Collateral perforation during CTO intervention

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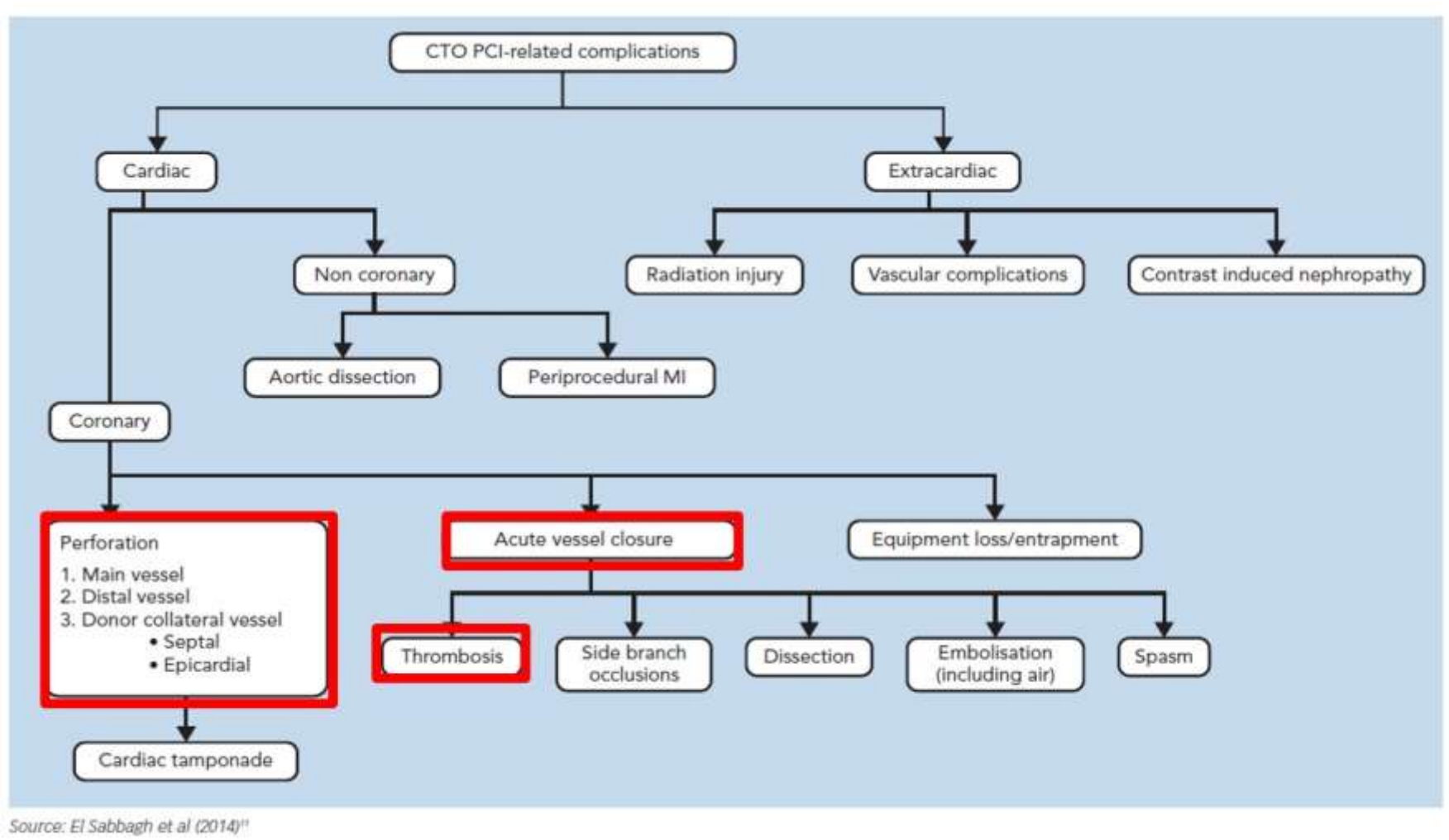
Complication During CTO PCI



Source: El Sabbagh et al (2014)[11]

Case #1

- M / 61
- C/C: exertional chest pain, 3 months ago
- DM / HTN (-/-)
- Ex-smoker
- Echo: EF 45%, basal inferior wall akinesia, apical septal wall hypokinesia

