High risk PCI & Hemodynamic support (IABP, Impella, ECMO)

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ΟΜΙΛΟΣ ΙΑΤΡΙΚΟΥ ΑΘΗΝΩΝ

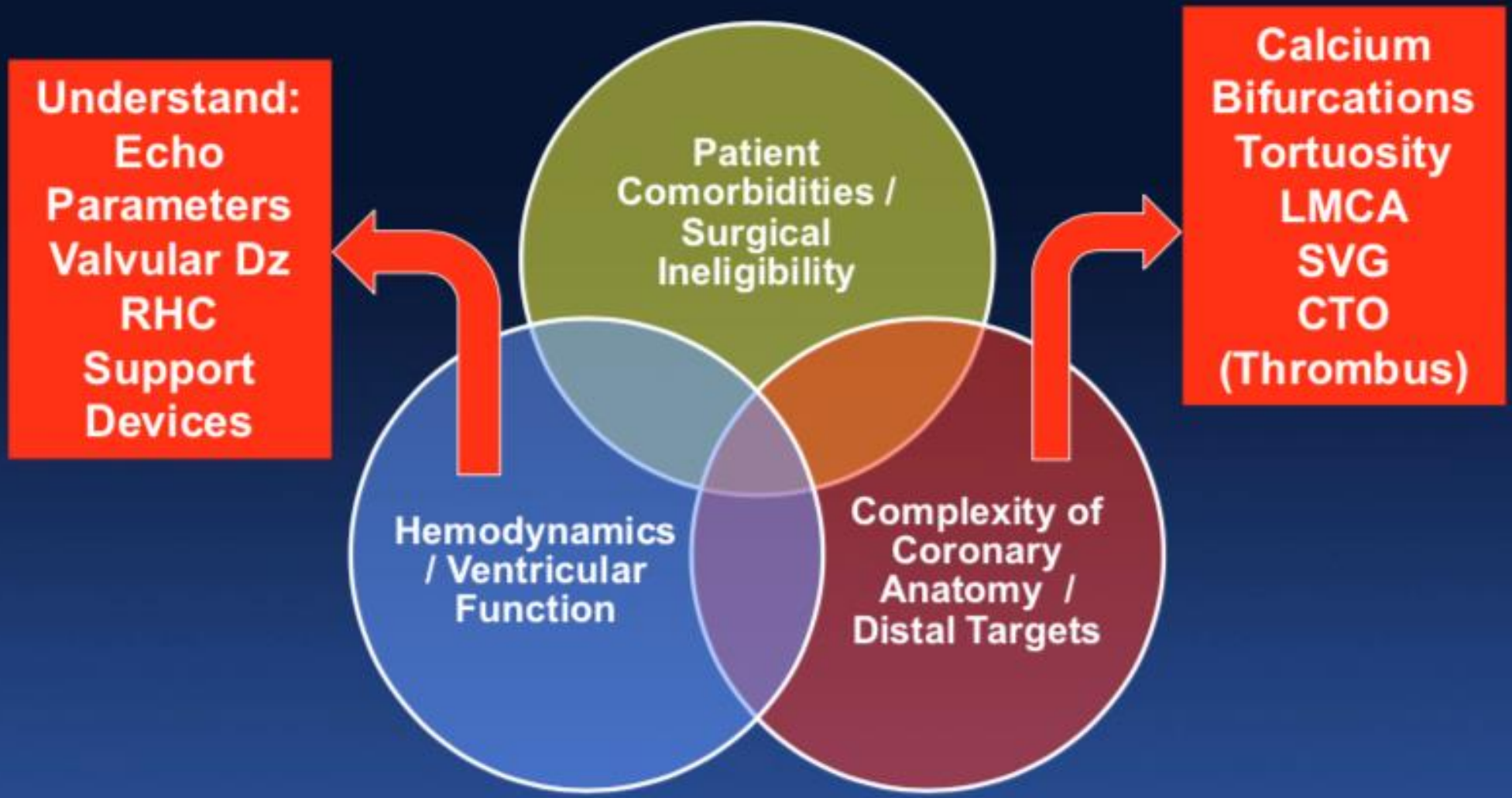
Ιατρικό Κέντρο Αθηνών

Conflict of interest:

Proctoring for IMPELLA ABIOMED

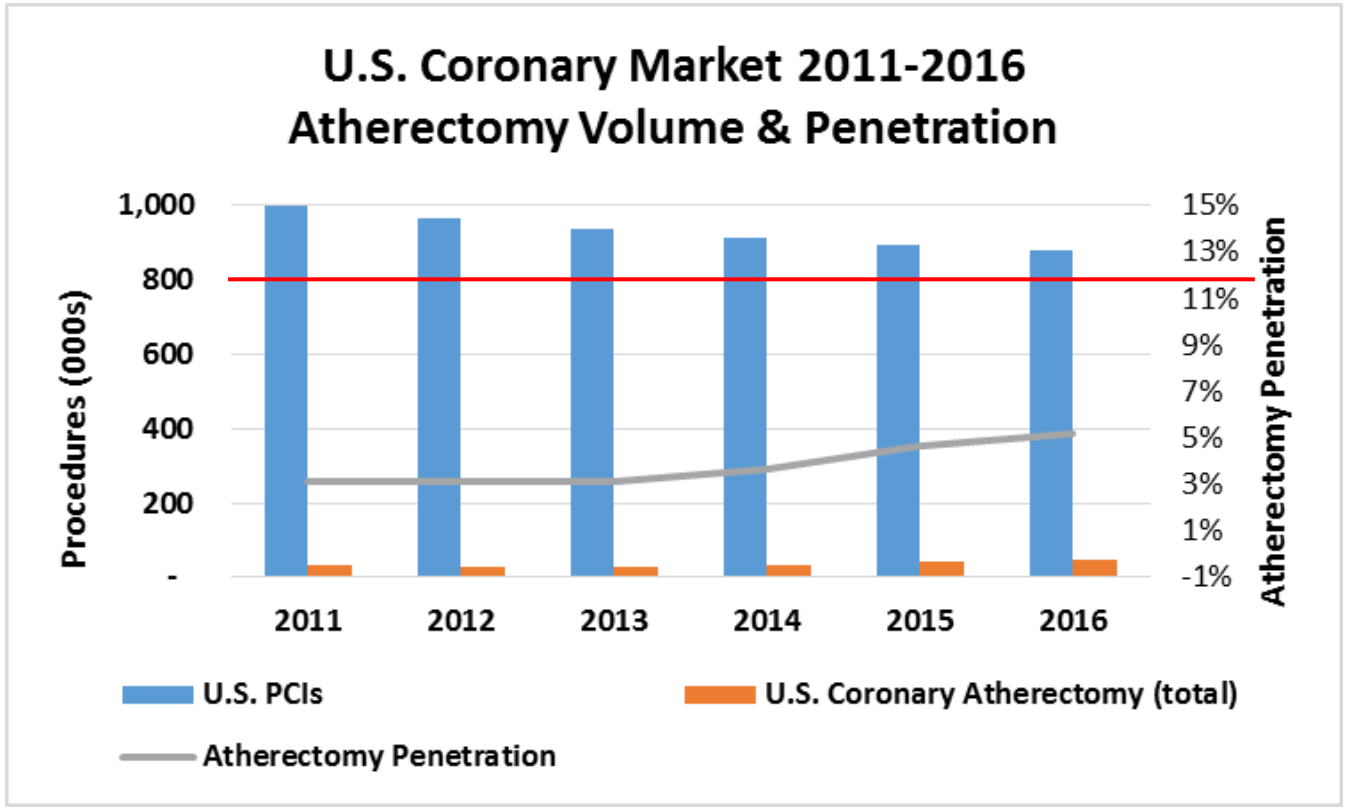
High Risk PCI - CHIP

Definition of the CHIP Population:
Complex Higher-Risk (and Indicated) Patients



Are We Treating These Patients Effectively?

Severely Calcified Lesions are Undertreated



12% Severely Calcified Lesions

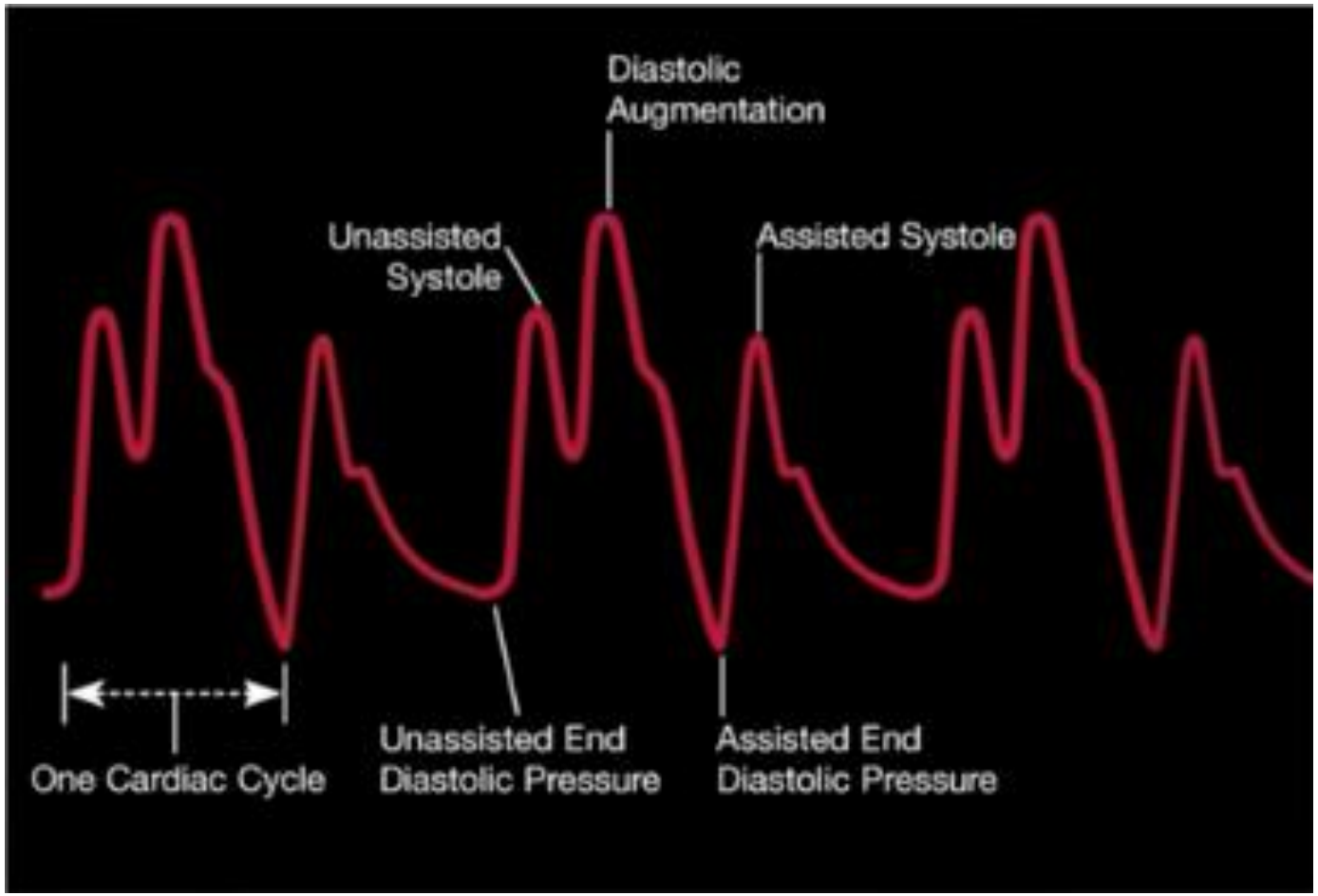
<5% Total Atherectomy* Penetration

* Total Atherectomy includes: Diamondback 360® Orbital Atherectomy, Rotablator™ and Laser Atherectomy systems

12% severe calcium
Bourantas CV, et al. Heart. 2014;100:1158-1164. 20% severe Ca++ in DES trials
Généreux P, et al. J Am Coll Cardiol. 2014;63:1845-54. 6% severe Ca++ in ACS
Feldman DN, et al. Circulation. 2013;127:2295-2306. 60% of PCIs ACS, 40% stable → 12% severe Ca++

IABP

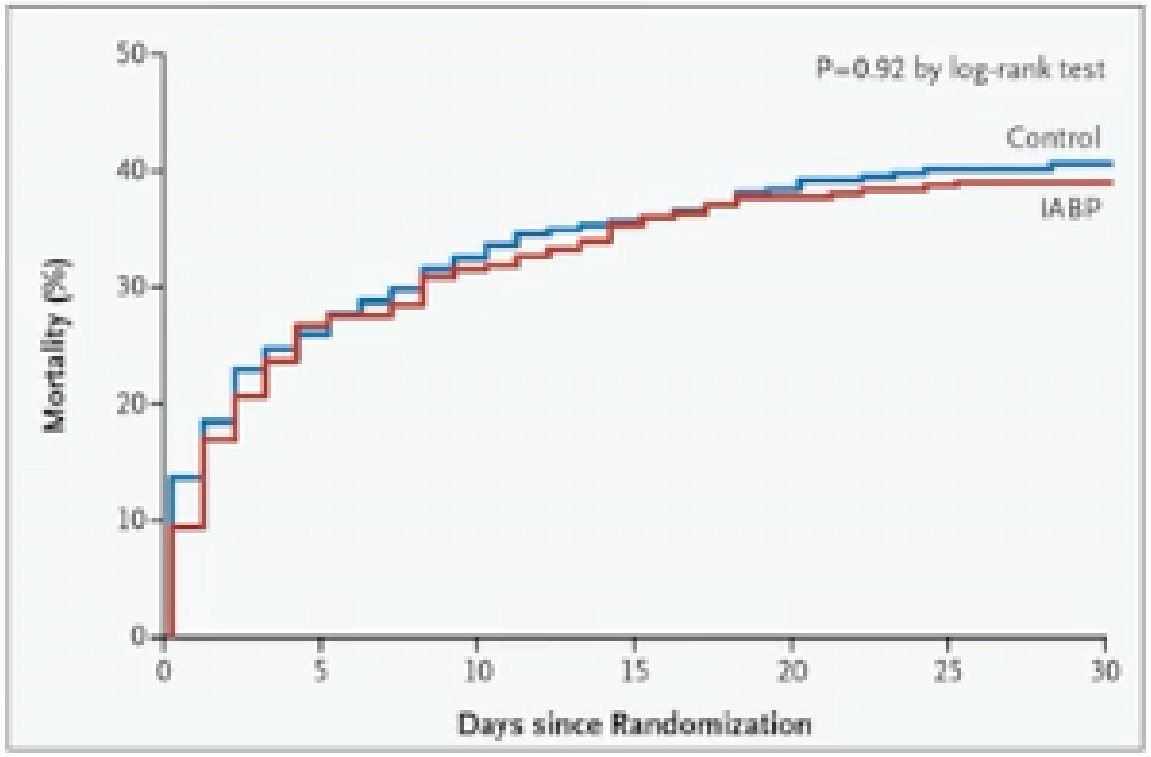
Φυσιολογική λειτουργία IABP



DATA- IABP-SHOCK

Shock and Acute MI

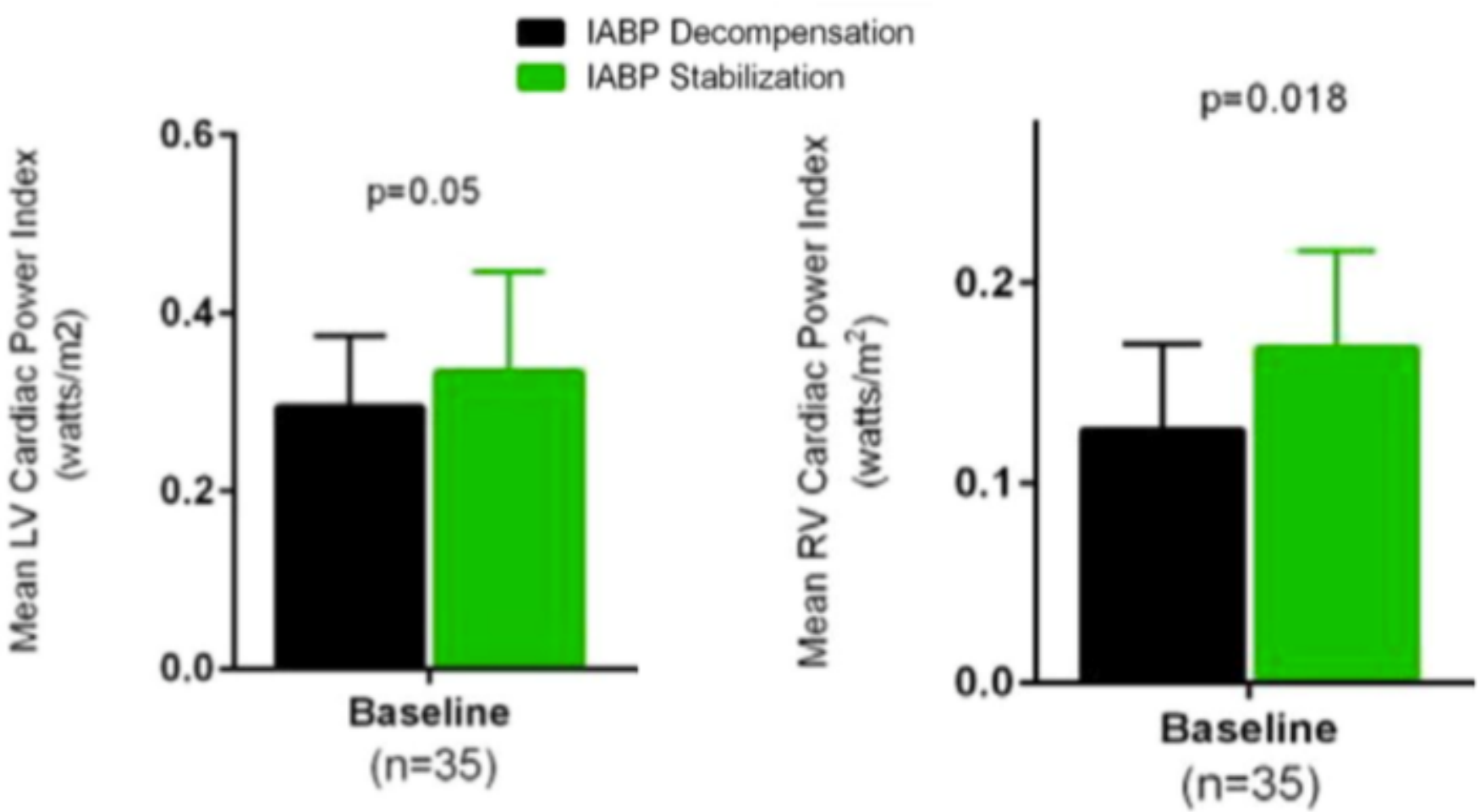
- Randomized, prospective, trial
- 600 patients with NSTEMI/STEMI
- Shock (SBP <90mmHg for >30min, pulmonary congestion, end-organ hypoperfusion)
- Early PCI expected
- PEP: 30d mortality
- IABP vs no IABP



- 30 **crossovers** to IABP group (26 protocol deviations, not done for mechanical complications)
- **Selection bias**: Rapidly deteriorating patients may not have been enrolled; biasing the study population towards patients exhibiting signs of stability with vasopressor and inotropic support.

