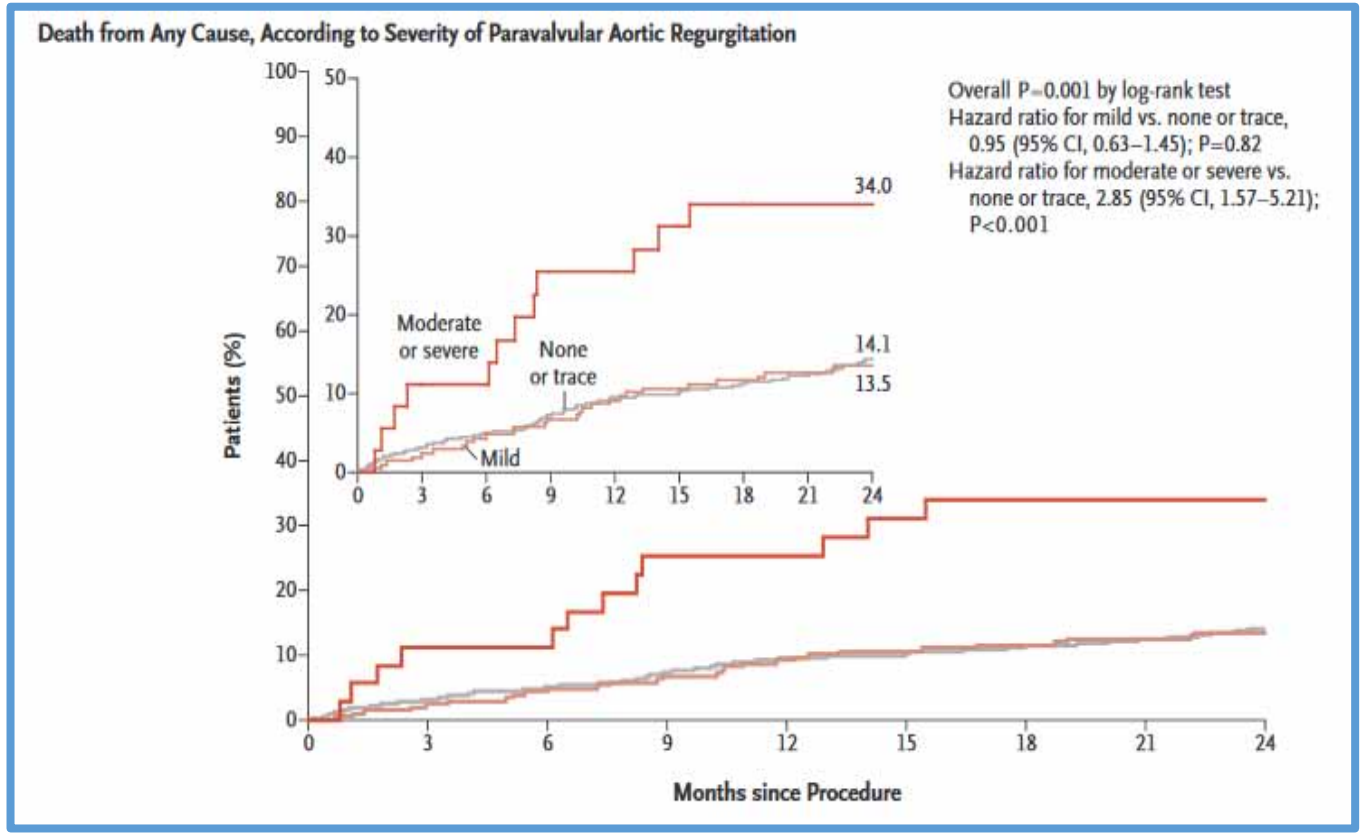
Kodali et al. N Engl J Med 2012;366:168695. PARTNER Trial

Impact on prognosis- Sapien Valve

Intermediate risk patients (PARTNER 2 cohort A Trial)



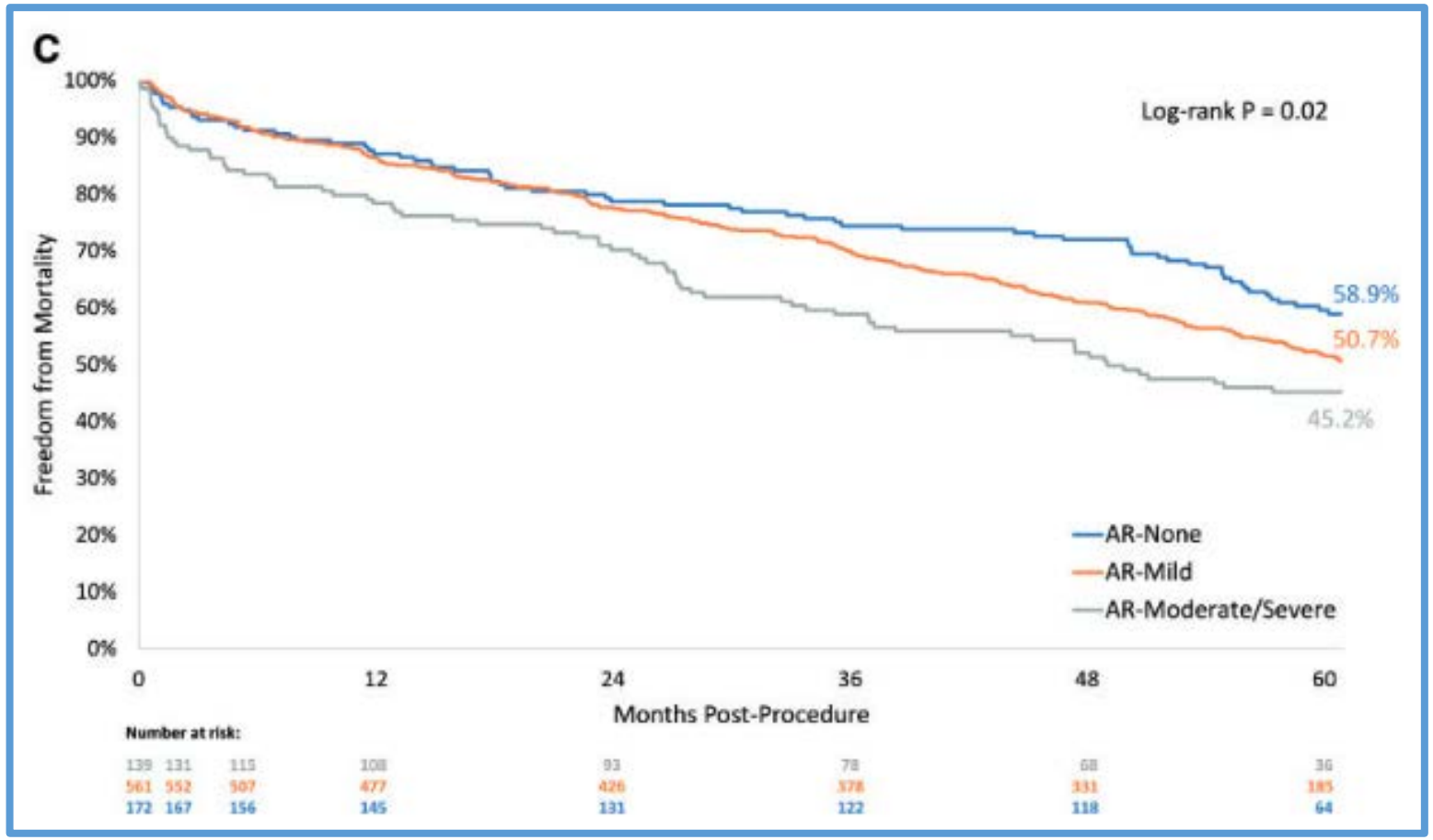
In the TAVR group at 30 days, mild paravalvular aortic regurgitation was observed according to the standard classification scheme in 22.5% of patients, and moderate or severe paravalvular aortic regurgitation in 3.7%.



Patients in the TAVR group who had moderate or severe, but not mild, paravalvular aortic regurgitation at 30 days had higher mortality during 2 years of follow-up than did patients who had no or trace regurgitation (P<0.001)

Leon et al. N Engl J Med 2016;374:1609-20

Impact on prognosis - Corevalve



Moderate or severe AR was associated with the lowest survival (45.2% at 5 years). There also appears to be an impact of mild AR on mortality demonstrated only after 2 years with a rate of 50.7% at 5 years

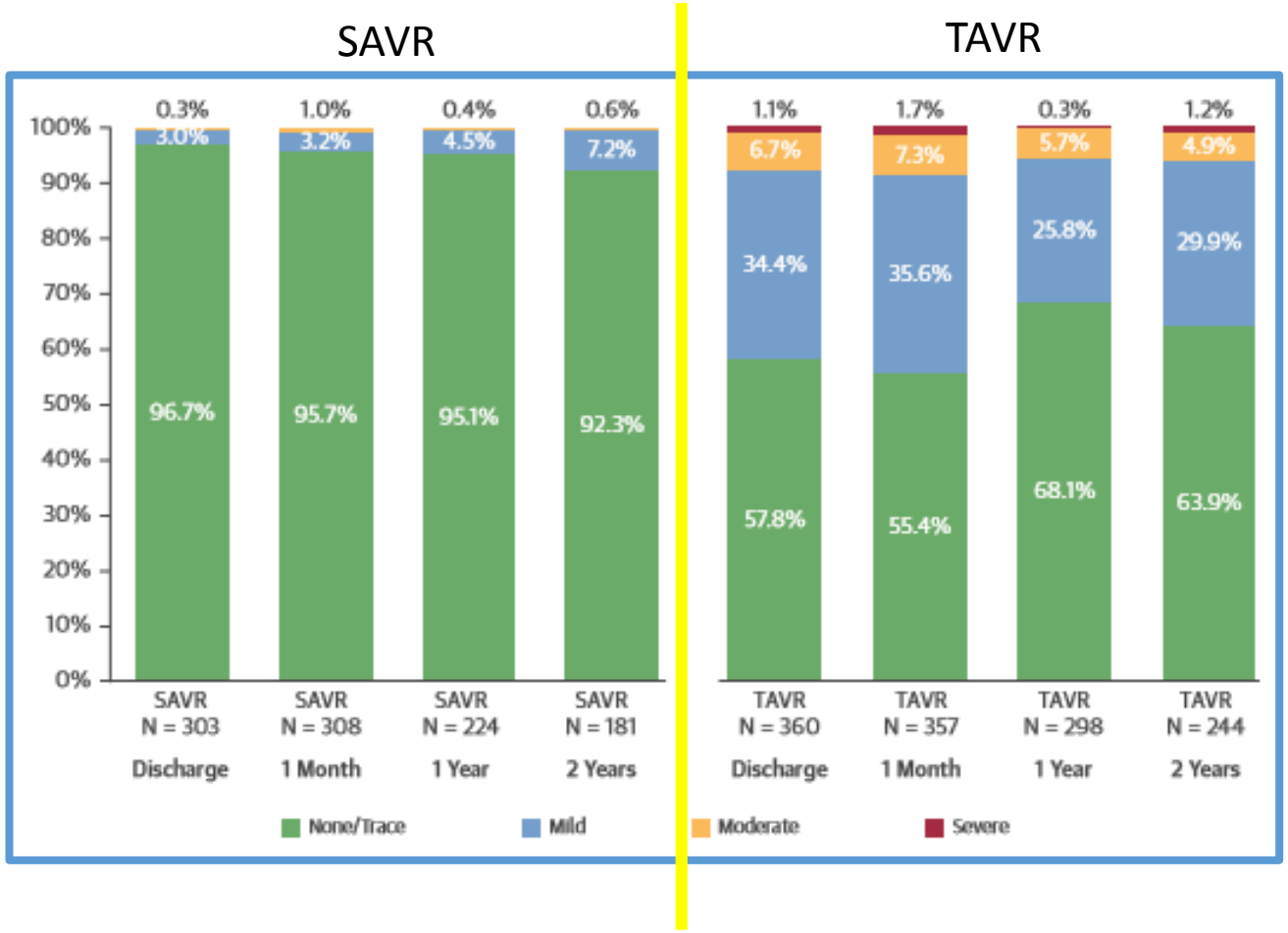
Gerckens et al. European Heart Journal (2017) 38, 2729–2738 (ADVANCE)

Impact on prognosis - Corevalve

High-risk patients:

Moderate to severe paravalvular regurgitation was higher in the TAVI group (6.1%), compared to surgical group (0.6%, p<0.001)

Reardon et al. JACC 2015;66:113-21 (Corevalve US Trial)

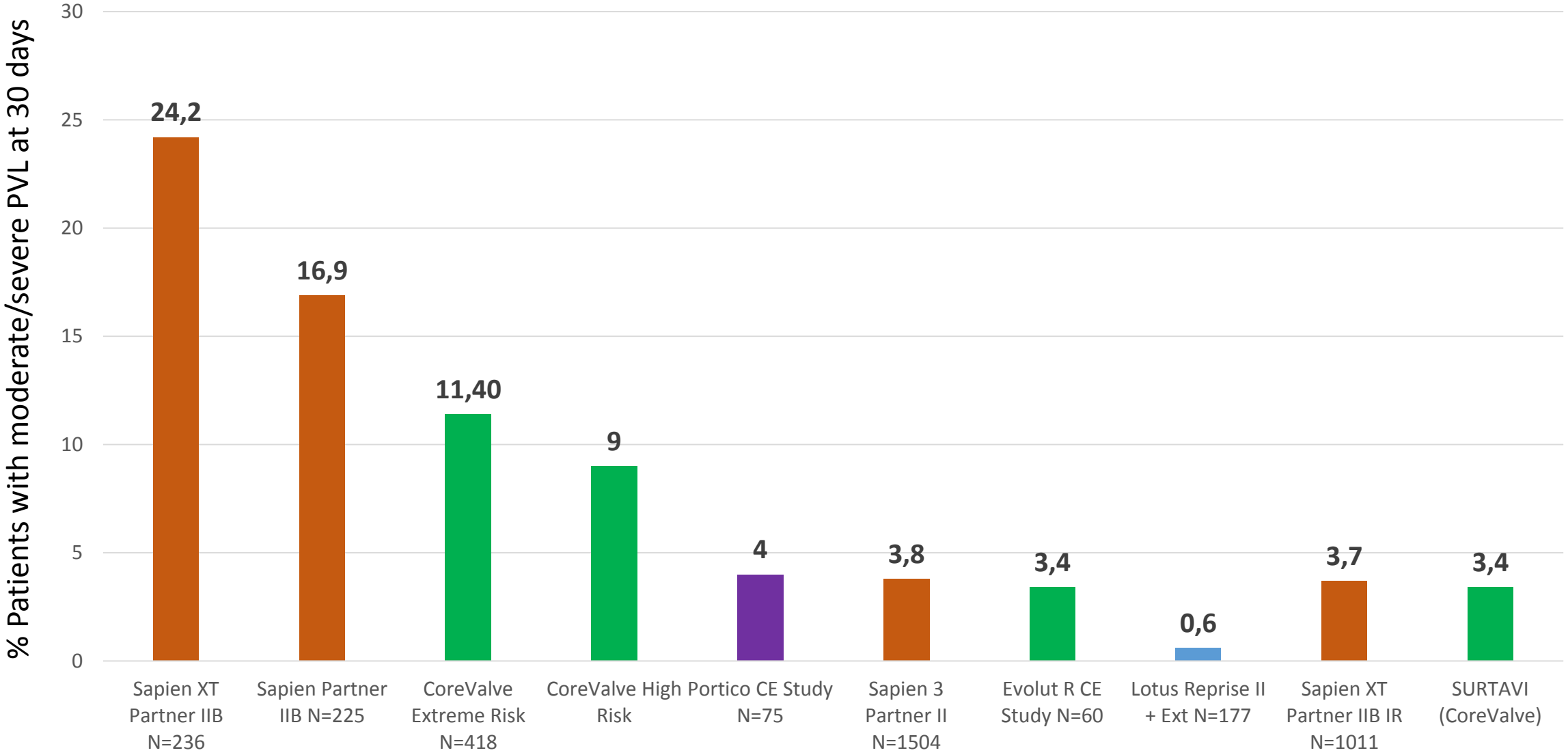


Intermediate-risk patients:

Moderate or severe paravalvular aortic regurgitation was more common after TAVR than after surgical replacement: 5.3% vs. 0.8% at 1 year, 5.7% vs. 1.2% at 2 years (P<0.001 for both comparisons).

Reardon et al. N Engl J Med 2017;376:1321-31 (SURTAVI).