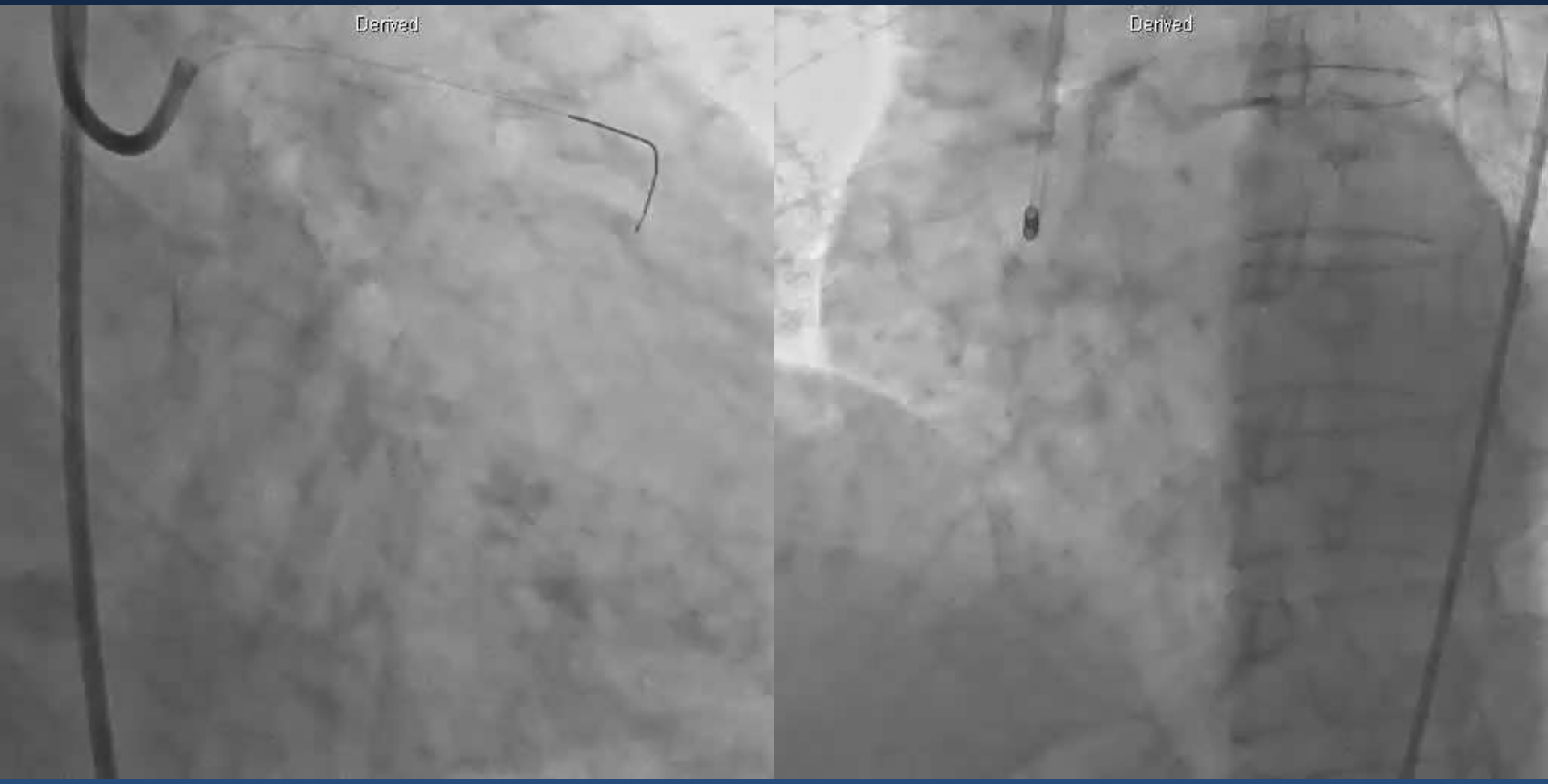
CAG

- Proximal~mid LAD stenosis up to 90%

CAG

- Proximal to mid LCX portion CTO lesion, Collateral from LAD, RCA
- Proximal RCA stenosis up to 90%