Thiele H, et al. NEJM 2012

Counterpulsation Requires Native Left Ventricular Pulsation



The more dysfunction the ventricle,
the *less functional* an IABP becomes

Sintek and Joseph et al J Card Fail 2015

Recommendations for the use of short-term mechanical circulatory support in patients with cardiogenic shock

Recommendations	Class	Level
Short-term MCS should be considered in patients with cardiogenic shock as a BTR, BTD, BTB. Further indications include treatment of the cause of cardiogenic shock or long-term MCS or transplantation.	IIa	C
IABP may be considered in patients with cardiogenic shock as a BTR, BTD, BTB, including treatment of the cause of cardiogenic shock (i.e. mechanical complication of acute MI) or longterm MCS or transplantation.	IIb	C
IABP is not routinely recommended in post-MI cardiogenic shock.	III	B

BTB = bridge to bridge; BTD = bridge to decision; BTR = bridge to recovery; IABP = intra-aortic balloon pump; MCS = mechanical circulatory support; MI = myocardial infarction.

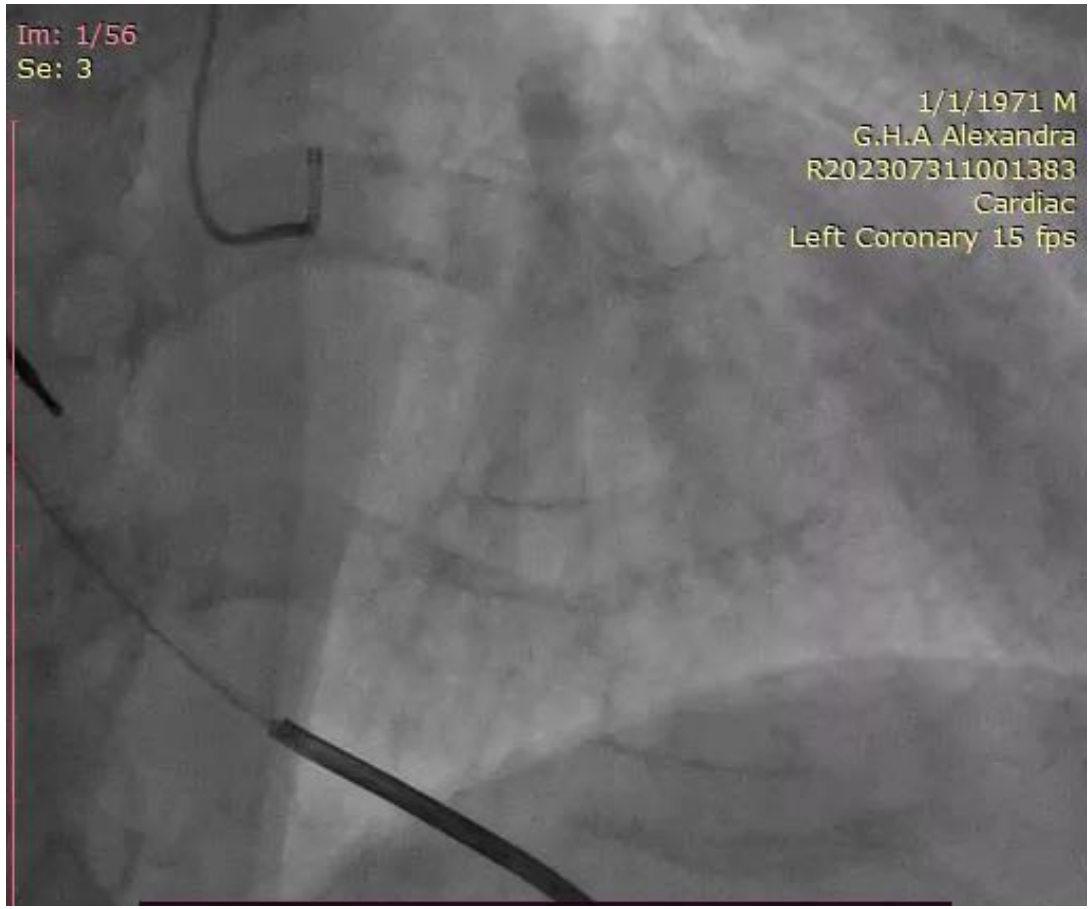
2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure
(European Heart Journal 2021 – doi:10.1093/eurheartj/ehab368)

CASE

- 51 M with PMH of ischemic cardiomyopathy LVEF 20%, CAD s/p PCI in LAD
- Presented after ICD shock x1 for VF
- Cath in OSH


Im: 1/53
Se: 6
1/1/1971 M
G.H.A Alexandra
R202307311001383
Cardiac
Left Coronary 15 fps


Im: 1/53
Se: 1
1/1/1971 M
G.H.A Alexandra
R202307311001383
Cardiac
Left Coronary 15 fps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1/1/1971 M
G.H.A Alexandra
R2023073110013 83
Cardiac
Left Coronary 15 fps


Im: 1/57
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G.H.A Alexandra
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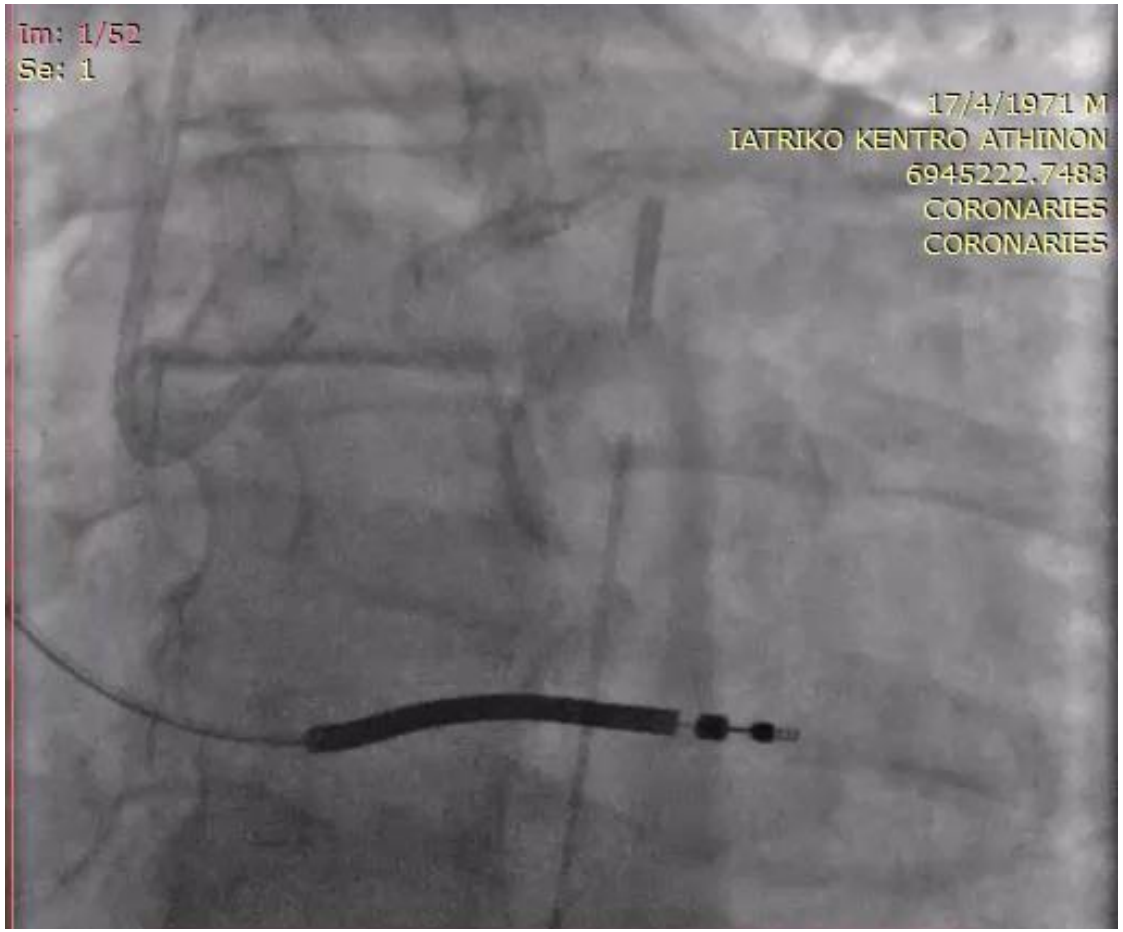
Cardiac
Left Coronary 15 fps

Decision for IABP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17/4/1971 M
IATRIKO KENTRO ATHINON
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CORONARIES

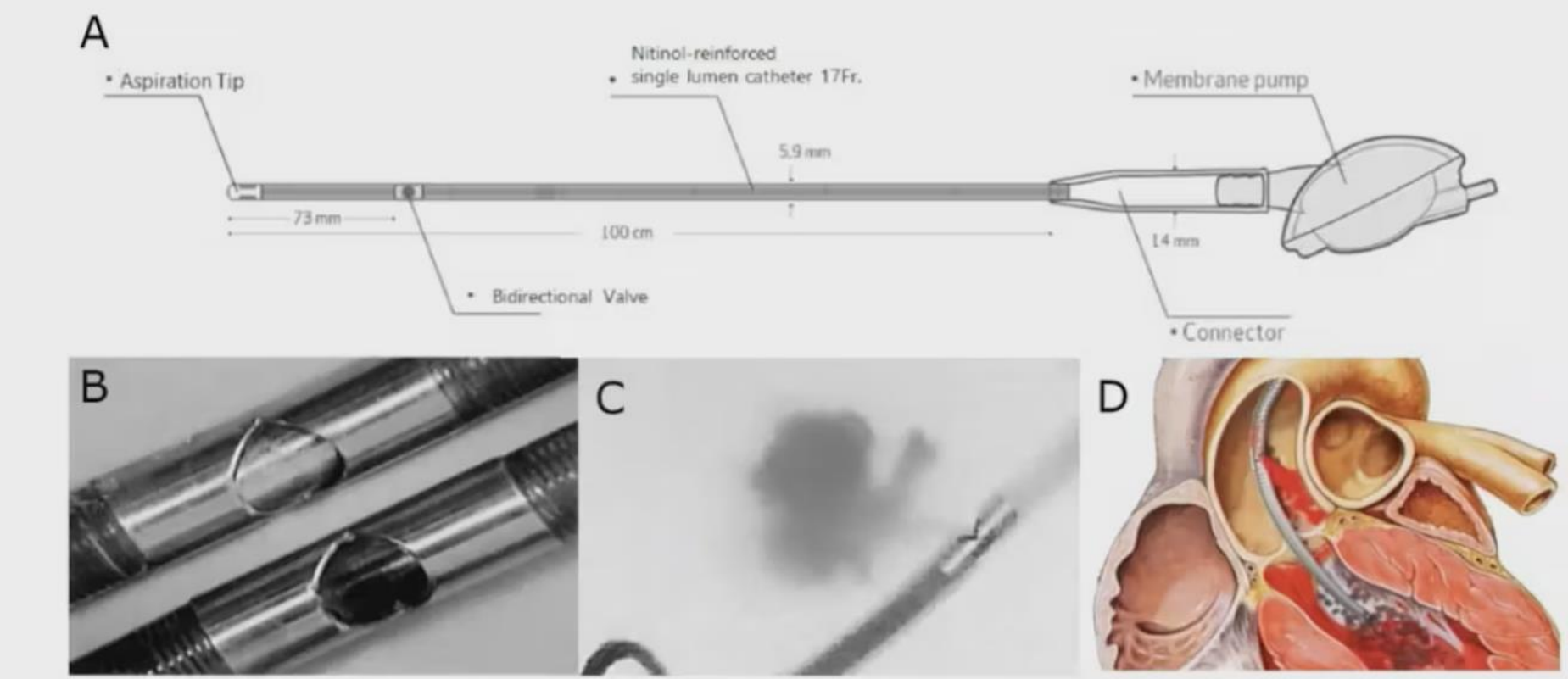

Im: 1/59
Se: 1
17/4/1971 M
IATRIKO KENTRO ATHINON
6945222.7483
CORONARIES
CORONARIES

2nd year follow up

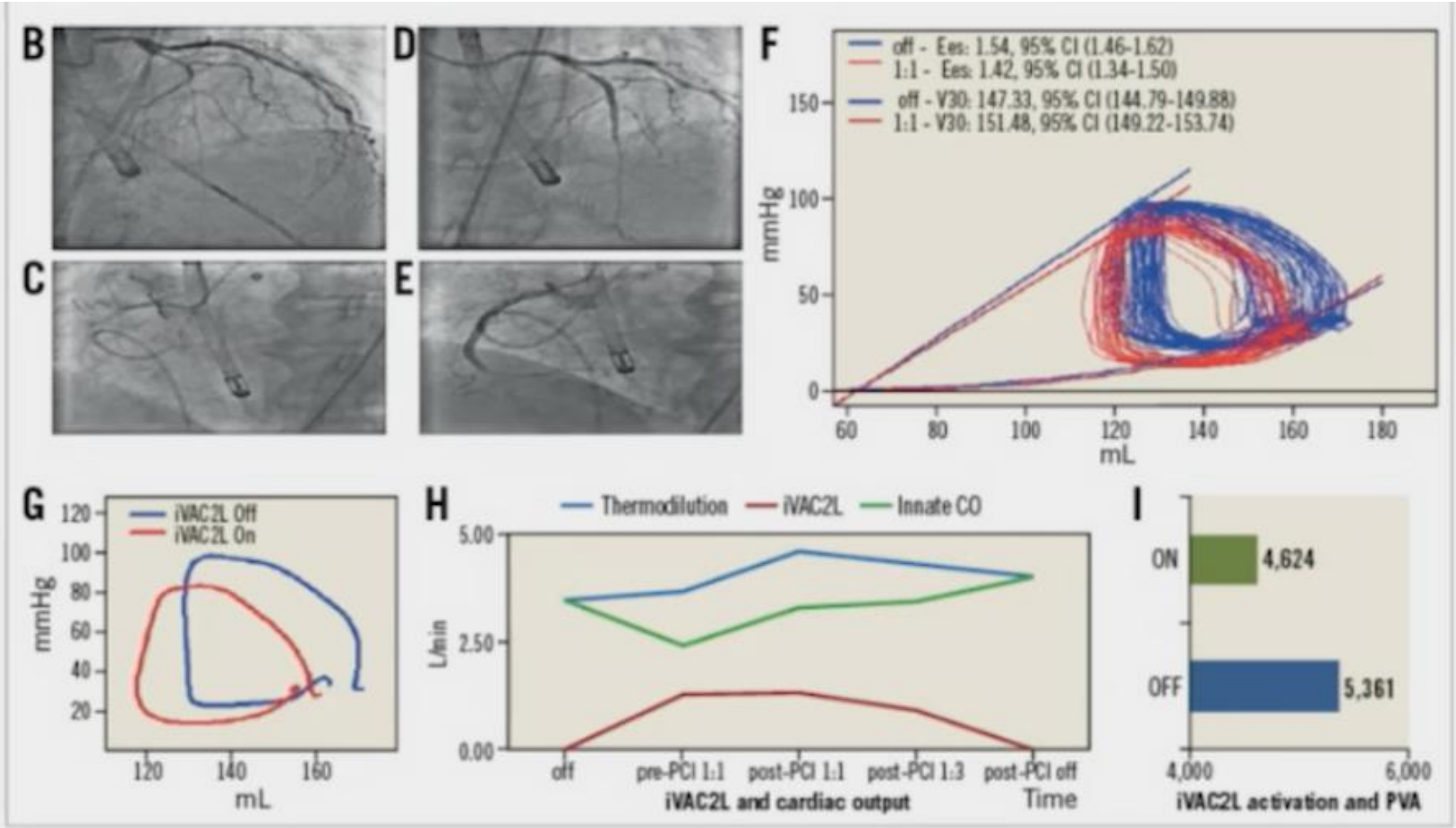
- Pt is tolerating maximum heart failure medical therapy
- He is NOT on the transplant list any more, since LVEF recovered to 35 – 40 %

IMPELLA και iVAC

iVAC 2L



Bastos et al. Future Cardiology 2020;16:103-112



Bastos et al. EuroIntervention 2018;14(7)

IMPELLA

- Continuous axial-flow pump
- Non-pulsatile, no ECG or waveform triggering
- From LV to aorta
- IMPELLA CP, 5.0, 5.5

- From IVC to PA
- IMPELLA RP

Axial Pump Flow Principles

Pump flow is a function of:

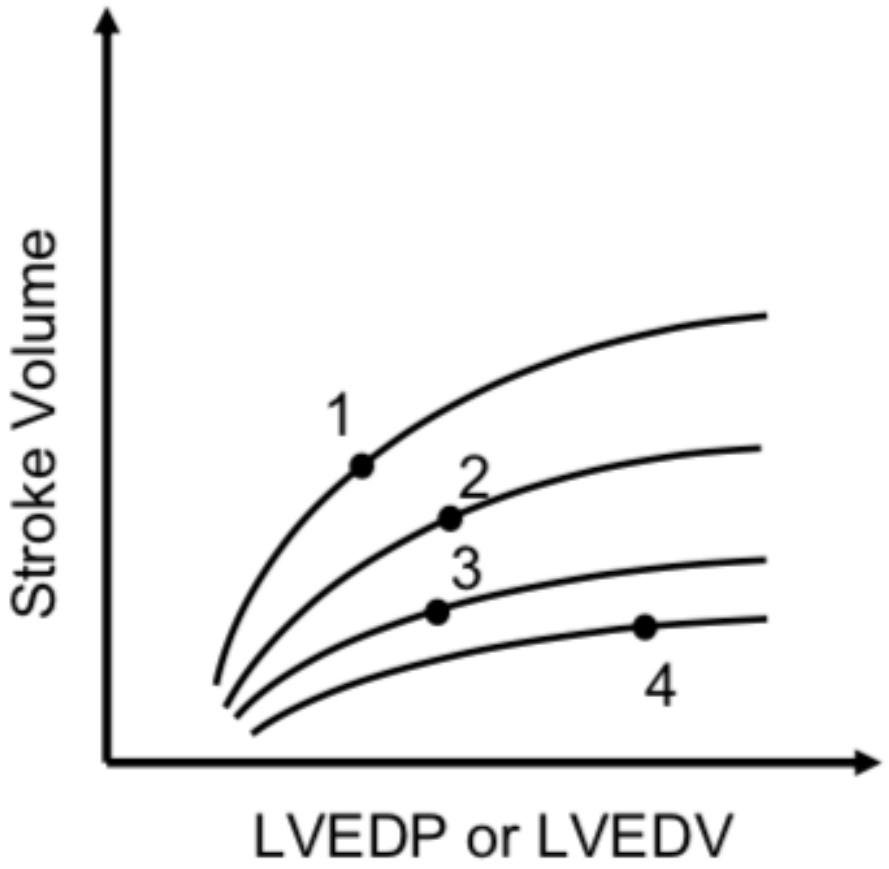
- The speed of the impeller
  - ↑Speed → ↑Flow
  - ↓Speed → ↓ Flow