Paravalvular leak: Defining the problem

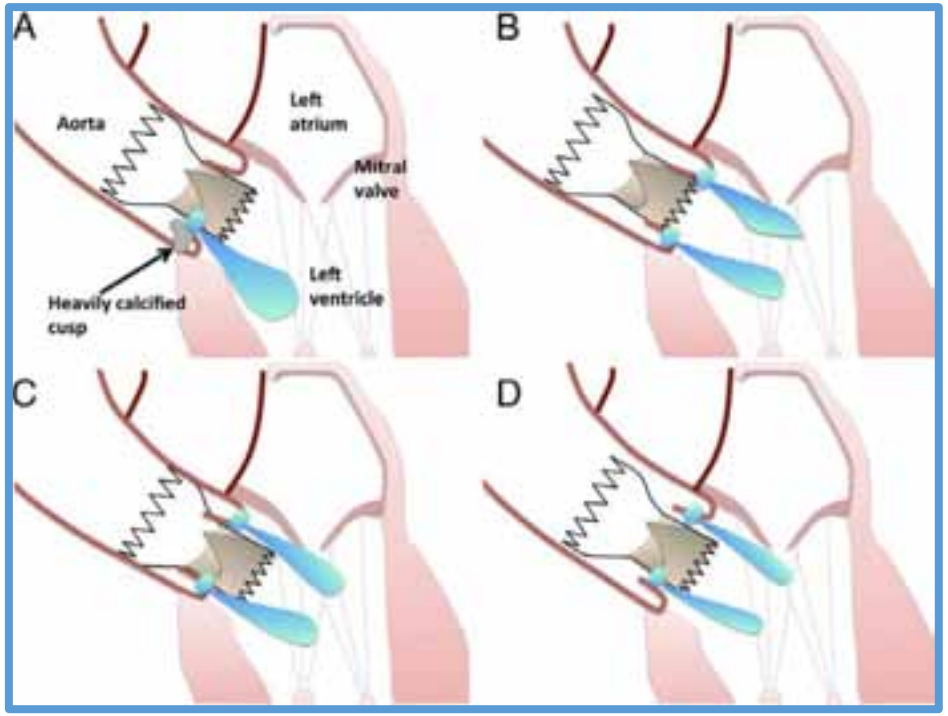


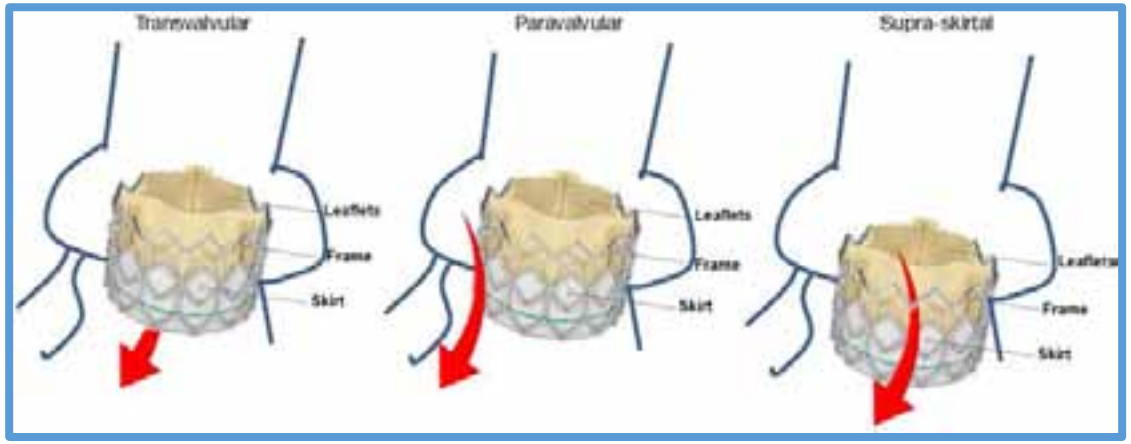
1 Leon, et. al. presented at ACC 2013; 2 Popma, et al., J Am Coll Cardiol 2014; 63: 1972 - 81; 3 Adams, et al., N Engl J Med 2014; 370: 1790-8; 4 Manoharan, et al., et. al. presented at TCT 2014; 5 Kodali, et al., presented at ACC 2015; 6 Meredith, et al., presented at ACC 2015; 7 Schofer, et al., J Am Coll Cardiol 2014; 63: 763-8; 8 Meredith, et al., presented at PCR London Valves 2014; 9 Leon, et al. NEJM 2016;374:1609-20 ; 10 Reardon et. al N Engl J Med 2017;376:1321-31

Risk factors for PVL after TAVI

Anatomical factors

- Bicuspid aortic valve
- Aortic annulus dimensions (perimeter, diameter)
- Annulus shape (eccentricity)
- LVOT-AO angle
- Extent and distribution of calcifications
- Calcification of commissures





Procedure and operator-dep. factors

- Undersizing of the device
- Malpositioning of the valve
- Depth of implantation
- Learning curve

Sinning et al. J Am Coll Cardiol. 2012 Mar 27;59(13):1134-41

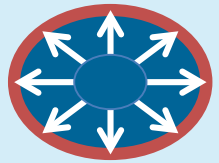
Stahli et al. Cardiovasc Diagn Ther. 2013 Mar;3(1):15-22

EVOLUT PRO TRANSCATHETER VALVE

Advanced Sealing

Conformable Frame

Self-expanding nitinol frame conforms to annulus regardless of shape

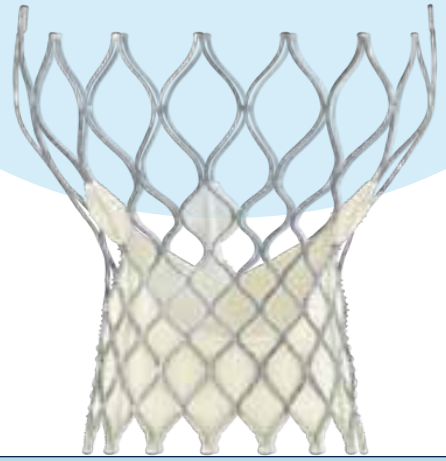


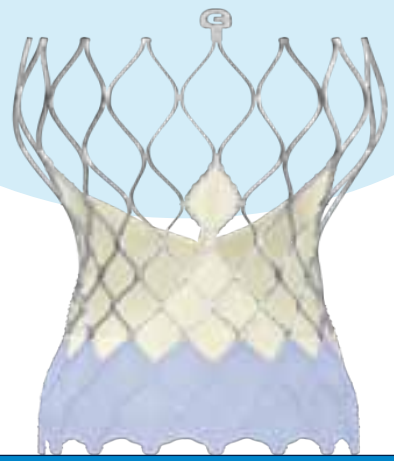
Consistent Radial Force

Frame oversizing and cell geometry provide consistent radial force across treatable range

External Wrap

External wrap increases surface contact with native anatomy





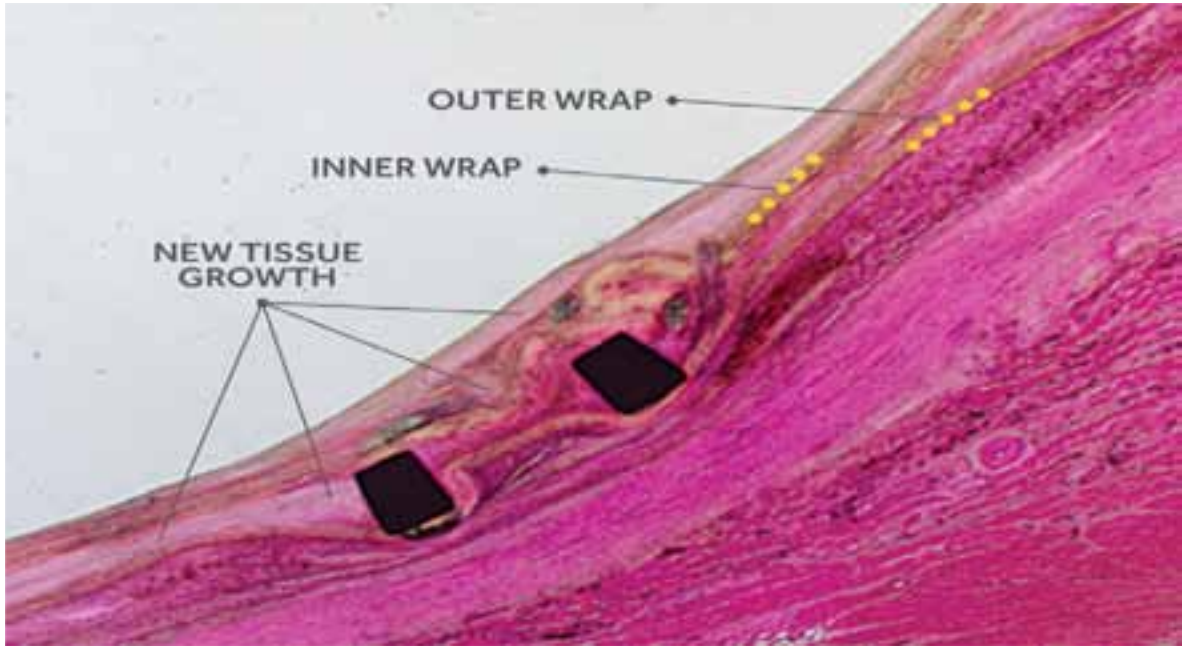
CoreValve → Evolut R → Evolut PRO

EVOLUT PRO

PORCINE PERICARDIAL TISSUE INTERACTION

Animal Studies suggest favorable Response and Interaction with Native Tissue

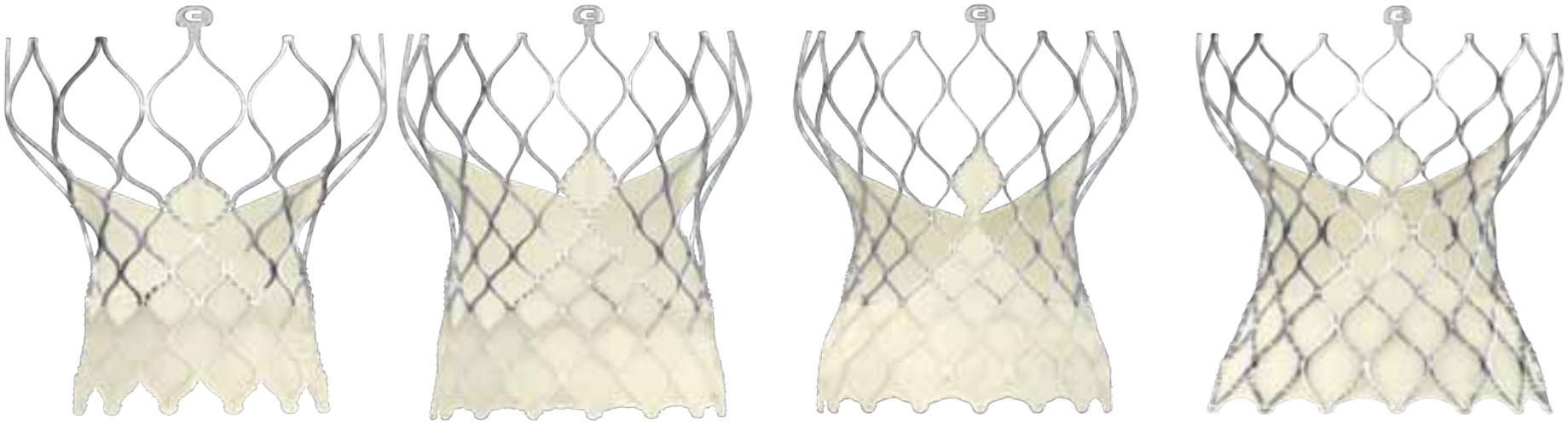
- Low inflammatory response[1]
- **Stable and mature tissue growth** observed at 90 days post implant[1]
  - Thin and even layer of endothelial cells on inner lumen of device



Evolut PRO explanted from Porcine Model at 60 Days, Cross Section between Nodes 1 and 2, example picture from MDT research study on file illustrating tissue interaction.[2]

1. Medtronic data on file. 90 day porcine GLP Evolut R study, results may not be indicative of clinical performance
2. Medtronic, data on file. 60 day porcine research study model, results may not be indicative of clinical performance.

EVOLUT PLATFORM



Evolut PRO TAV			Evolut R TAV
23 mm	26 mm	29 mm	34 mm

Diameter (mm)	18	19	20	21	22	23	24	25	26	27	28	29	30
Perimeter (mm) †	56.5		62.8			72.3			81.7				94.2

Vessel Access (mm)	5.5
French Size	16 Fr eq

* Based on CT measurement
† Annulus Perimeter = Annulus Diameter x π

EVOLUT PRO SYSTEM CLINICAL TRIAL

PATIENT CHARACTERISTICS

Characteristic, mean ± SD or %	N=60
Age, years	83.3 ± 7.2
Female	65.0
BSA, m^2	1.8 ± 0.2
STS – PROM, %	6.4 ± 3.9
NYHA Class III or IV	70.0
Peripheral vascular disease	43.3
Atrial fibrillation / atrial flutter	18.6
Diabetes mellitus	43.3
Severe aortic calcification	20.5
LV ejection fraction, %	58.9 ± 12.4
Pre-existing pacemaker	15.0

Forrest, et al., ACC, 2017

Evolut PRO Clinical Study,
n=60, 30-day outcomes

EVOLUT PRO SYSTEM CLINICAL TRIAL

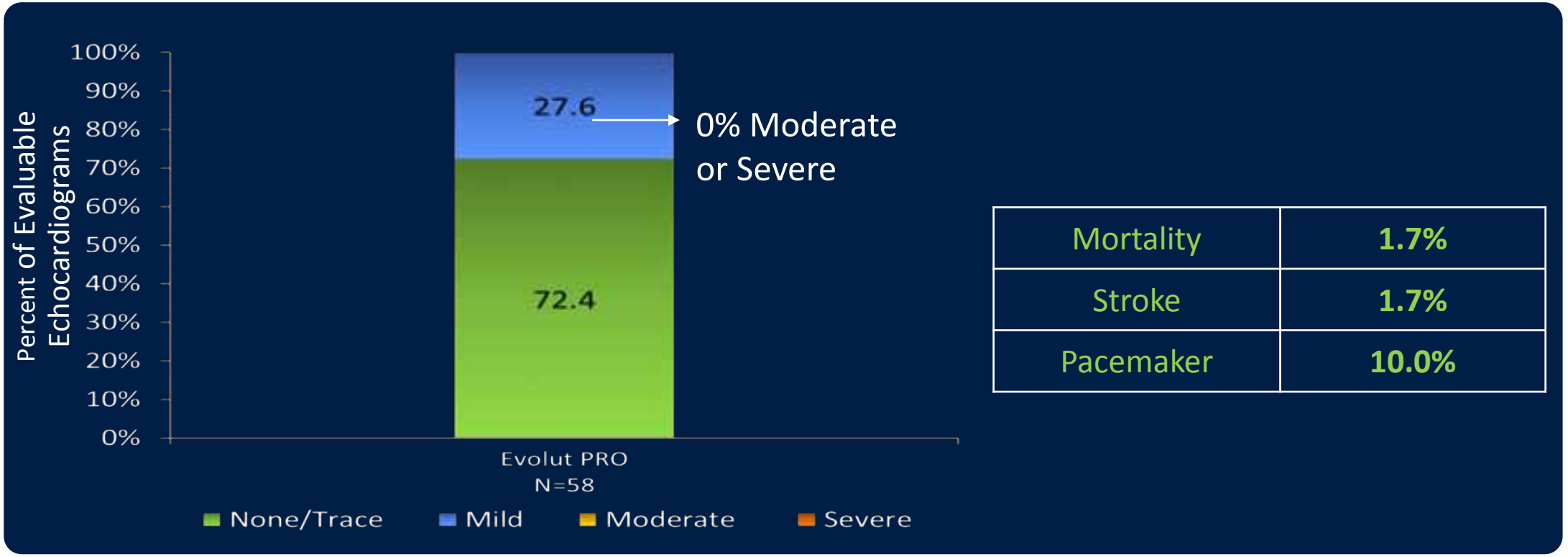
PROCEDURAL OUTCOMES

Characteristic, % or mean ± SD	N = 60
General anesthesia	58.3
Iliofemoral access approach	98.3
Valve Size Implanted	
26 mm	40.0
29 mm	60.0
Pre-TAVR balloon dilation	51.7
Post-implant balloon dilation	26.7
Percentage of patients repositioned	35.0
Average implant depth, mm	4.3 ± 1.6