PCI on LAD, RCA



- Proximal~mid LAD: Xience 3.0/33mm
- Proximal RCA: Xience 3.0/28mm

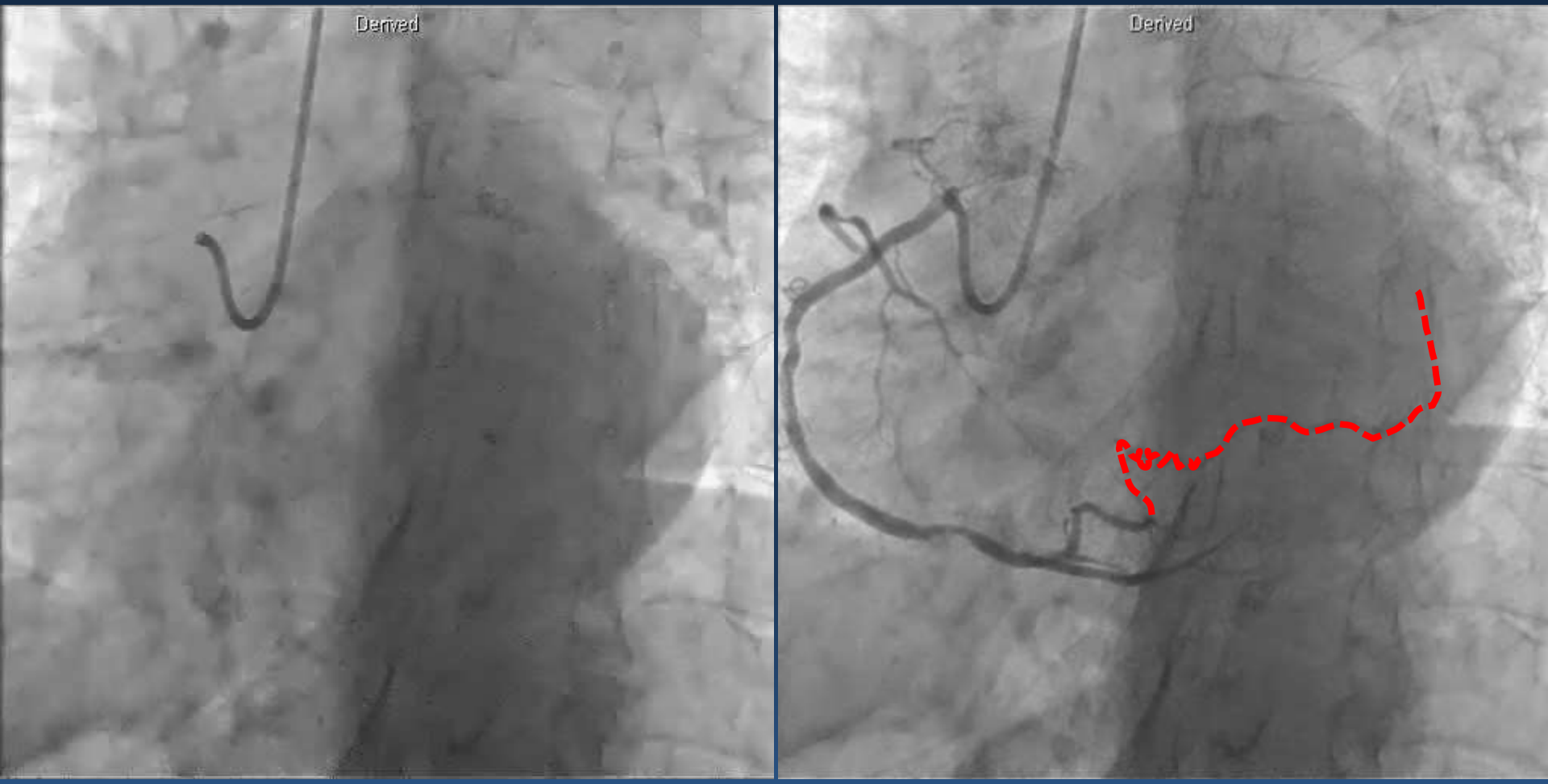
PCI on LCX CTO lesion

8Fr XB4 (Rt. femoral a.) & 6Fr AL 1 (Rt. radial a.)

