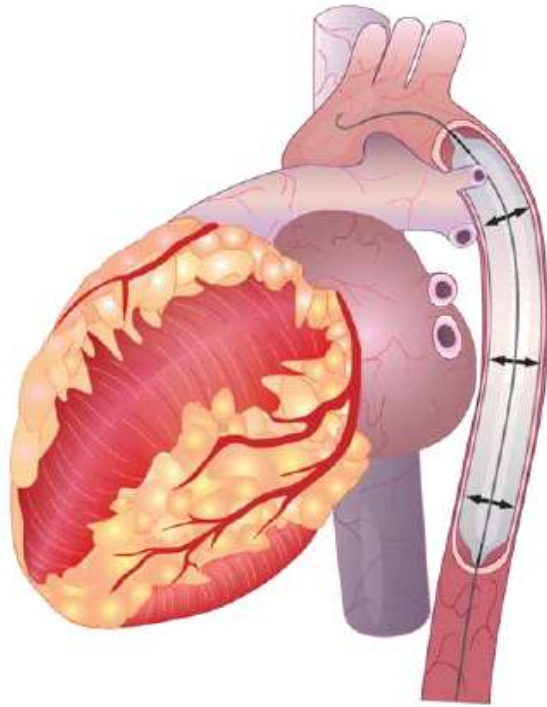


When is Hemodynamic Support needed during Left Main PCI?

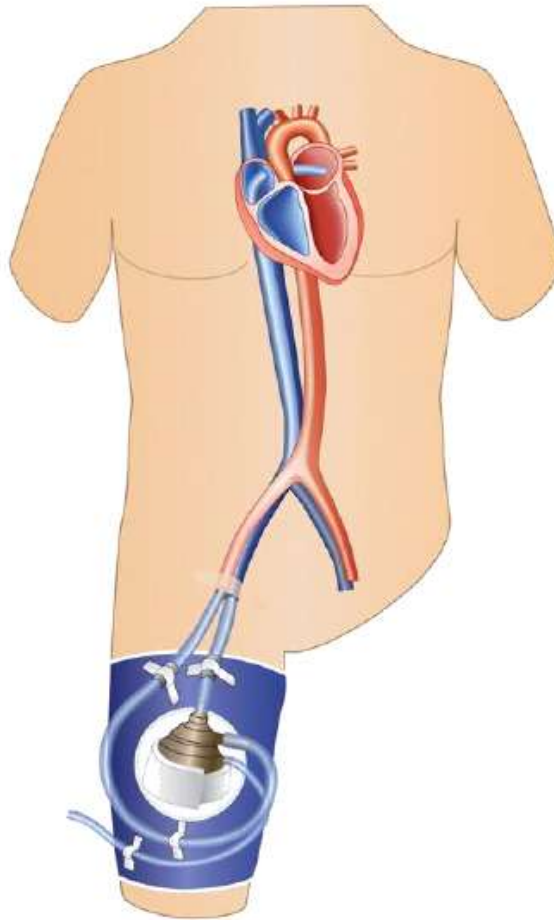
Raj R. Makkar, MD

**Director, Interventional Cardiology and Cath Lab
Associate Director, Cedars-Sinai Heart Institute**

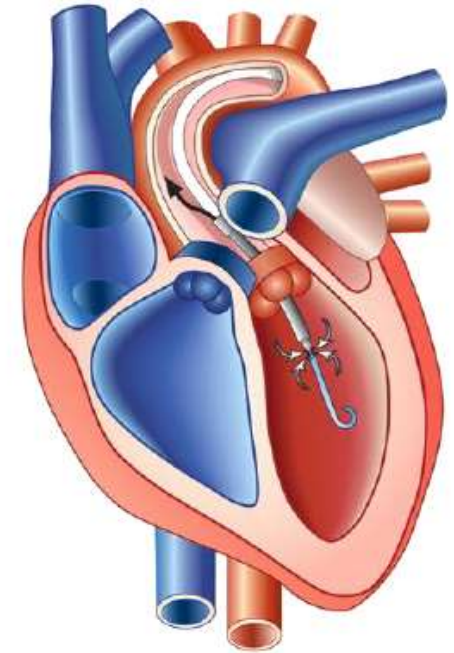
Most commonly used hemodynamic support devices in the cath lab



IABP



TandemHeart



Impella

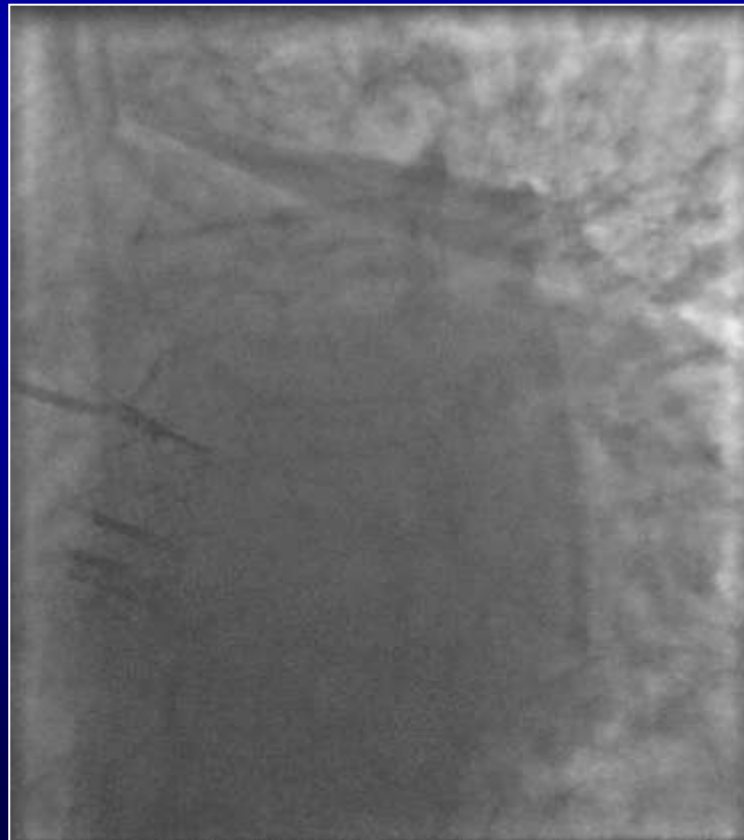
LM subsets requiring hemodynamic support

- Severely depressed LV systolic dysfunction
- Occluded/Non-dominant RCA
- Severe aortic stenosis
- Cardiogenic shock
- Ventricular arrhythmias
- Complex/calcified coronary anatomy, requiring atherectomy, multiple balloon dilatations and aggressive lesion prep

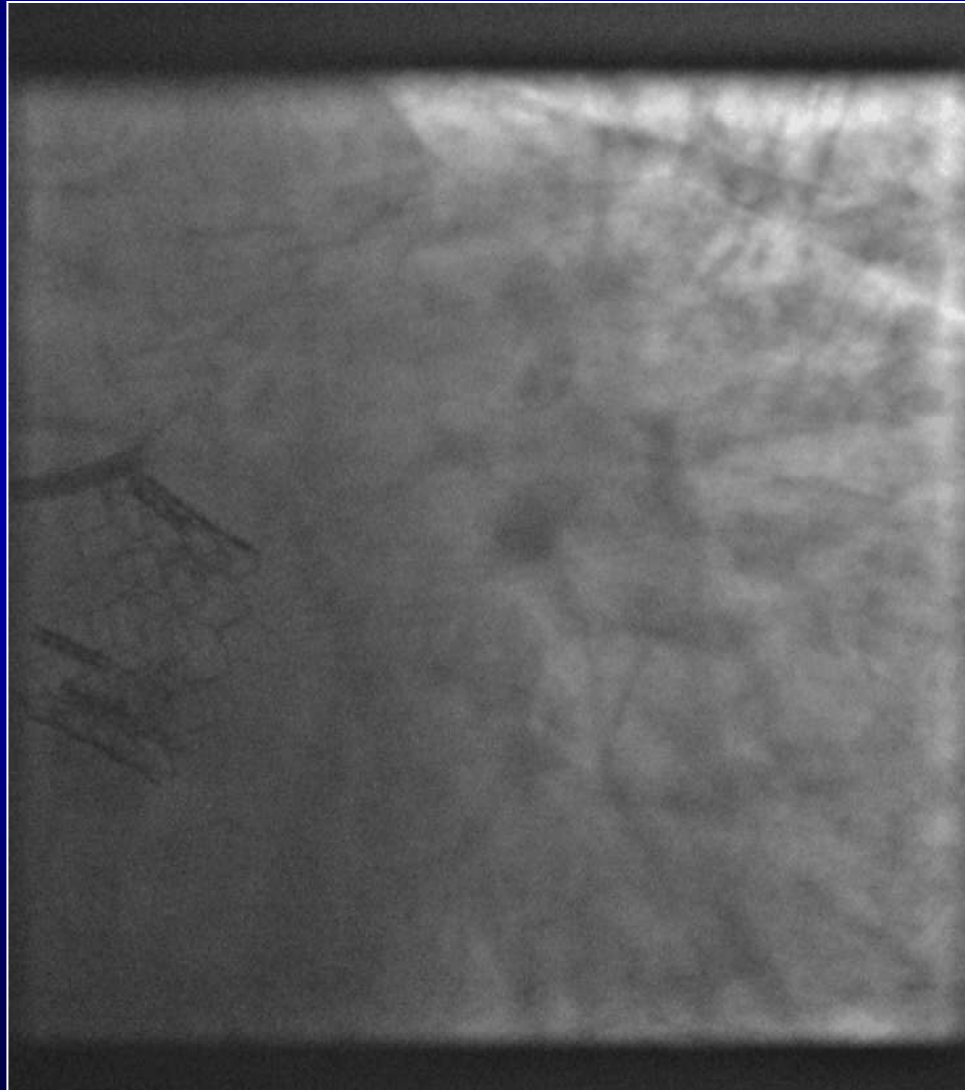
**84 y/o female with h/o severe AS s/p TAVR with
23mm Edwards-SAPIEN 2 years ago
p/w SOB on exertion. LVEF Normal**