Forrest, et al., ACC, 2017

Evolut PRO Clinical Study,
n=60, 30-day outcomes

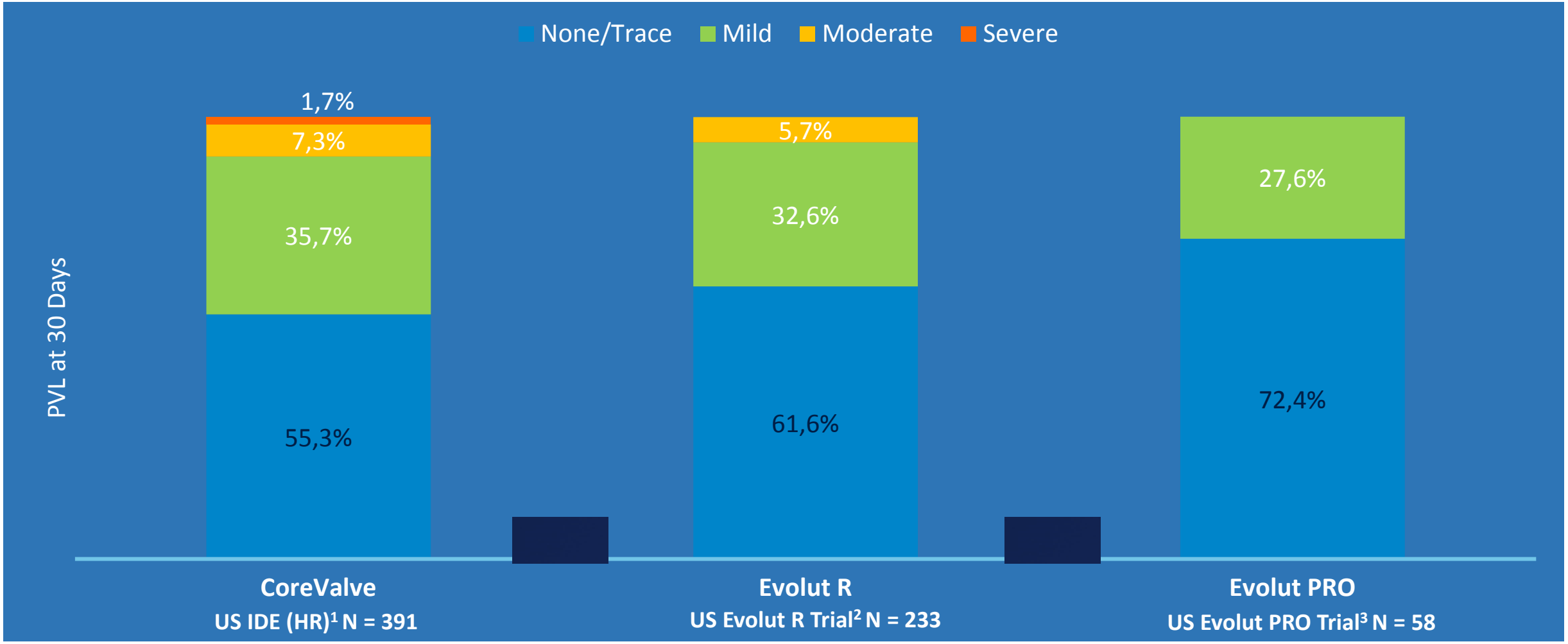
EVOLUT PRO SYSTEM CLINICAL TRIAL



Mortality	**1.7%**
Stroke	**1.7%**
Pacemaker	**10.0%**

Forrest, et al., ACC, 2017

EVOLUT PRO PARAVALVULAR PERFORMANCE
30 DAYS



1. CoreValve HR Data; Adams et al., ACC, 2014; 2. Popma, et al., JACC 2017; 3. Forrest, et al., ACC, 2017

NOTE: PVL performance data represent different device performance in different trials; comparison of results is for illustration purposes only and may not be indicative of clinical performance.

First experience at Mauriziano Hospital: Pt #1

Sex: **Male** ***Age:*** **85**

Clinical symptoms

- **Angina and Cardiac decompensation with dyspnea, weakness, dizziness**

Medical History

- **COPD**
- **Hypertension**
- **Previous smoke**
- **CAD familiar history**
- **Peripheral artery disease**
- **Chronic kidney disease**
- **Paroxymal atrial fibrillation (Rivaroxaban)**
- **Active lifestyle and normal mental status**
- **CAD: 06/2017 --> PCI + DES on LCx and RCA**

Echo

- **Severe Aortic Stenosis (Pmax 77 mmHg, Pmed 47 mmHg, AVA 0.51 cm^2) and moderate aortic regurgitation**
- **Trivial mitral and tricuspid regurgitation**
- **Mild pulmonary hypertension (PAPs 36 mmHg)**

Lab

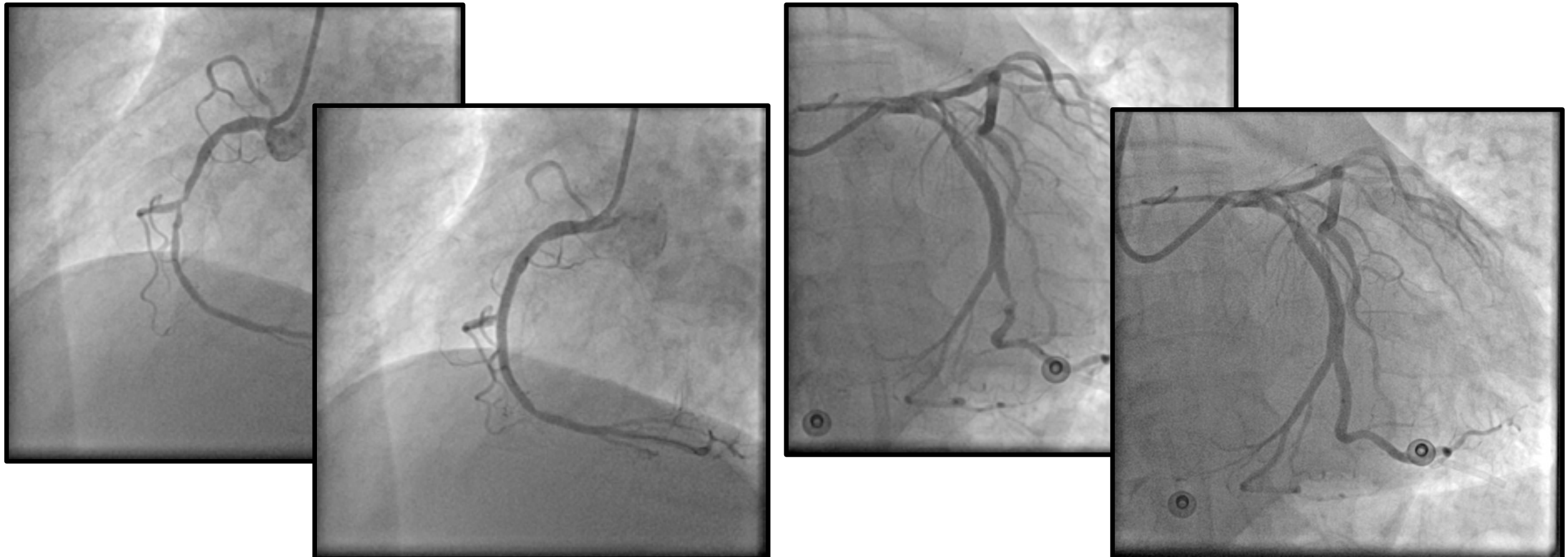
- **Creatinine 1.94 mg/dl (eGFR) 30 ml/min**
- **Hb 13.1**
- **PLTS 269**
- **ALB 34**

Heart Team

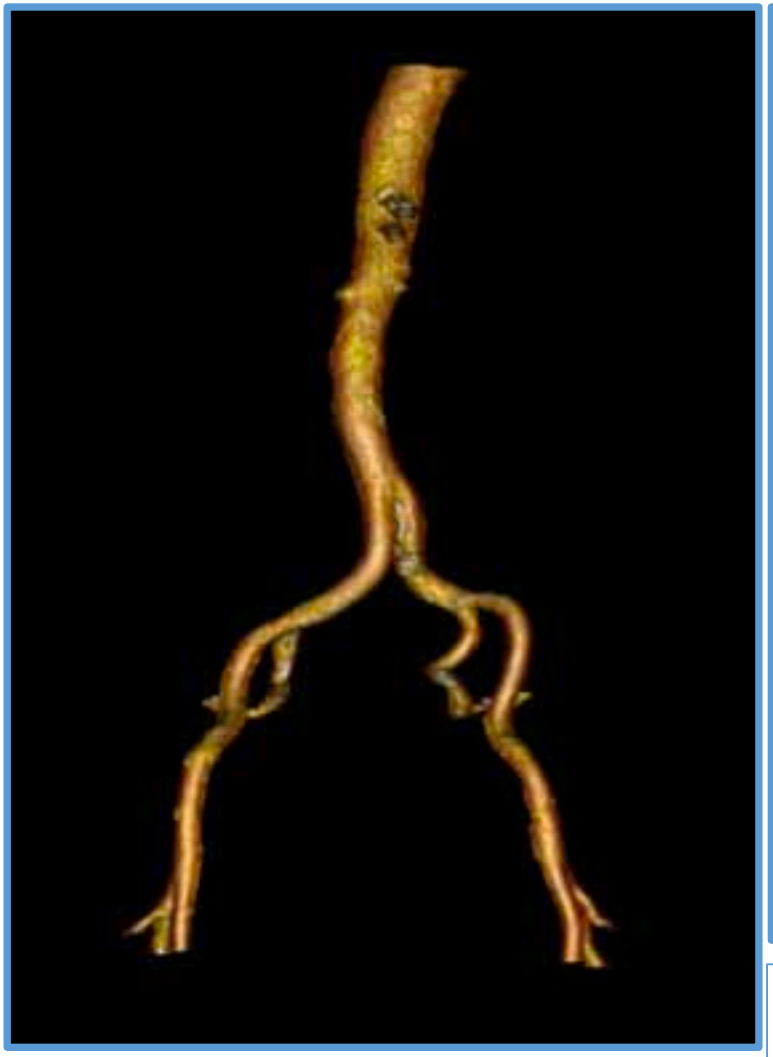
Risk scores:

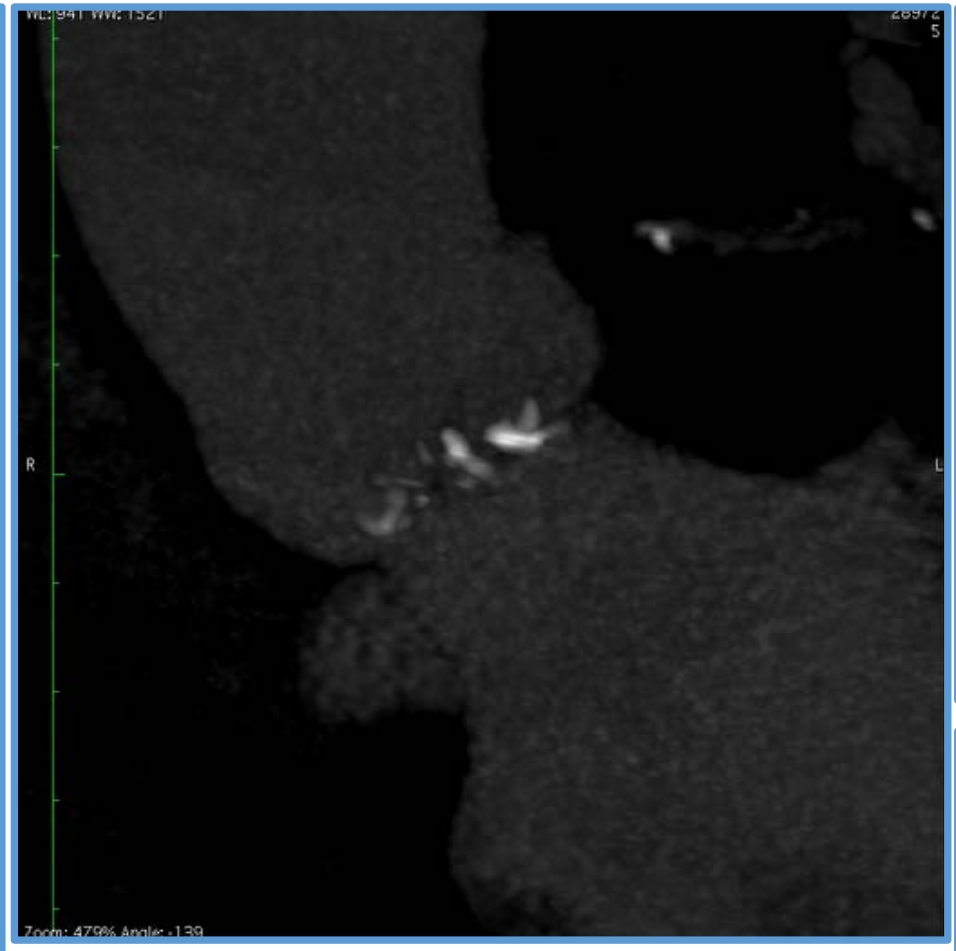
- **STS Score : Risk of Mortality 4.055%, Risk of Morbidity or Mortality 24.94%**
- **Logistic Euroscore: 13.69%**

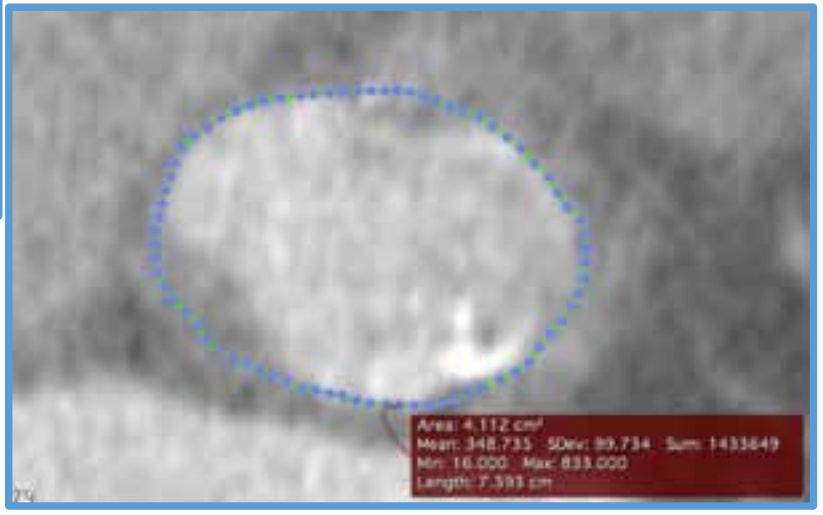
Coronary angio



CT evaluation







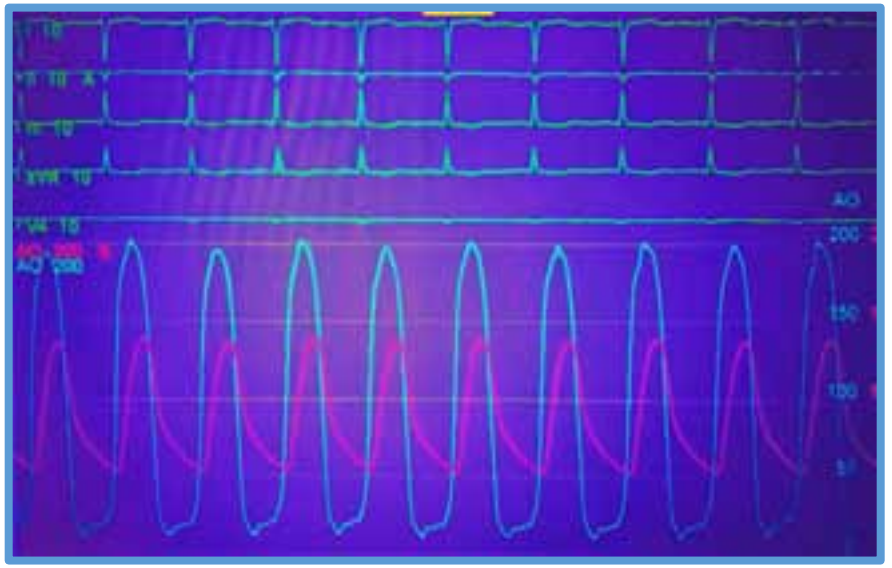
Aortic annulus:

- Perimeter 74 mm
- Area 0.41 cm^2

Sinotubular junction 33 mm

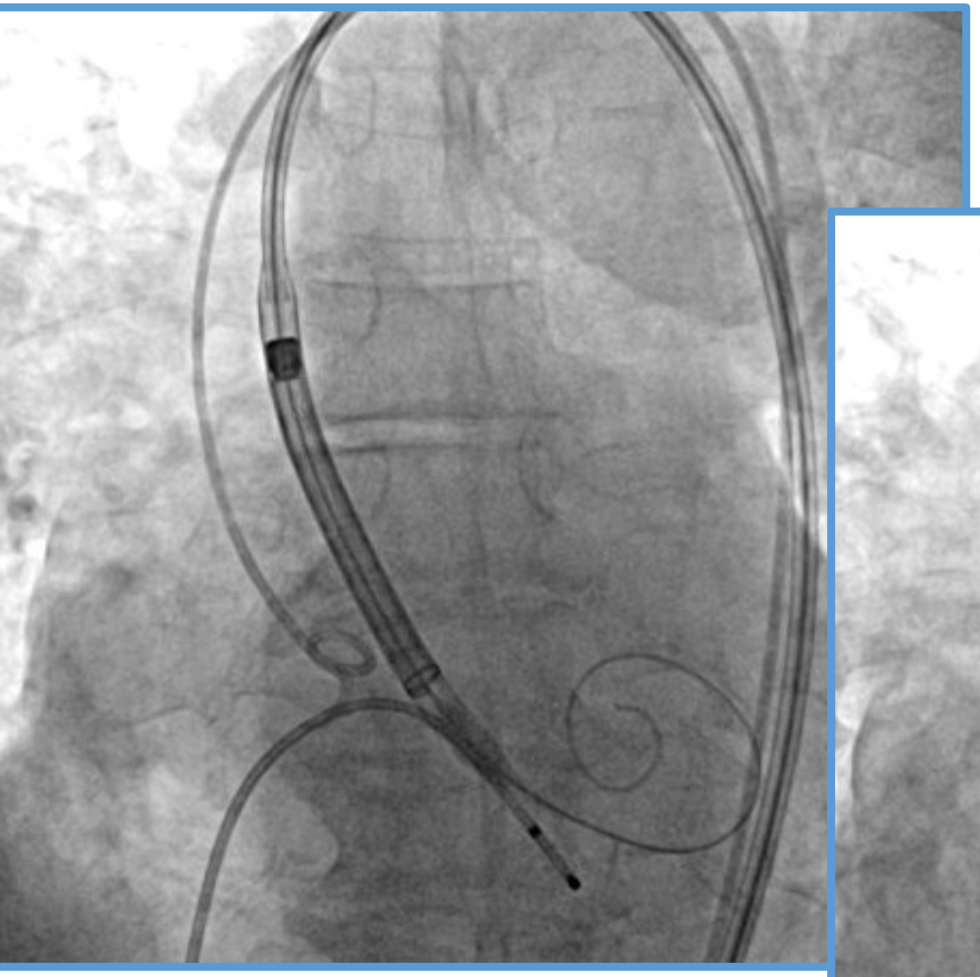
Diametri

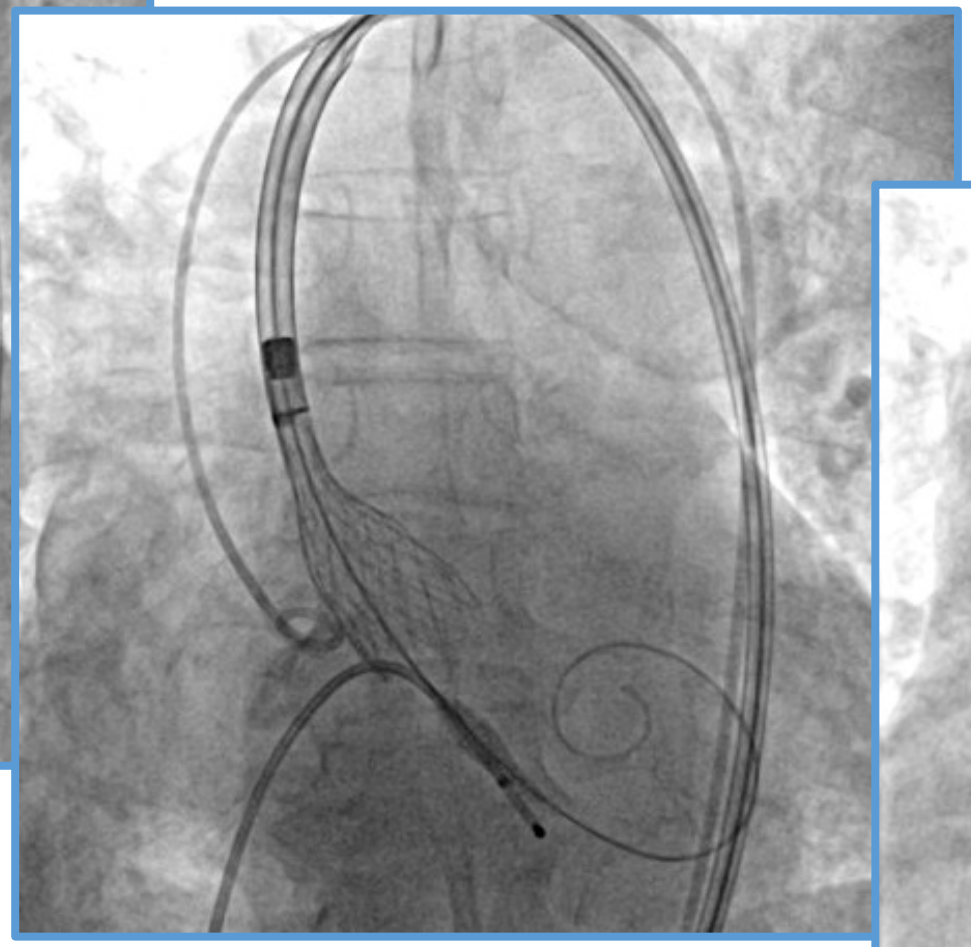
Aortography

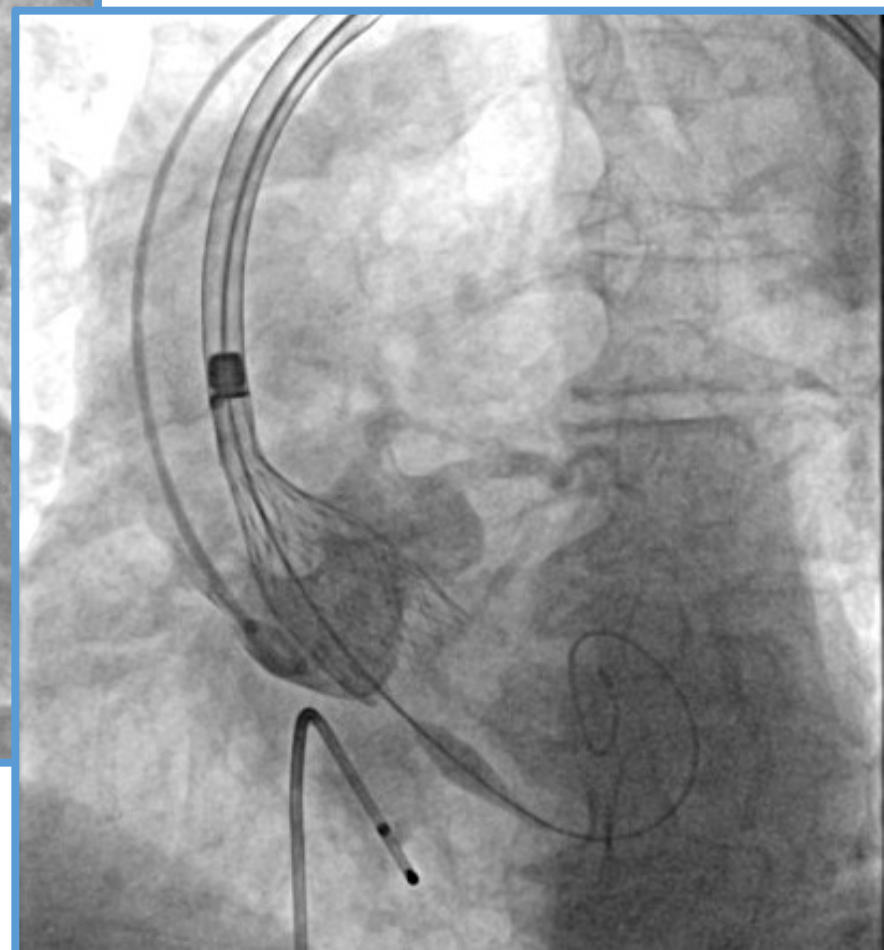


Peak-to-peak gradient:
60 mmHg

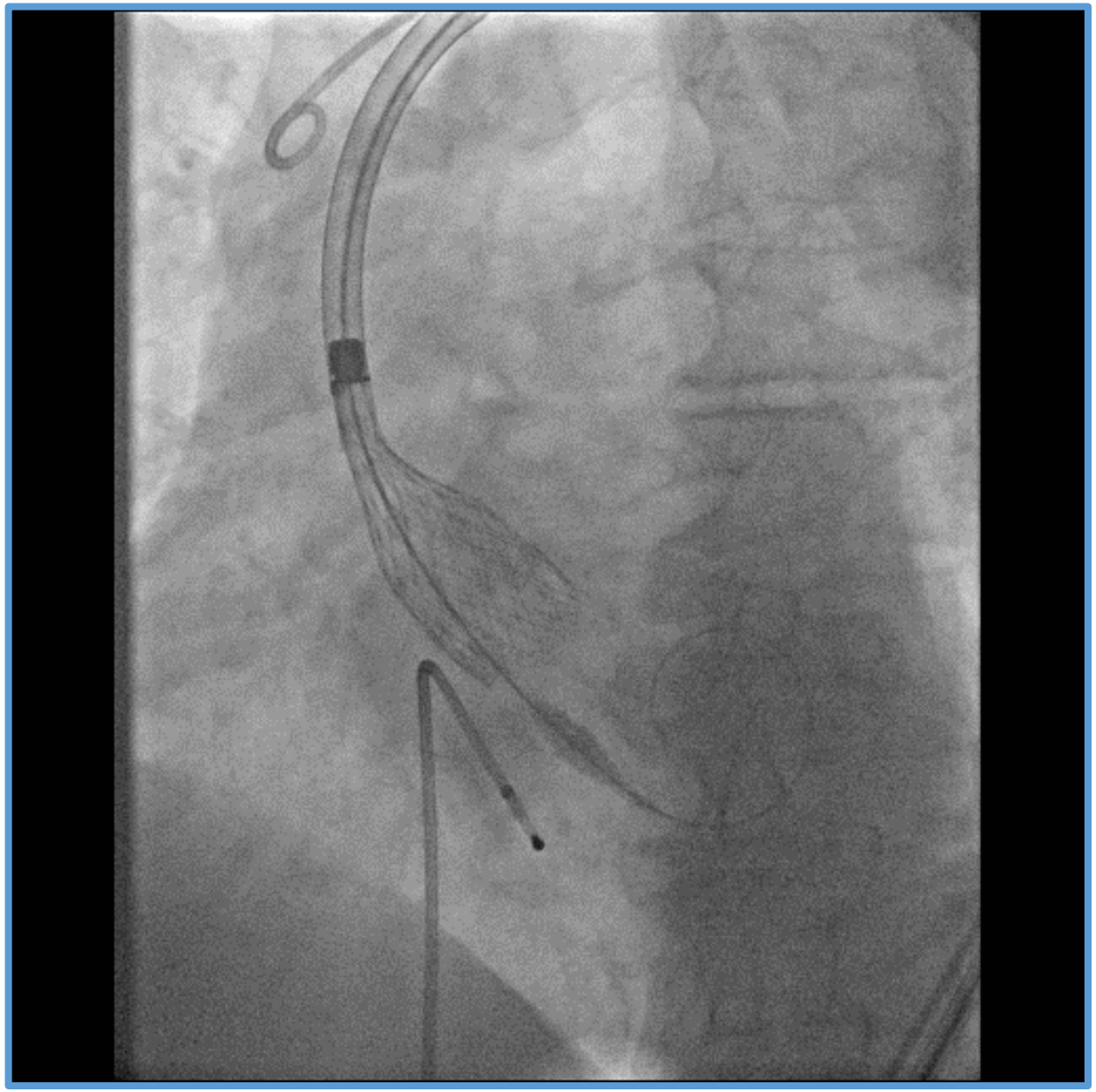
Evolut PRO 29 mm implantation



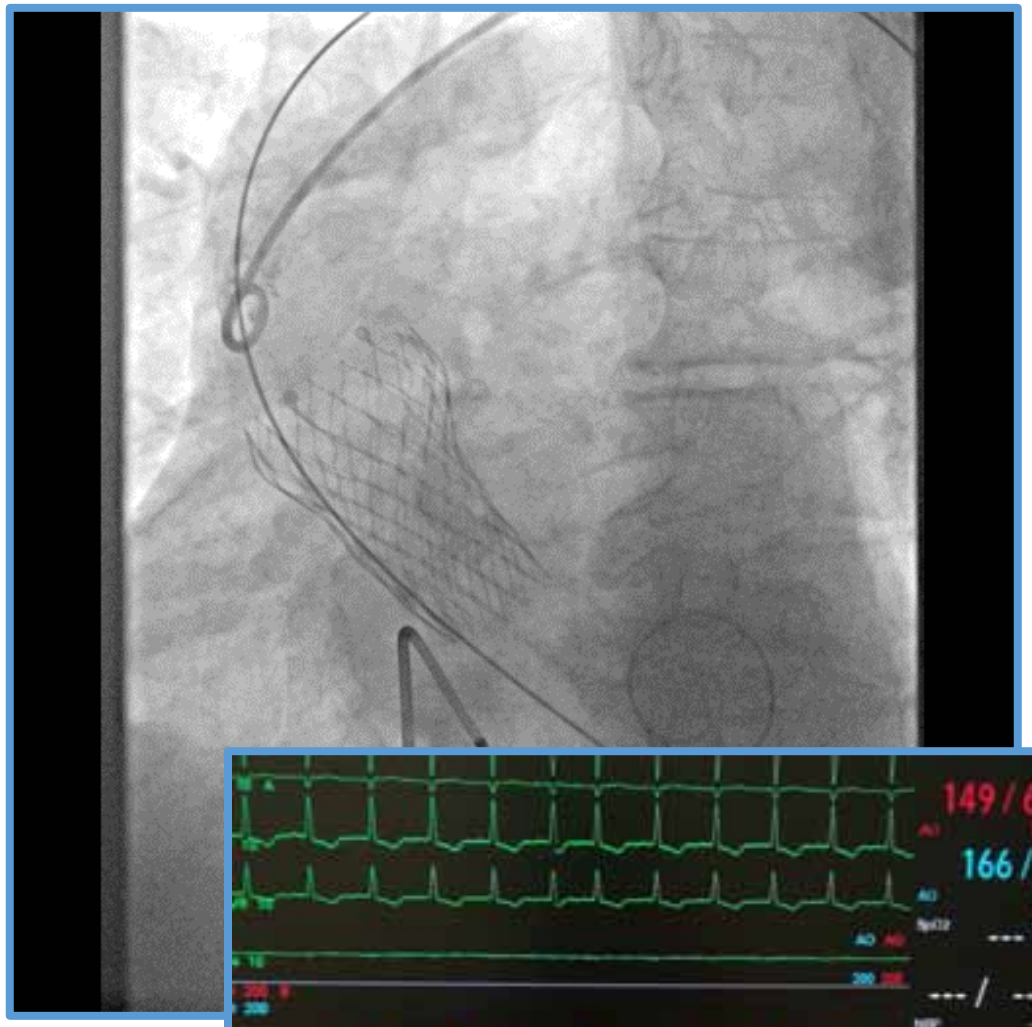


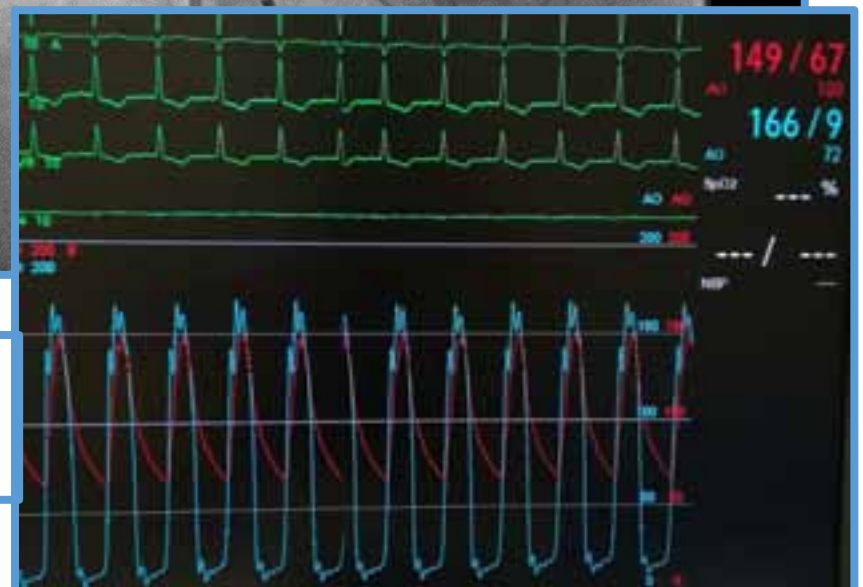


Evolut PRO 29 mm implantation



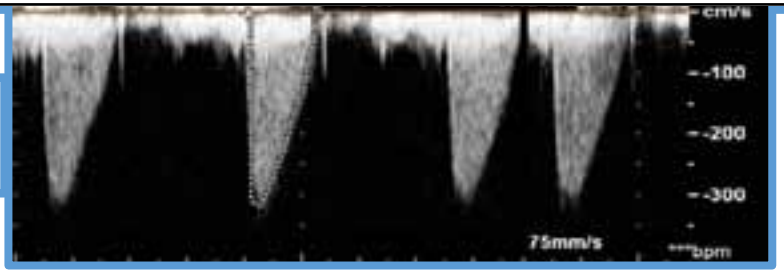
Pressure gradient after implantation



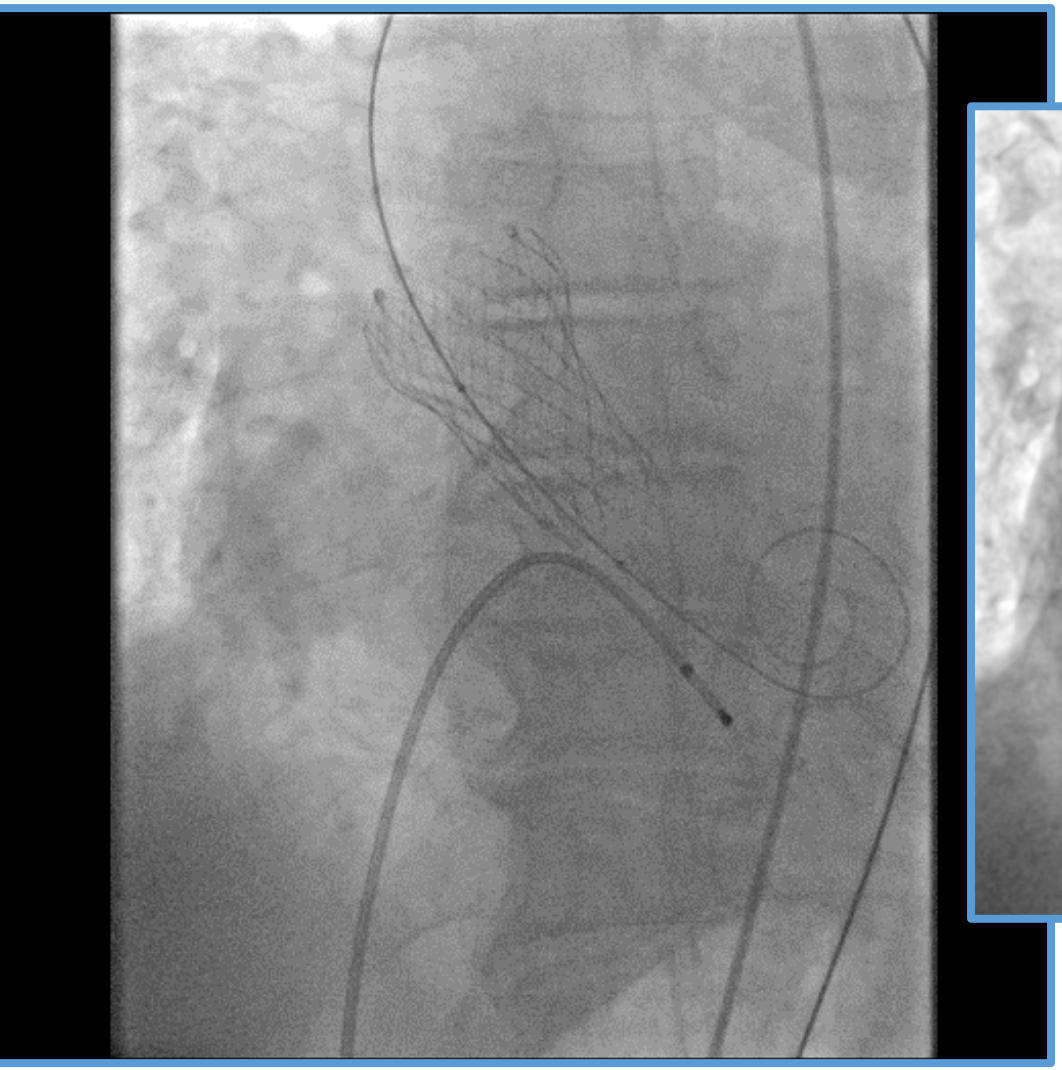


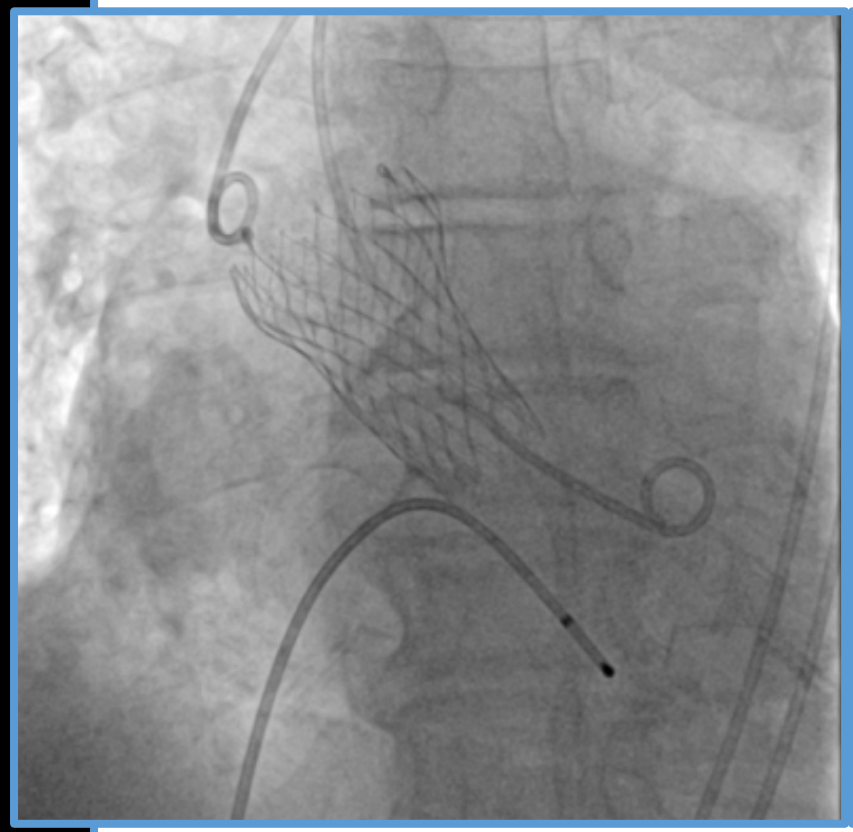
Peak-to-peak gradient:
17 mmHg

Mean gradient:
19 mmHg

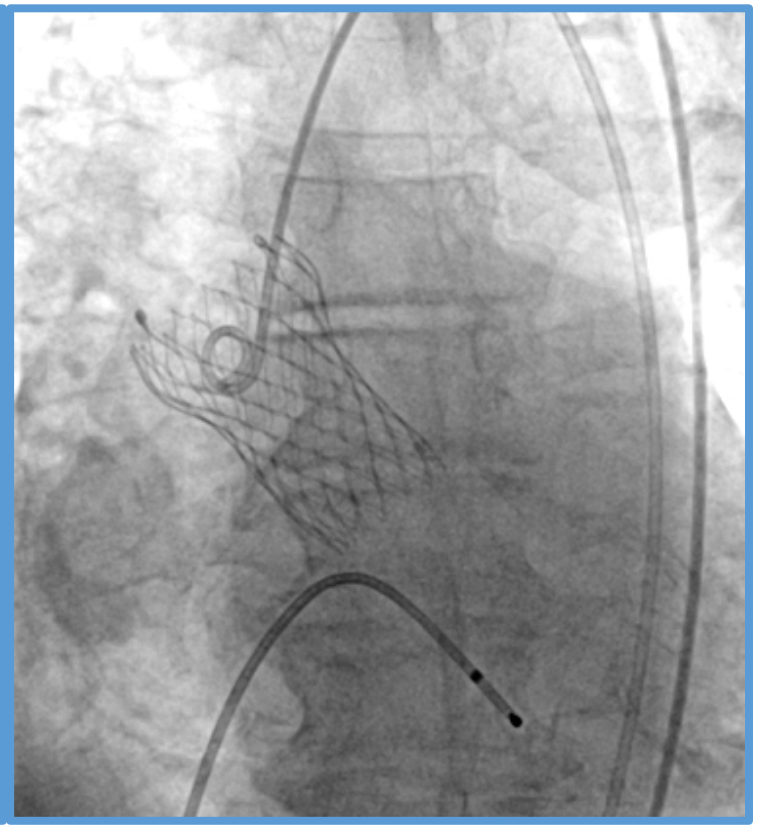


Evolut PRO 29 mm postdilation





Pre

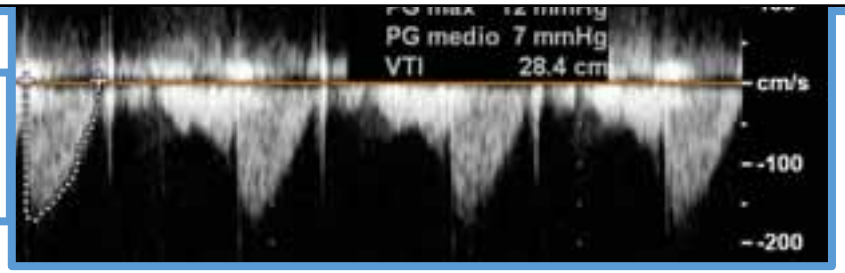


Post

Pressure-Gradient after postdilation

Peak-to-peak gradient:
5 mmHg

Mean gradient:
7 mmHg