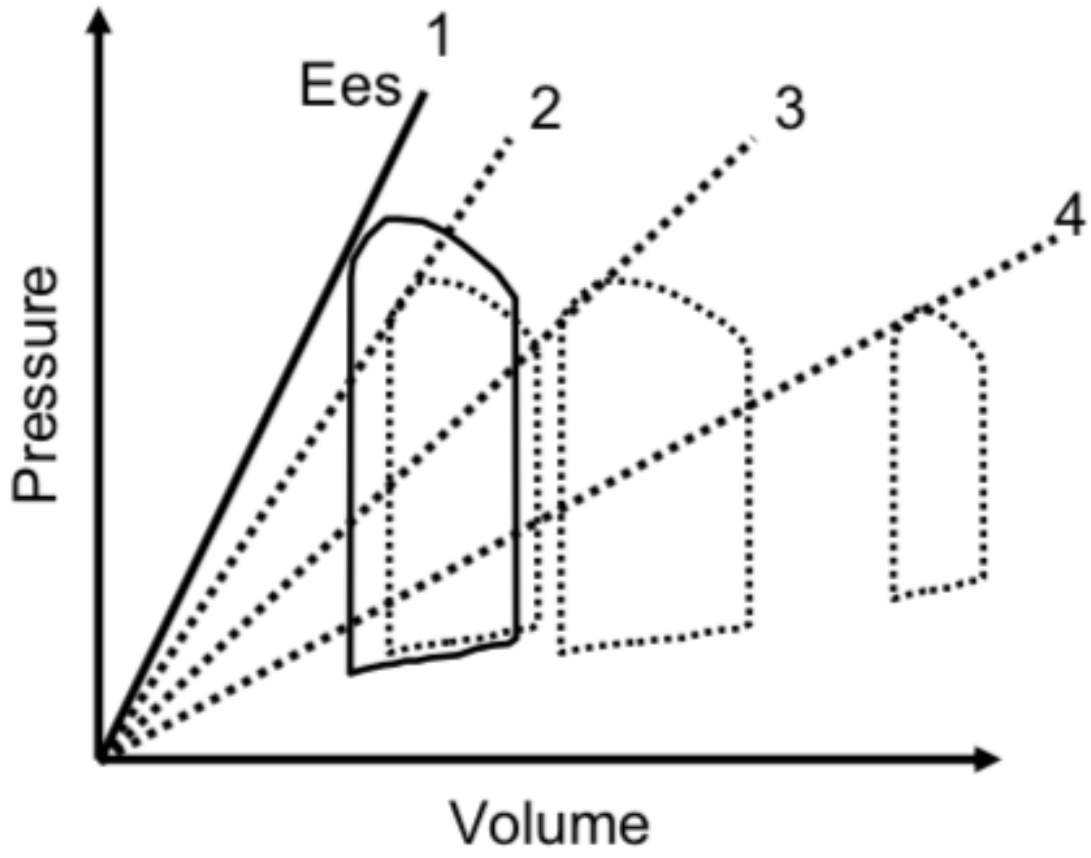
AND

- The difference in pressure across the pump
  - ↑ Pressure gradient → ↓ Flow
  - ↓ Pressure gradient → ↑ Flow

At any given speed, increased pressure gradient across the aortic valve will decrease flow

The Spectrum of Patients Requiring Acute MCS Therapy





Condition 1: 'Normal'
Condition 2: AMI
Condition 3: Compensated HFrEF
Condition 4: Cardiogenic Shock (AMI or HFrEF)

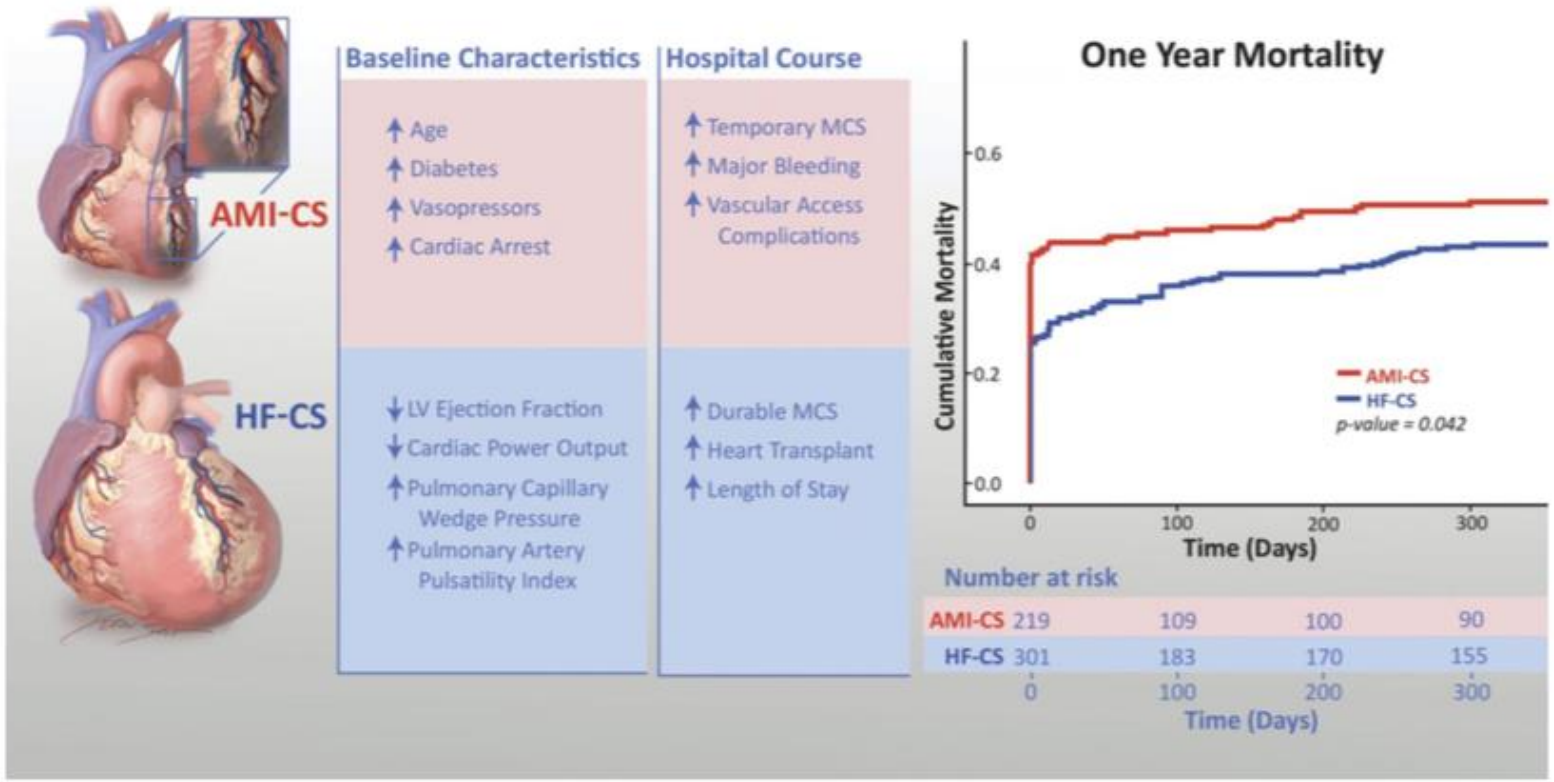
Circulation: Heart Failure
Volume 15, Issue 6, June 2022; Page e009279

ORIGINAL ARTICLE

Cardiogenic Shock From Heart Failure Versus Acute Myocardial Infarction: Clinical Characteristics, Hospital Course, and 1-Year Outcomes

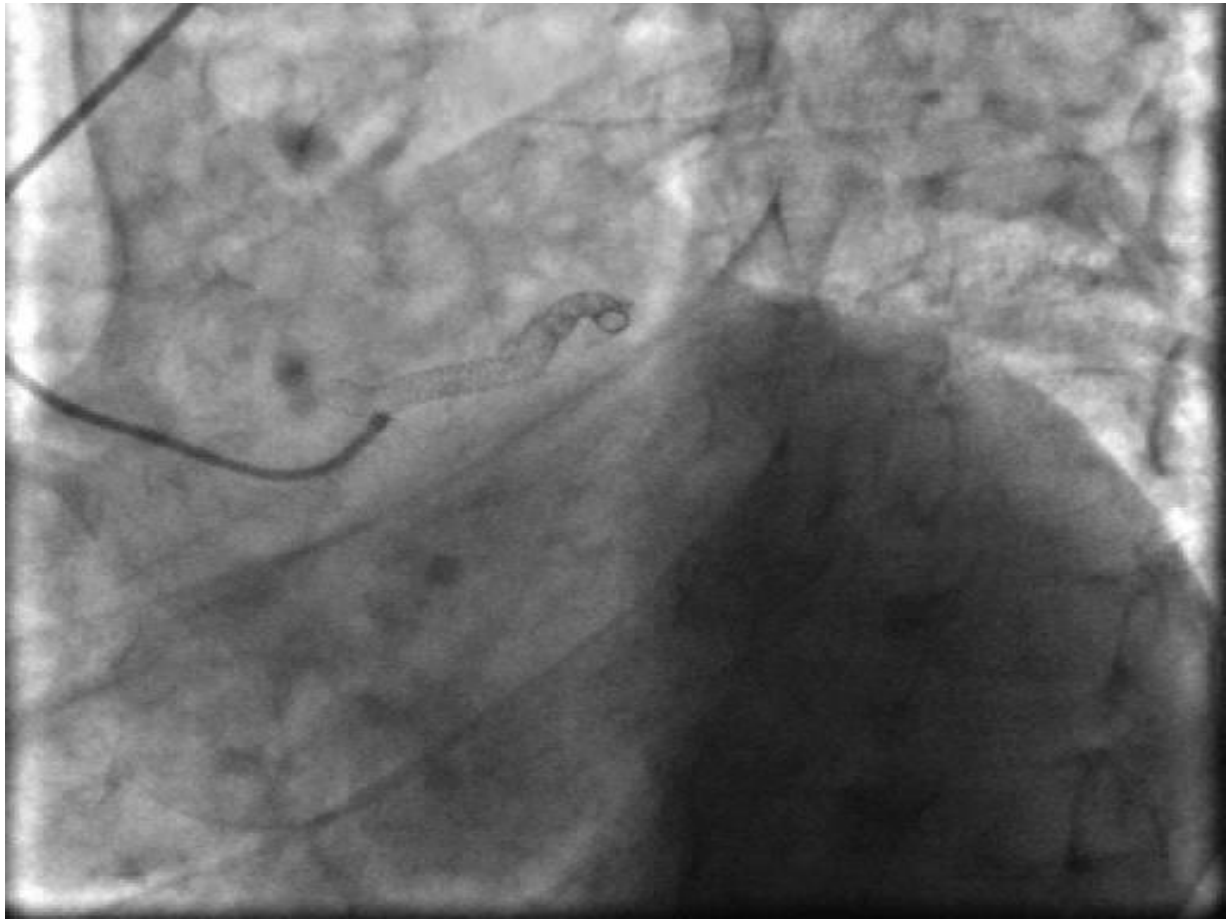
Shashank S. Sinha, MD, MSc*, Carolyn M. Rosner, MSN, NP-C, MBA*, Behnam N. Tehrani, MD, Aneel Maini, BS, Alexander G. Truesdell, MD, Seiyon Ben Lee, PhD, Pramita Bagchi, PhD, James Cameron, MS, Abdulla A. Damluji, MD, PhD, MPH, Mehul Desai, MD, Shashank S. Desai, MD, MBA, Kelly C. Epps, MD, Christopher deFilippi, MD, M. Casey Flanagan, MD, Leonard Genovese, MD, Hala Moukhachen, MD, James J. Park, BA, Mitchell A. Psotka, MD, PhD, Anika Raja, BS, MPH, Palak Shah, MD, MS, Matthew W. Sherwood, MD, MHS, Ramesh Singh, MD, Daniel Tang, MD, Karl D. Young, PA, Timothy Welch, MD, Christopher M. O'Connor, MD, and Wayne B. Batchelor, MD, MHS

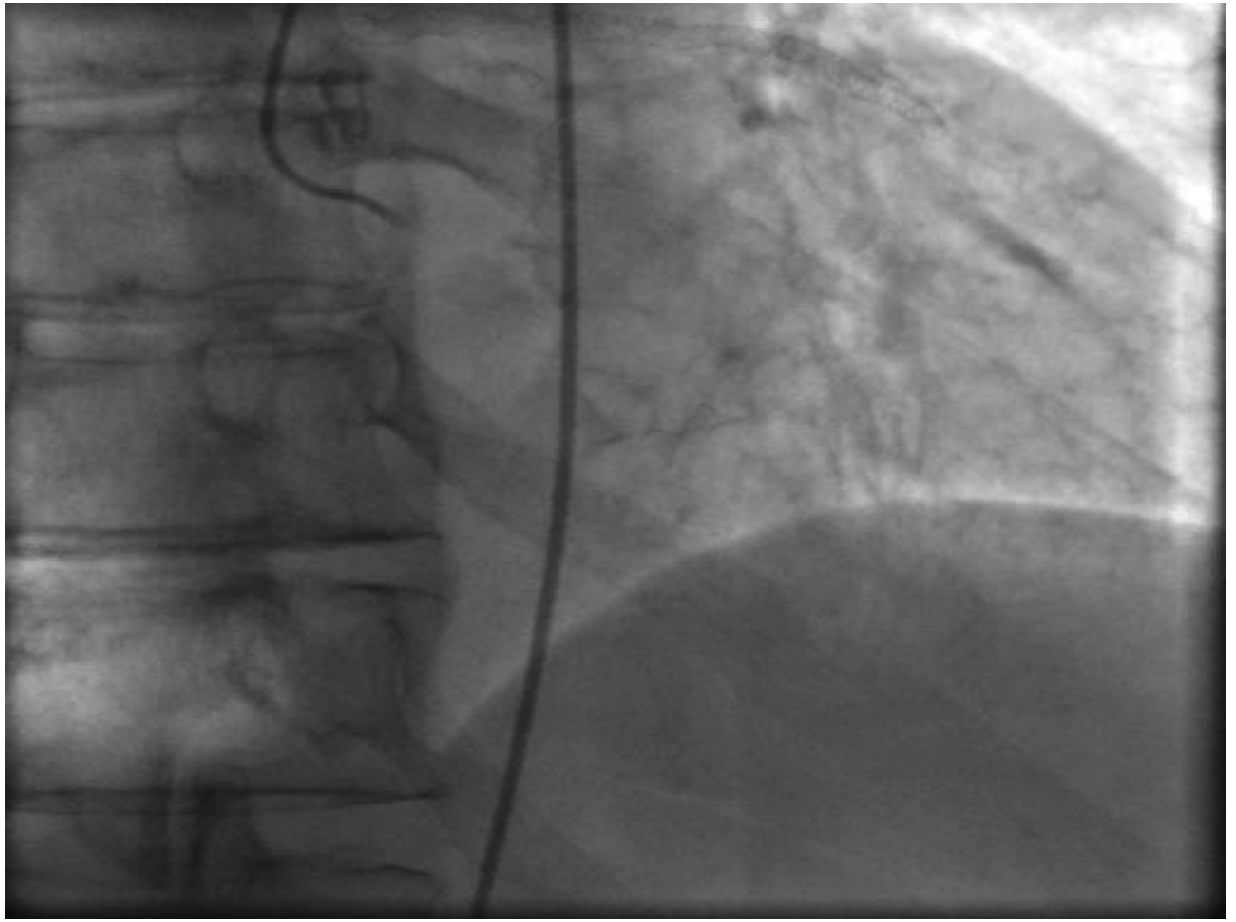
"the acute onset seen in the AMI-CS phenotype may be associated with less tolerance of the hemometabolic perturbation. In contrast, patients with HF-CS appear to have an acute on chronic presentation with a degree of chronic compensation"