Baseline coronary angiogram via trans-radial approach

Although FFR LM \rightarrow LAD 0.81, but IVUS MLA of LM 4.6
mm²

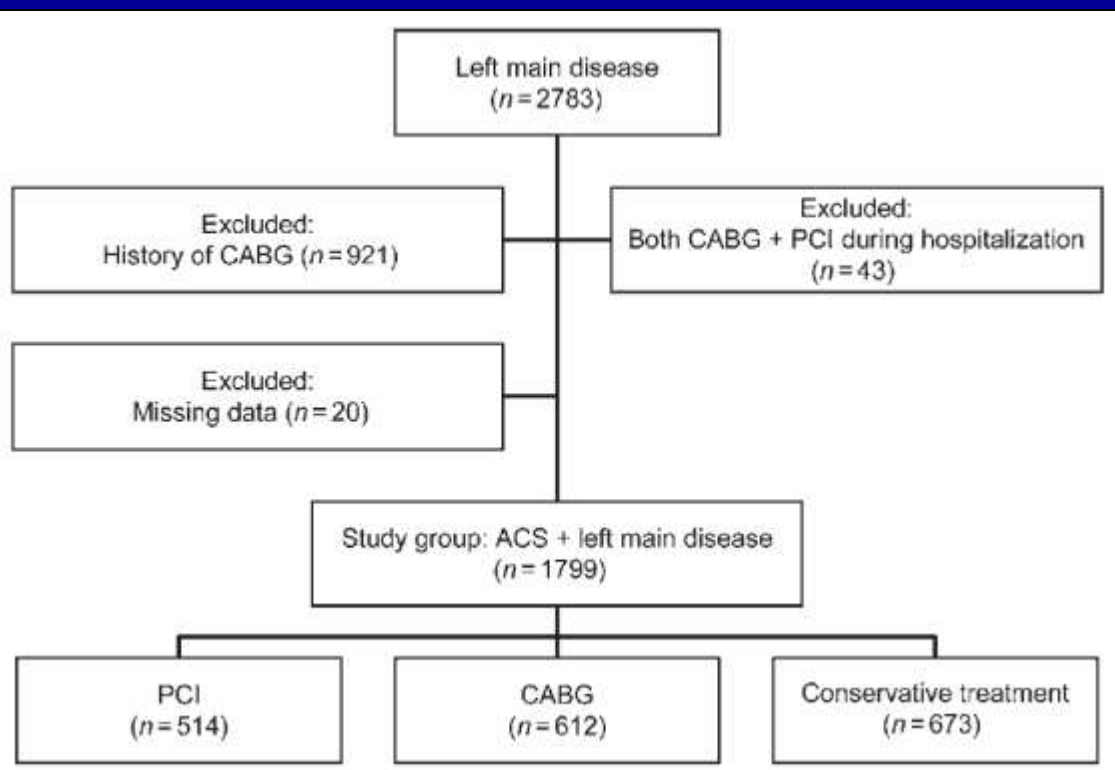


DES 3.5 x 18 mm to LM to LAD by
Trans-radial approach, No hemodynamic support



Unprotected left main revascularization in patients with acute coronary syndromes

1799 patients with unprotected left main coronary artery stenosis presenting with ACS in the GRACE Registry



**Balloon pump used
in 20% of patients
with undergoing
PCI of ULMCA for
ACS**

Use and Effectiveness of IABP during high-risk PCI: NCDR Registry

Background—Intra-aortic balloon pumps (IABP) frequently are used to provide hemodynamic support during high risk percutaneous coronary intervention (PCI), but clinical evidence to support their use is mixed. We examined hospital variation in IABP use among high risk PCI patients, and determined the association of IABP use on mortality in this population.

Methods and Results—We analyzed data submitted to the CathPCI Registry between January 2005 and December 2007.

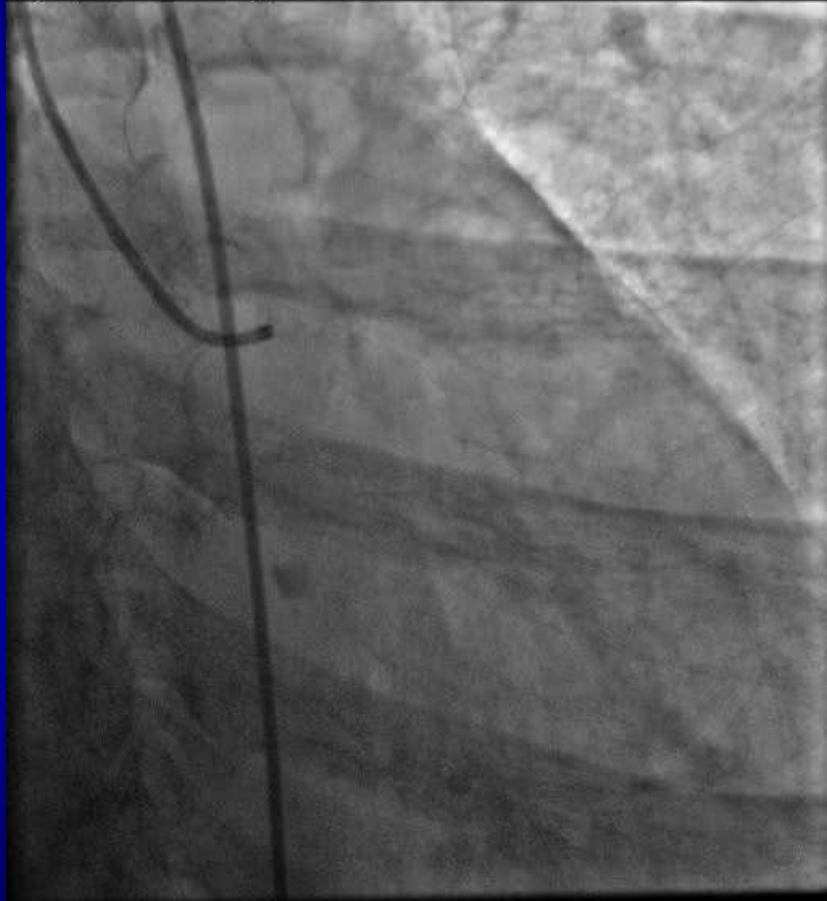
IABP used in 28.1% of ULMCA PCI in the United States

Hospitals were categorized into quartiles by their proportional use of IABP. We examined differences in in-hospital mortality across hospital quartiles using a hierarchical logistic regression model to adjust for differences in patient and hospital characteristics across hospital quartiles of IABP use. IABPs were used in 18 990 (10.5%) of 181 599 high risk PCIs. Proportional use of IABP varied significantly across hospital quartiles: Q1, 0.0 to 6.5%; Q2, 6.6 to 9.2%; Q3, 9.3 to 14.1%; Q4, 14.2 to 40.0%. In multivariable analysis, after adjustment for differences in patient and hospital characteristics, in-hospital mortality was comparable across quartiles of hospital IABP usage (Q1, Ref; Q2, odds ratio 1.11, 95% CI 0.99–1.24; Q3, OR 1.03, 95% CI 0.92–1.15; Q4, OR 1.06, 95% CI 0.94–1.18).

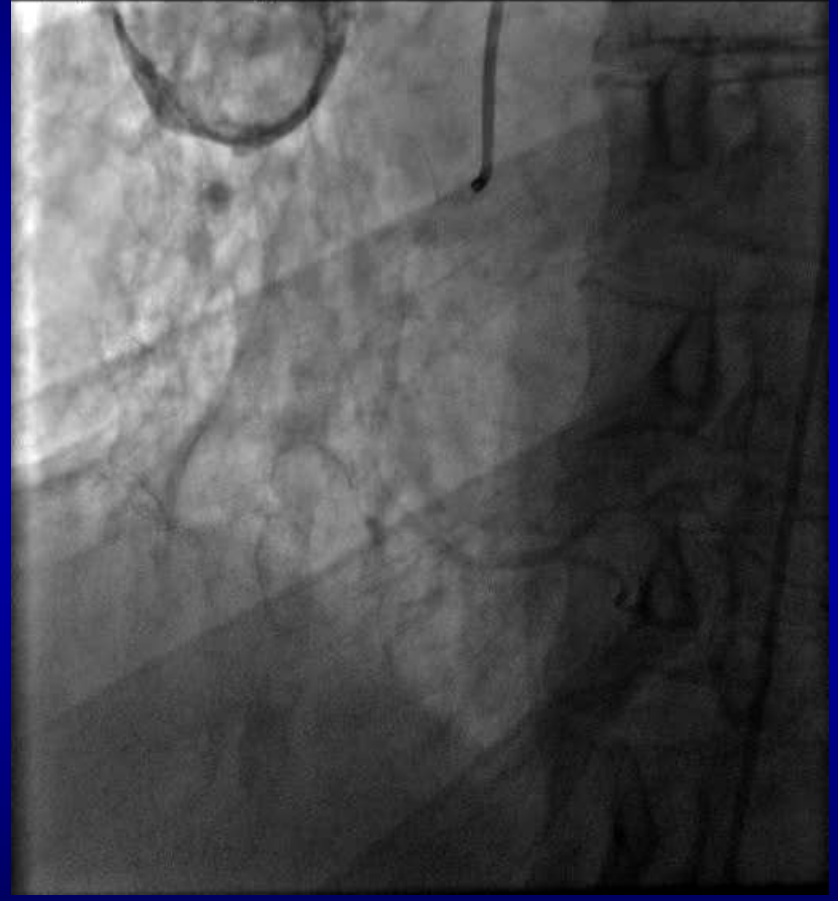
Conclusions—IABP use varied significantly across hospitals for high risk PCI. However, this variation in IABP use was not associated with differences in in-hospital mortality. (*Circ Cardiovasc Qual Outcomes*. 2012;5:21-30.)