First experience at Mauriziano Hospital: Pt #2

Sex: **Female** ***Age:*** **82**

Clinical symptoms

- **Cardiac decompensation and dyspnea (NYHA III)**

Medical History

- **Hypertension**
- **Previous smoke**
- **CAD familiar history**
- **Peripheral artery disease**
- **Ascending aortha aneurysm**
- **Chronic kidney disease (Grade III)**
- **Permanent atrial fibrillation (Warfarin)**
- **Active lifestyle and normal mental status**

Echo

- **Severe Aortic Stenosis (Pmax 80 mmHg, Pmed 50 mmHg, AVA 0.40 cm^2) and mild aortic regurgitation**
- **Moderate mitral stenosis and regurgitation, moderate tricuspid regurgitation**
- **Severe pulmonary hypertension (PAPs 55 mmHg)**

Lab

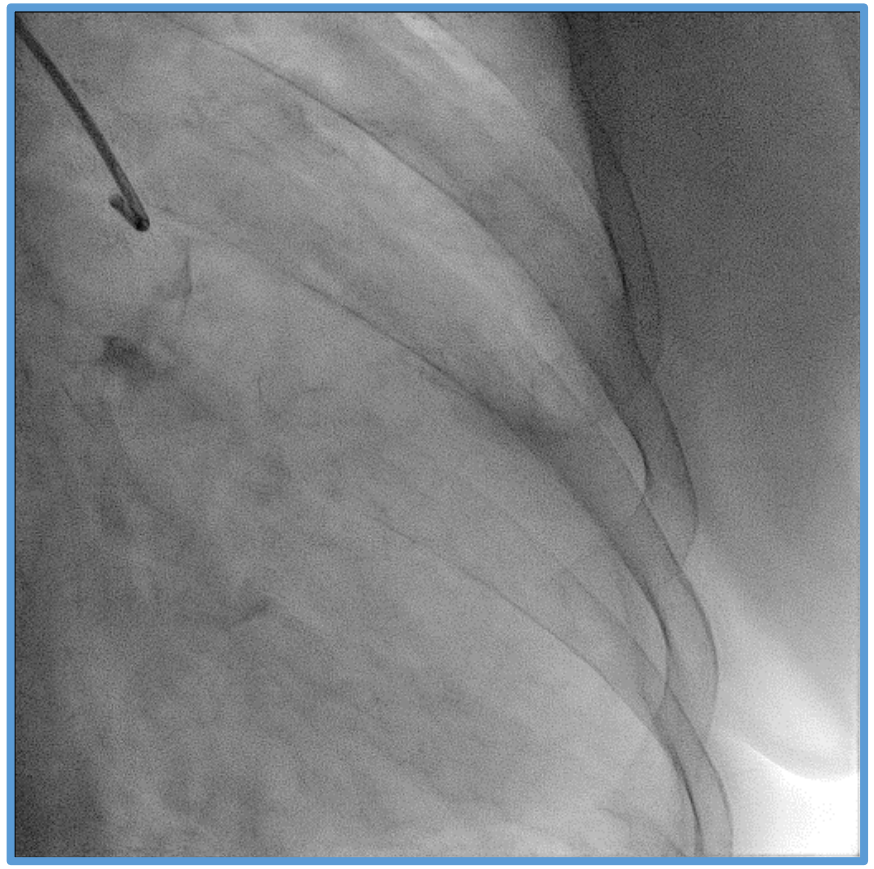
- **Creatinine 0.9 mg/dl (eGFR) 57 ml/min**
- **Hb 11**
- **PLTS 284**
- **ALB 34**

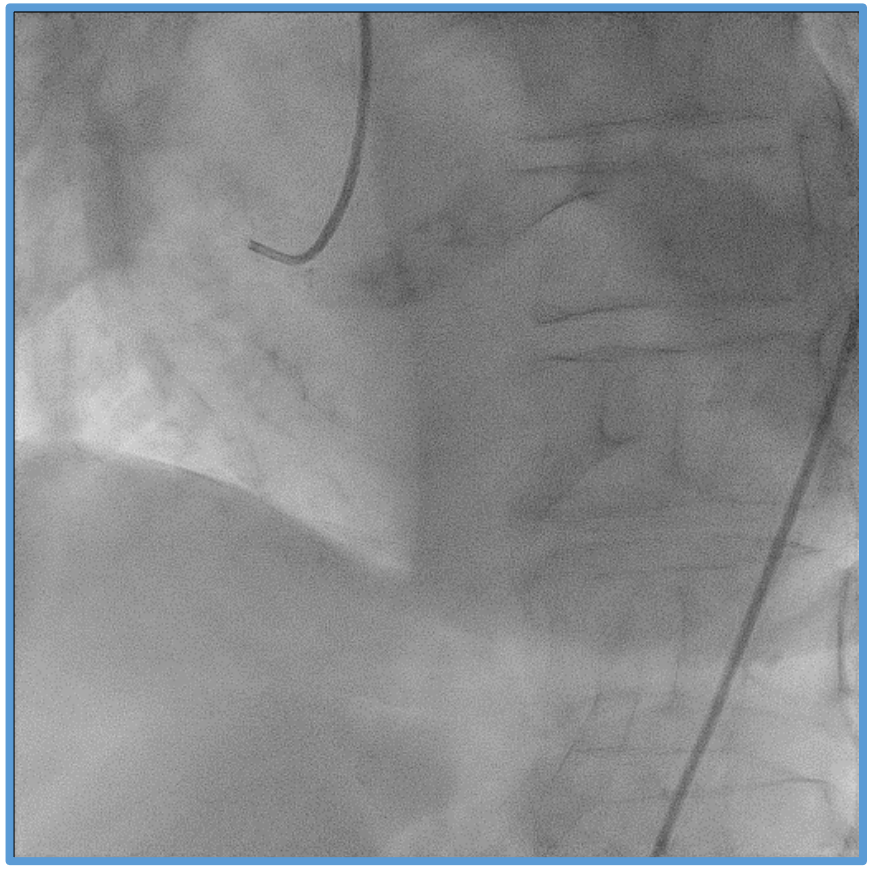
Heart Team

Risk scores:

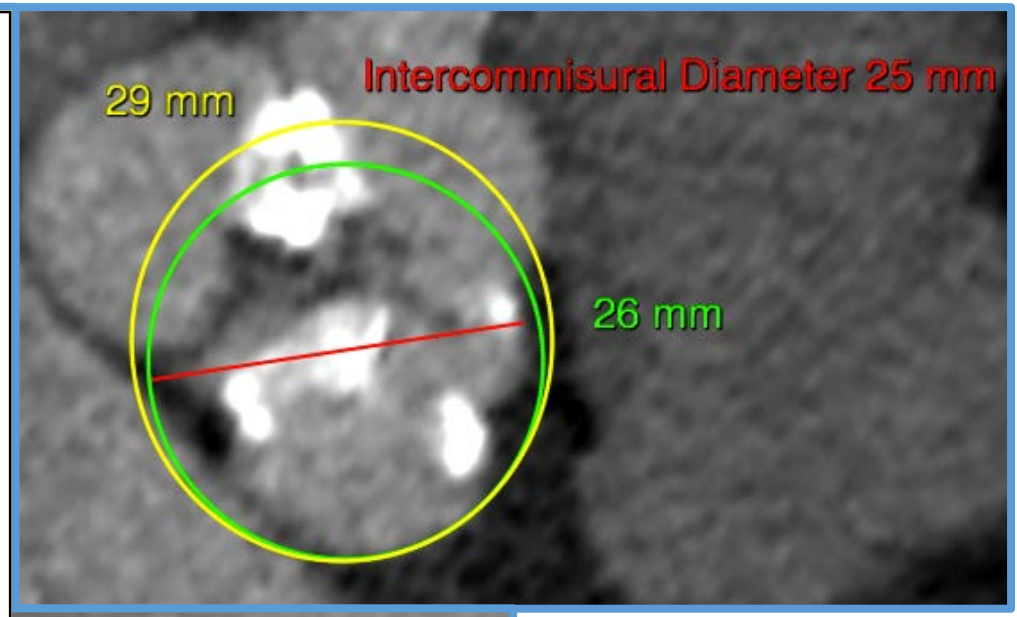
- **STS Score : Risk of Mortality 4.55%, Risk of Morbidity or Mortality 29.4%**
- **Logistic Euroscore: 16.43%**

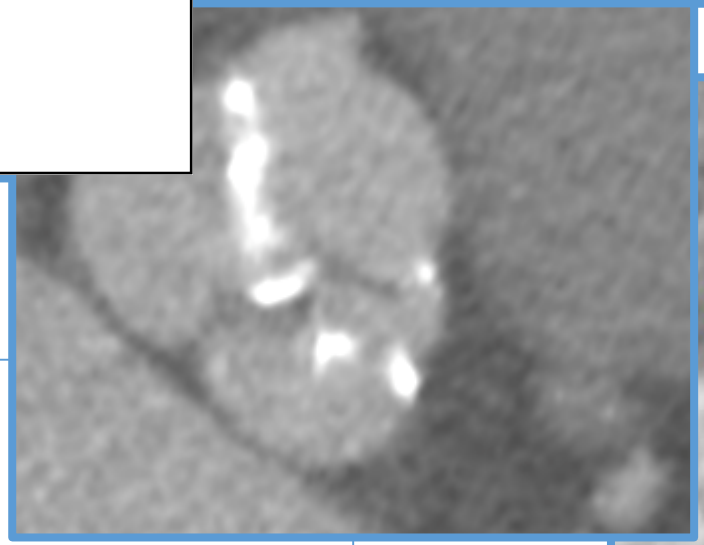
Coronary angio

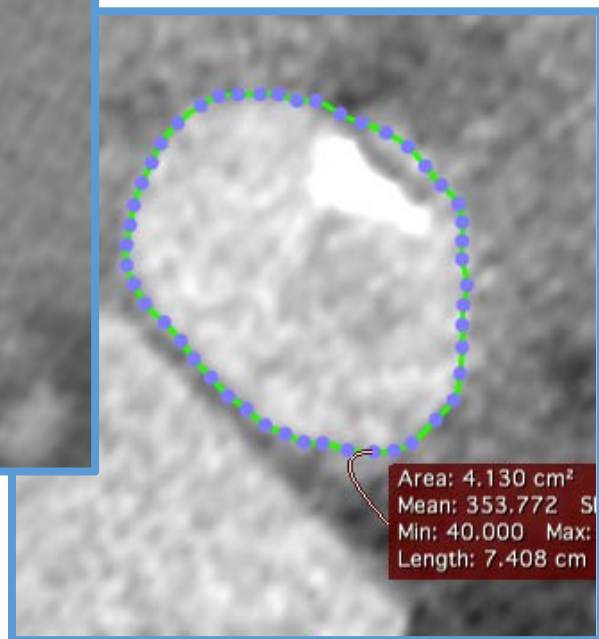




CT evaluation







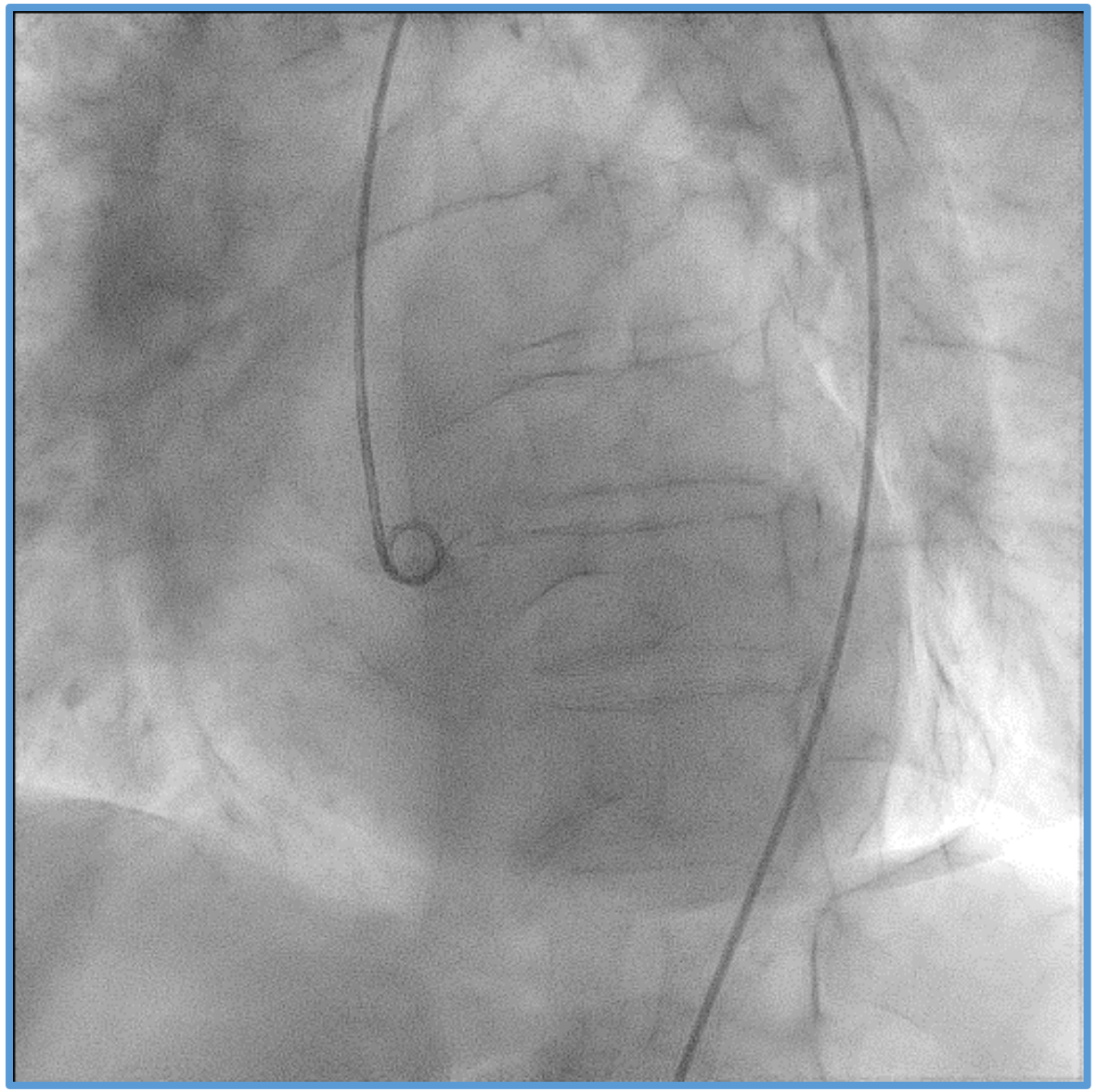
Aortic annulus:

- Perimeter 74 mm
- Area 0.41 cm^2

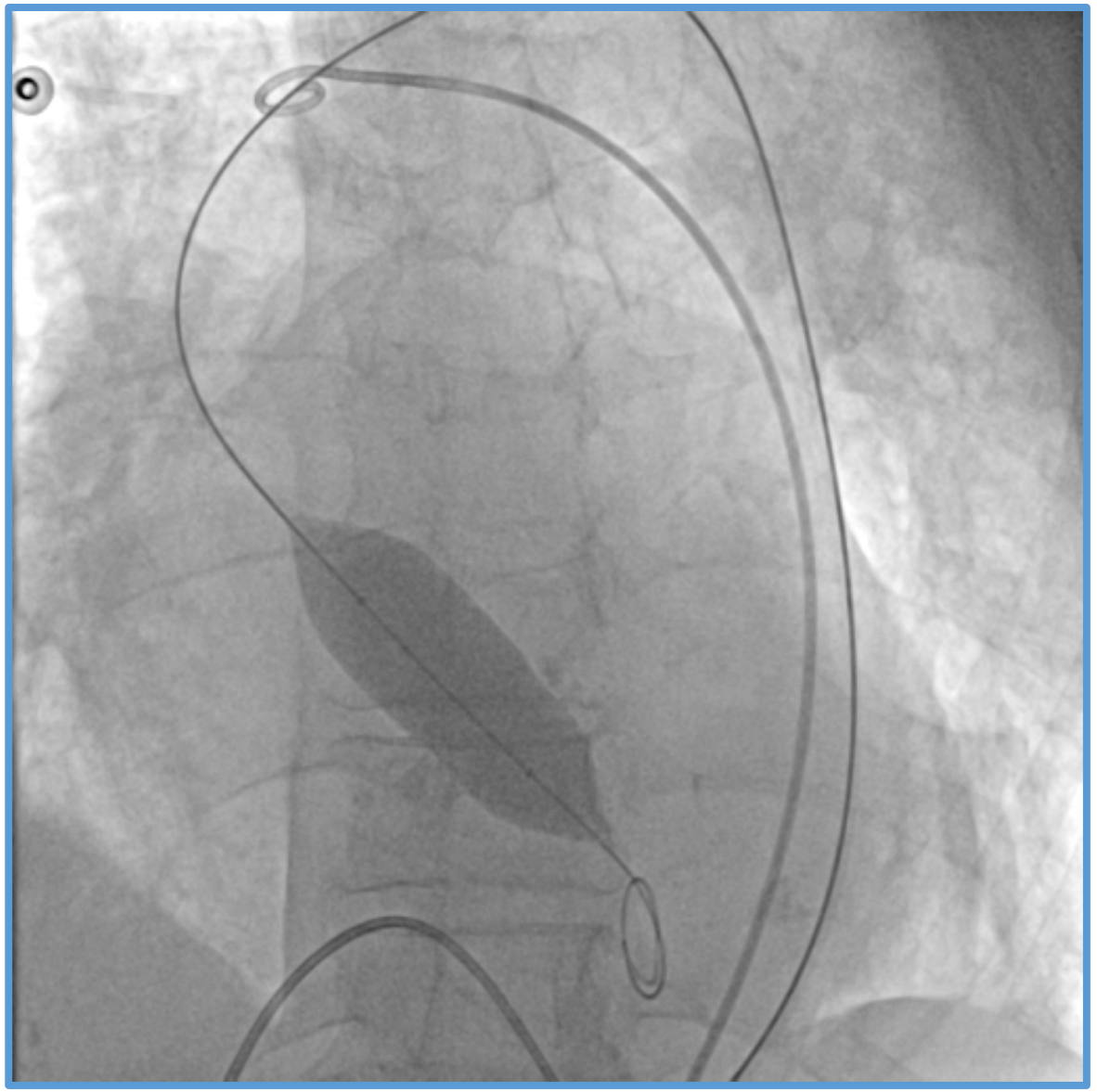
Sinotubular junction 38 mm

Diameters: 24 mm X 21 mm

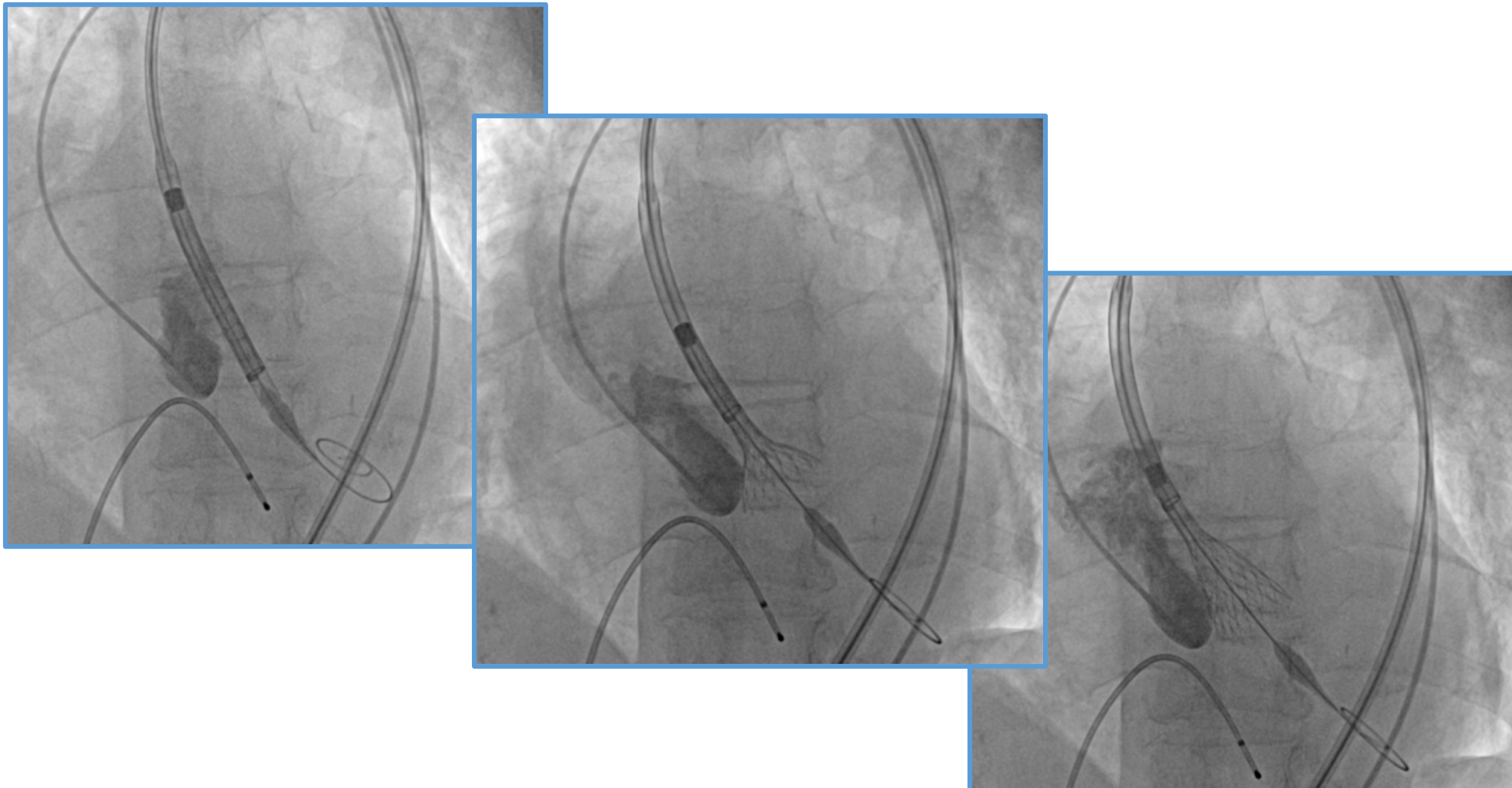
Aortography



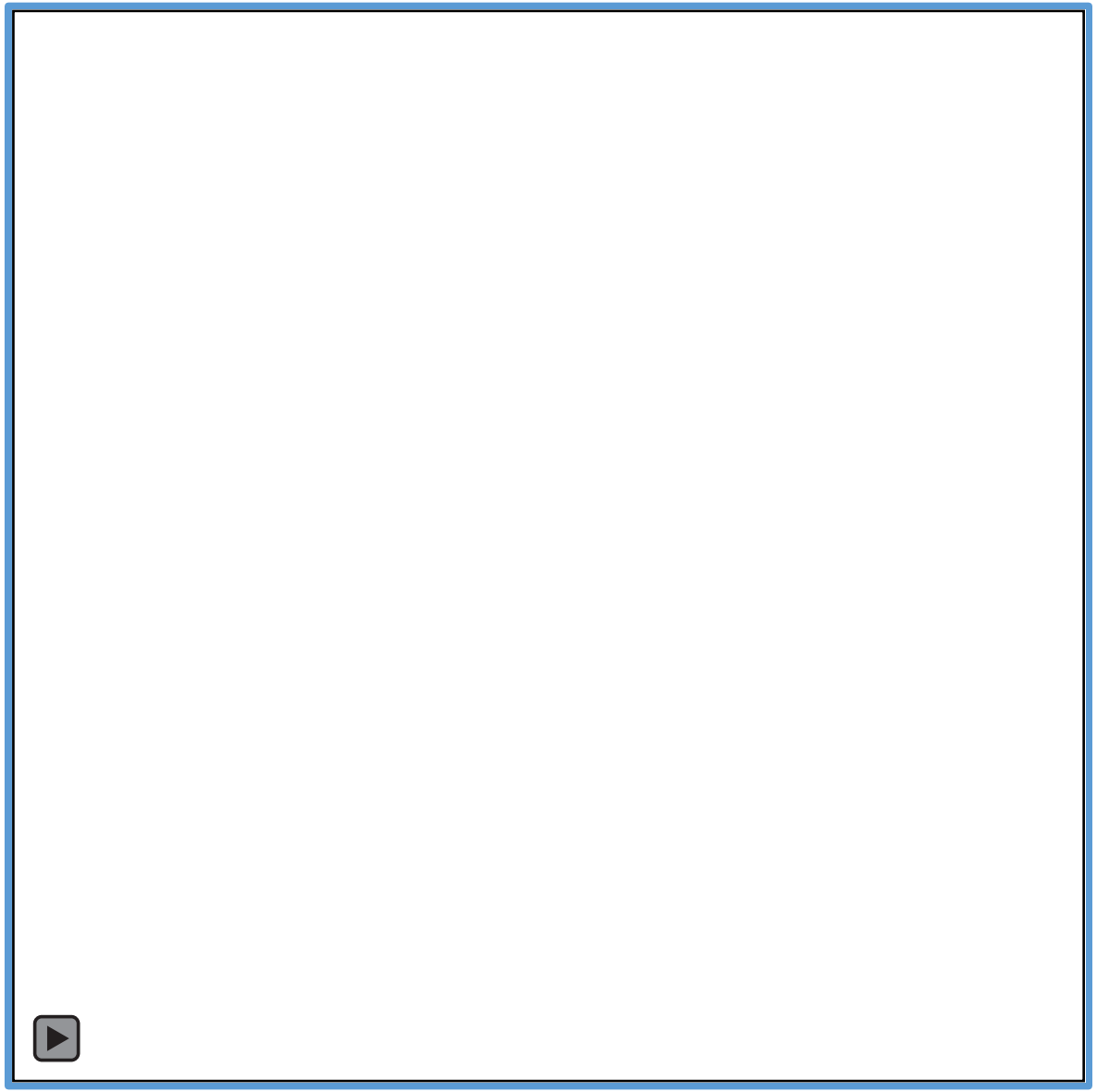
Predilatation with 23 mm balloon

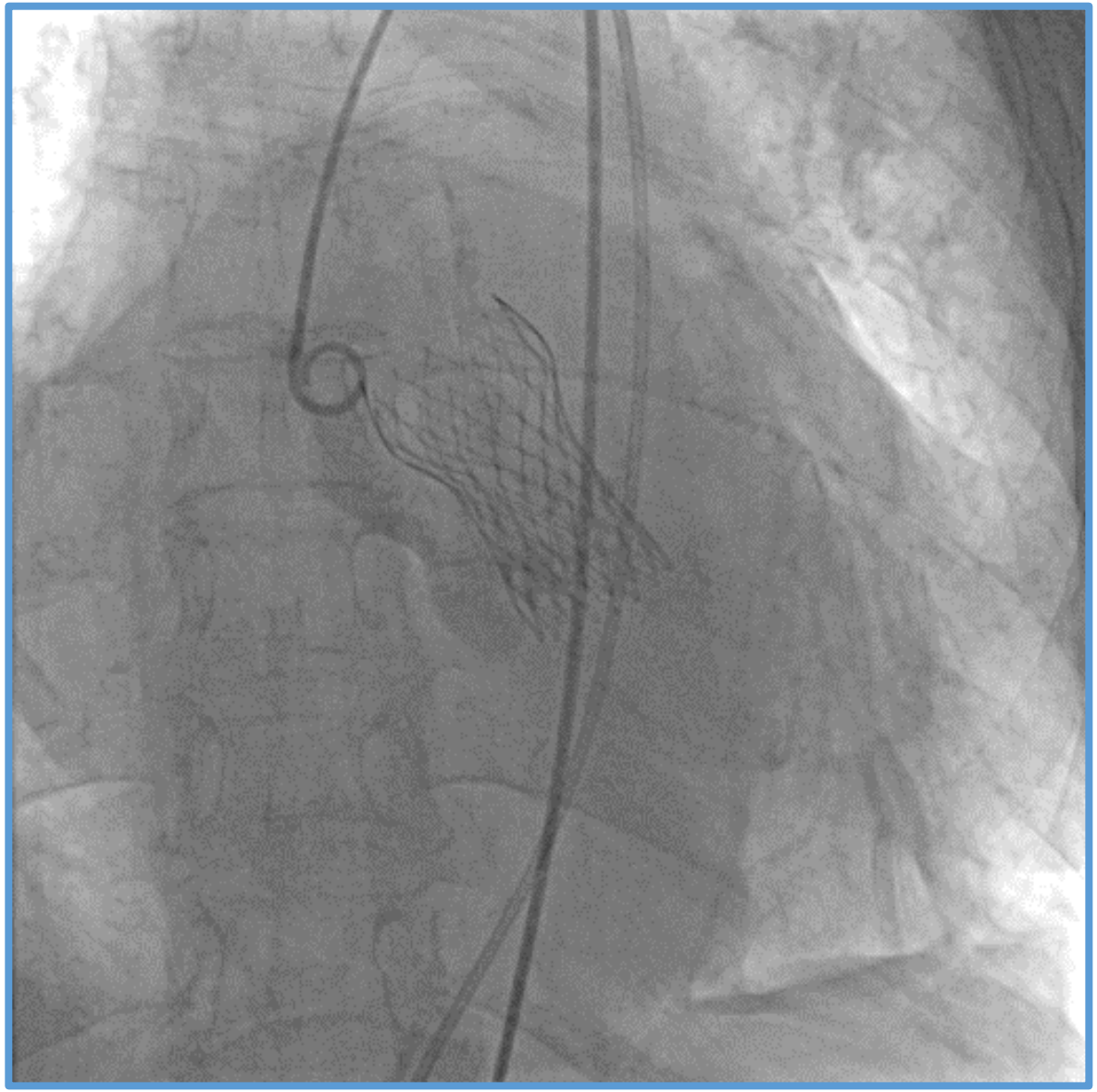


Evolut PRO 29 mm implantation



Evolut PRO 29 mm implantation





First experience at Mauriziano Hospital: Pt #3

Sex: **Female** ***Age:*** **89**

Clinical symptoms

- **Cardiac decompensation with acute renal failure, dyspnea (NYHA III)**

Medical History

- **Hypertension**
- **Peripheral artery disease**
- **Chronic kidney disease (Grade II)**
- **Active lifestyle and normal mental status**

Echo

- **Severe Aortic Stenosis (Pmax 68 mmHg, Pmed 40 mmHg, AVA 0.60 cm^2) and mild aortic regurgitation**
- **Mild mitral and tricuspid regurgitation**
- **No pulmonary hypertension (PAPs 25 mmHg)**

Lab

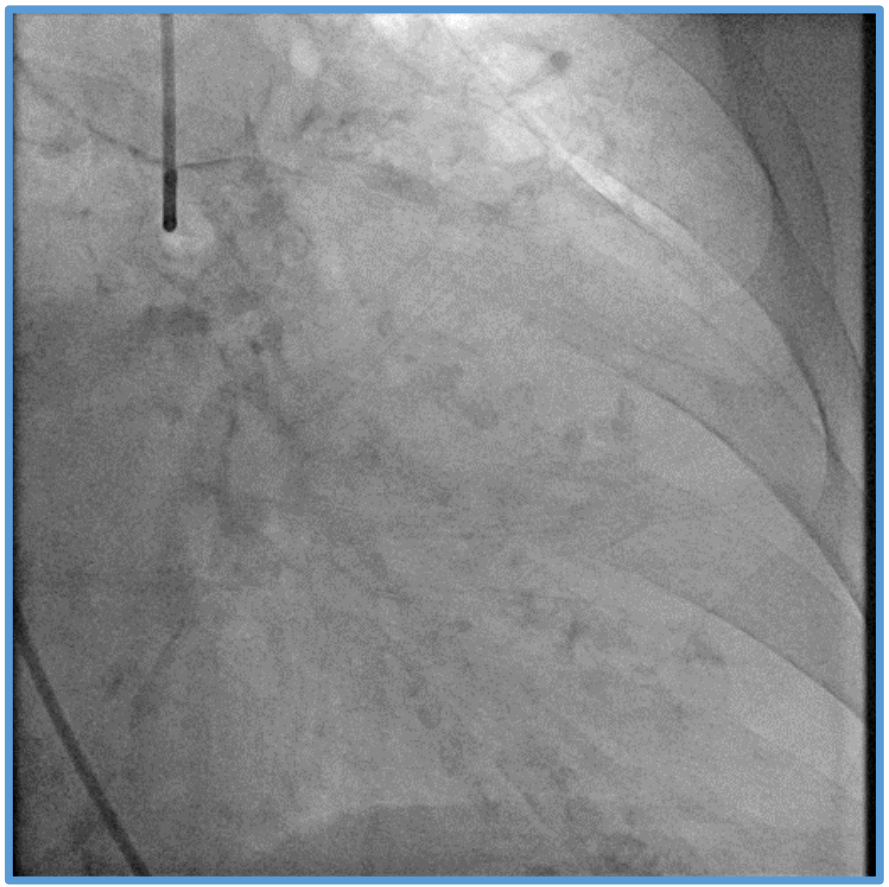
- **Creatinine 0.82 mg/dl (eGFR) 63 ml/min**
- **Hb 11.1**
- **PLTS 262**
- **ALB 36**

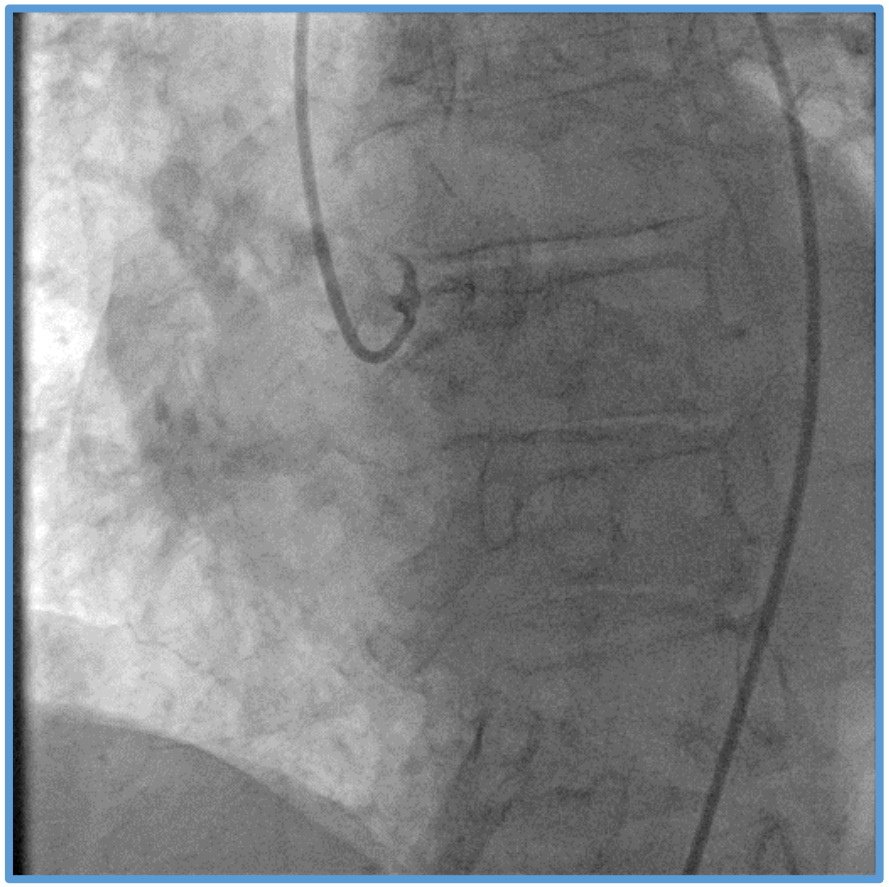
Heart Team

Risk scores:

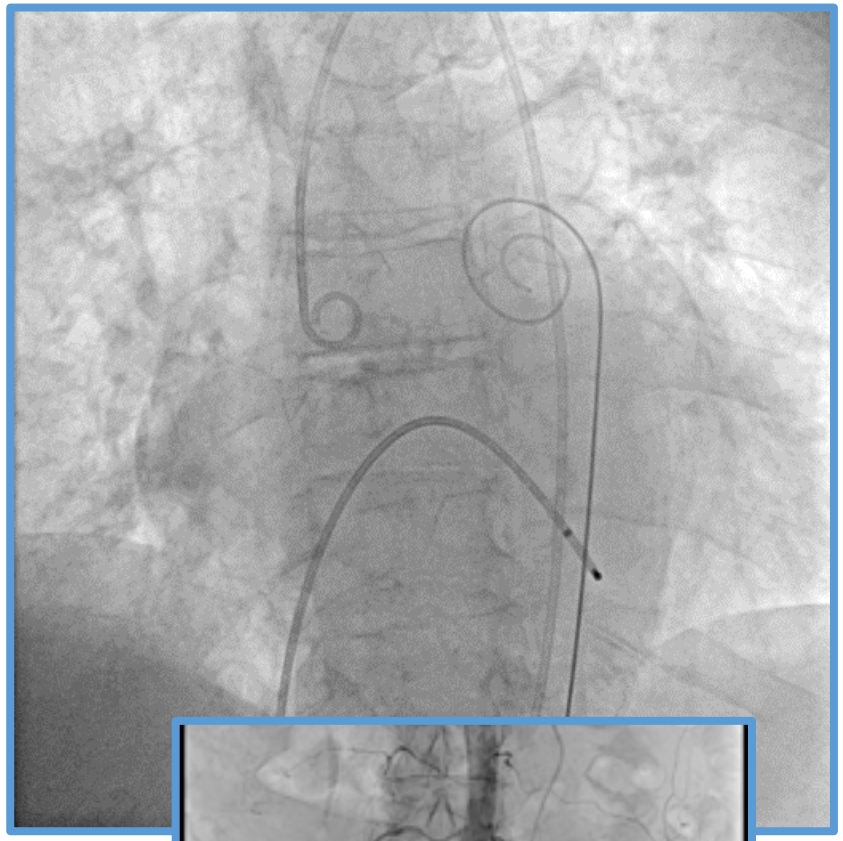
- **STS Score : Risk of Mortality 4.85%, Risk of Morbidity or Mortality 38.7%**
- **Logistic Euroscore: 31.51%**

