

Management of CTO Complications

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Disclosure Statement of Financial Interest

- None



**Outcomes, Patient health status, and Efficiency
in Chronic Total Occlusion hybrid procedures**

Complications

(N=1000 patients)

MACCE	70 (7.0%)	Perforations (all)	88 (8.8%)
Death	9 (0.9%)	Ellis grade 1	11 (12.5%)
MI	26 (2.6%)	Ellis grade 2	44 (50.0%)
Stroke	0 (0.0%)	Ellis grade 3	28 (31.8%)
Emergent surgery	7 (0.7%)	Ellis grade 3 cavity spilling	5 (5.7%)
Clinical perforation (Treated)	48 (4.8%)	Perforation Location	
		CTO Vessel	75 (85%)
		Non CTO vessel	3 (3.4%)
		Collateral	8 (9.1%)
		Septal	3 (37.5%)
		Epicardial	5 (62.5%)

Complications

(N=1000 patients)

Patient	In Hosp	Perforation	Periproc MI	Post CABG
1	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	No
3	Yes	Yes	No	No
4	Yes	Yes	No	Yes
5	Yes	Yes	No	No
6	Yes	Yes	No	No
7	Yes	Yes	No	Yes
8	Yes	Yes	No	Yes
9	Yes	Yes	No	Yes

All 9 deaths were associated with a perforation

*5/9 deaths associated with perforation were in post CABG patients
similar mortality of perforation with and without prior CABG (1.1% vs. 0.8%, p=0.62)*

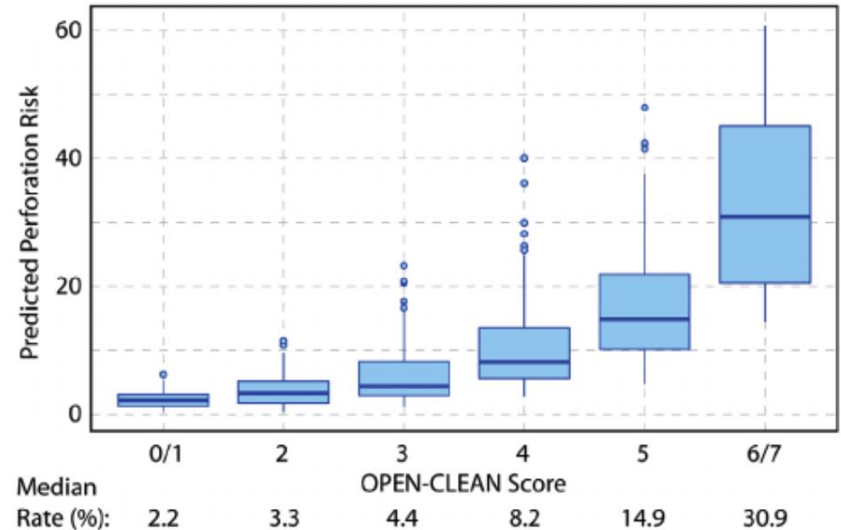
Perforations: Predictors

OPEN-CLEAN perforation score

TABLE 4 Five variables of the OPEN-CLEAN perforation score

Variables	Points
<u>C</u> ABG	1
Occlusion length	
20 to <60 mm	1
≥60 mm	2
<u>E</u> jection fraction <50%	1
<u>A</u> ge	
50 to <70	1
≥70	2
<u>C</u> alcification	1

Note: Maximal Points: 7.

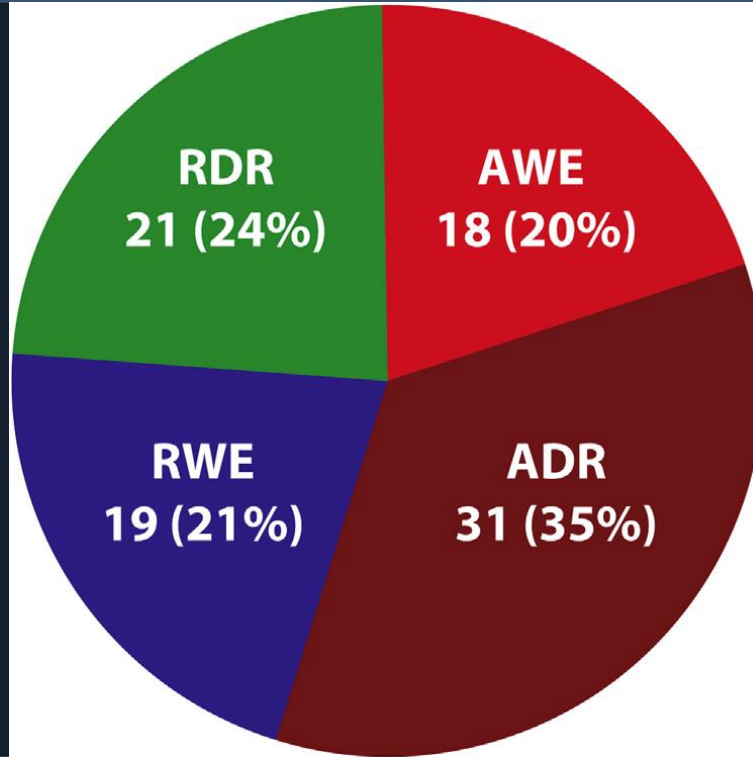


Perforations: Predictors

PROGRESS CTO perforation score

1. Age of 65 (+1)
2. Moderate / severe calcification of vessel (+1)
3. Blunt / no stump (+1)
4. Use of antegrade dissection and re-entry (+1)
5. Use of the retrograde approach (+2)