47 y old executive with history of hodgkin's disease and radiation to chest. Presents with exertional angina. Vital capacity 40% of normal, MRI possible constriction. CT Surgical consultation is obtained.

Lousy compression - not intended for diagnosis



Lousy compression - not intended for diagnosis



Post Procedure, Procedure time 1 hour, Discharged <24 hrs

Lousy compression - not intended for diagnosis



Lousy compression - not intended for diagnosis



BCIS-1 Study: Randomized trial of elective IABP versus no IABP in high-risk PCI

IABP (n=150, 27% LM); no IABP (n=151, 29% LM)

Primary end-point: MACCE at 28 days (Death/MI/Stroke/Revascularization)

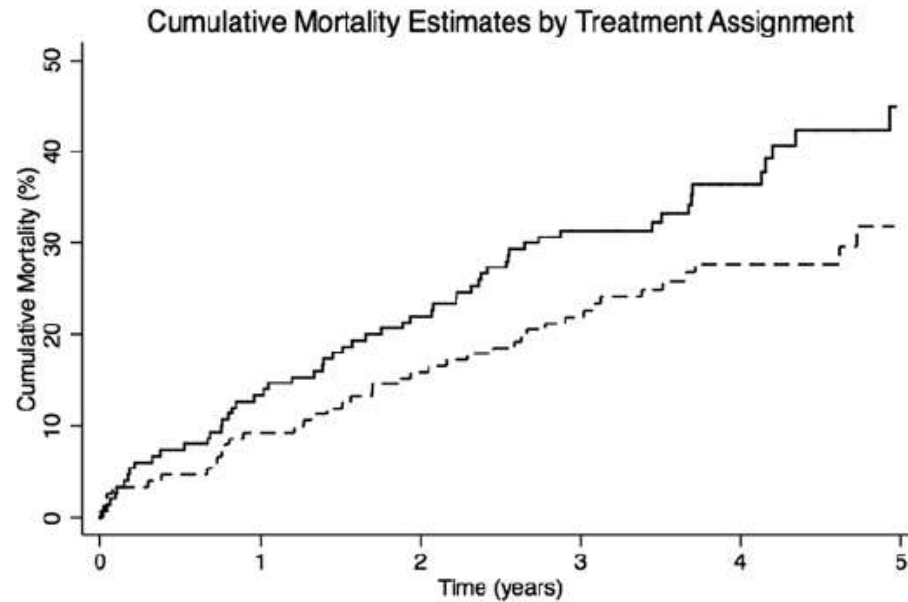
No difference in primary end point at 28 days
Trend towards improved mortality at 6 months

Variable	No. (%)		OR (95% CI) ^a	P Value
	Elective IABP (n = 151)	No Planned IABP (n = 150)		
Primary end point MACCE ^b	23 (15.2)	24 (16.0)	0.94 (0.51-1.76)	.85
MI	19 (12.6)	20 (13.3)	0.93 (0.48-1.83)	.85
Death	3 (2.0)	1 (0.7)	3.02 (0.31-29.37)	.34
CVA	2 (1.3)	0		
Further revascularization	1 (0.7)	4 (2.7)	0.24 (0.03-2.20)	.21
Secondary end points 6-mo mortality	7 (4.6)	11 (7.4) ^c	0.61 (0.24-1.62)	.32

BCIS-1 Study: Randomized trial of elective IABP versus no IABP in high-risk PCI

IABP (n=150, 27% LM); no IABP (n=151, 29% LM)

Significantly improved long-term mortality with IABP in high-risk PCI



Number at risk	0	1	2	3	4	5
No planned IABP	150	130	117	93	52	19
Planned IABP	151	137	127	111	66	21

— No planned IABP - - - - Planned IABP

31% relative reduction in long-term mortality with IABP

28% vs. 38.4%

Elective versus provisional intraaortic balloon pumping in unprotected left main stenting

Milan Experience

Elective IABP (n=69); Conservative group (n=150)

Elective IABP used in 31% of patients undergoing LM PCI

Milan criteria for
elective IABP before
ULMCA PCI

- LM bifurcation lesion
- EF < 40%
- Atherectomy
- Unstable angina
- RCA critical stenosis

15% (12/150) patients in the
conservative group required
insertion of IABP due to
hemodynamic instability

Elective versus provisional intraaortic balloon pumping in unprotected left main stenting Milan Experience

Elective IABP (n=69); Conservative group (n=150)

Predictors of outcomes during LM PCI

Elective IABP is protective during LM PCI

	Odds ratio
Elective IABP	0.08 (0.01-0.69)
Euroscore > 6 plus distal LM	5.49 (1.47-20.51)
SBP < 100mmHg	3.52 (0.50-24.73)

Intraprocedural events are higher with conservative approach

1.4% vs. 9.5%

	Elective IABP group (N = 69)	Conservative group (N = 150)	P
Intraprocedural events			
Cumulative	1 (1.4%)	14 (9.5%)	.032
VF/VT	0	2 (1.4%)	1.00
CPA	0	3 (2.0%)	.48
Hypotension/shock	0	12 (8%)	.020
Death	0	0	1.00
AMI	0	2 (1.4%)	1.00
Urgent CABG*	1 (1.4%)	5 (3.3%)	.42

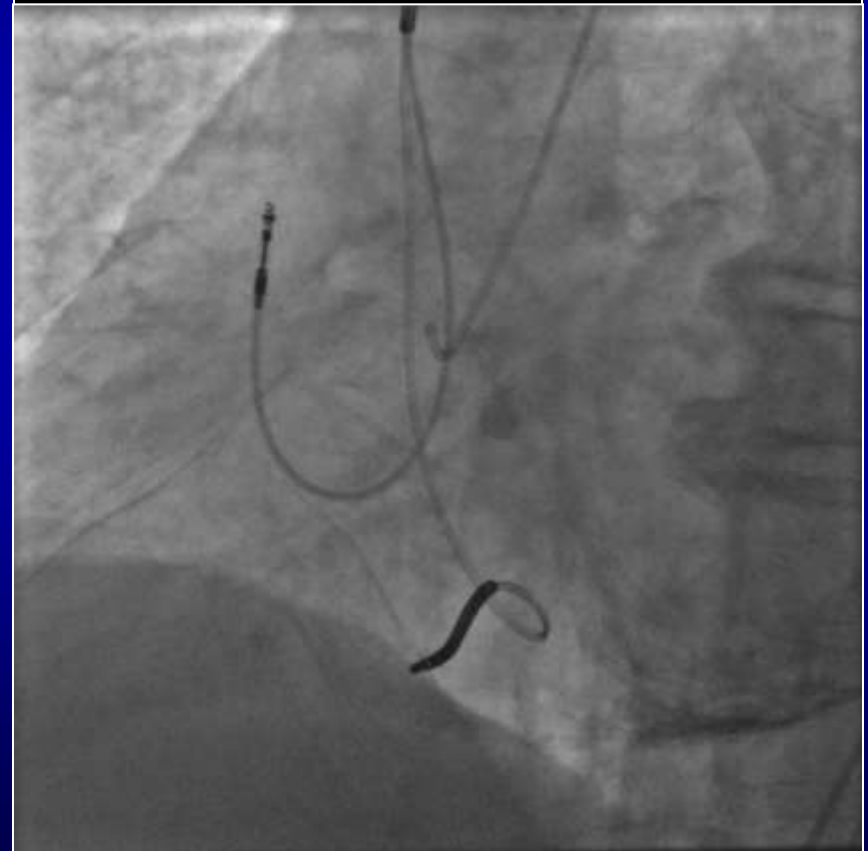
87 y/o male presenting with NSTEMI

Severely depressed cardiac function (EF 15%)