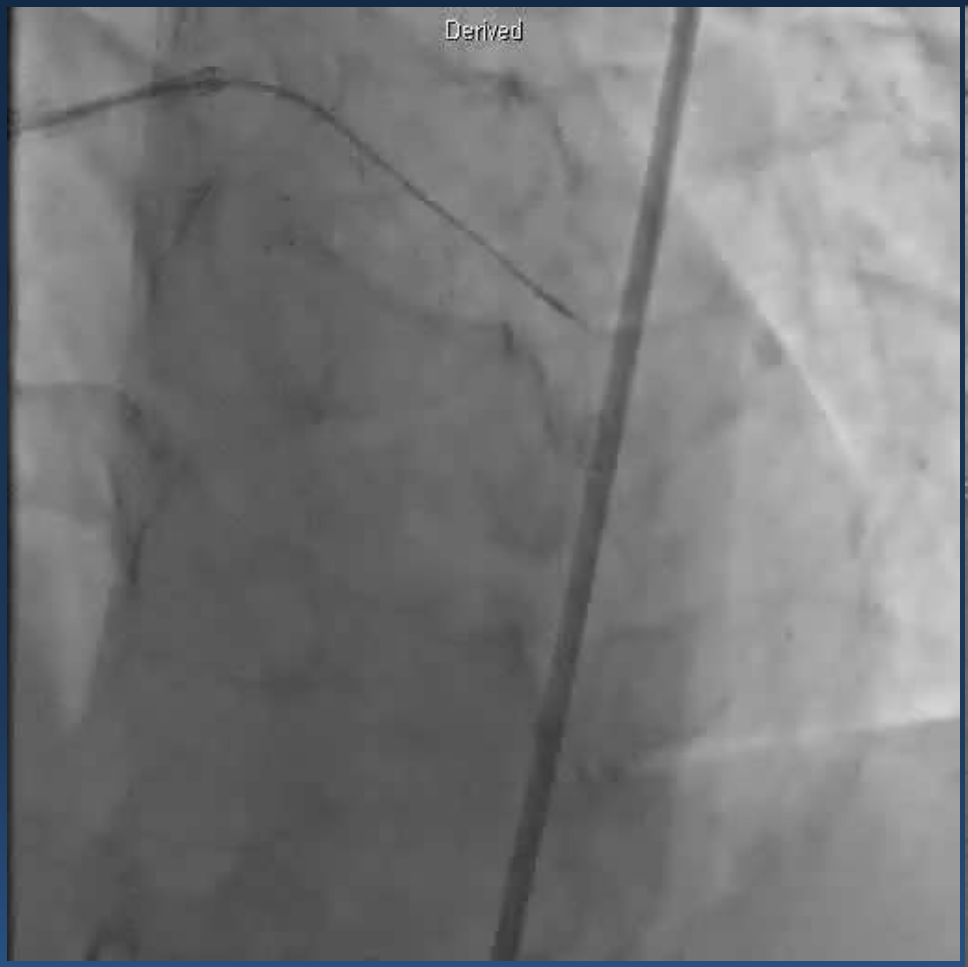
CTO PCI: antegrade wire first

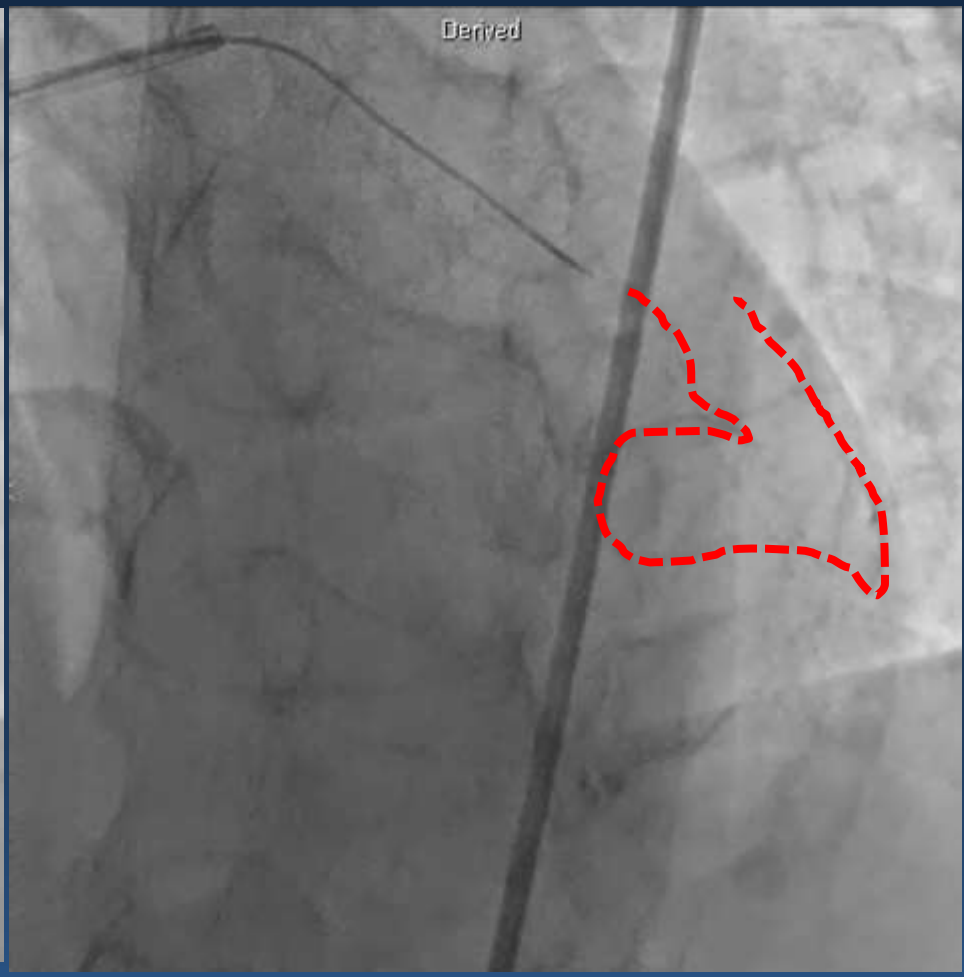
Corsair microcatheter + Sion black & Gaia 2nd
Failed to pass by antegrade approach