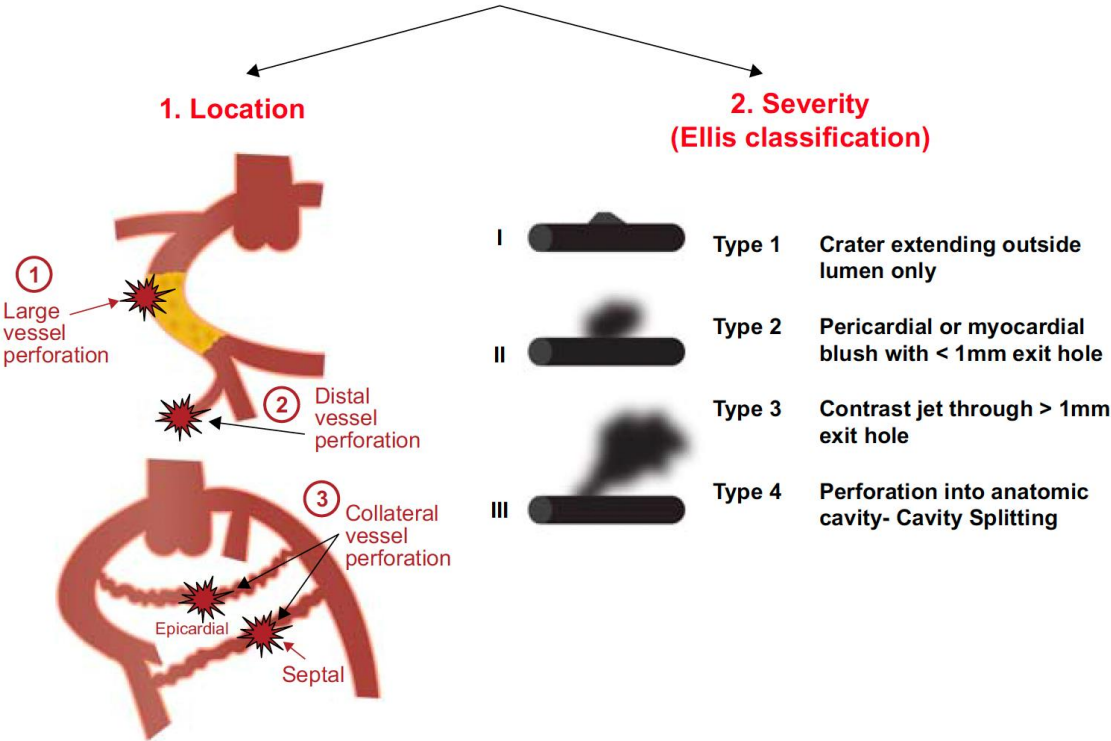
Perforations: Risk Factors



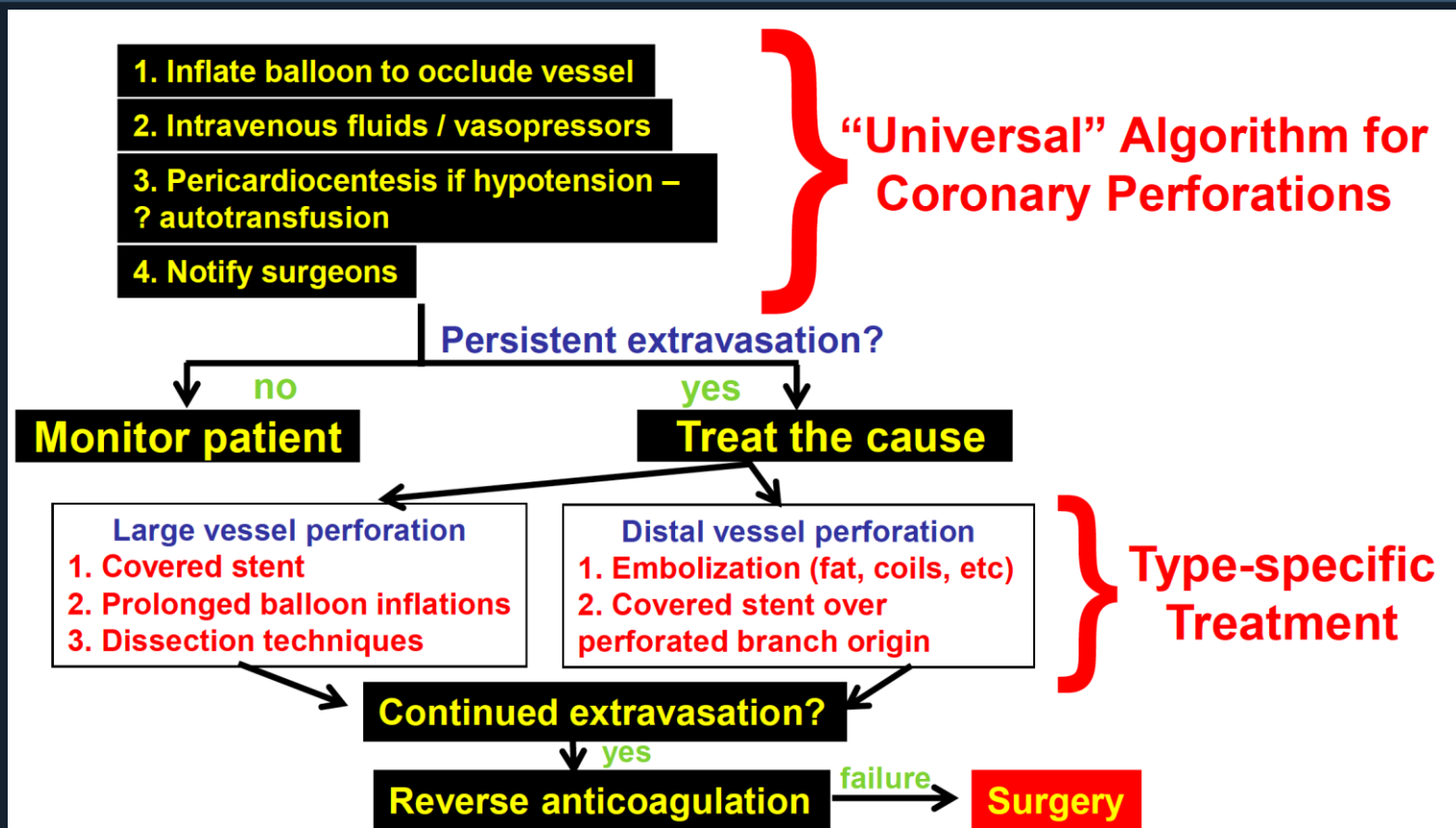
Karmpaliotis Circ Cardiovasc Interv 2016
Hirai et al JACC Cardiovasc Interv 2019