80% ostial LM, 90% distal LM, 90%
ostial LAD, 80% mid-LAD



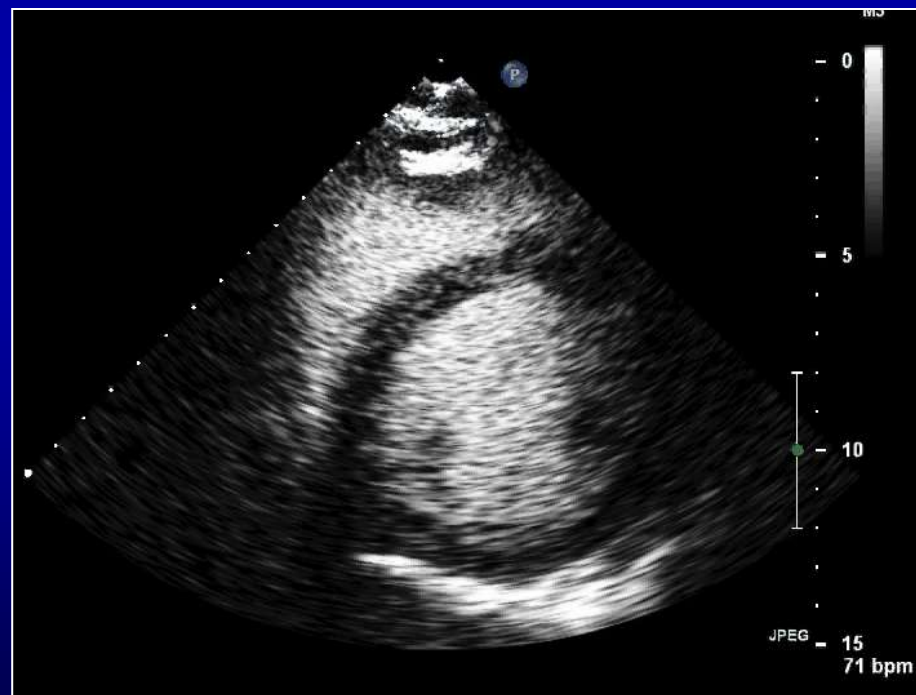
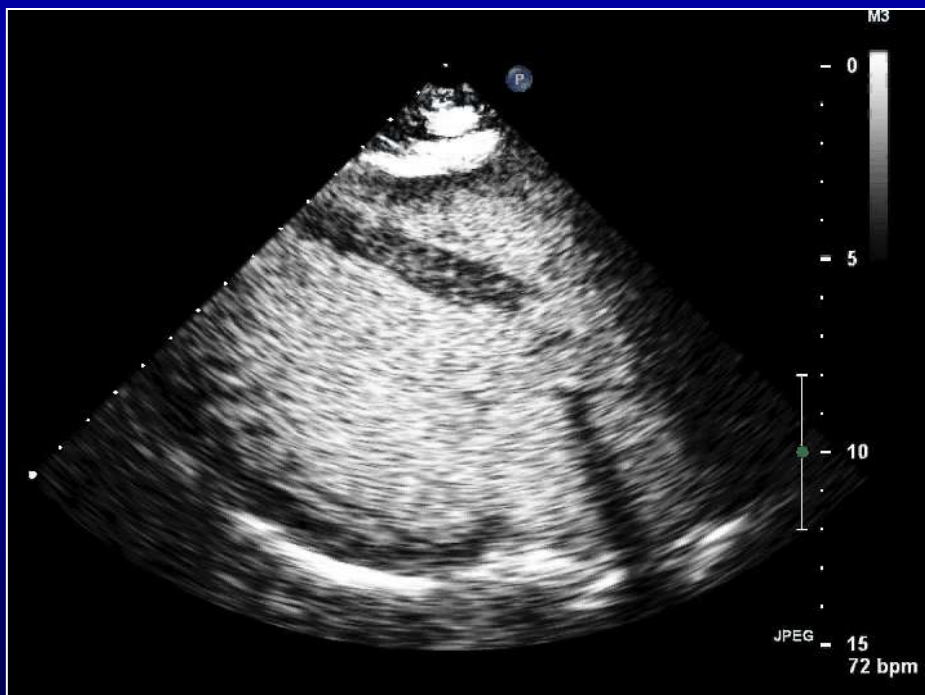
100% prox-RCA with bridging
collaterals to mid-RCA



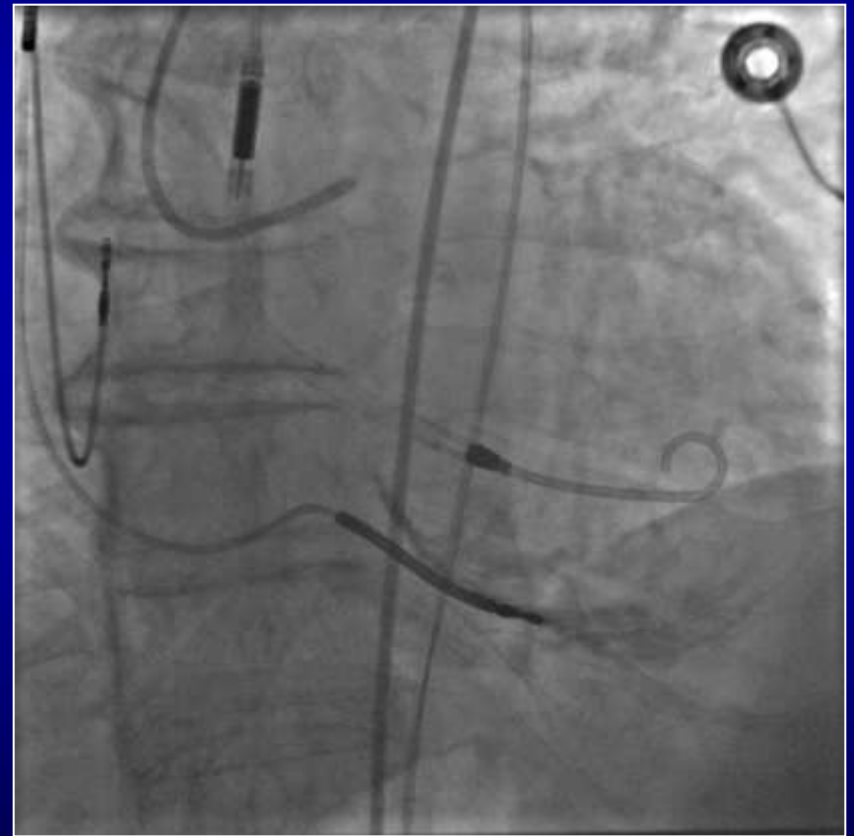
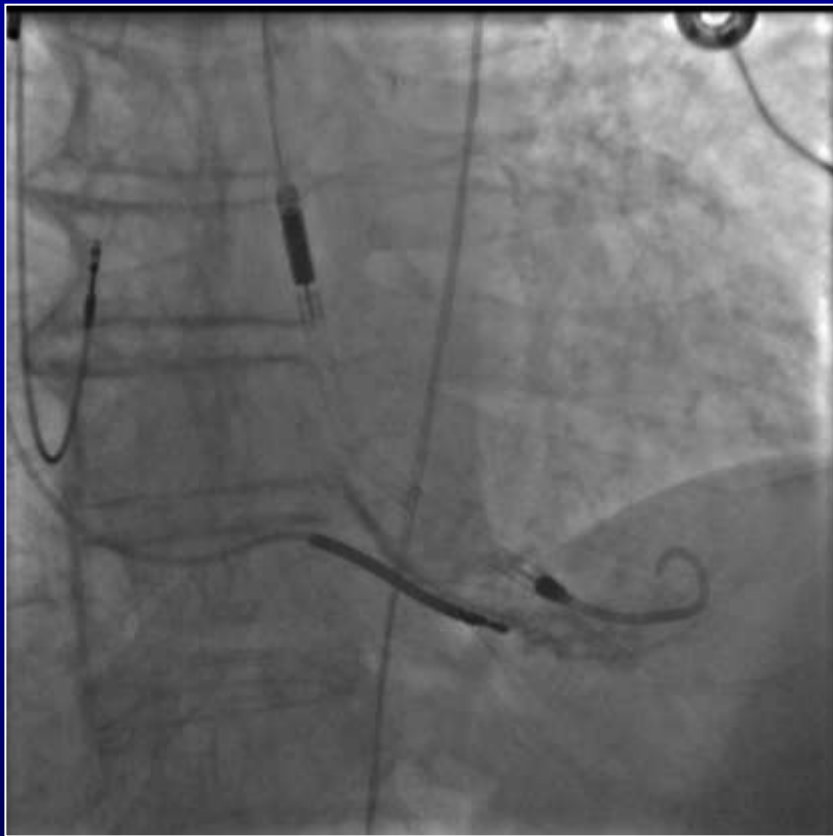
Severely depressed systolic function