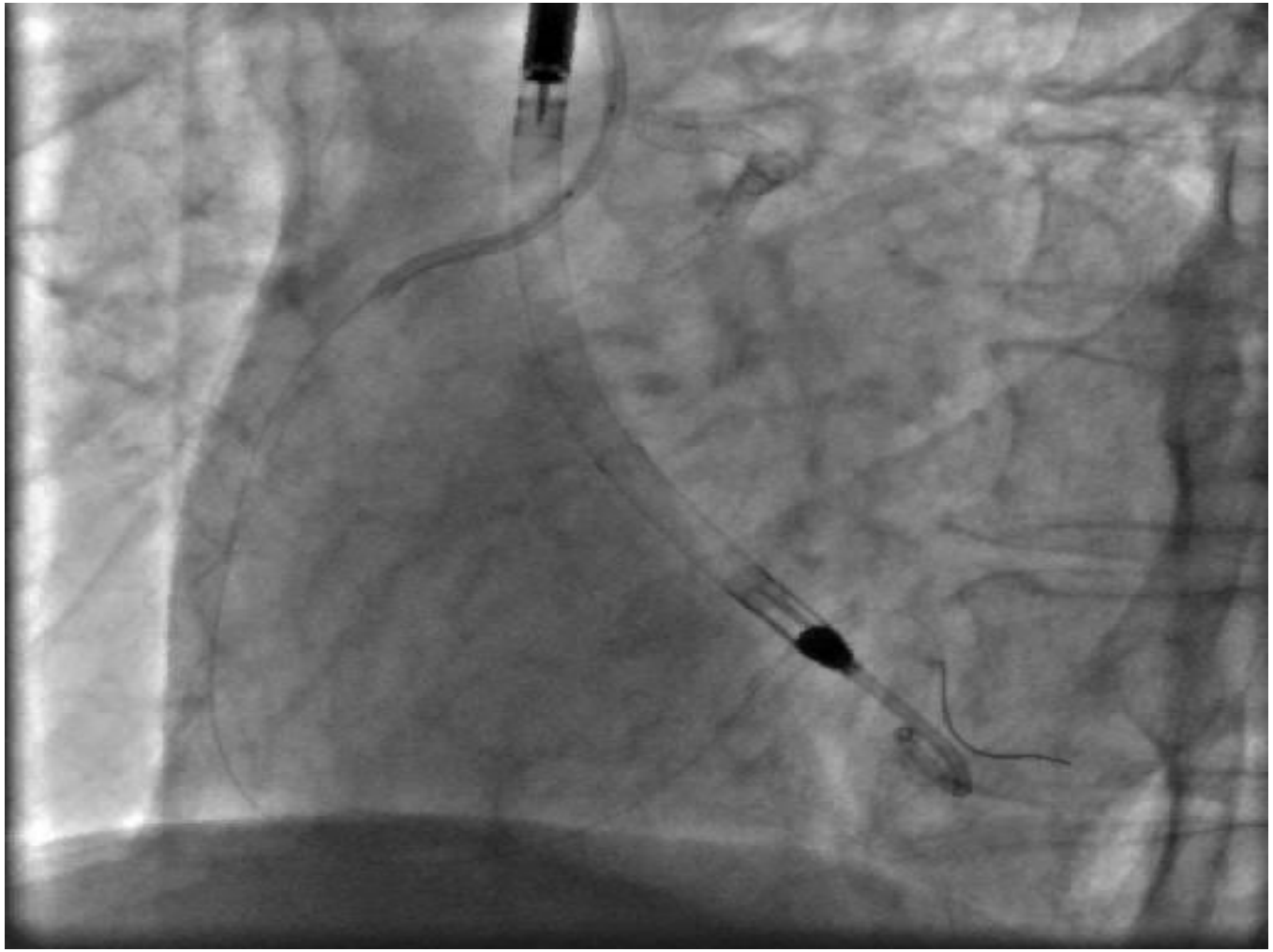


Case

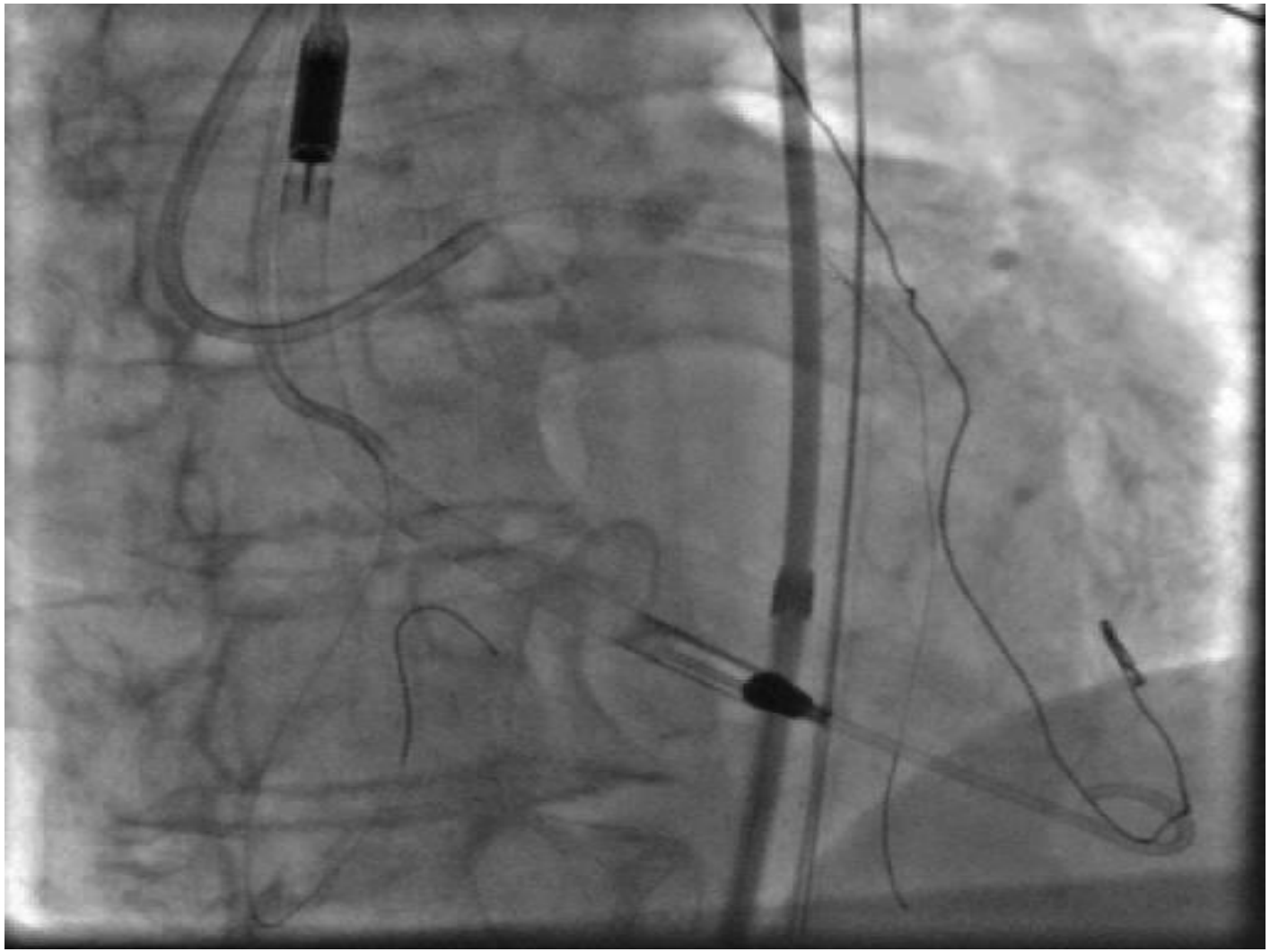
- 72 man referred for PCI to distal RCA and LM ISR CTO
- PMH: CAD s/p STEMI 2015 with LM PCI, ischemic HFrEF 20%, hepatitis C with cirrhosis c/b HCC s/p TACE, stroke, COPD
- TTE: LVEF 20%, anterior septal/apical and distal inferior HK, mild AI
- Cardiac MRI showed viable anterior wall
- Turned down by CT surgery as poor surgical candidate
- Meds: aspirin, ticagrelor, crestor, metoprolol succ, Aldactone