Coronary Perforation: Classification

New classification of coronary perforations

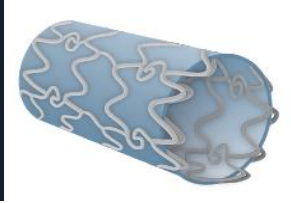


Perforation Management: Universal Algorithm



Large Vessel Perforation Management

Covered Stents



	Graftmaster Rx	PK Papyrus
Design	Two stents (sandwich)	Single stent
Material	ePTFE	Polyurethane
Guide needed	6 French (7 French for 4.5 and 4.8 mm stents)	5 French (6 French for 4.5 and 5.0 mm stents)
Available diameters (mm)	2.8, 3.5, 4.0, 4.5, 4.8	2.5, 3.0, 3.5, 4.0, 4.5, 5.0
Available lengths (mm)	16, 19, 26	15, 20, 26

Perforation Management: Covered Stents

PK Papyrus Pearls

Guide Extension Catheter compatibility

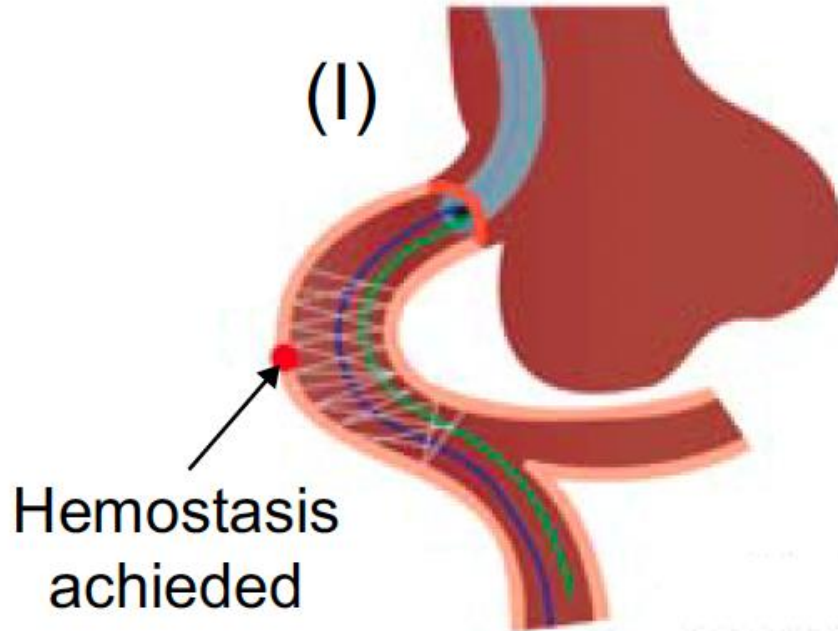
- 4.0 and smaller sizes: 6F Guide Extension
- 4.5 and 5.0: 7 or 8F Guide Extension