Ejection Fraction 15%

Patient not a surgical candidate



High-risk PCI of the LM performed with Impella 4.0 hemodynamic support



Final result

s/p Resolute 2.5x22mm, 2.25x14mm, 2.75x12mm and
3.0x26mm stents to the LAD



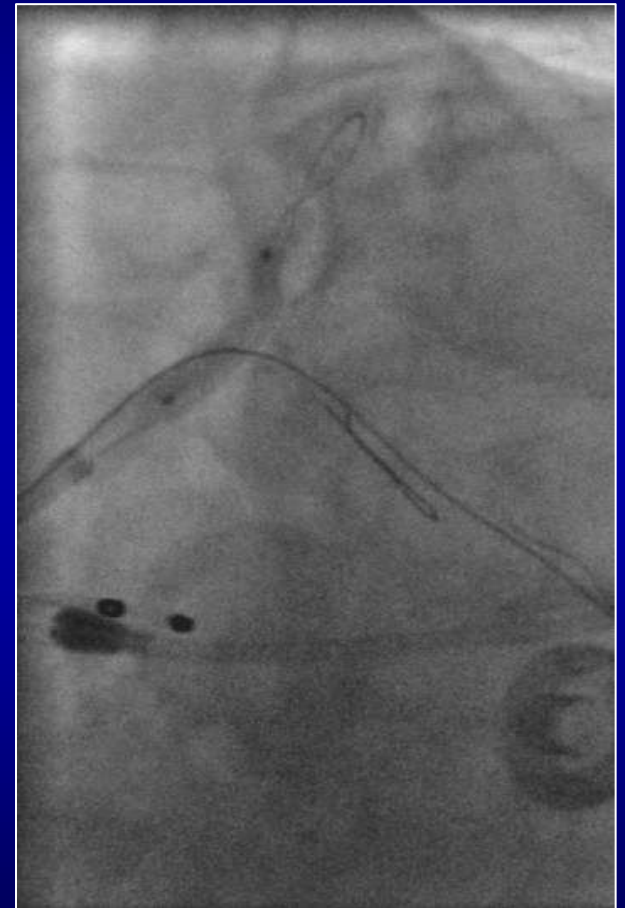
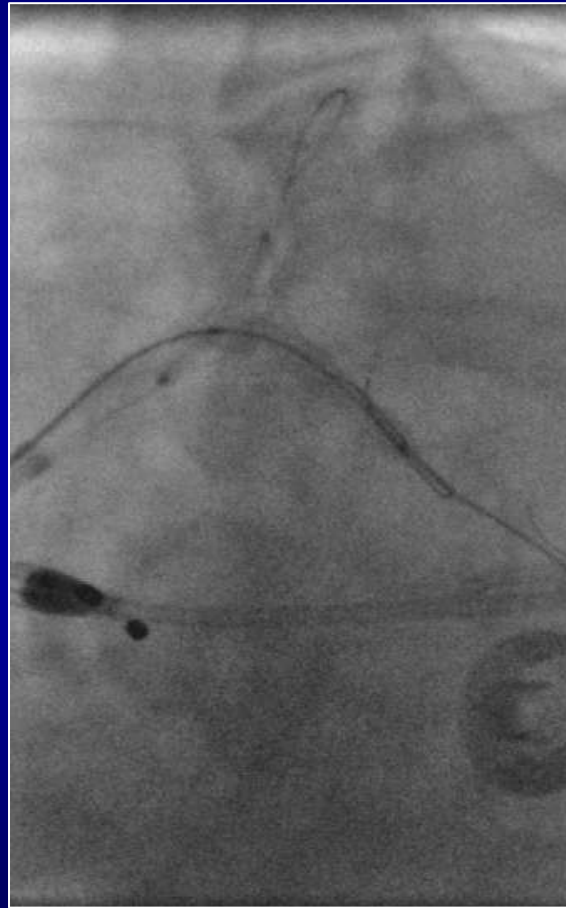
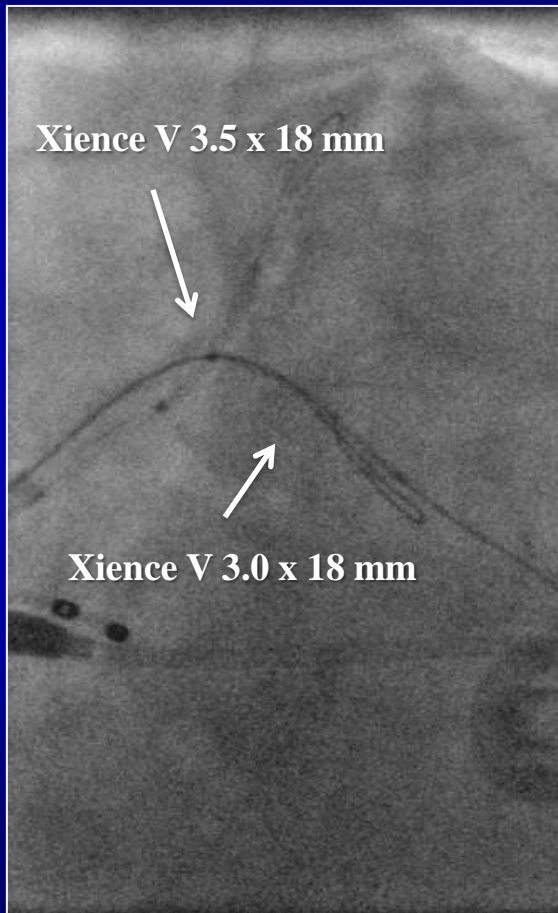
Patient discharged
home 5 days later

71 y/o male with AVA 1.3 cm², LVEF 60%

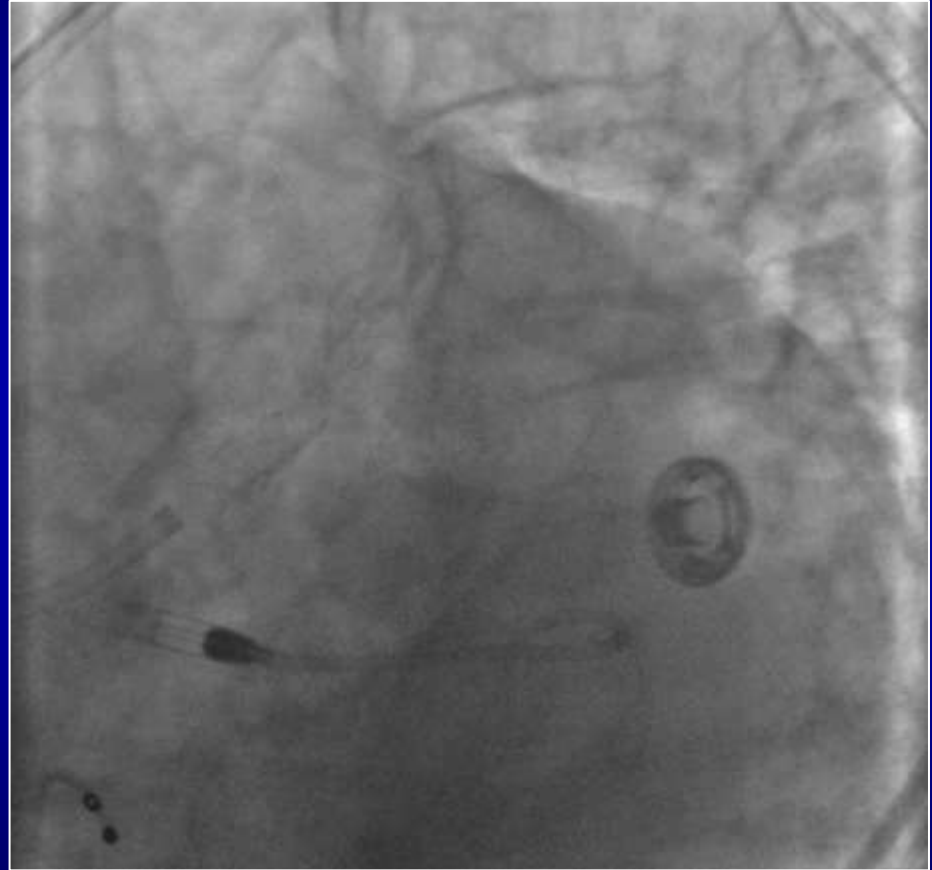
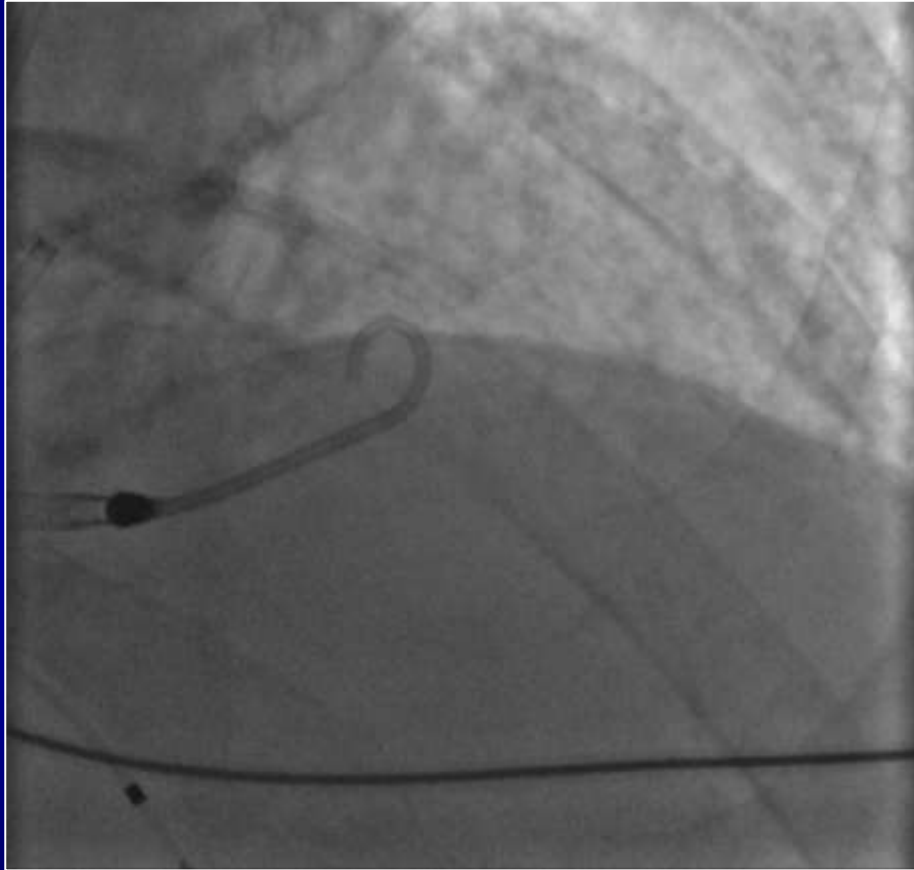
Baseline Coronary Angiogram