Septal Collateral Channel: PL branch to OM

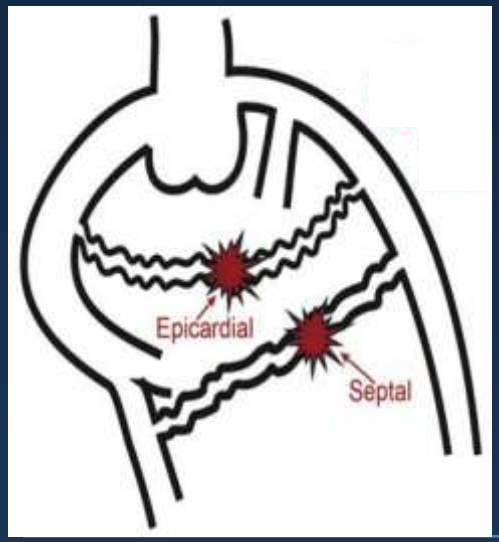


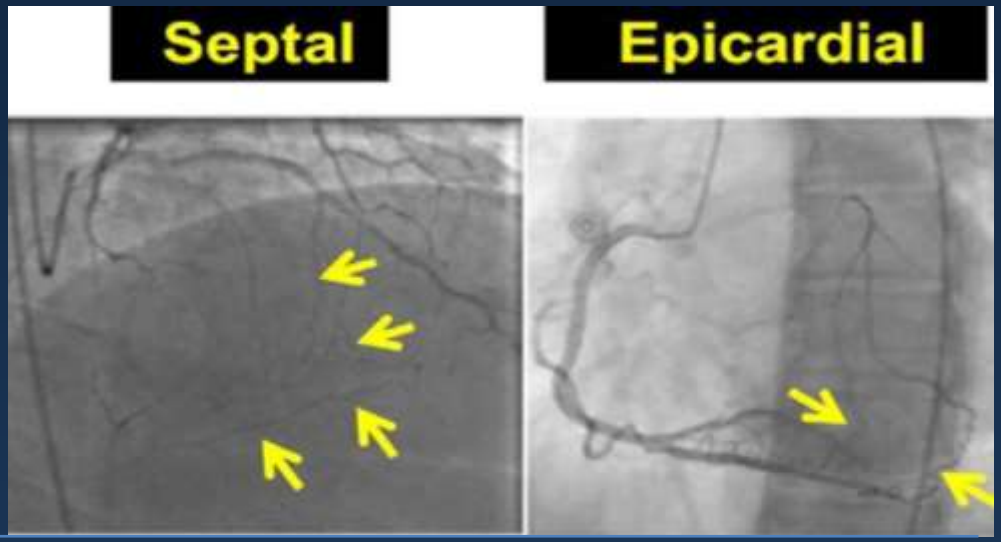
Epicardial Collateral Channel: Diagonal to OM