Single Guide block and deliver compatibility

- 7F guide

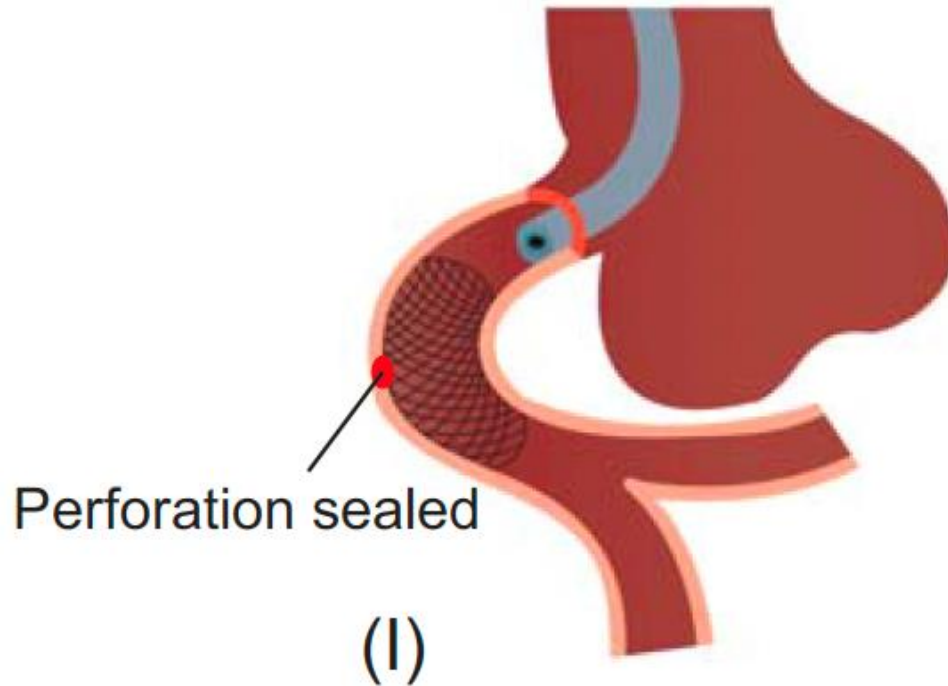
Large Vessel Perforation Management

Single Guide Block and Deliver Technique



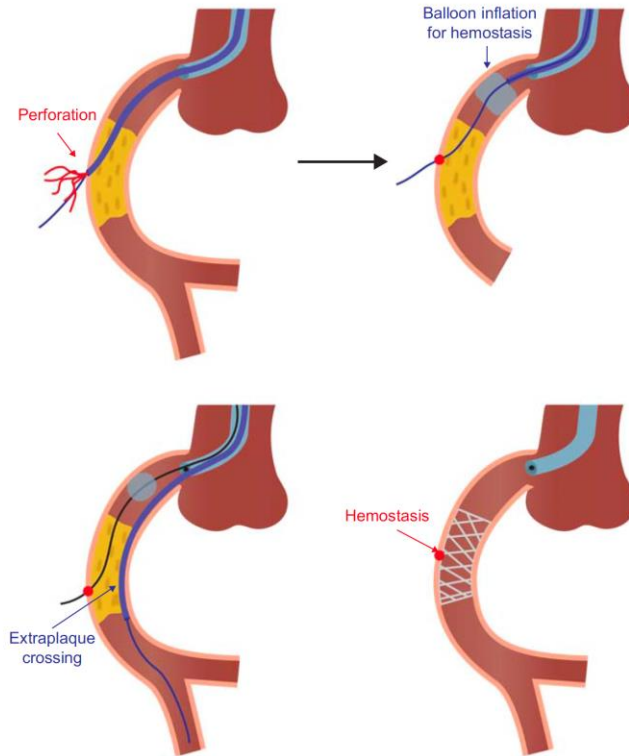
Large Vessel Perforation Management

Ping-Pong Guide Technique



Large Vessel Perforation Management

Dissection Technique



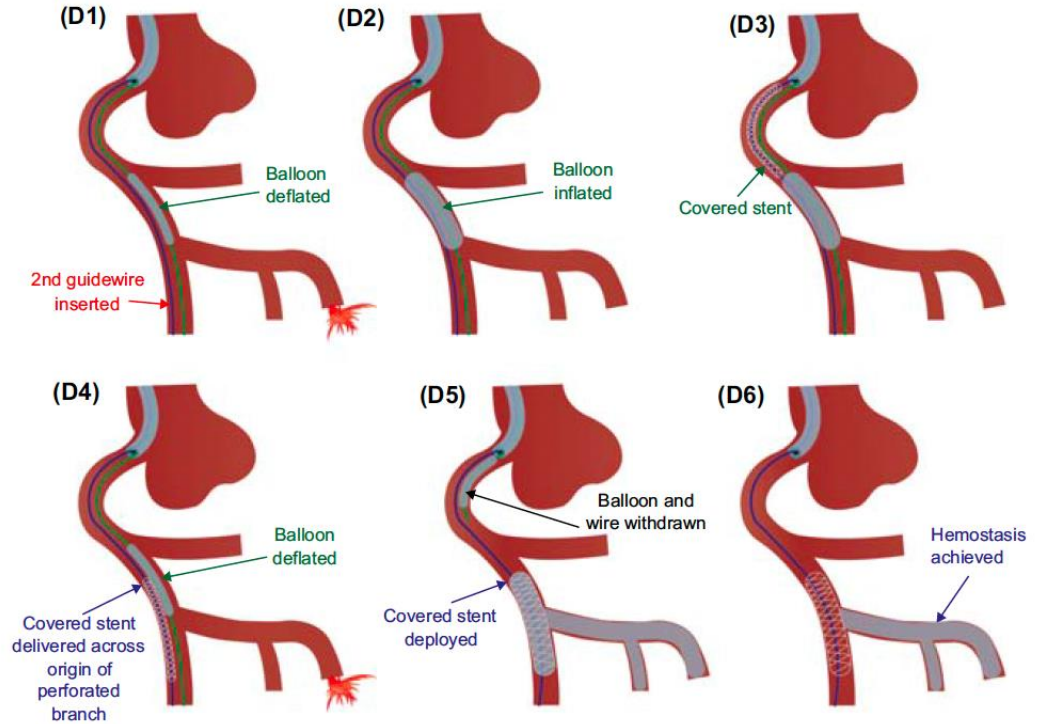
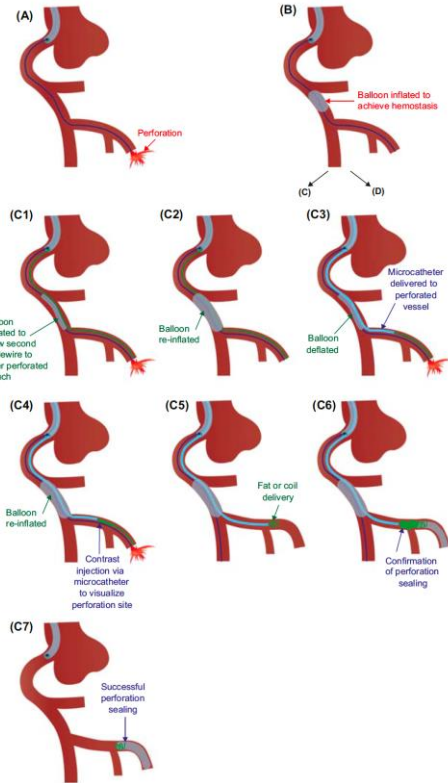
Distal Vessel Perforation Management