Stent Positioning and Deployment



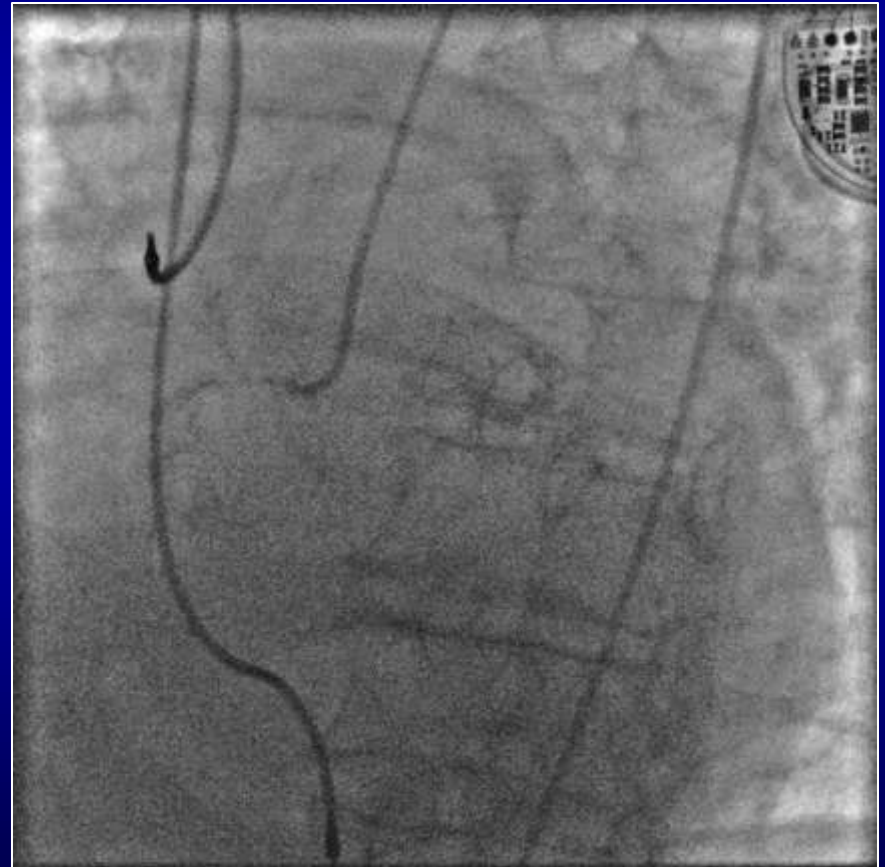
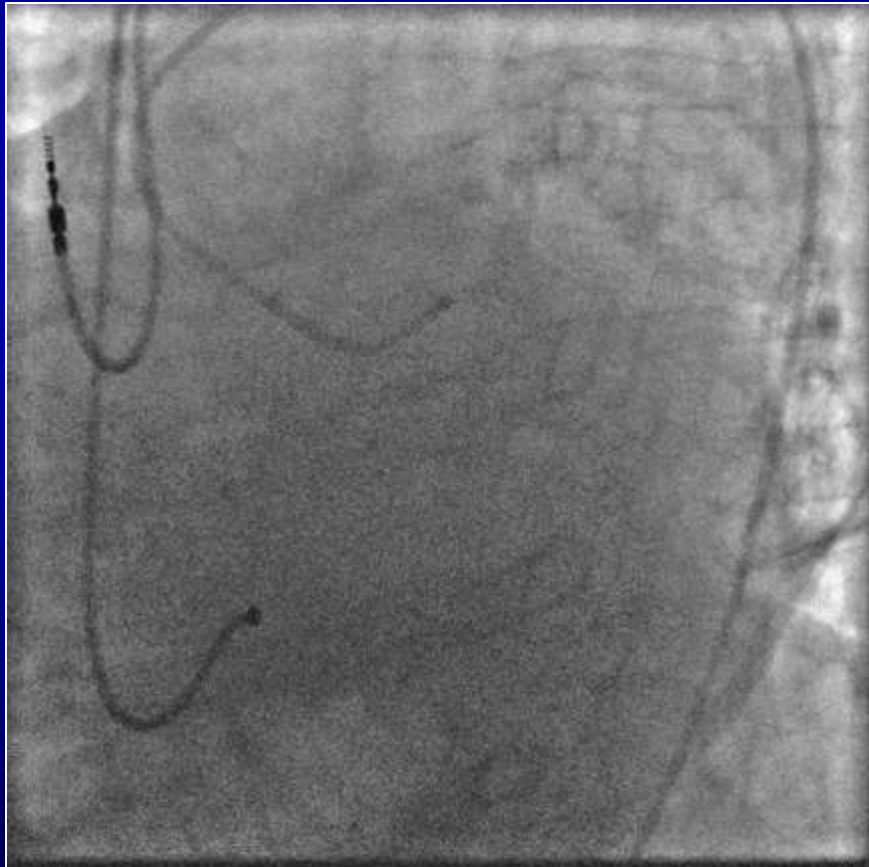
Final Angiogram