Types of Collaterals

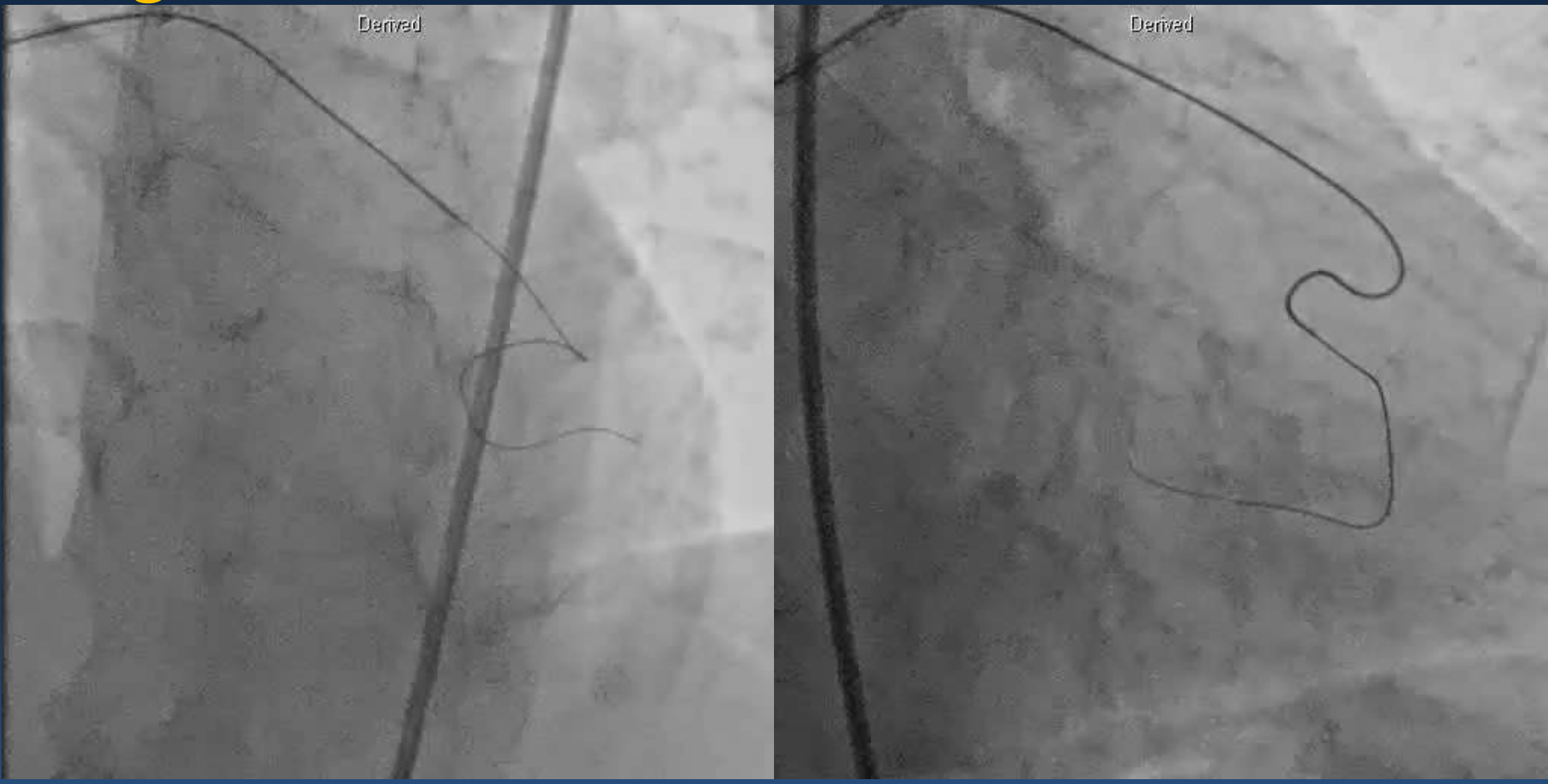




	Septal	Epicardial
Tortuosity	++	+++
Tamponade risk	+	+++
Wiring difficulty	++	+++
Able to dilate	Yes	No