Micro-catheter Suction Technique



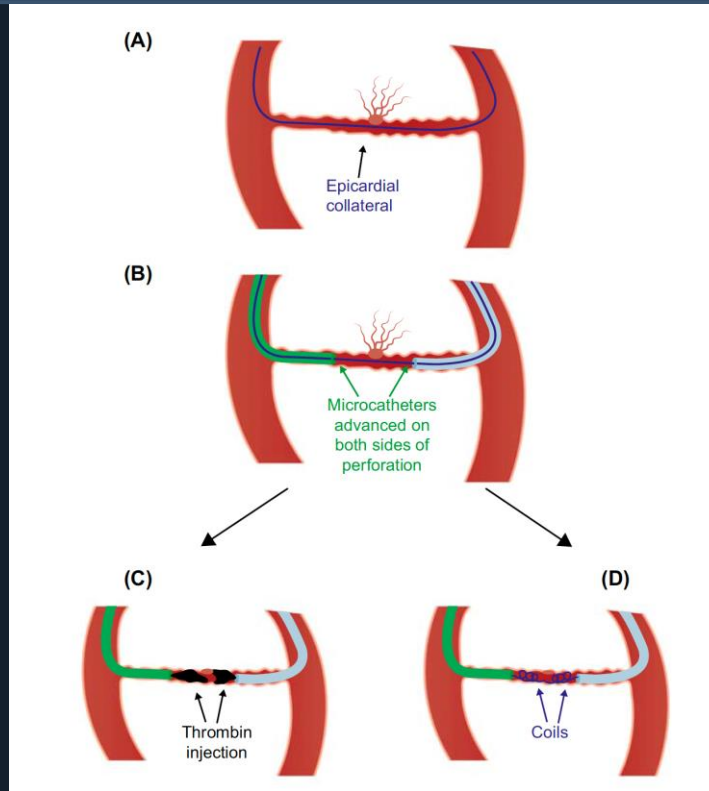
Distal Vessel Perforation Management

Embolization Techniques



Collateral Perforation Management

Epicardial Collateral Perforation



73 y/o with refractory angina

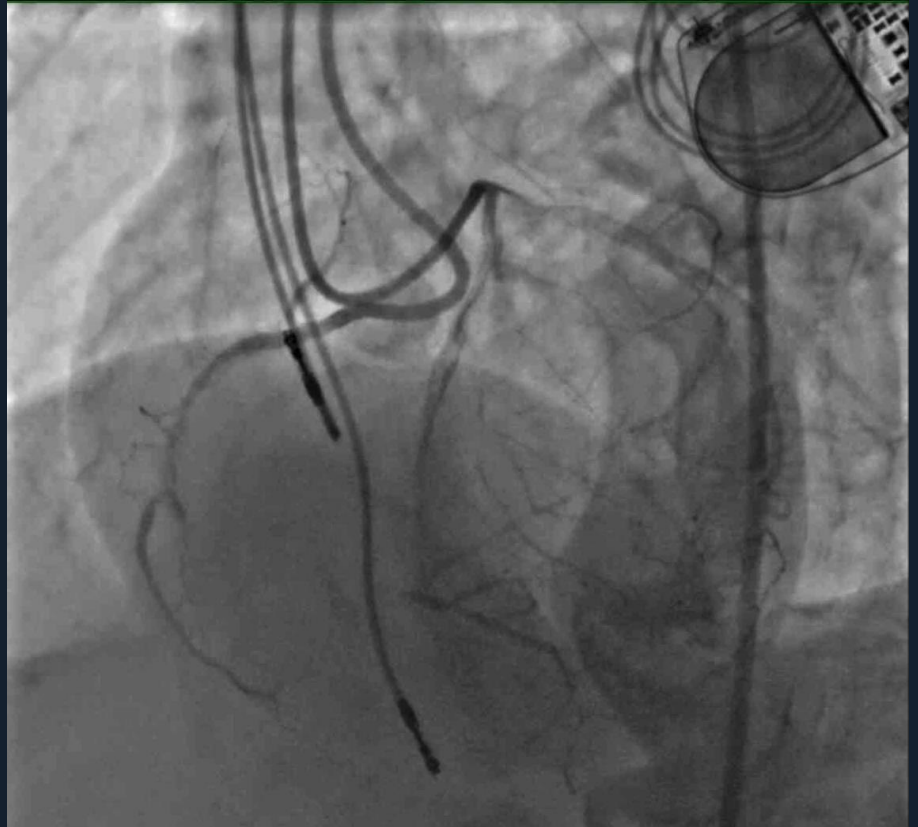
- 73 y/o with hx of HTN, HLD, DM, PAD s/p iliac stent, SSS s/p PPM with refractory angina. Known CAD with CTO of RCA, distal LCx (small), D1 (small) 3 years prior
- Cath
 - Access- Right radial 6F
 - Anatomy- CTO of mid RCA, distal LCx (small), D1 (small) unchanged from before
- EF 60%
- Take off the table for consideration of CTO PCI of mid RCA

73 y/o with refractory angina

- Meds: ASA, Losartan, Amlodipine, metoprolol, imdur, Ranexa, metformin,
- Still complains of CCS III angina

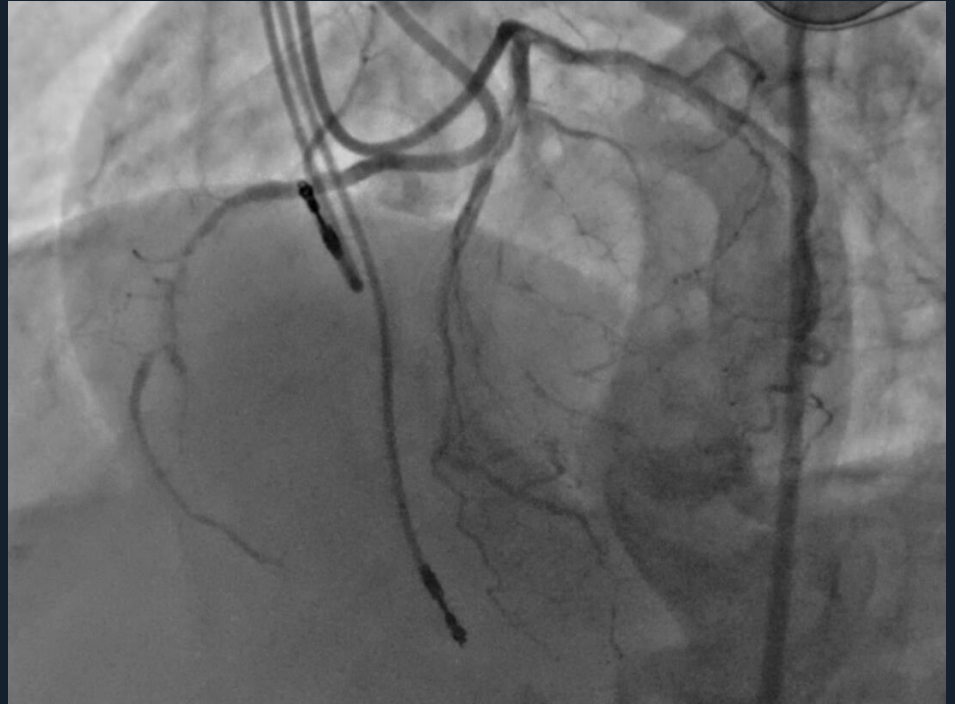
73 y/o with refractory angina

- Access-dual
 - Right radial- 6F slender
 - Right femoral (Ultrasound guided)- 7F 45 cm
- Target vessel: Mid RCA
- Prox cap: Blunt, Heavy Ca
- Length: >20 mm
- Distal vessel: Distal RCA
- Collaterals: L to R (septals)



73 y/o with refractory angina

- Plan A- Antegrade
- Plan B- Retrograde
- RCA: 7F AL 0.75 guide
- LCA: 6F EBU 3.5 guide



73 y/o with refractory angina: AWE

- Anticoag: Heparin (ACT >250)
- Antiplatelet: ASA+Clopidogrel
- Turnpike LP
 - RunThrough
 - Sion black
 - Gladius Mongo (Crossed)
- Unable to cross prox cap with MC
 - Takeru 1.5 → Turnpike
 - Gold → Mamba Flex (crossed)