**94 y/o male with LM trifurcation stenosis,
severe AS and severely depressed EF (20%)**

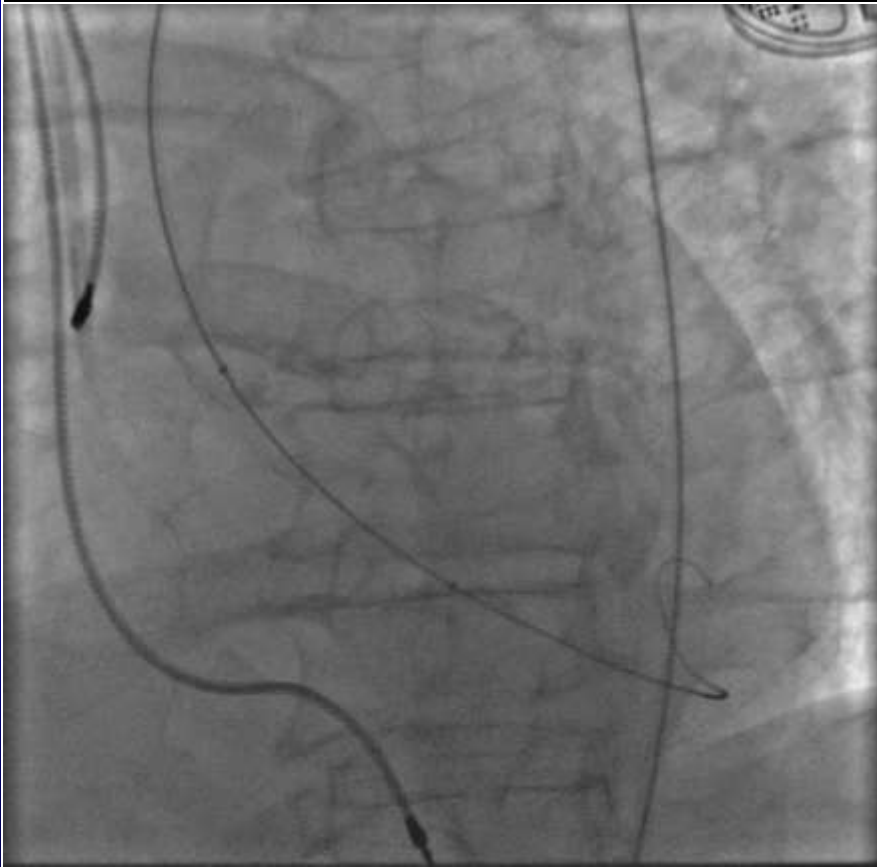
Patient turned down by 2 surgeons

Baseline Coronary Angiogram



Balloon aortic valvuloplasty performed, followed by insertion of Impella 4.0

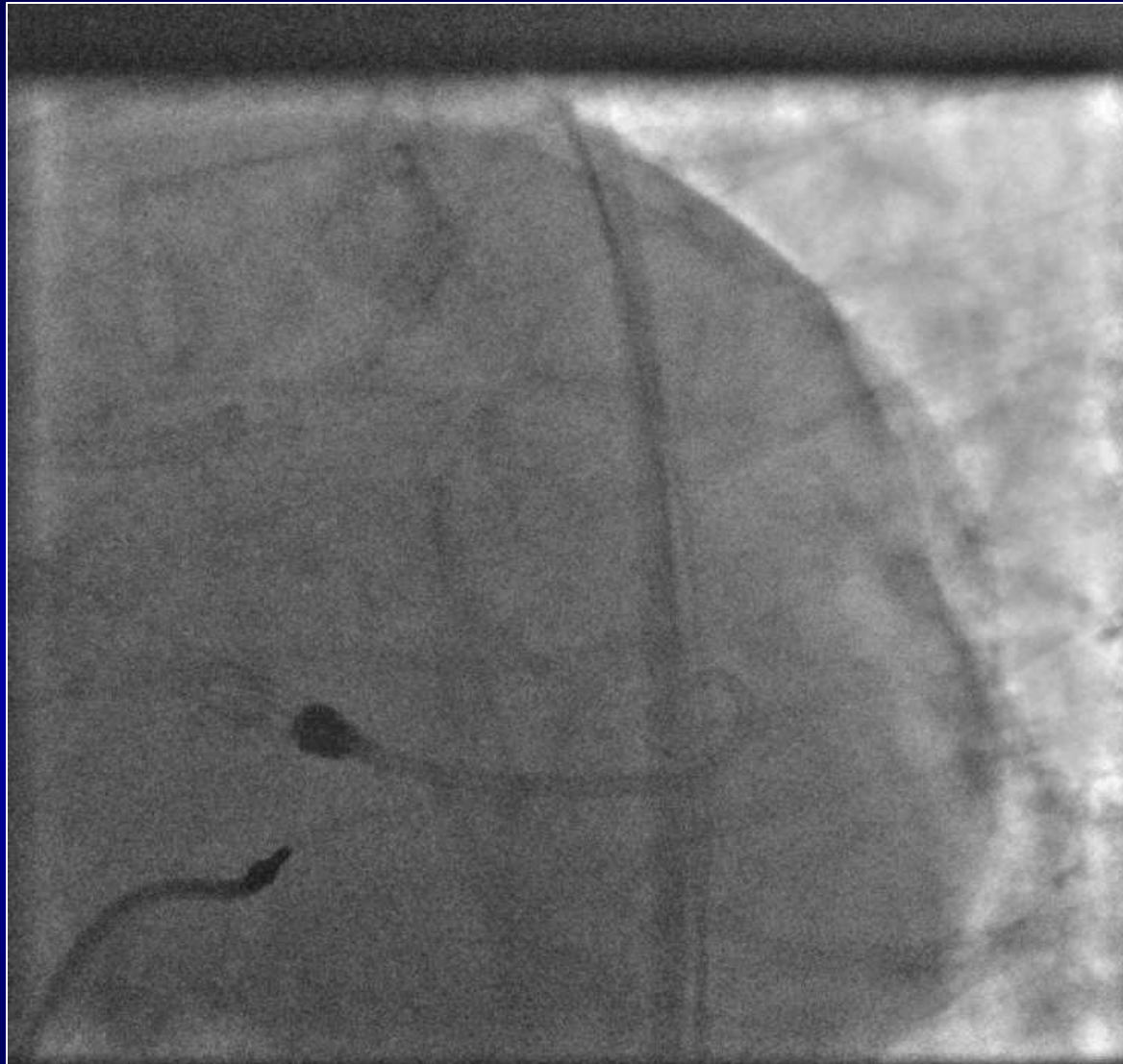
**22 x 5 mm Z-med BAV
balloon**



**Angiogram after Impella
insertion**



Final Result



Impella removed at the end of the procedure

Transfemoral TAVR performed 1 month later

29mm Sapien-XT deployed

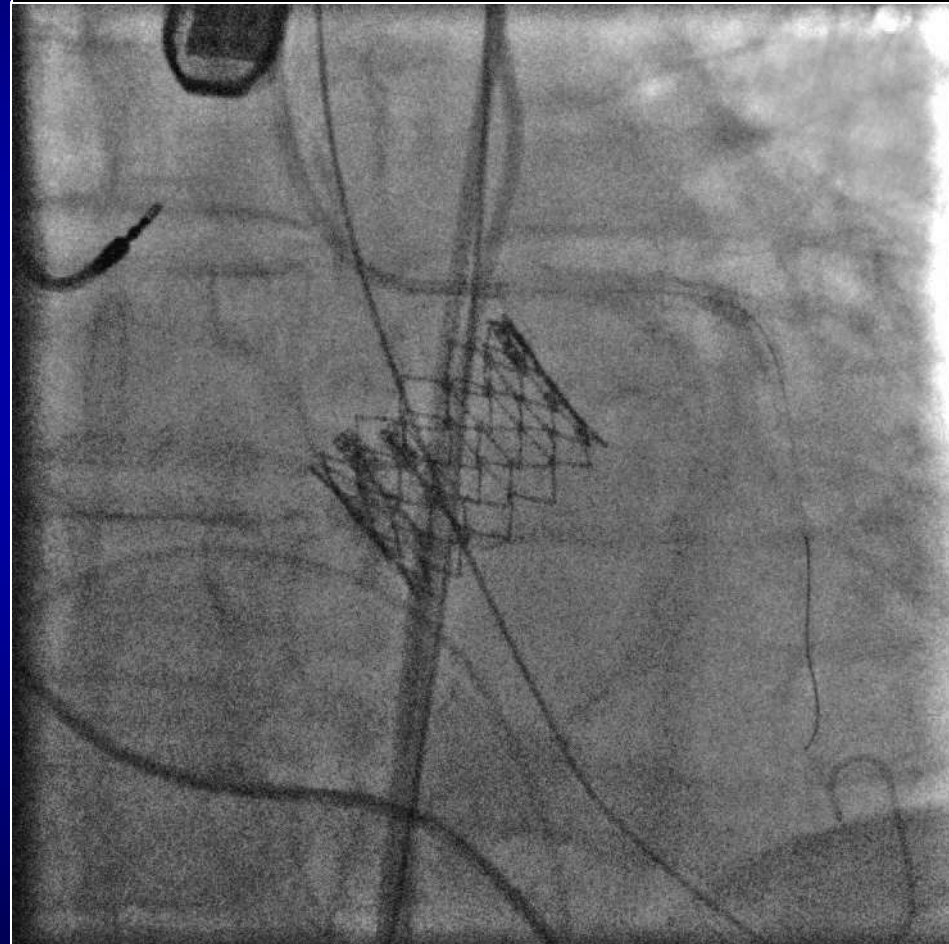


4.0 x 12 mm
angioplasty balloon
positioned in the
LAD

POBA of the LM Stent performed
with the 4.0x12 balloon



Final Result



Safety and feasibility of Impella 2.5 in patients undergoing high-risk PCI: Europella Registry

144 patients undergoing high-risk PCI

LM PCI performed in 52.8% (76/144) patients

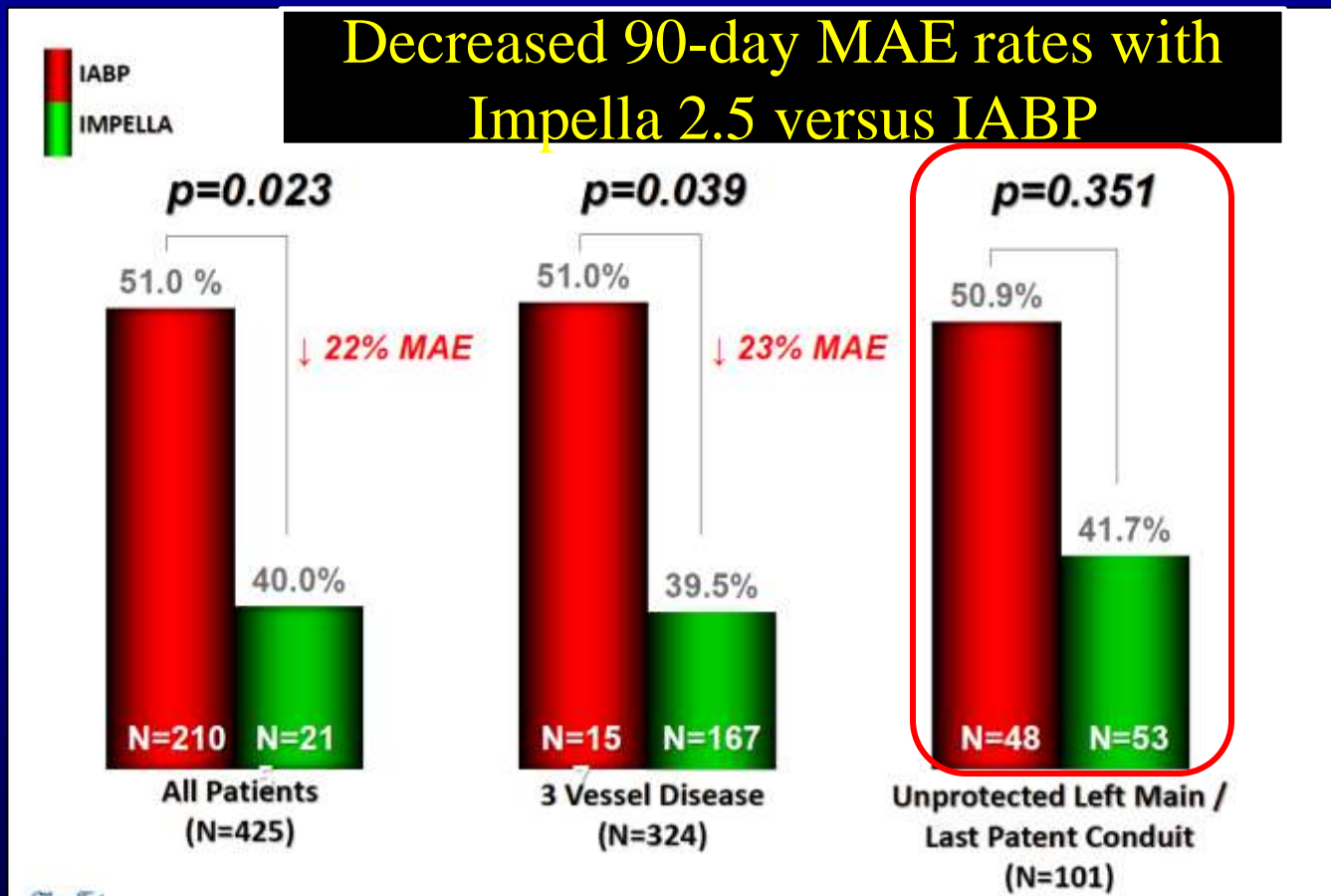
30-day mortality 5.5%; 30-day MI 0%

Qualification for high-risk PCI	
Left main coronary artery PCI	76 (52.8)
Last patent vessel PCI	25 (17.4)
Multivessel disease	118 (81.9)
Low LVEF	51 (35.4)
Other	12 (8.3)
Refused for CABG	62 (43.1)

PROTECT II Study: Randomized trial of Impella 2.5 versus IABP during high-risk PCI