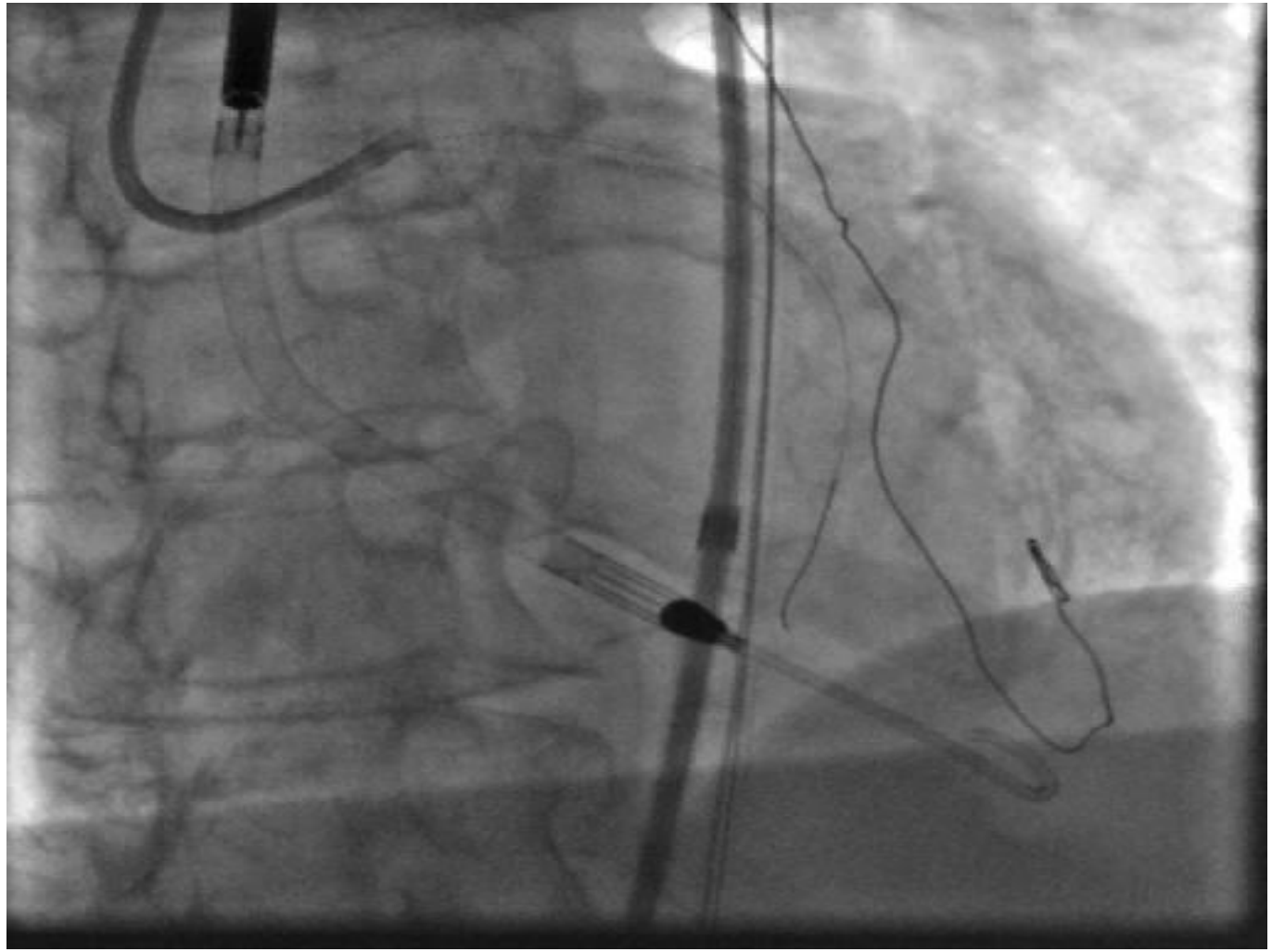


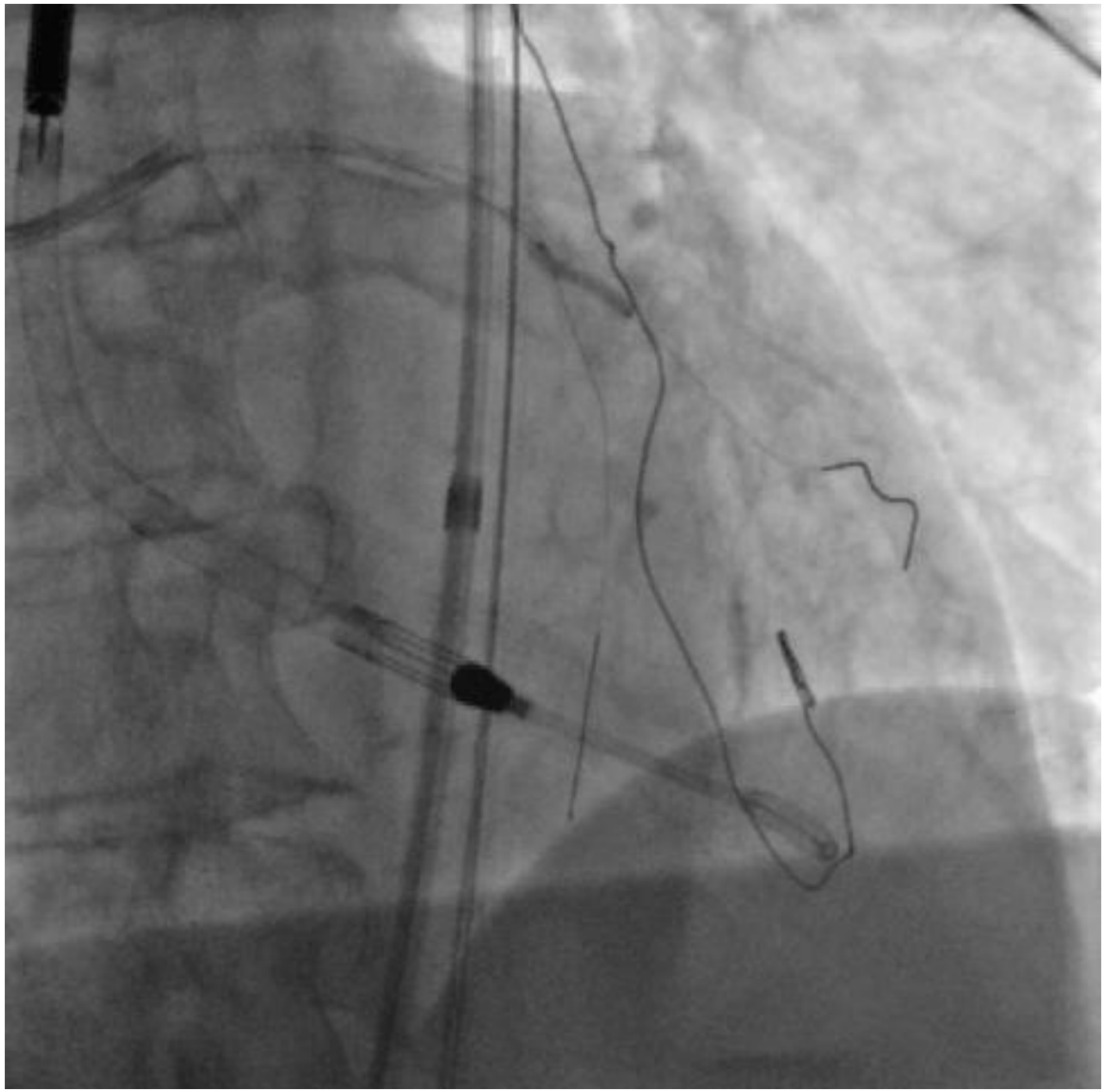


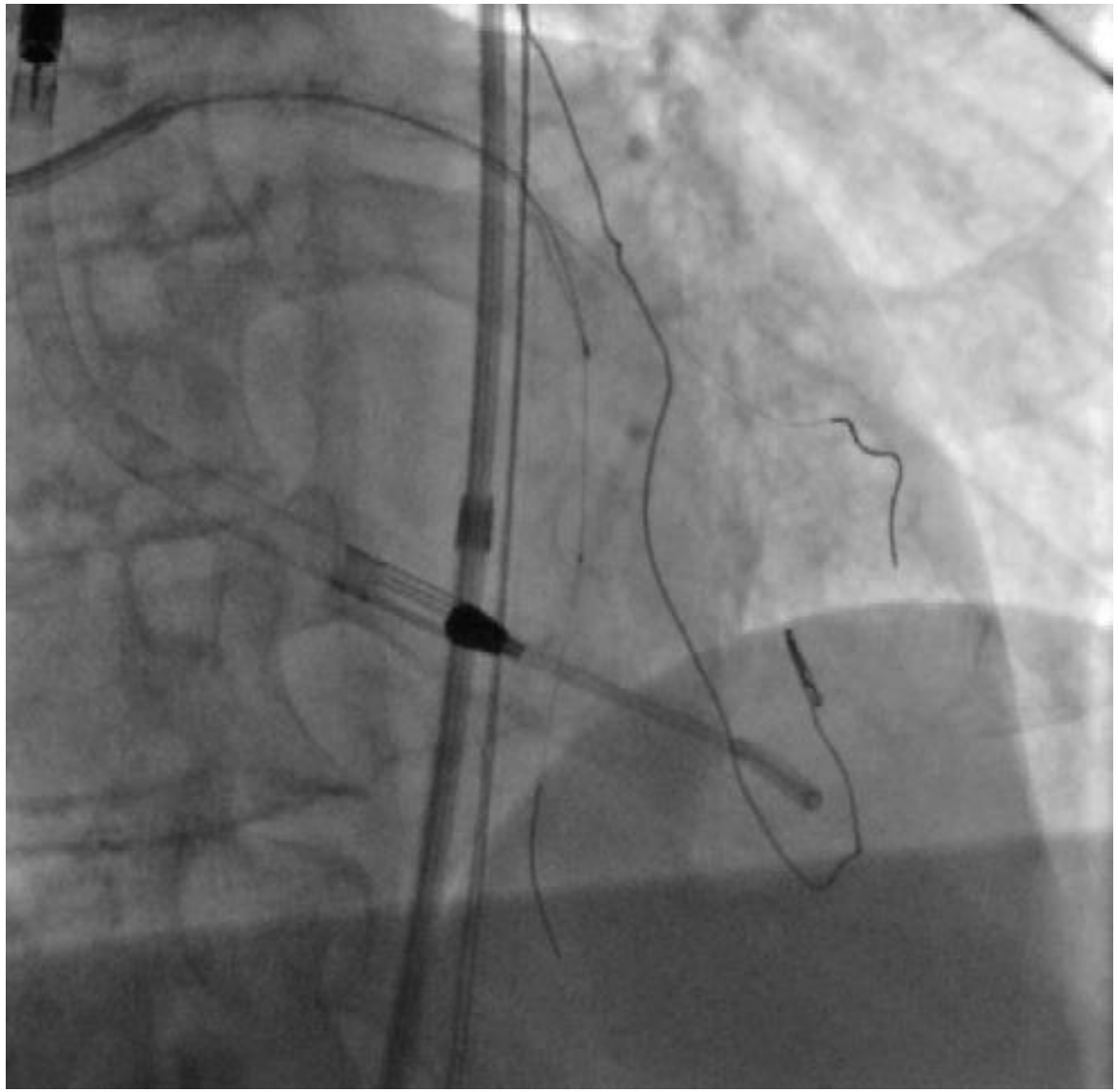


- **RHC**
- **IMPELLA placement**
- **PCI of the RCA**

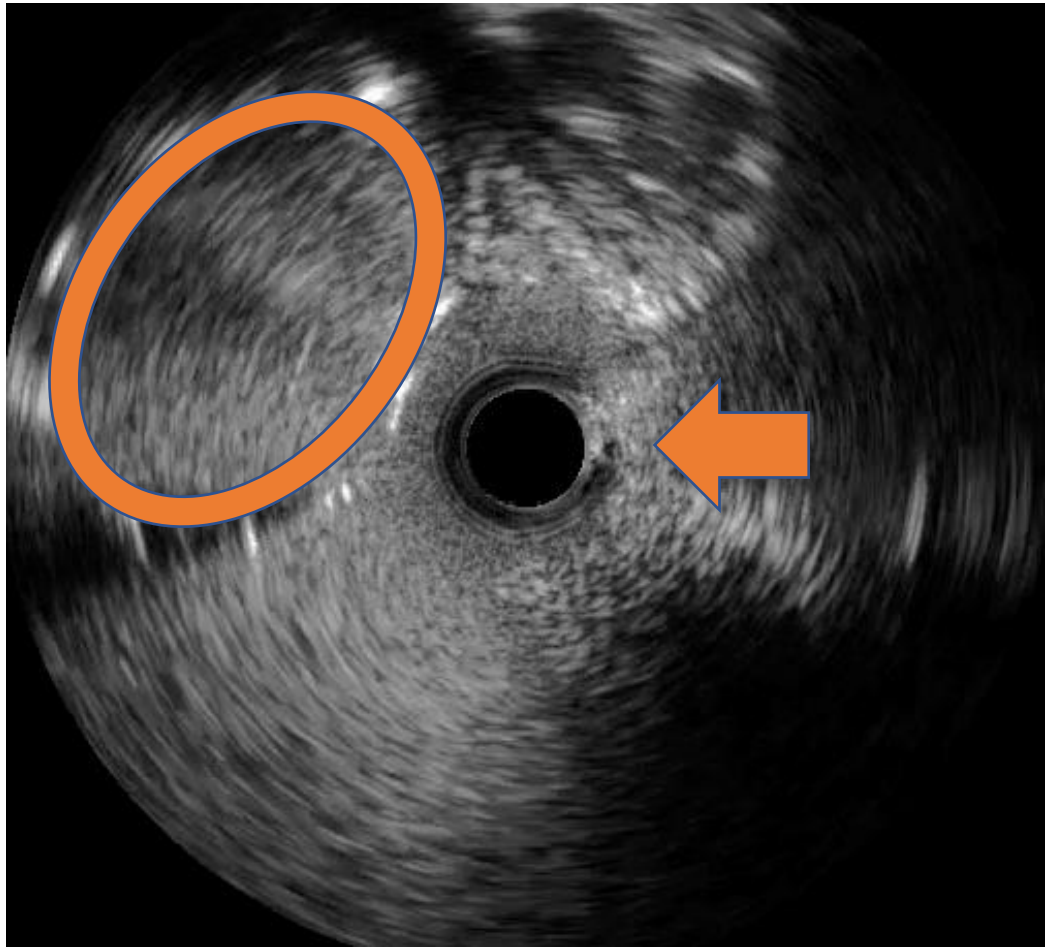


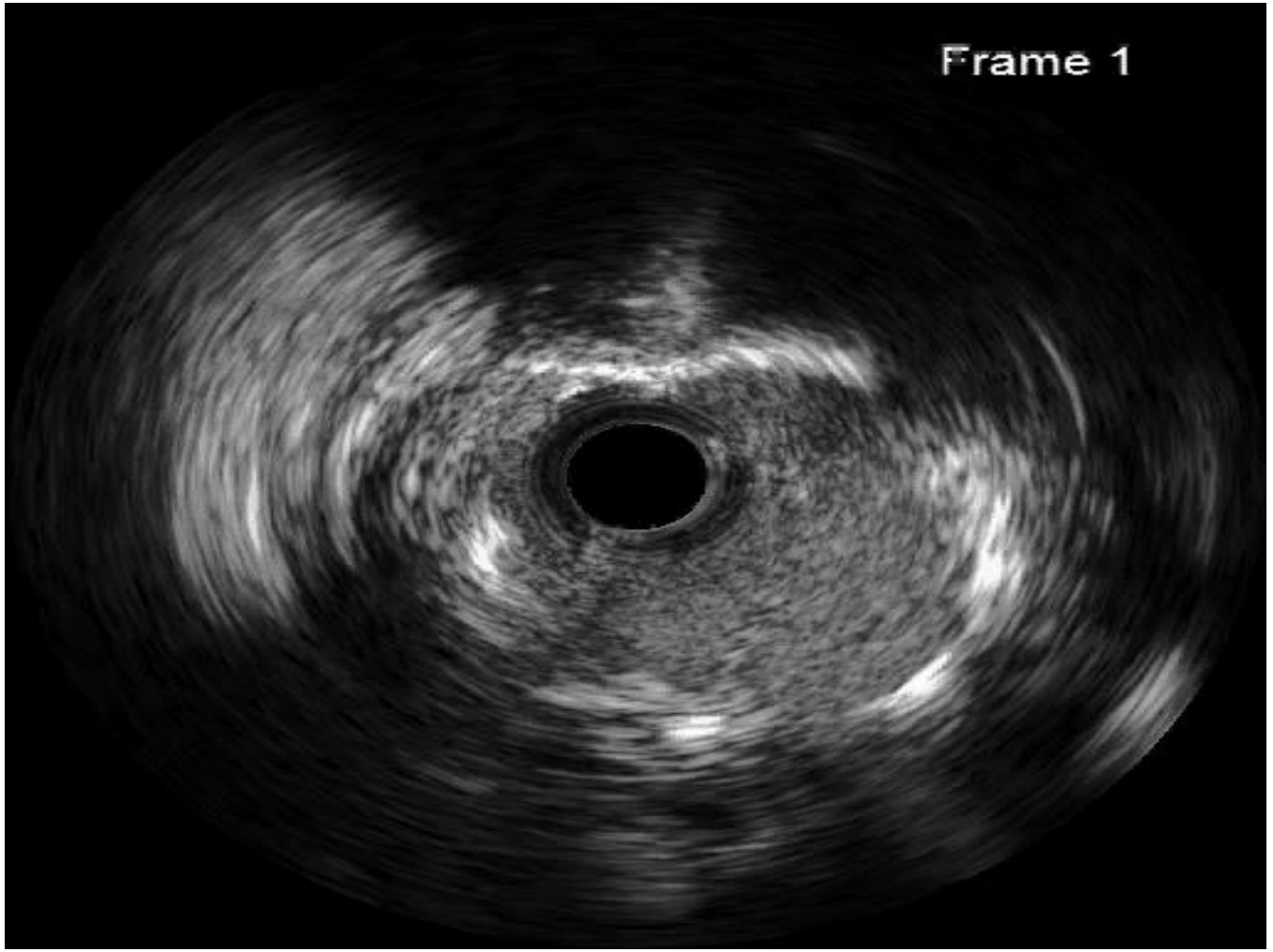


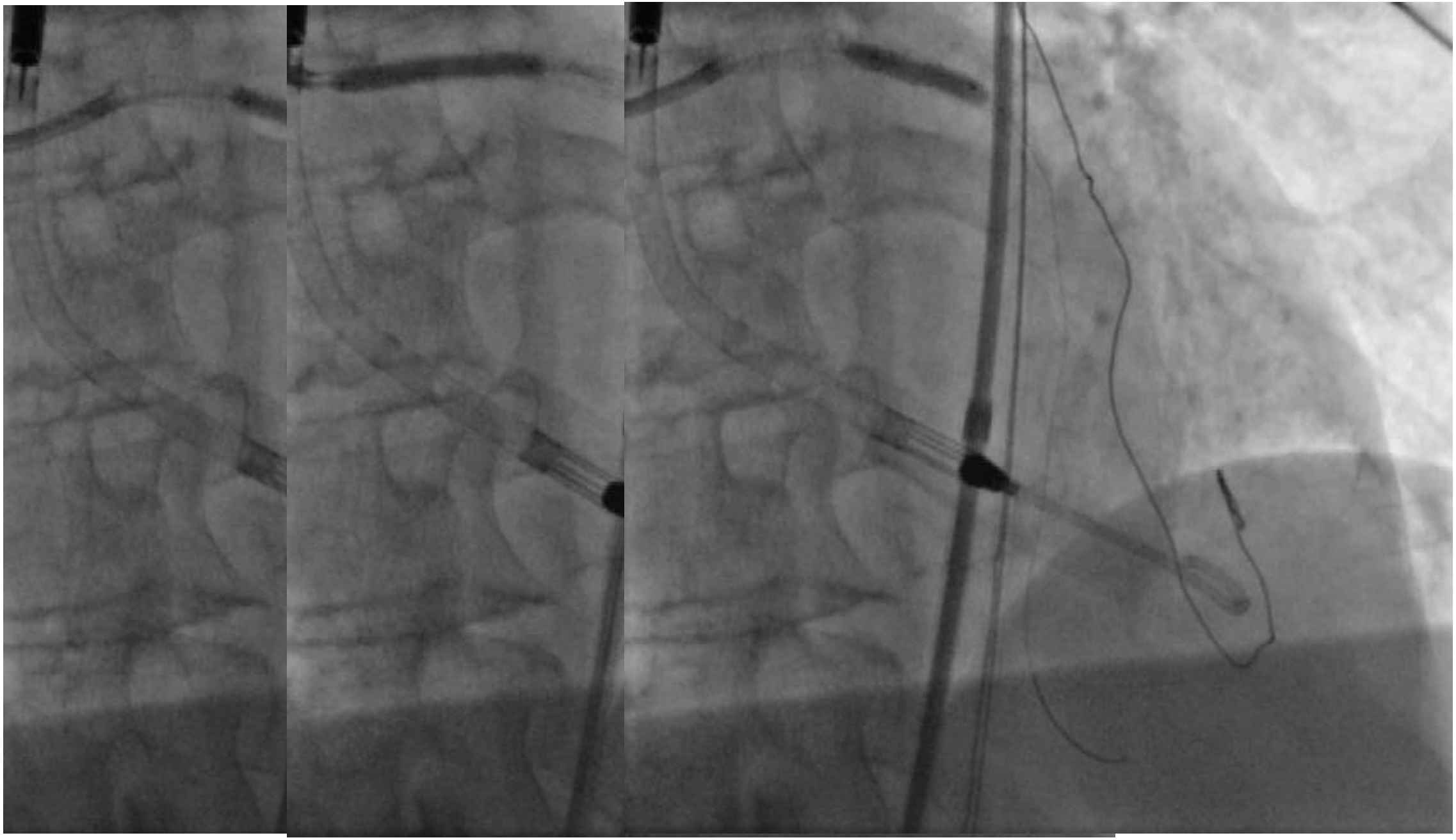




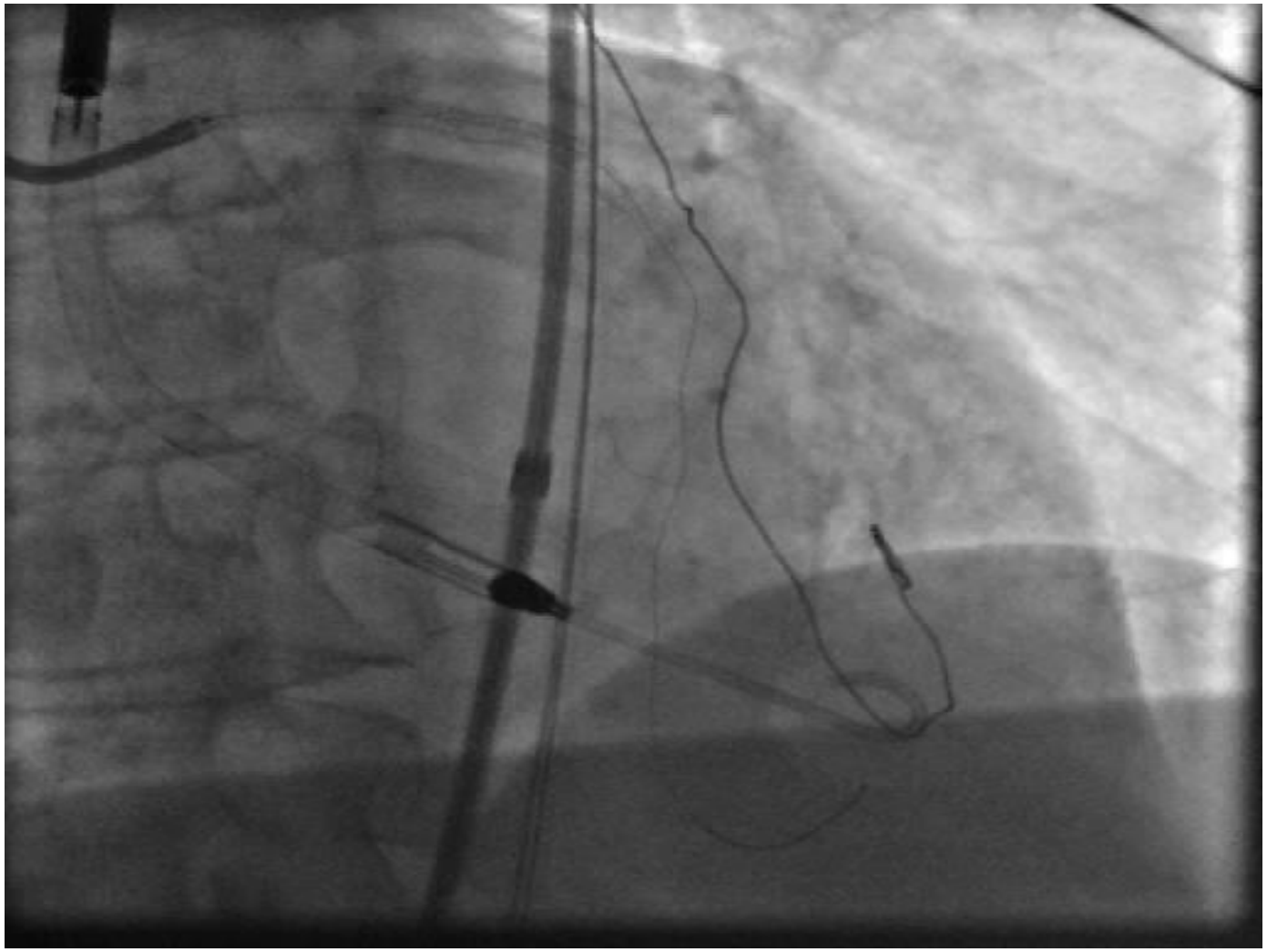
IVUS

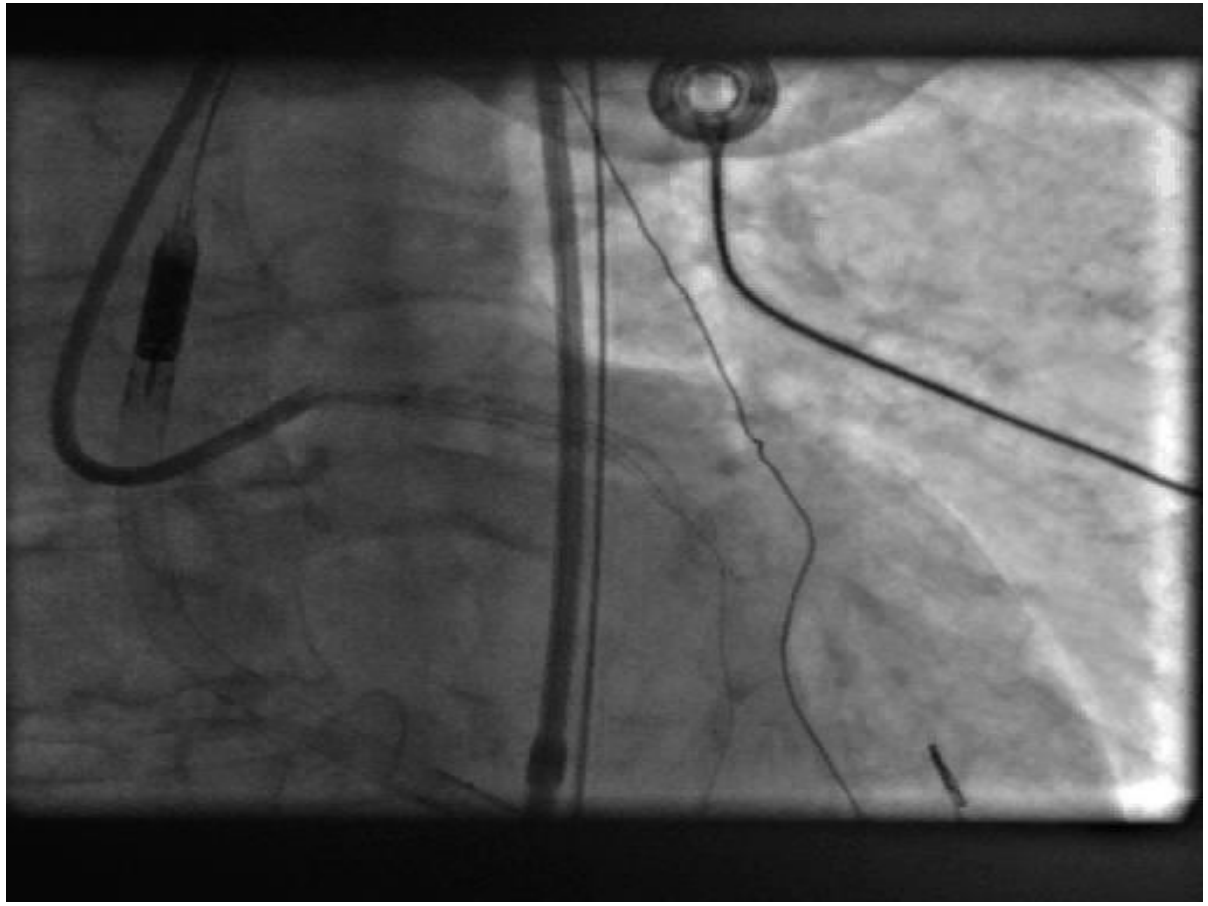


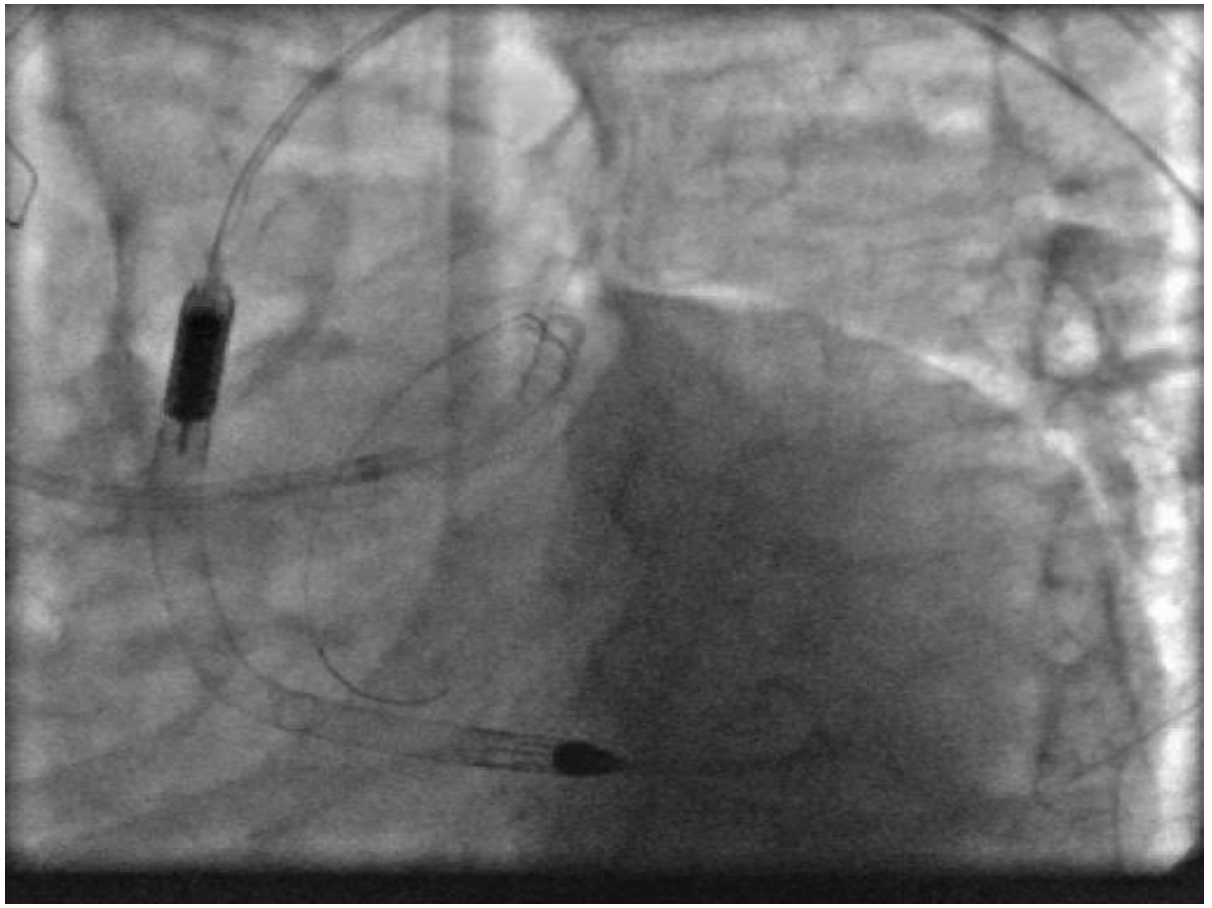




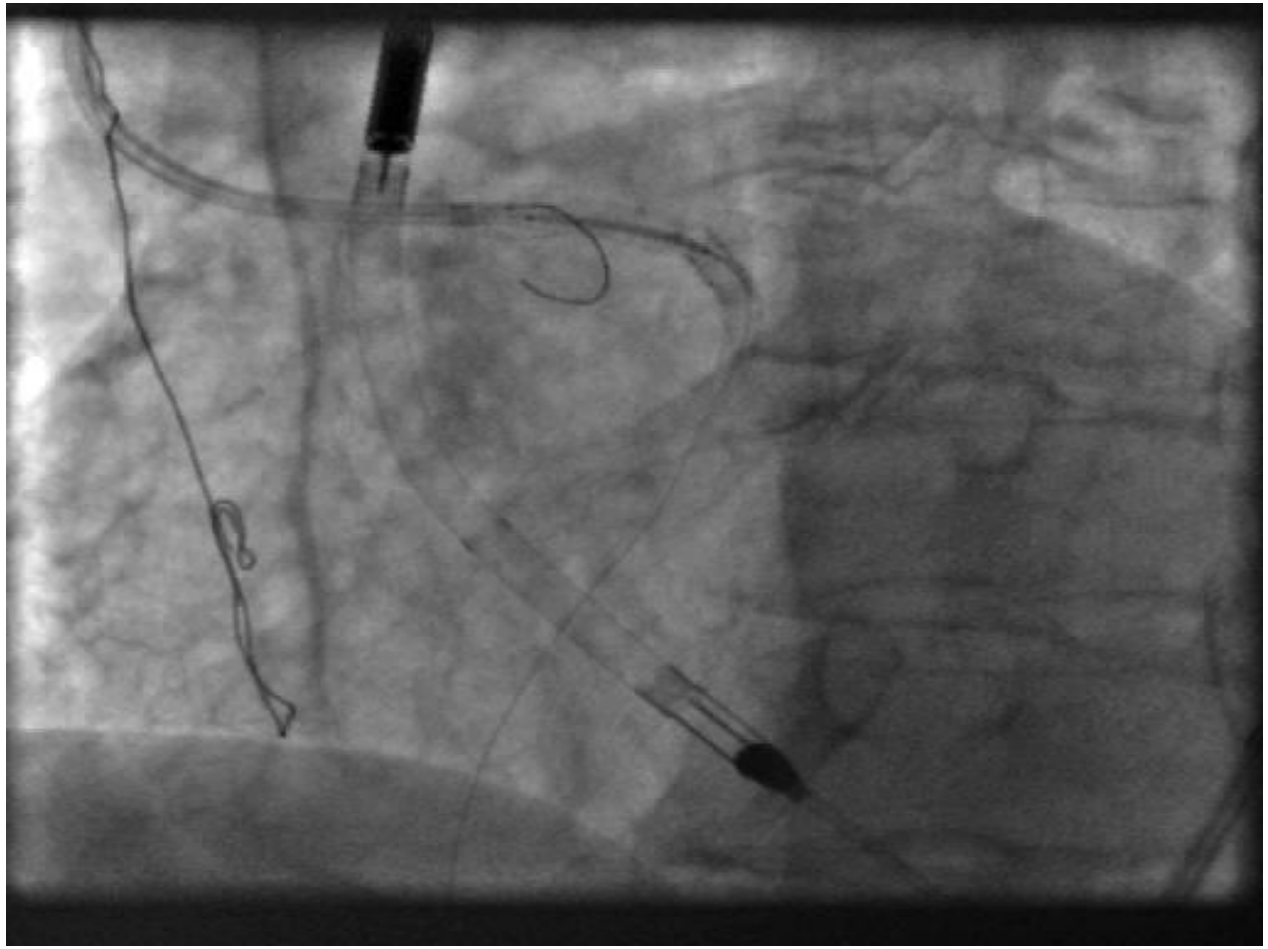
After stenting the mid LAD…

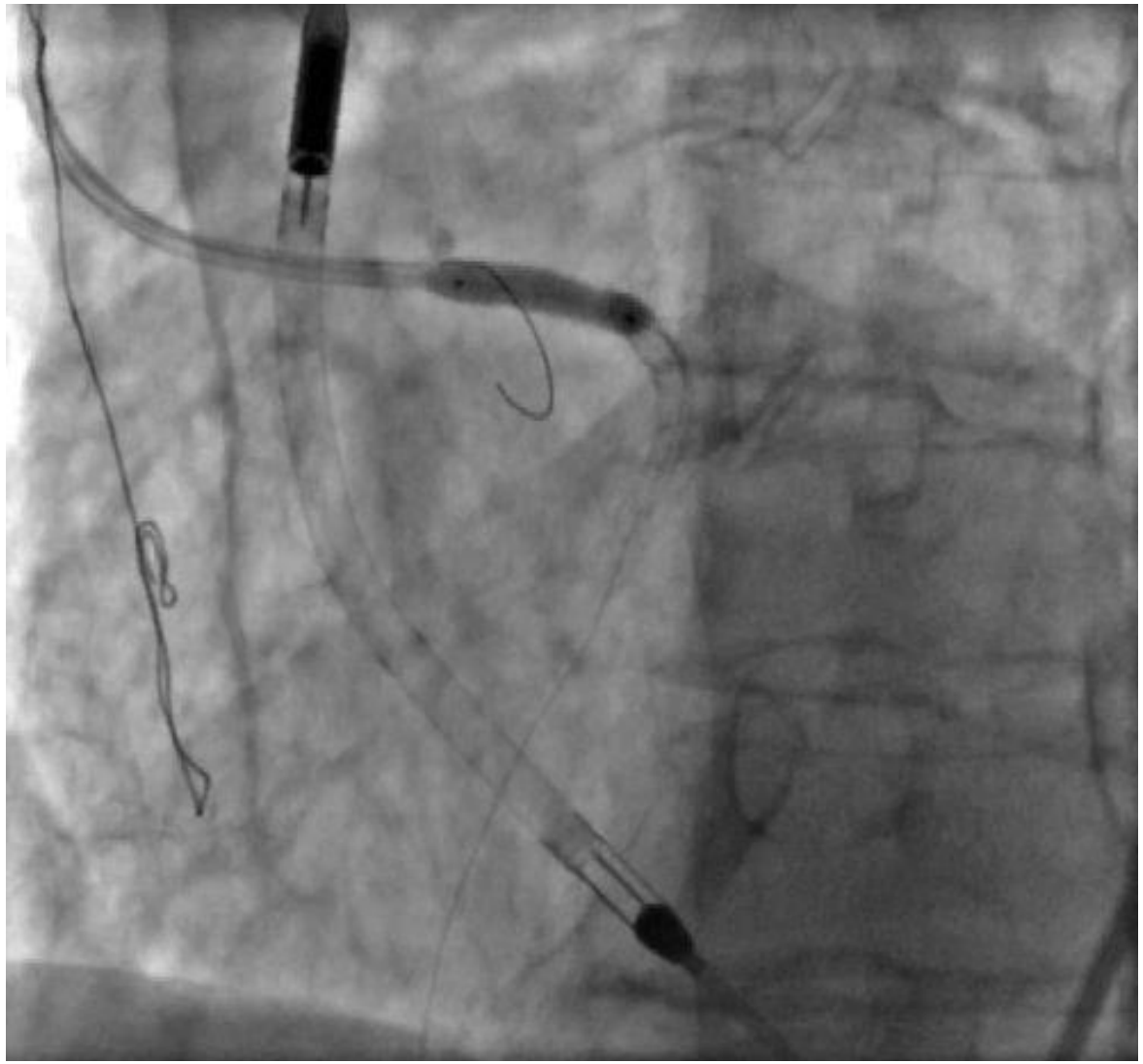