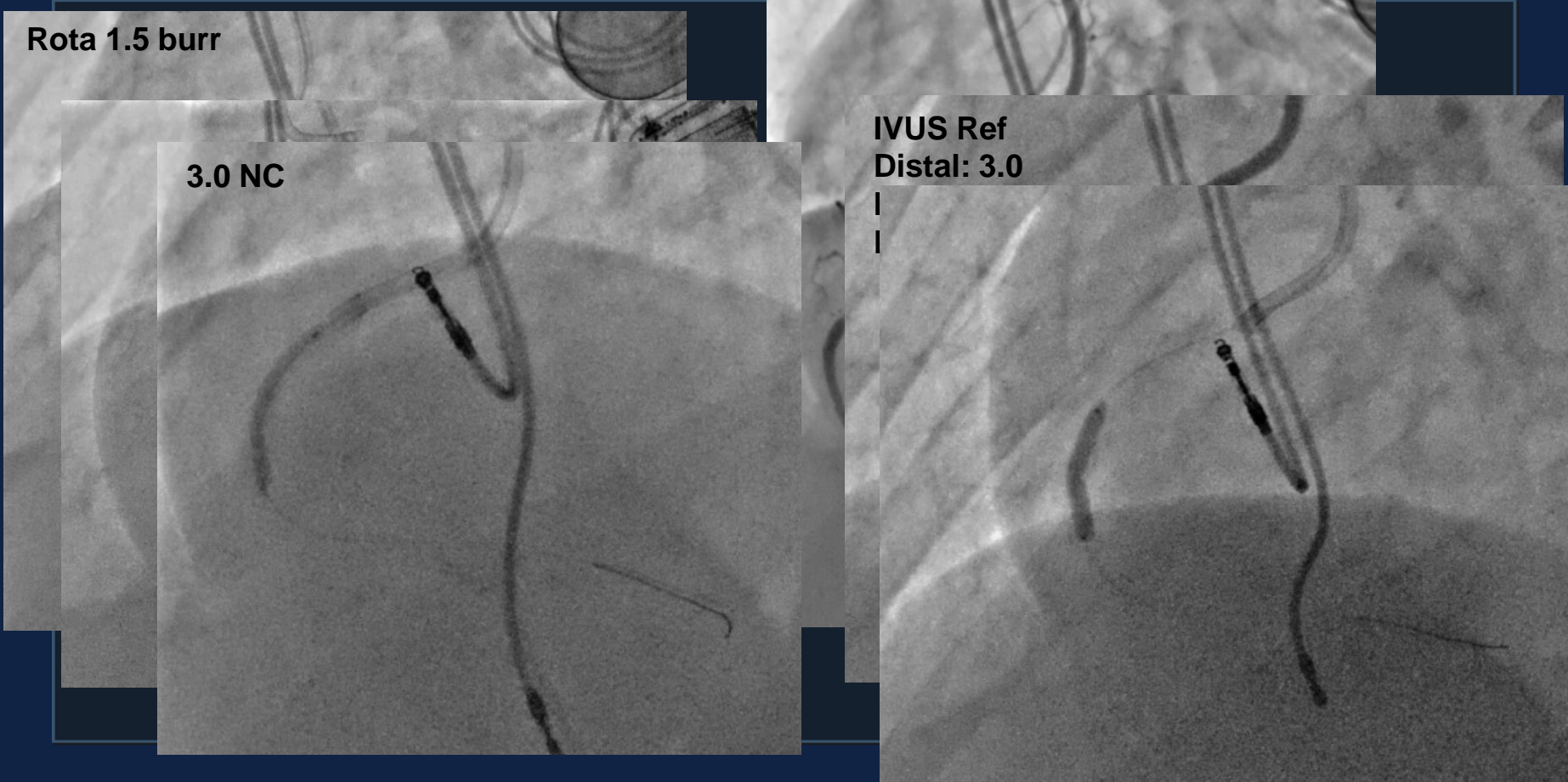
73 y/o with refractory angina: AWE

Rota 1.5 burr

3.0 NC

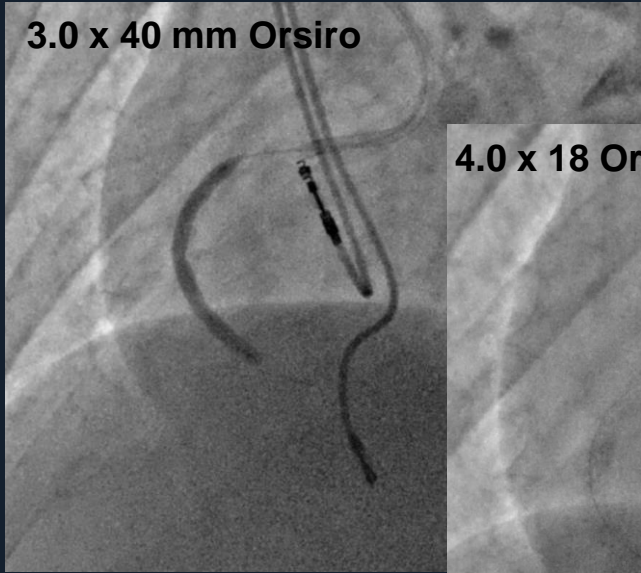
IVUS Ref
Distal: 3.0

|
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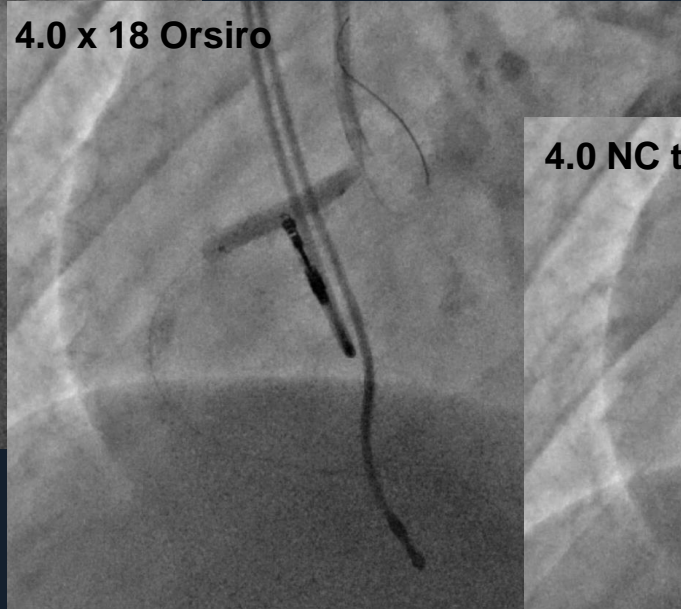