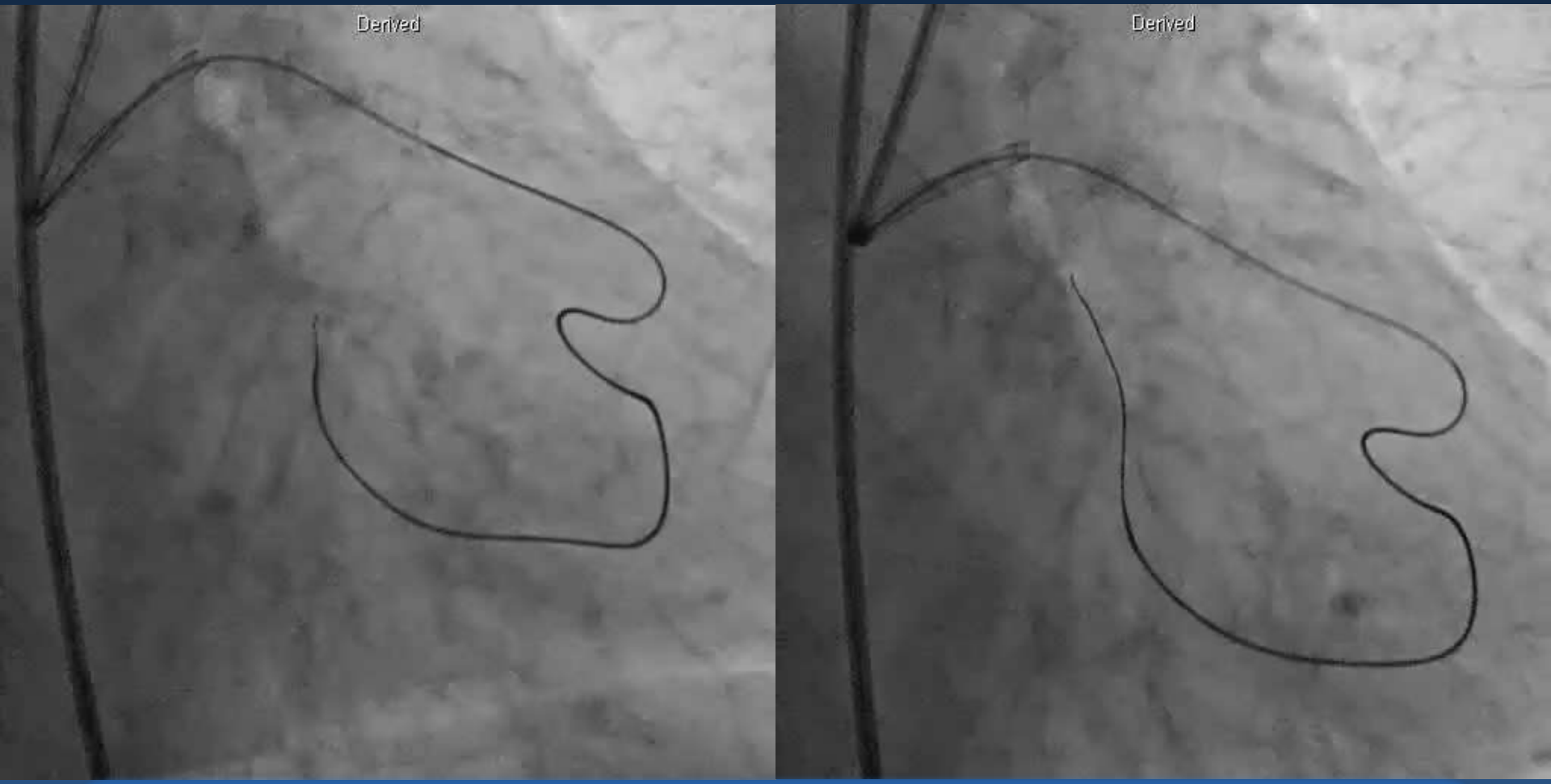
Circ Cardiovasc Interv. 2020;13(5):e008900