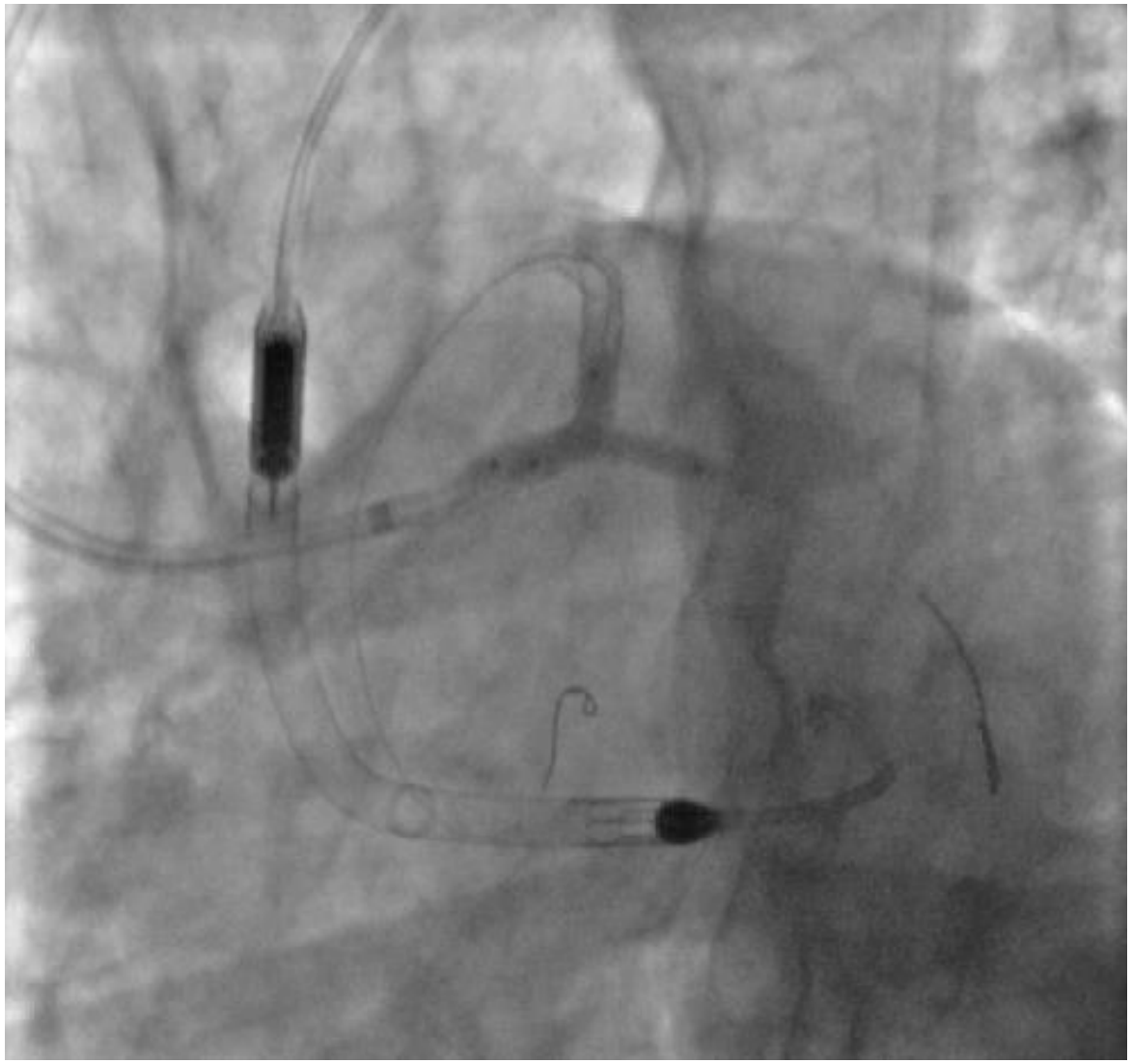


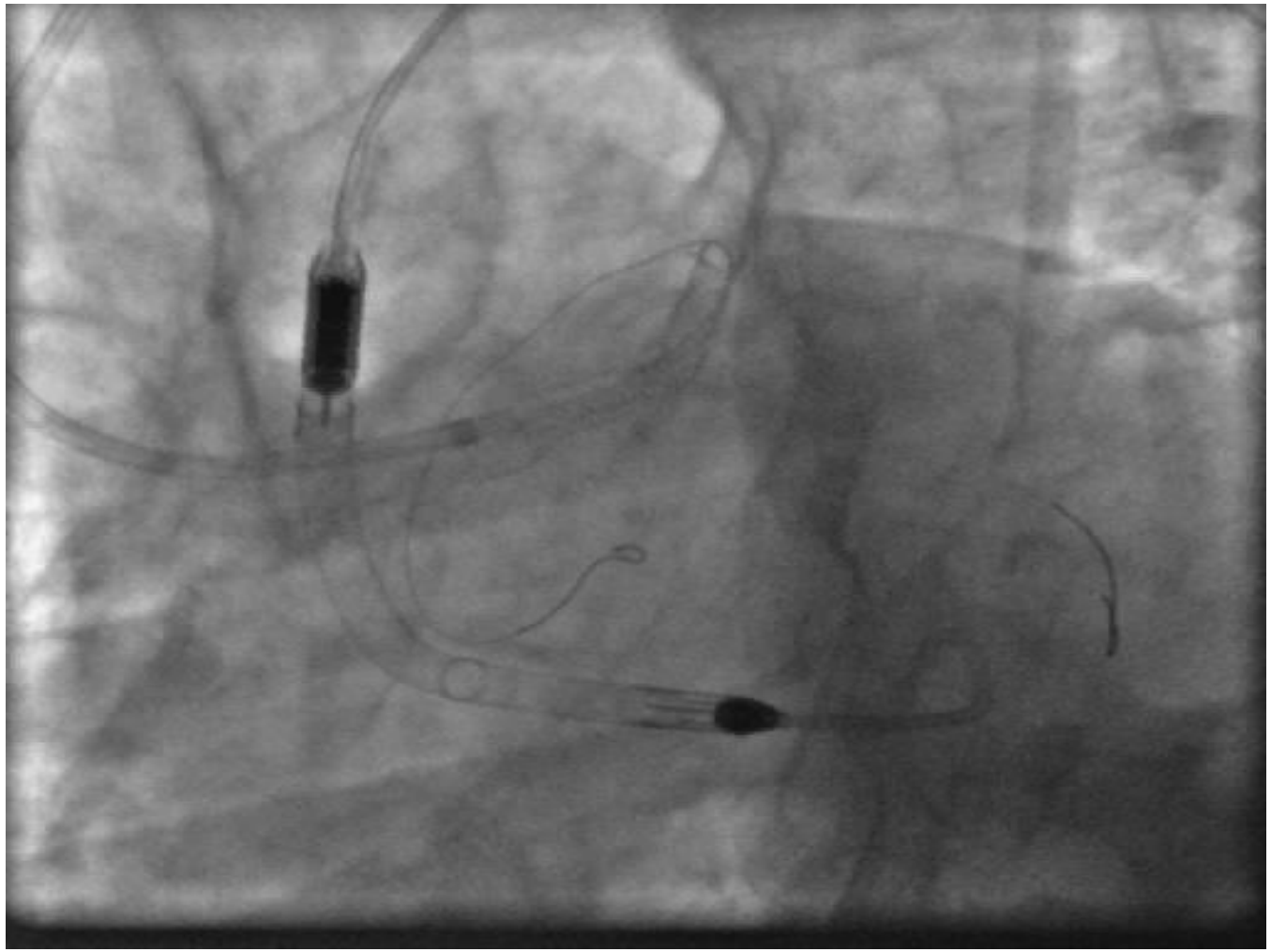


Deploy the LM/LAD stent

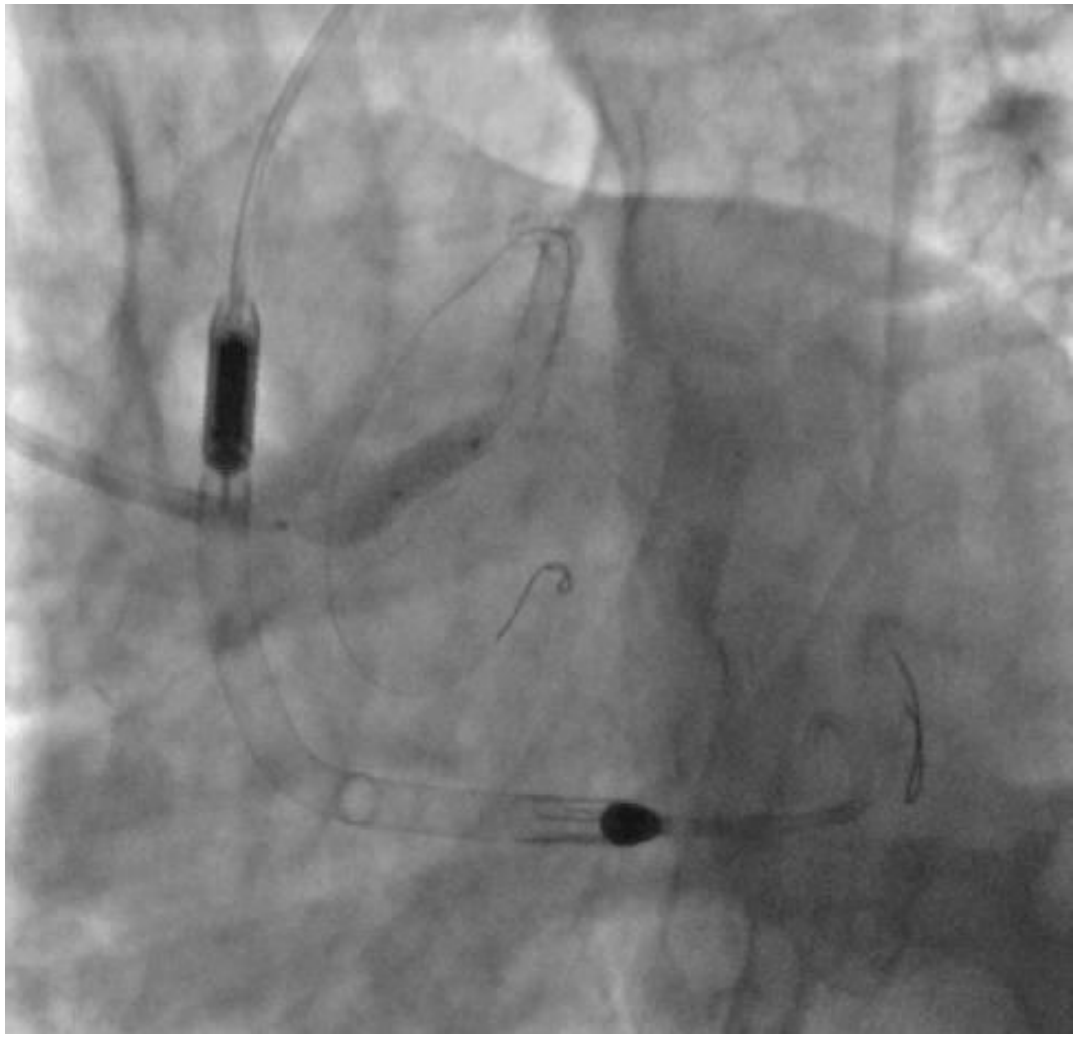


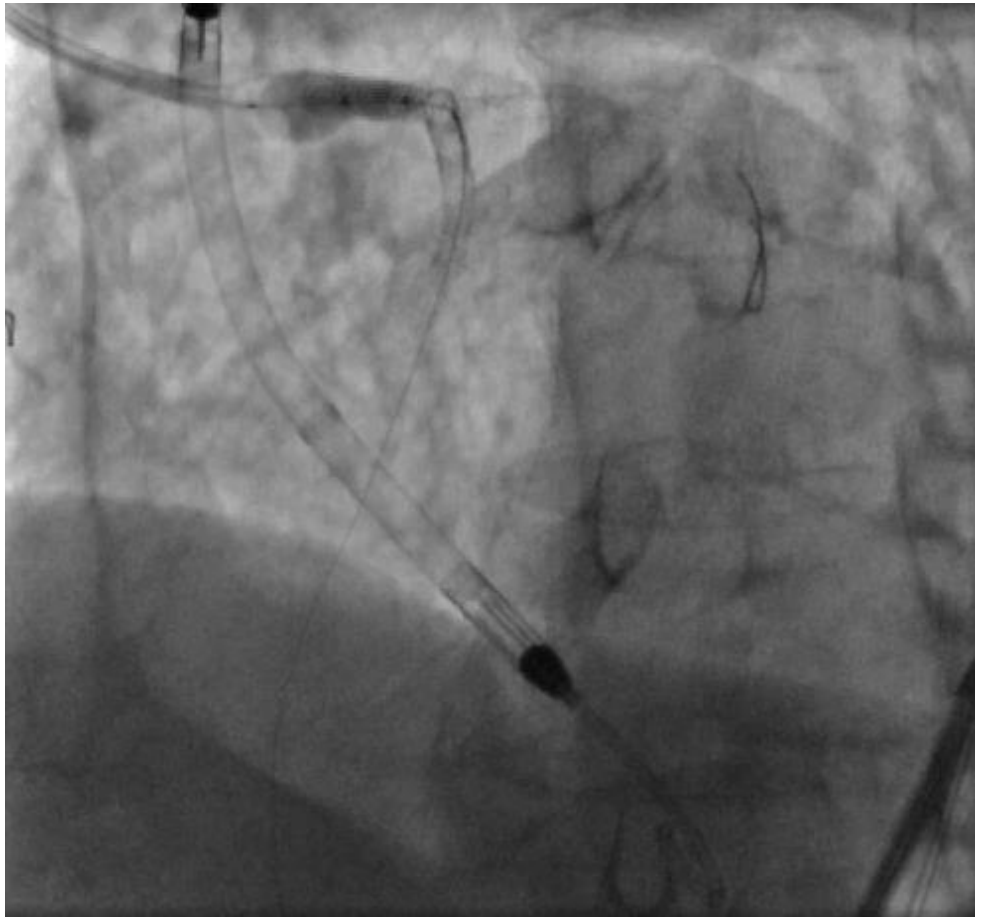






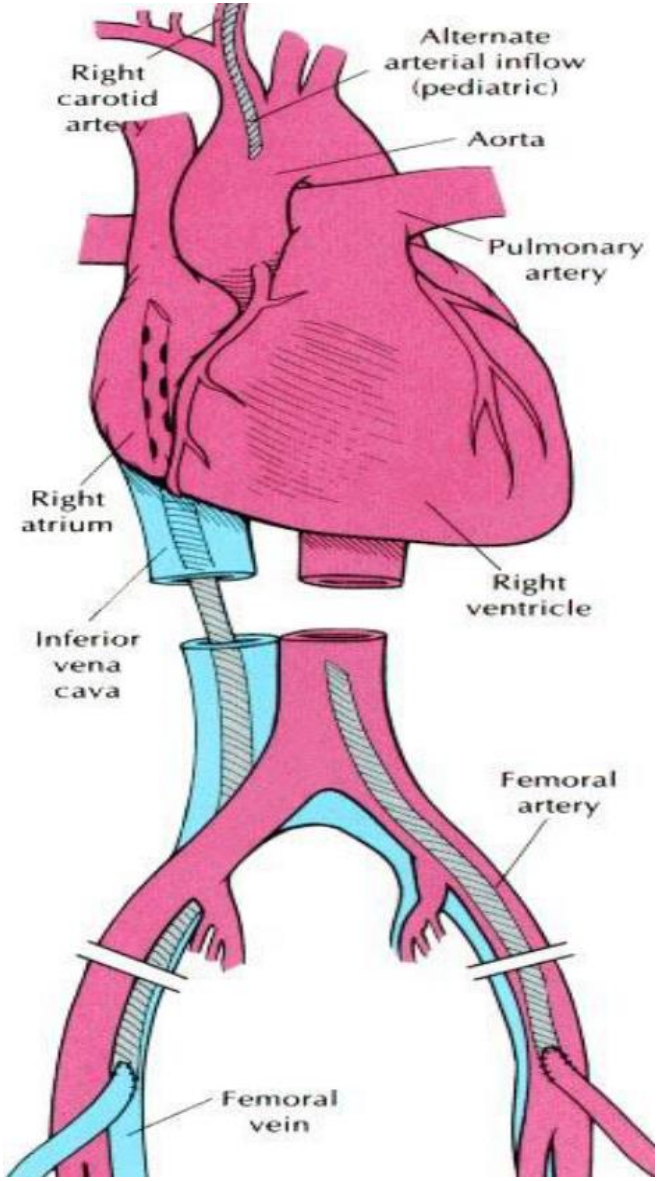
Ostial flash balloon





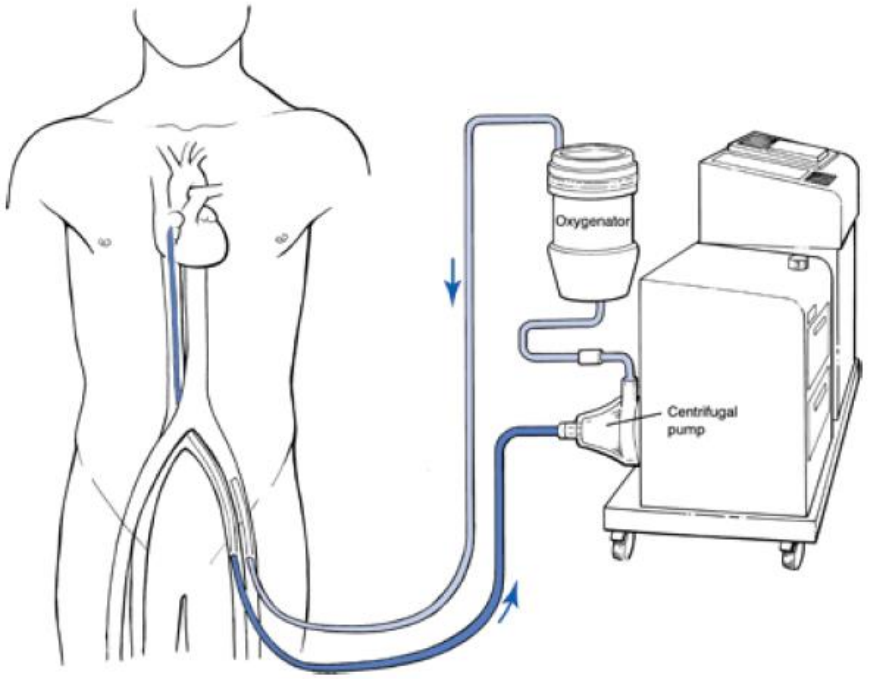
ECMO

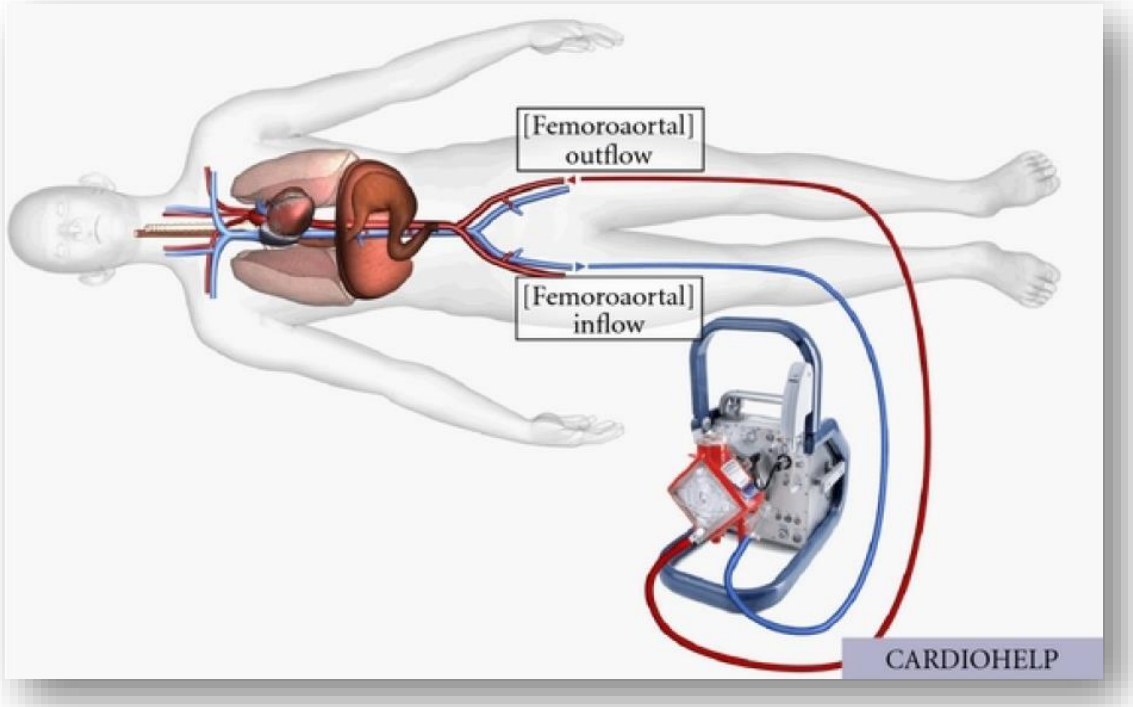
ECMO



VA ECMO is composed of:

- **Inflow cannula**
- **Tubing**
- **Pump**
- **Oxygenator**
- **Heat-exchanger**
- **Outflow cannula**

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outflow