73 y/o with refractory angina: AWE

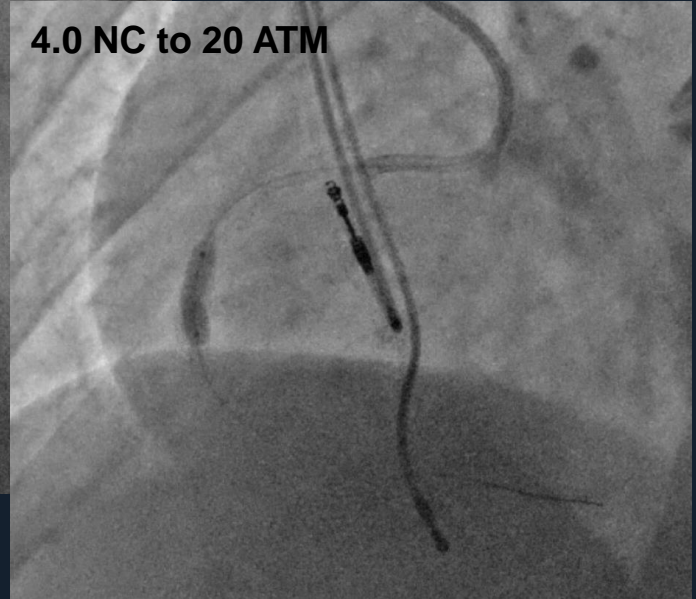
3.0 x 40 mm Orsiro



4.0 x 18 Orsiro

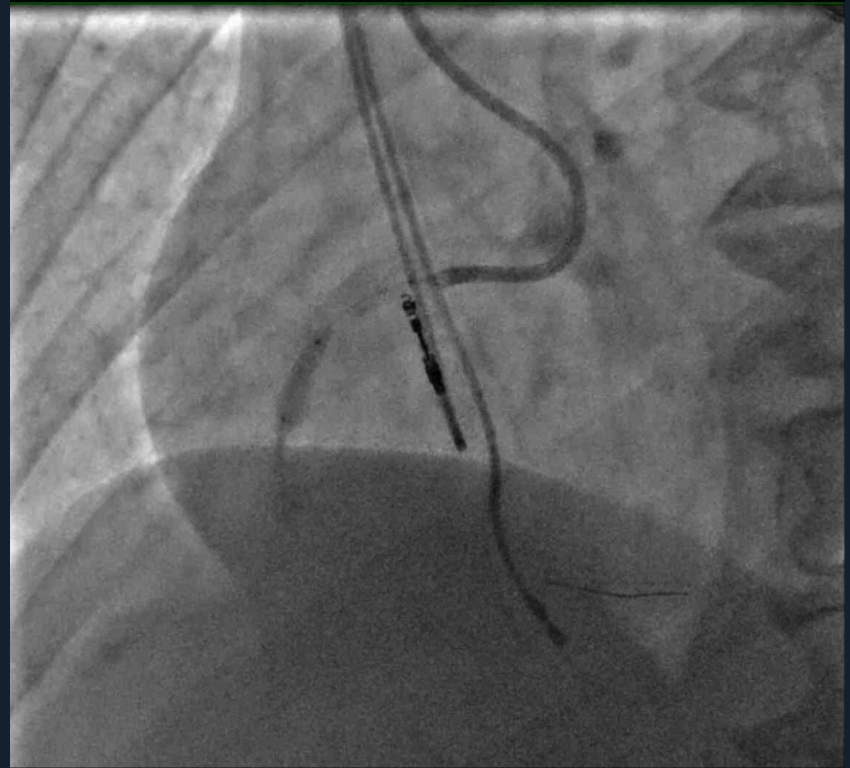


4.0 NC to 20 ATM



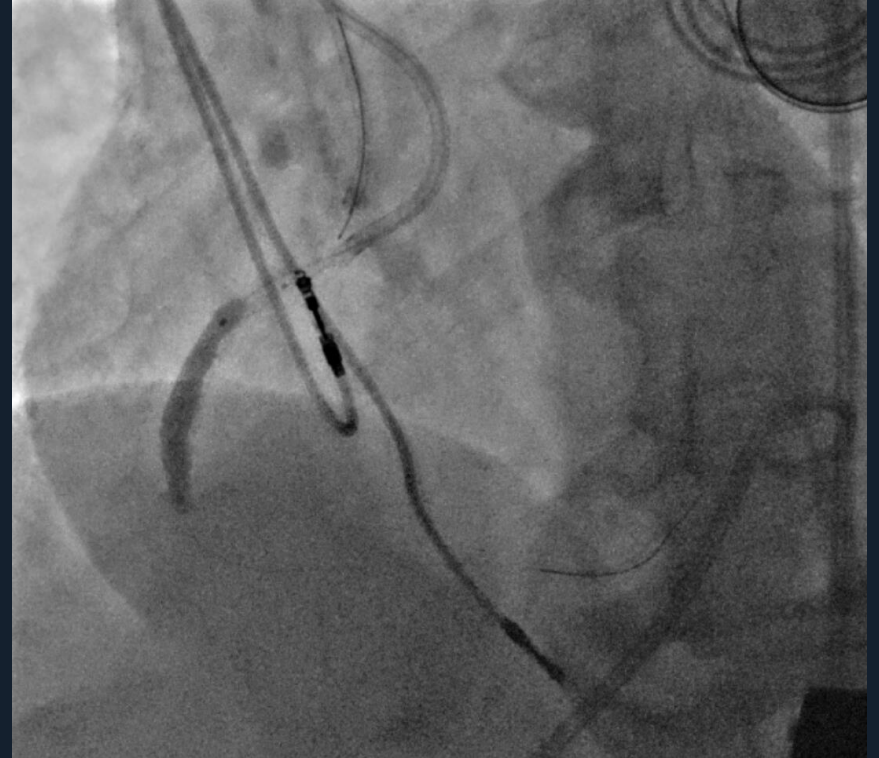
73 y/o with refractory angina: Ellis 3 Perforation

- 4.0 NC inflated to 10 ATM
- JR 4.0 guide right radial
 - Parallel wire
 - 4.0 compliant balloon to swap the balloon in the 7F guide