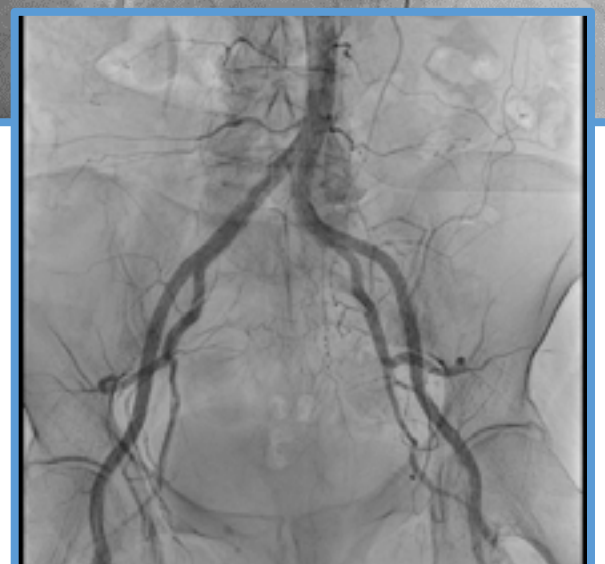
Coronary angio

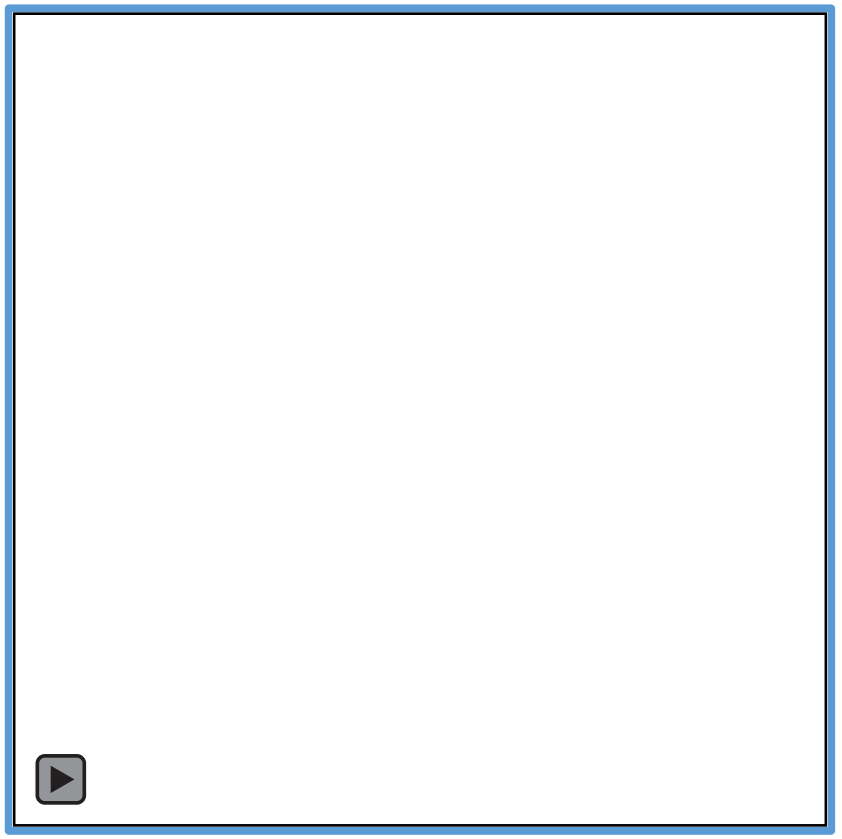


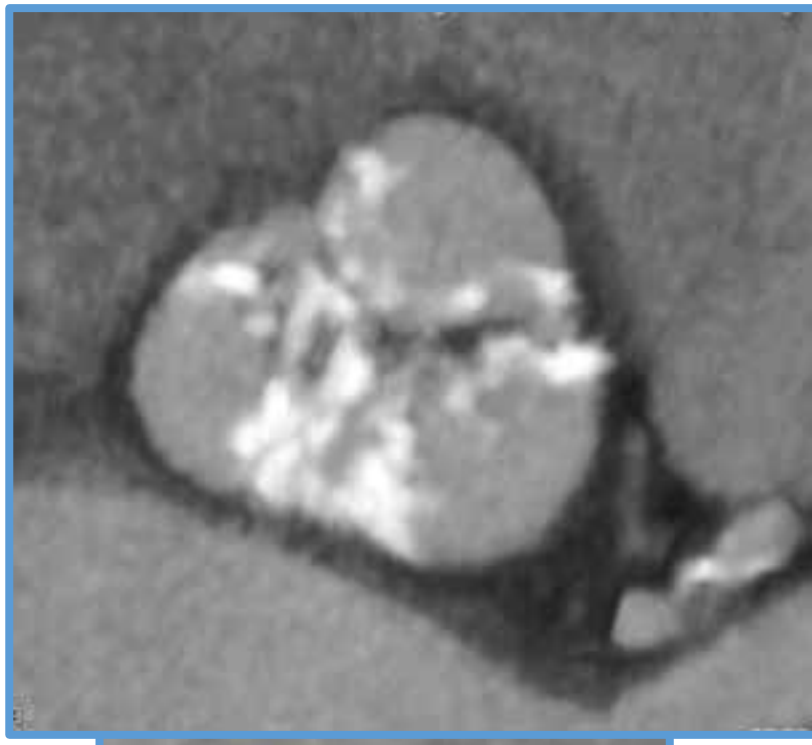


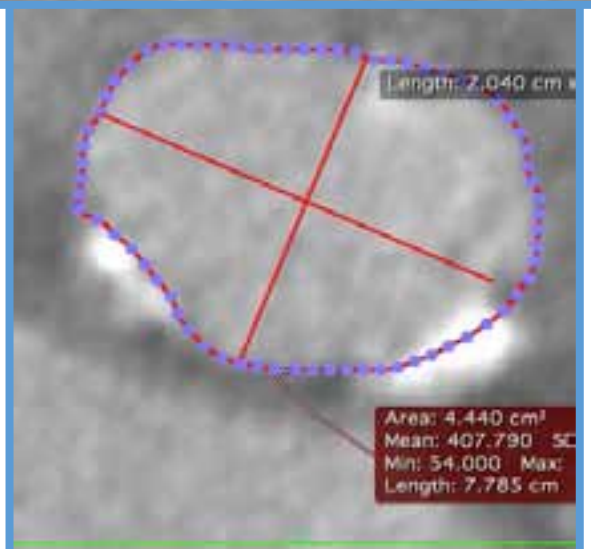
Angio and CT evaluation











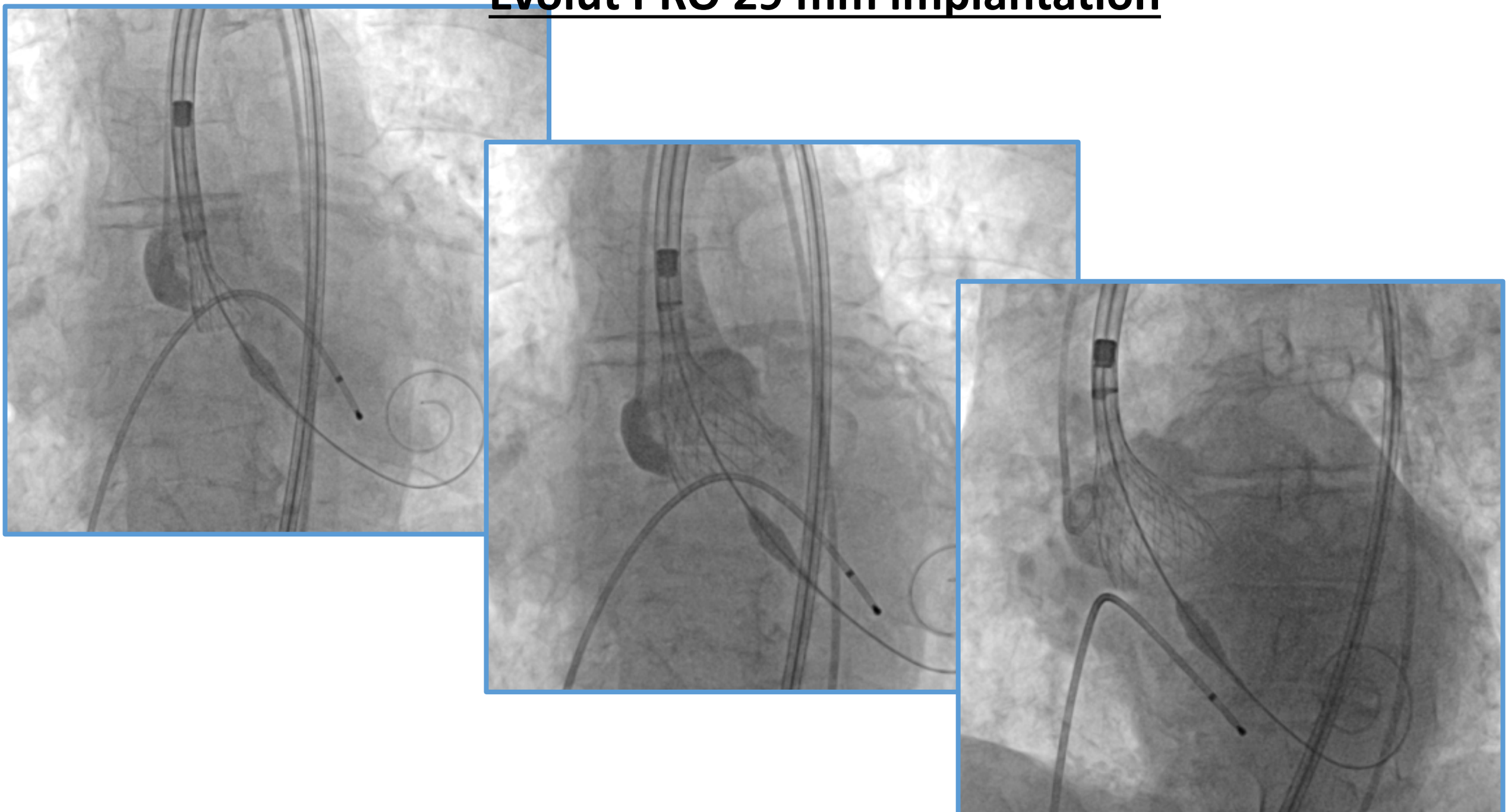
Aortic annulus:

- Perimeter 77 mm
- Area 0.44 cm^2

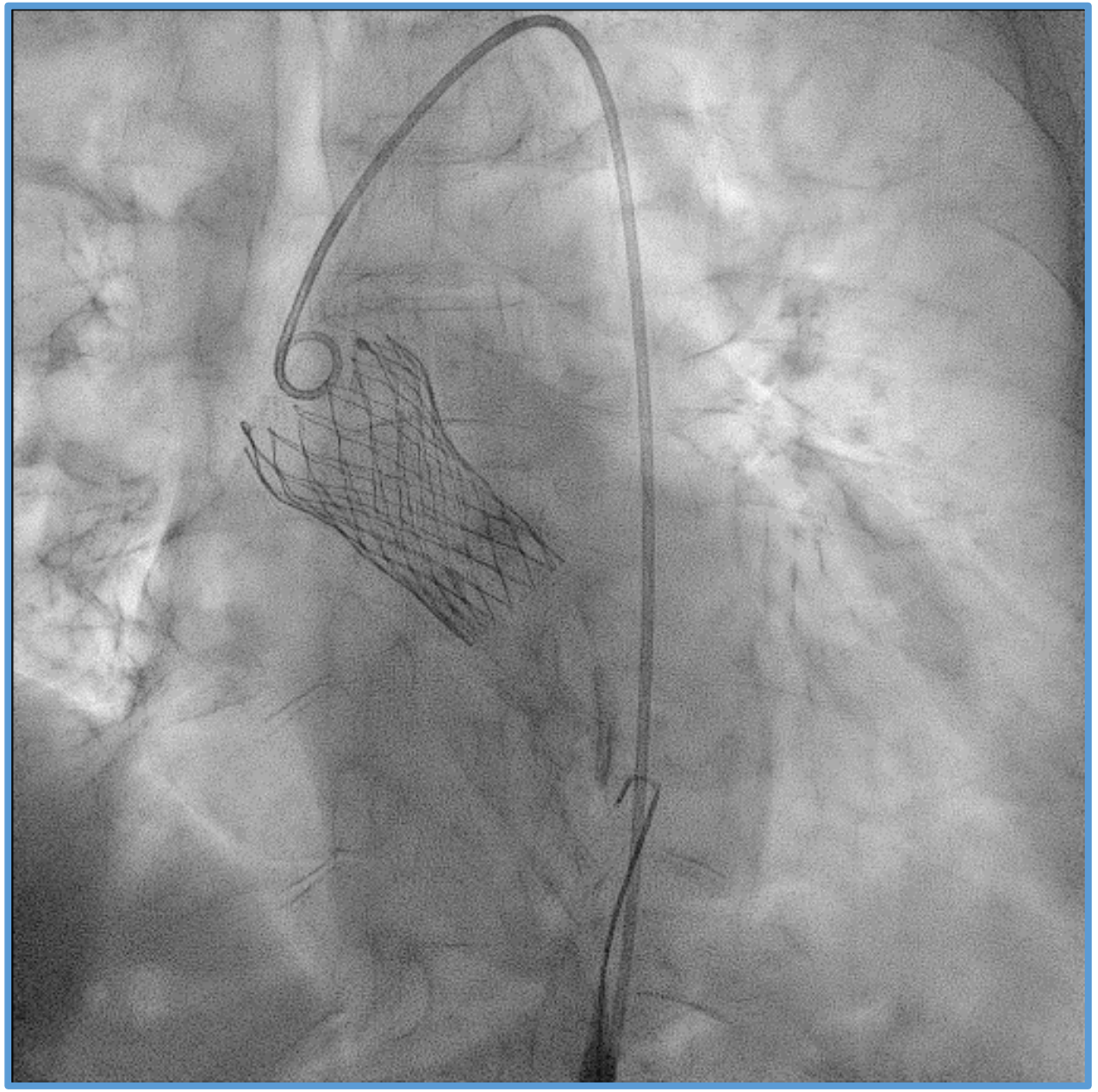
Sinotubular junction 36 mm

Diameters: 25 mm X 20 mm

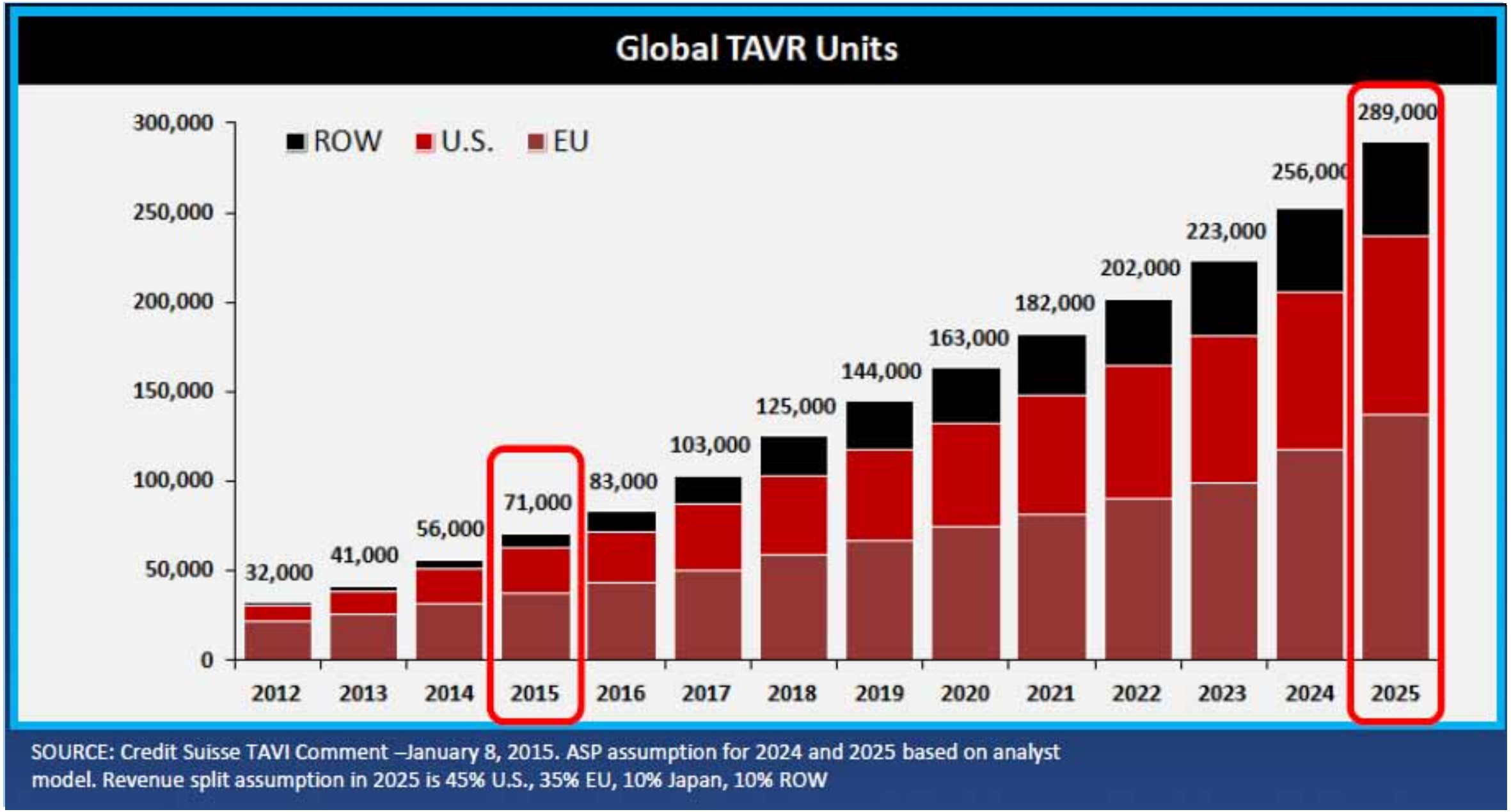
Evolut PRO 29 mm implantation



Evolut PRO 29 mm implantation



Estimated Global TAVI Procedure Growth



SOURCE: Credit Suisse TAVI Comment –January 8, 2015. ASP assumption for 2024 and 2025 based on analyst model. Revenue split assumption in 2025 is 45% U.S., 35% EU, 10% Japan, 10% ROW