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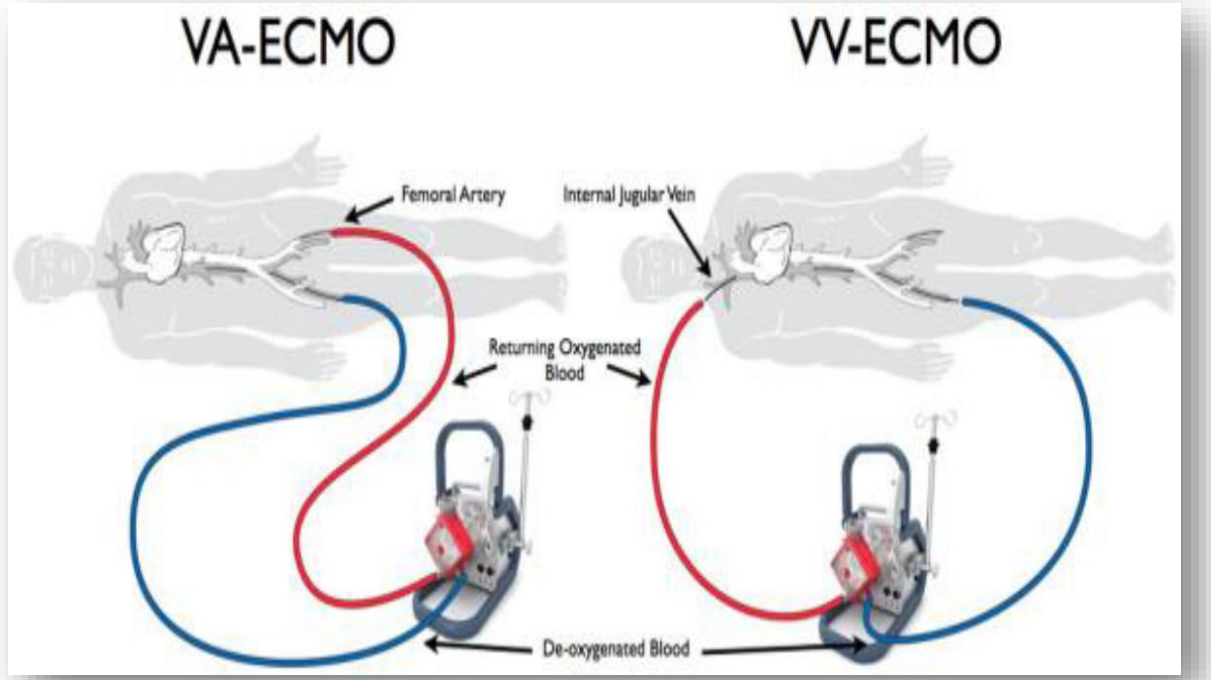
inflow
CARDIOHELP

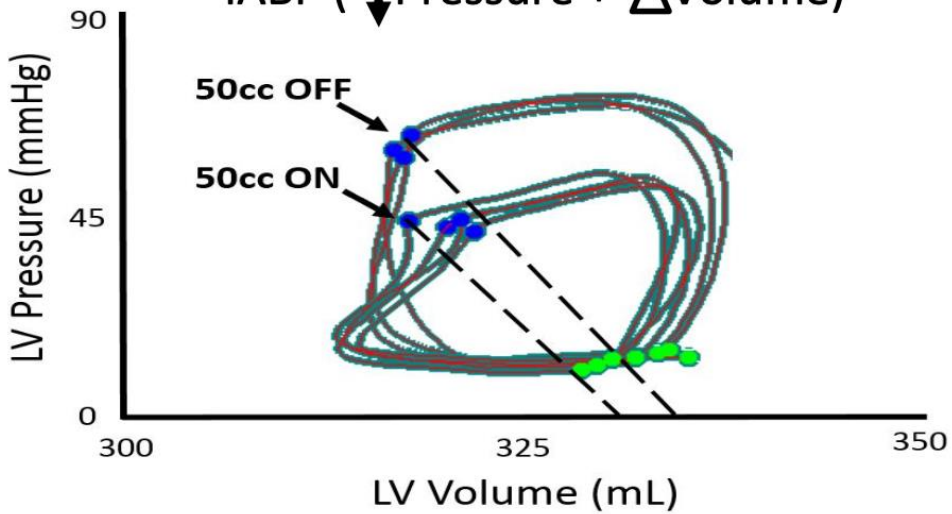

VA-ECMO
VV-ECMO
Femoral Artery
Internal Jugular Vein
Returning Oxygenated
Blood
De-oxygenated Blood

VA ECMO

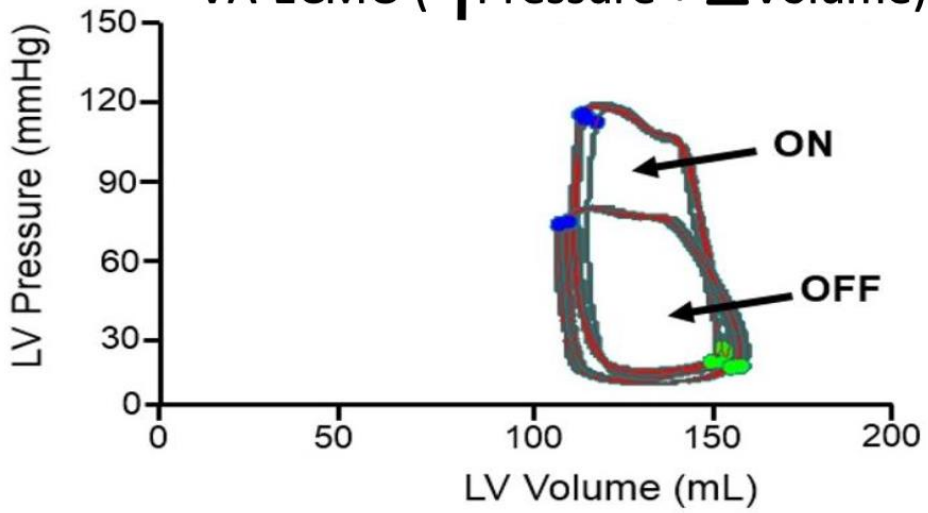
Heart

Hemodynamic Effects of MCS Therapy

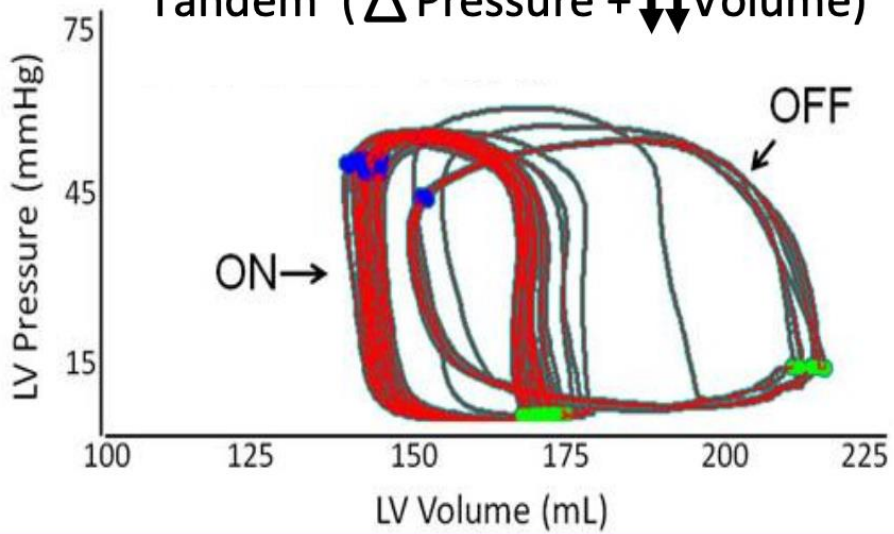
IABP (↓Pressure + ΔVolume)



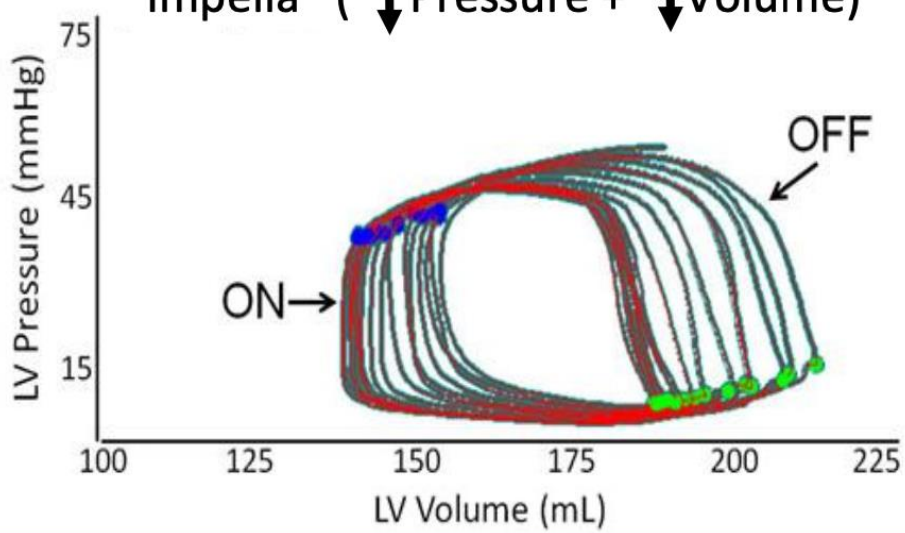
VA-ECMO (↑Pressure + ΔVolume)



Tandem (Δ Pressure + ↓↓Volume)



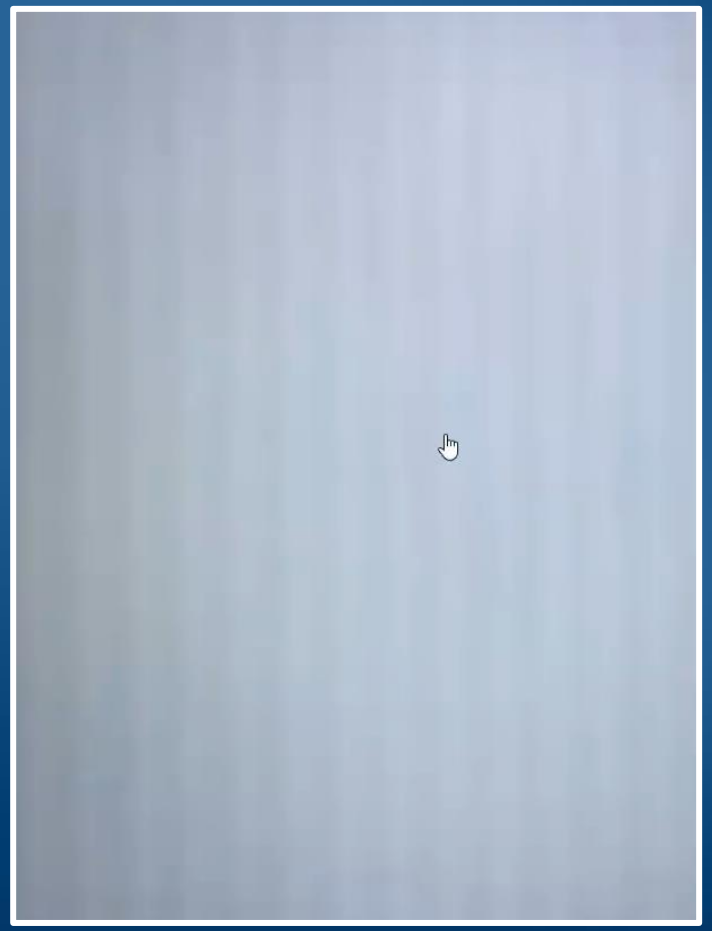
Impella (↓Pressure + ↓Volume)