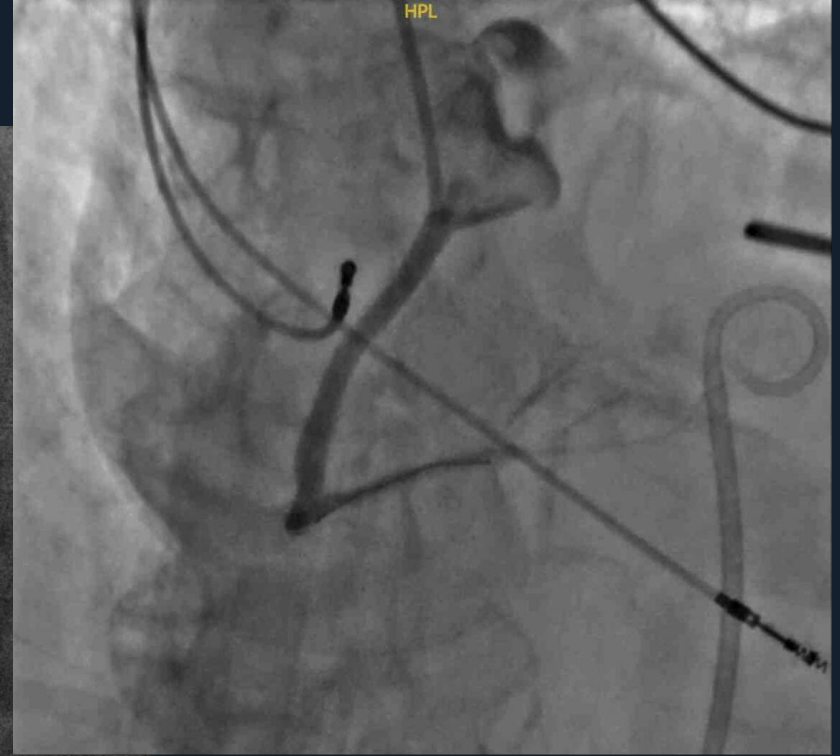
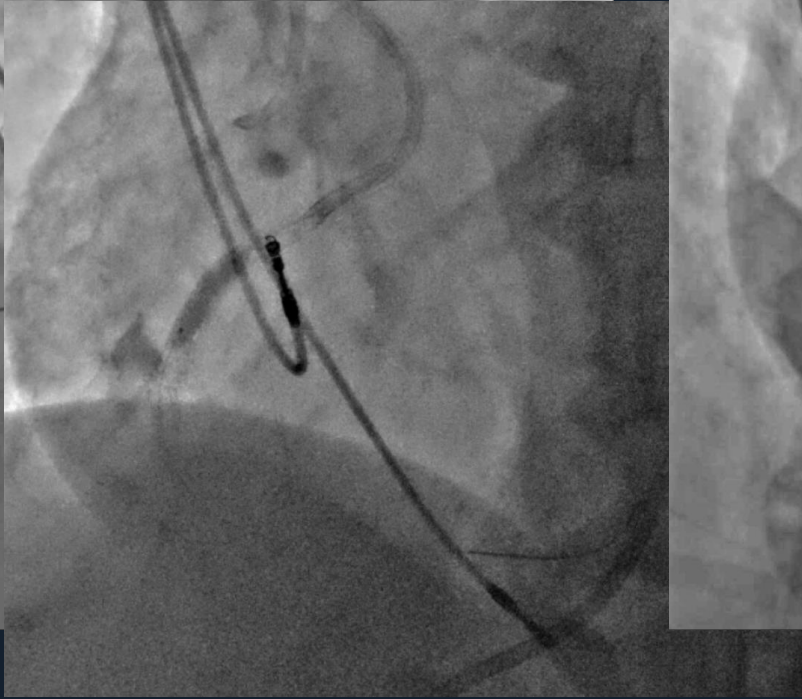
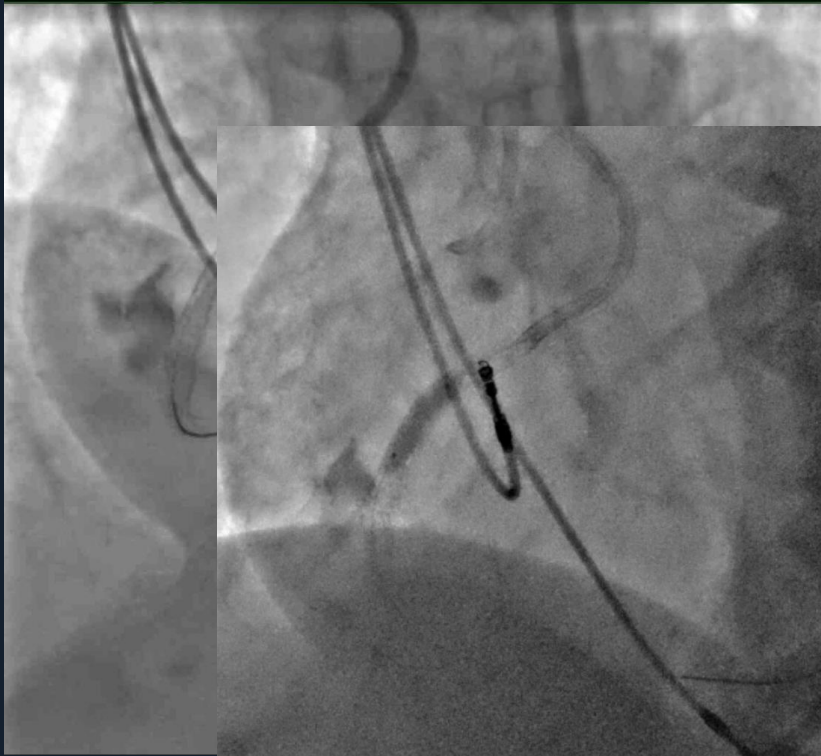


73 y/o with refractory angina: Ellis 3 Perforation

- Hypotensive. Pericardiocentesis w 400 cc of blood
- Papyrus 4.5 x 26 mm 30 seconds inflation 12-14 ATM x 2
- NC post dilatation high pressure



73 y/o with refractory angina: Ellis 3 Perforation



Summary

- ASA/Ticagrelor
- Imdur, Ranexa stopped
- 1.5 years of follow-up
 - No chest pain
 - EF normal
 - Off anti-anginals

Complications Prevention

General Principles

- Never undertake “drive-by” CTO PCI
- Always use double guide injections
- Careful evaluation of the angio
- Skills in antegrade, dissection/re-entry, retrograde
- Discuss with colleagues