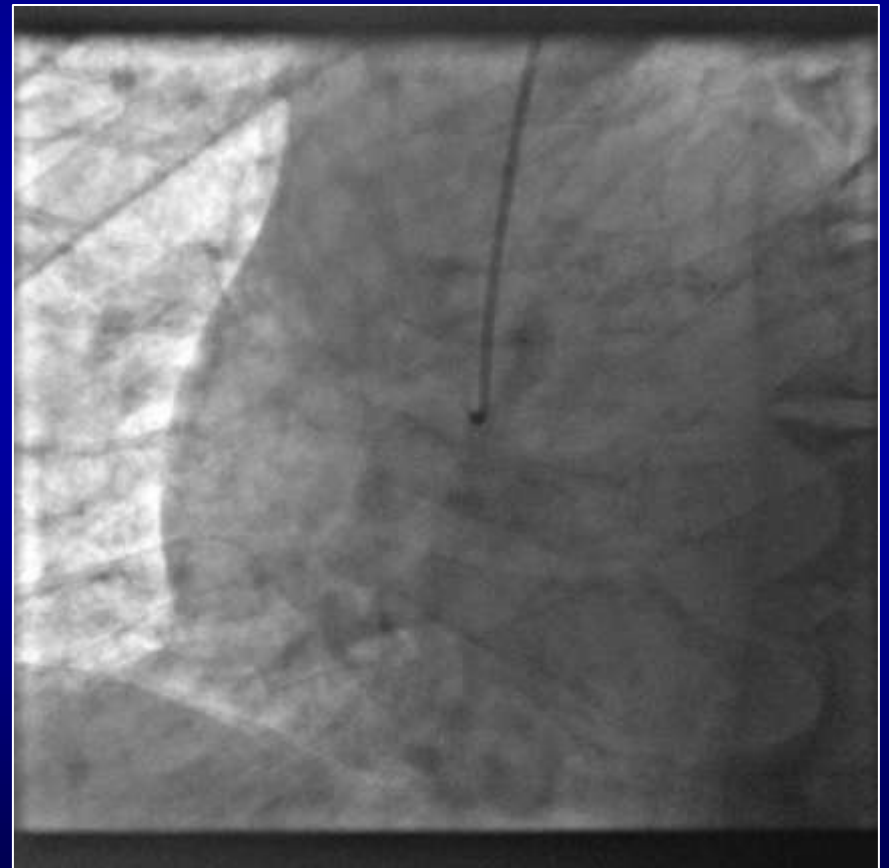
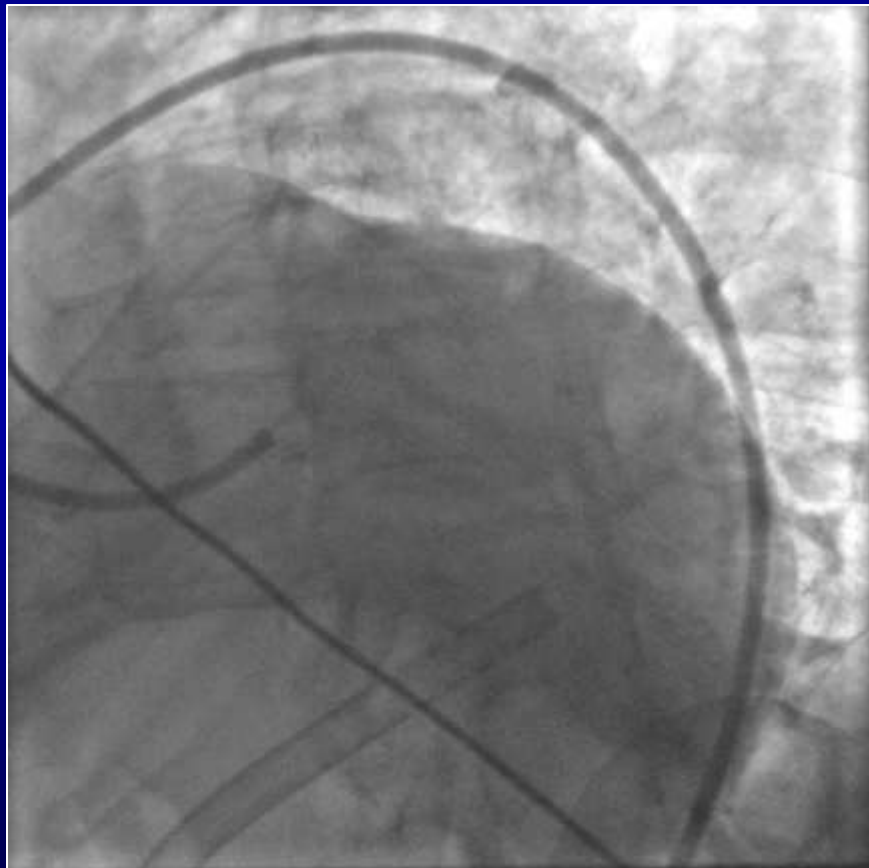
Unprotected left main/Last Patent Conduit group

90 day Major Adverse Event (Per-Protocol)



84 y/o male with unstable angina, LVEF 15%

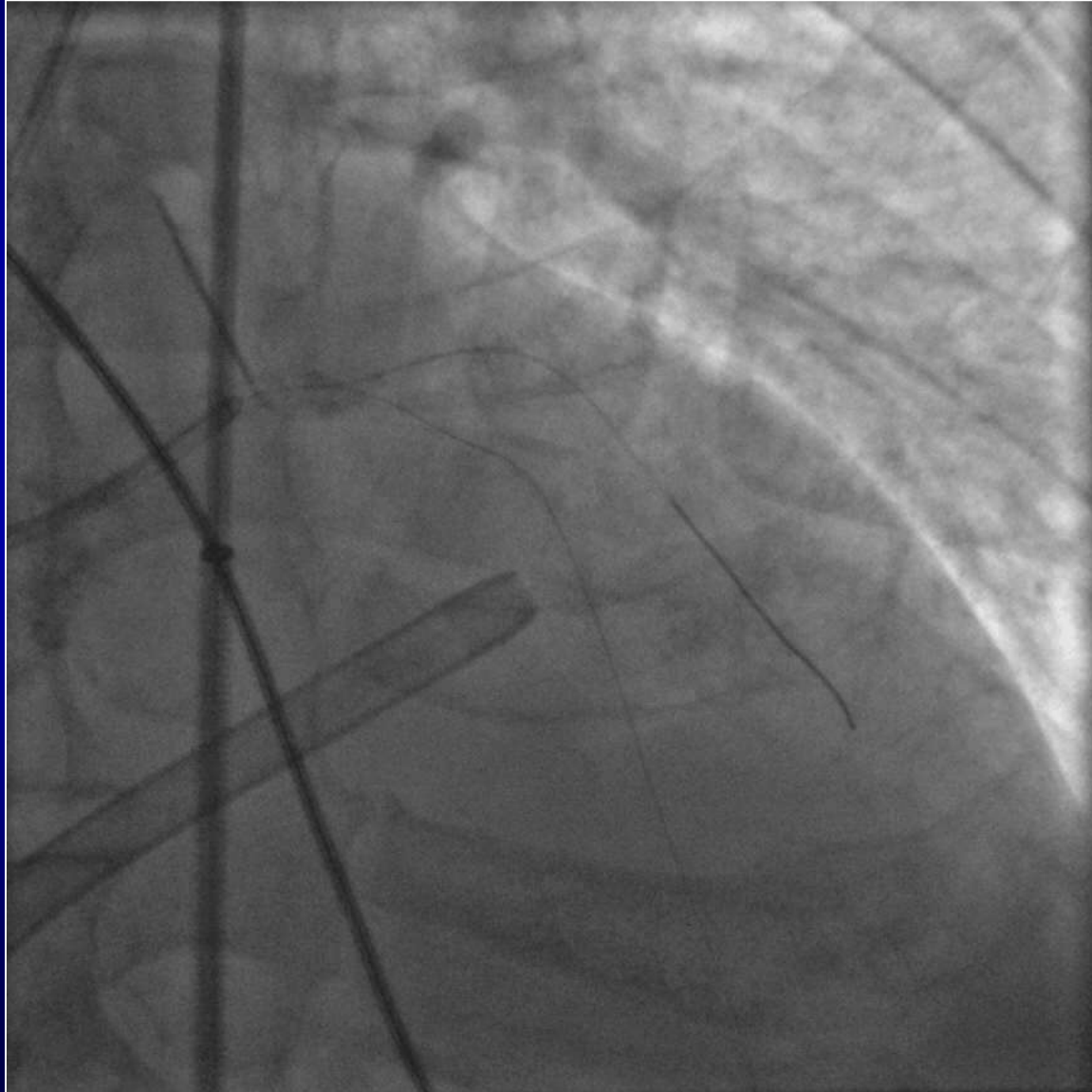
Baseline Coronary Angiogram



Lossy compression - not intended for diagnosis



Tandem heart placed for hemodynamic support



5 stents later...



Percutaneous Left Ventricular Assist Device With **TandemHeart** for High-Risk Percutaneous Coronary Intervention: The Mayo Clinic Experience

High-risk PCI = Left main/Multivessel PCI with low EF
33/54 patients (62%) underwent LM PCI

High-risk LM PCI is feasible with Tandem Heart support

**Favorable hemodynamics with
Tandem Heart**

**97% procedural
success**
***10% 30-day
mortality***

	Pre-tandem heart	Post-tandem heart	P- value
RA pressure	16 mmHg	10 mmHg	<0.001
PA pressure	45 mmHg	36 mmHg	0.04
PCWP	25 mmHg	17 mmHg	0.02
CO	4.7 L/min	5.7 L/min	0.03

Percutaneous Left Ventricular Assist Device With **TandemHeart** for High-Risk Percutaneous Coronary Intervention: The Mayo Clinic Experience

High-risk PCI = Left main/Multivessel PCI with low EF

33/54 patients (62%) underwent LM PCI

Mayo Clinic Algorithm for hemodynamic support during high-risk PCI

	Simple PCI	Complex PCI
LVEF > 30%	None	IABP
LVEF < 30%	IABP	Impella or Tandem Heart

My approach to hemodynamic support in LM PCI

	Simple anatomy (Ostial, mid-shaft, single stent strategy)	Complex anatomy (Bifurcation lesion)	Very complex anatomy
LVEF < 20%	IABP/ Impella	Impella/ Tandem Heart	Impella/ Tandem Heart
LVEF 20-35%	IABP	IABP/ Impella	Impella
LVEF > 35%	4 French sheath	IABP	Impella