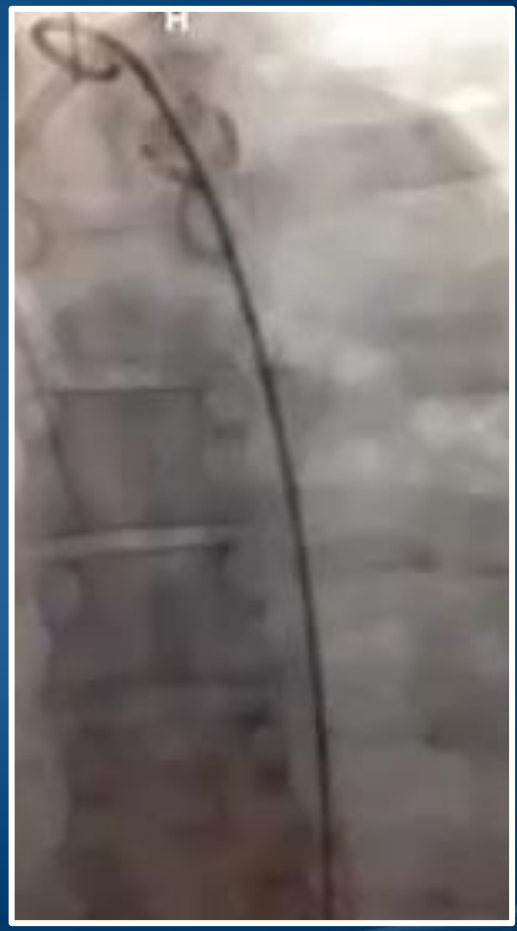


Annamalai et al JHLT 2016; Esposito et al ASAIO 2016; Kapur et al. ASAIO 2016

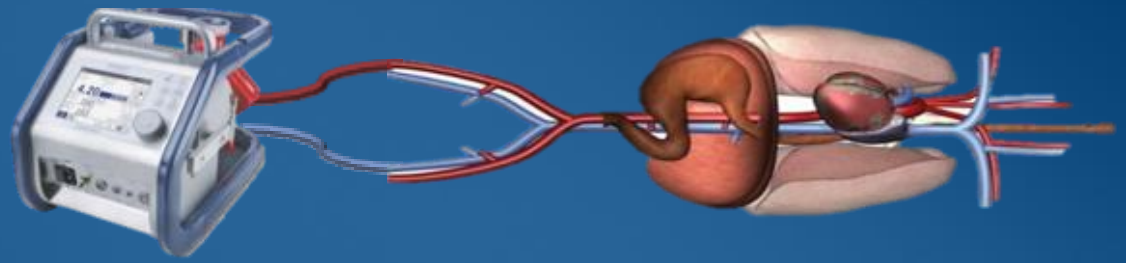
The Need for Active Unloading in CS

- Further Impairment of Vulnerable LV
- Retrograde Perfusion
- LV Thrombus Formation





V-A ECMO Loads the Left Ventricle



Flow

MAP

LVEDP and LVEDV

Wall Tension

LAP

Mechanical Work

Microvascular Resistance

Cardioprotective Signaling*

Myocardial Perfusion

Pulmonary Congestion

Cardiac Power Output

End Organ Perfusion

O_2 Supply

O_2 Demand

Reperfusion Injury*

Loads the Vulnerable LV

* Under study

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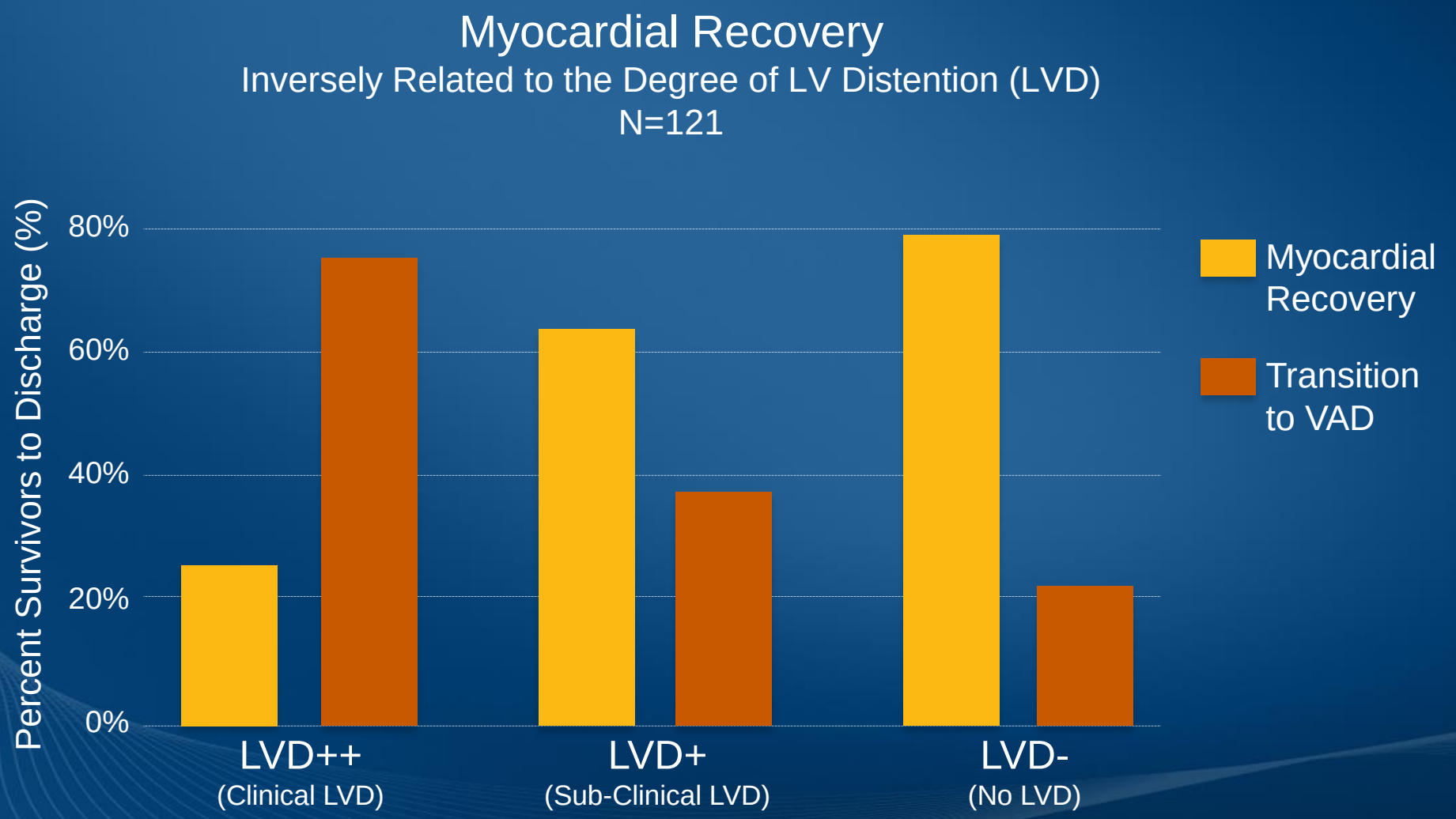
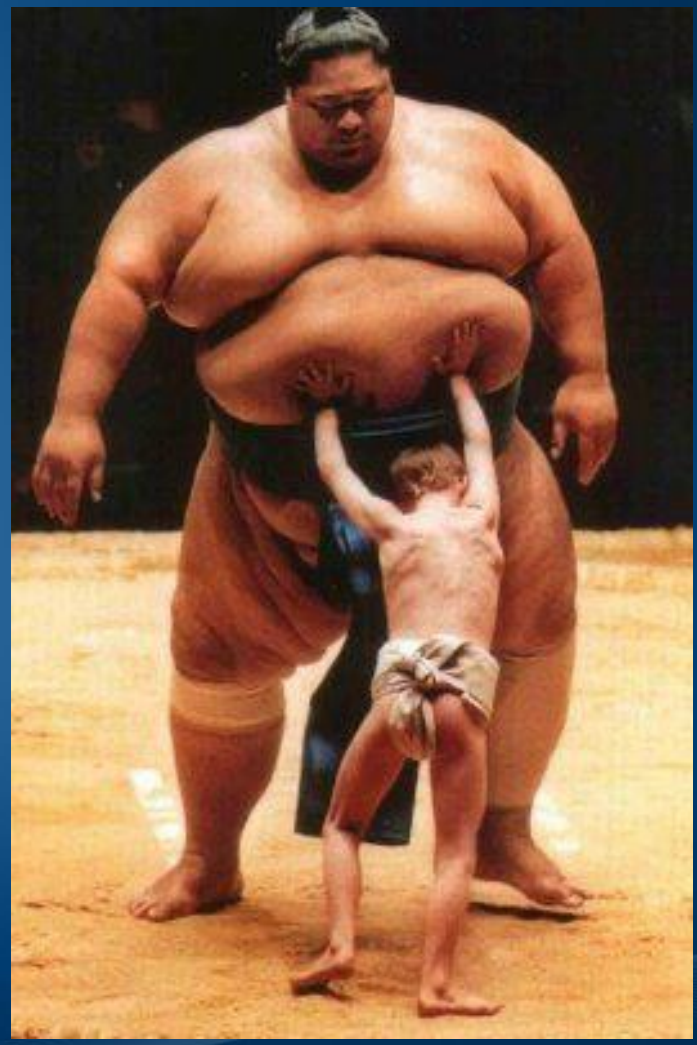
Effects of LV Distention During V-A ECMO



Truby, et al. ASAIO Journal 63(3):257-265, May/June 2017. (Figure 3)

VA ECMO

Heart



MCS complications

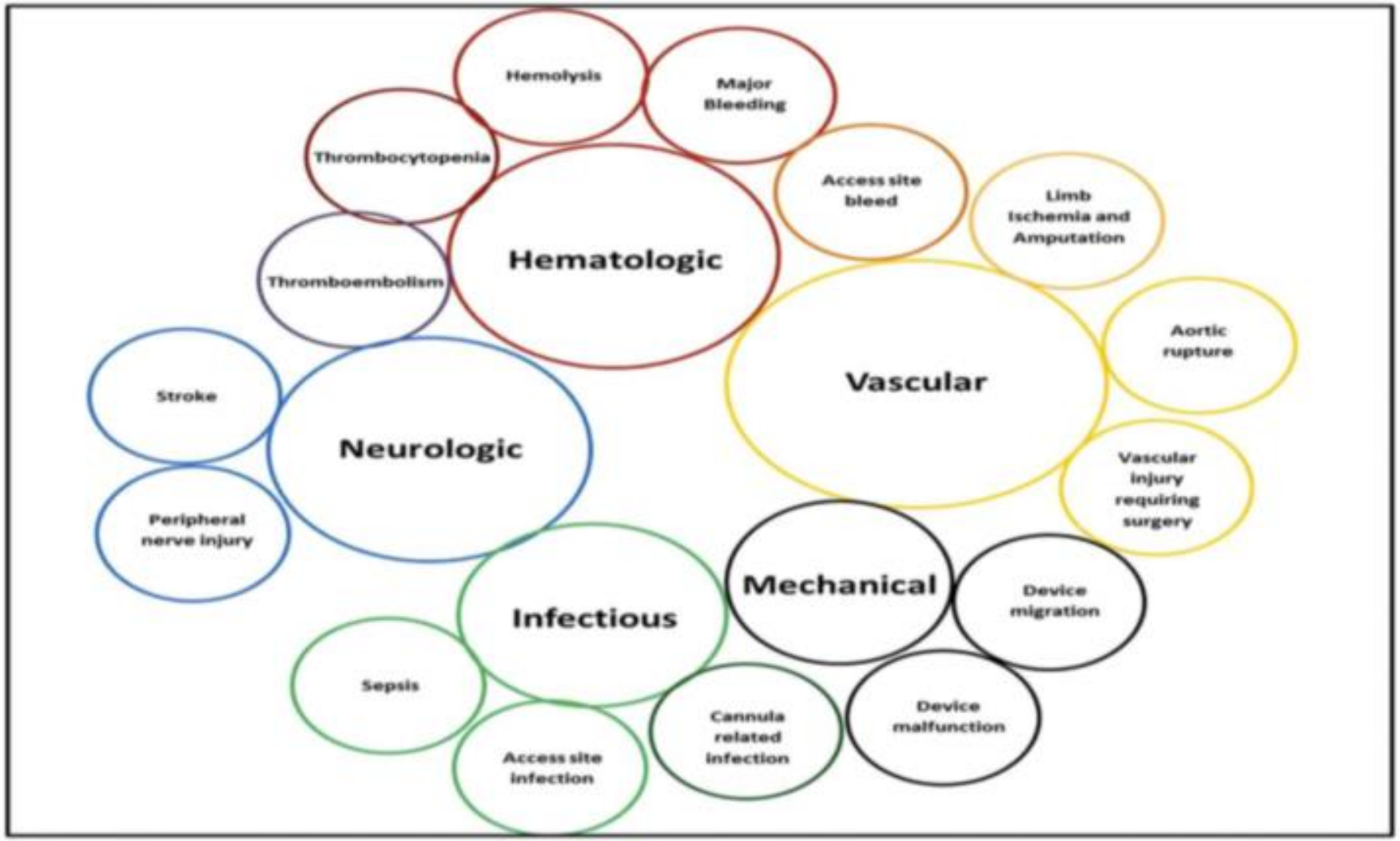


Fig. 1 Complications of MCS by category. Each *color* represents a unique complication category. Complications across more than one category are shown in a combination of colors of the two categories

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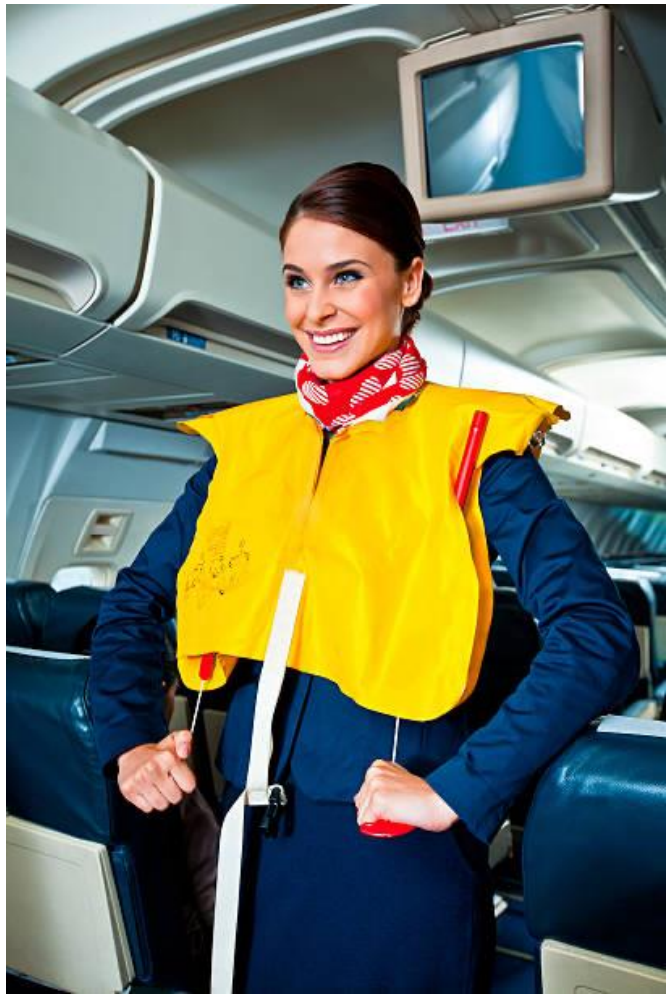
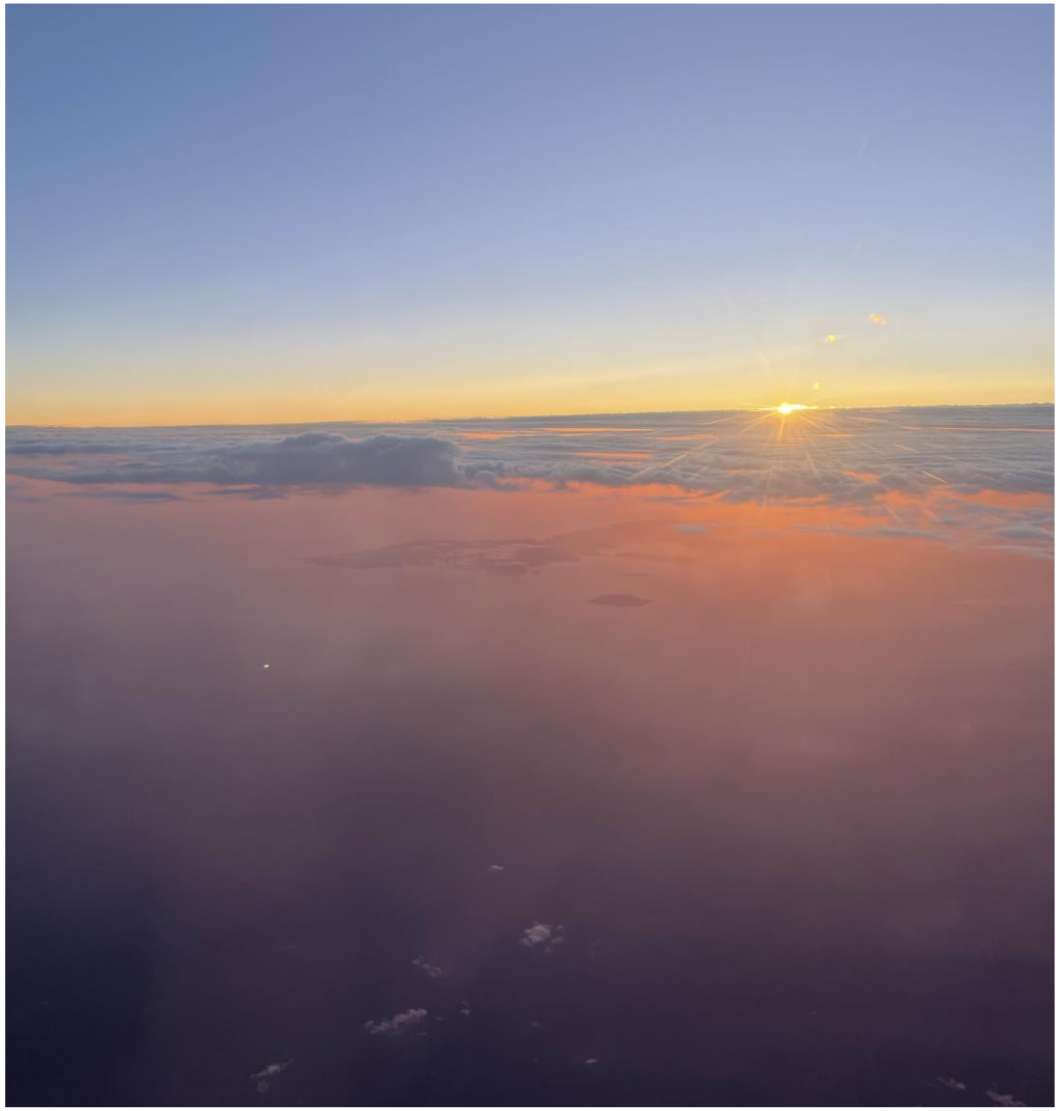


KEEP
CALM
&
FOLLOW
THE RULES



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Ευχαριστώ για την προσοχή σας