Epicardial Collateral Channel approach: Diagonal to OM



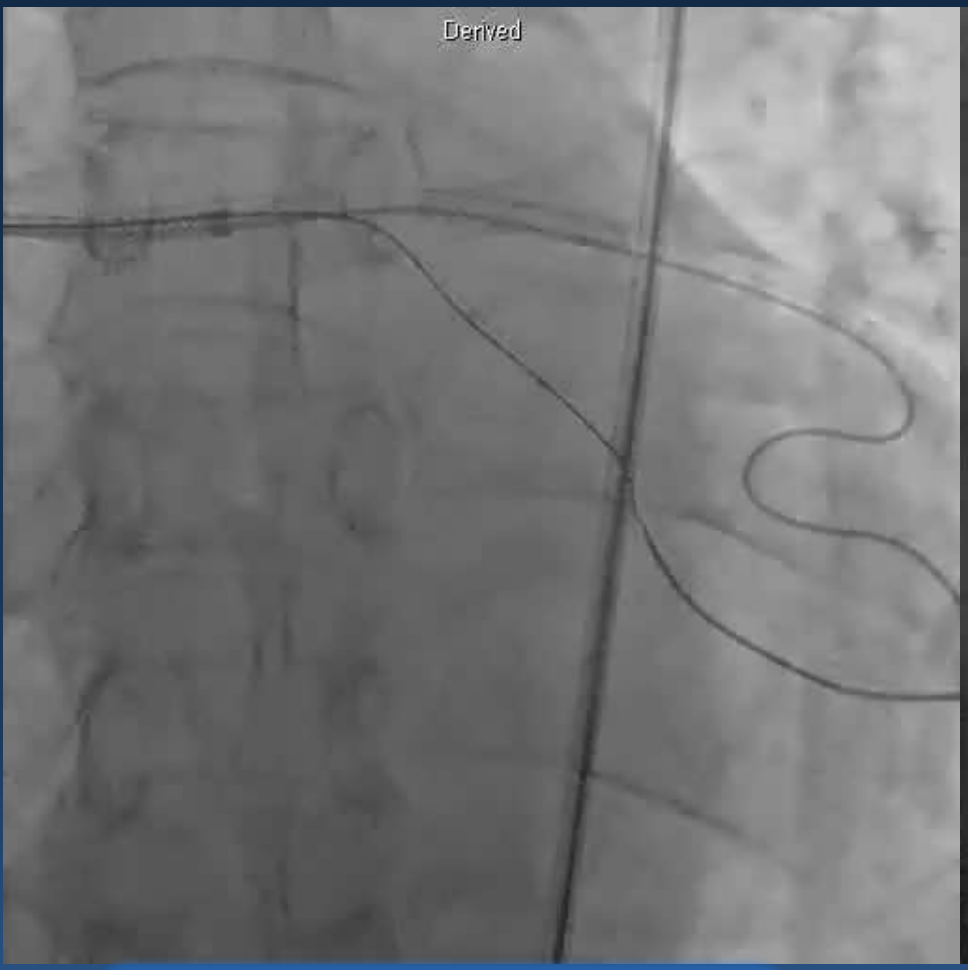
Caravel microcatheter + Fielder XT-R

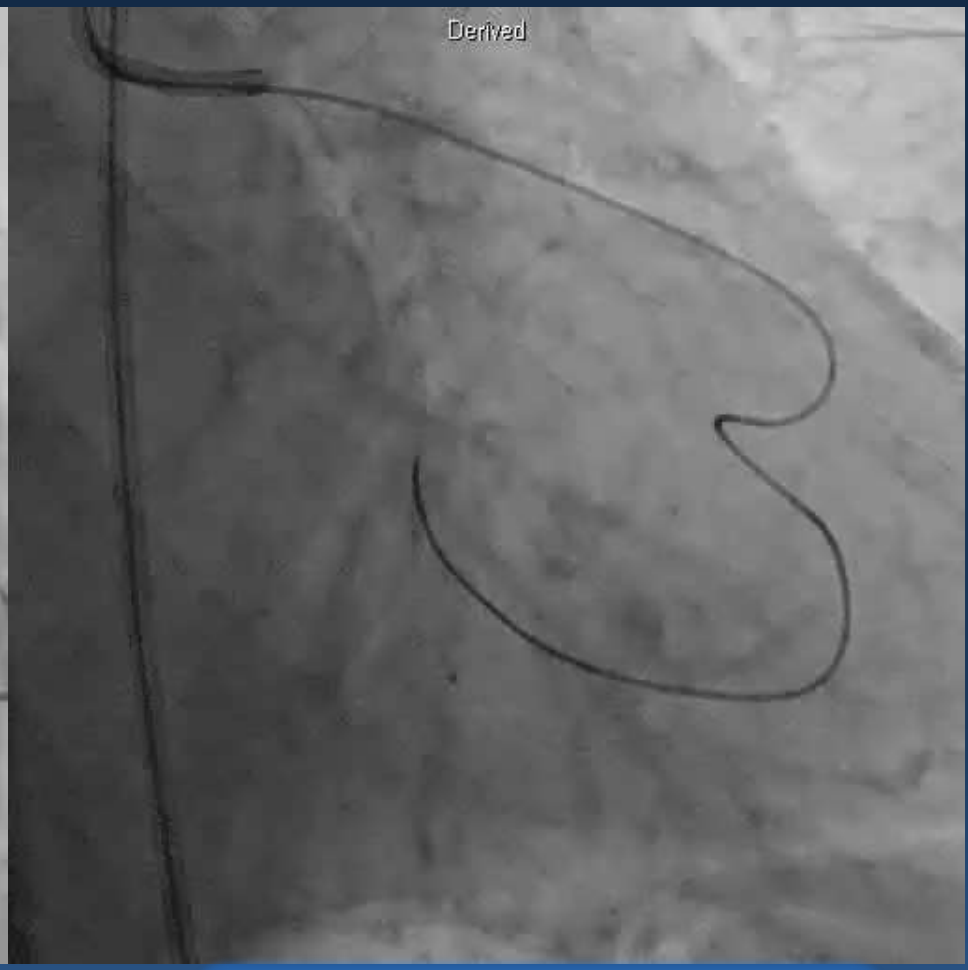
Epicardial Collateral Channel approach: Diagonal to OM



True lumen advanced fail

Bilateral approach

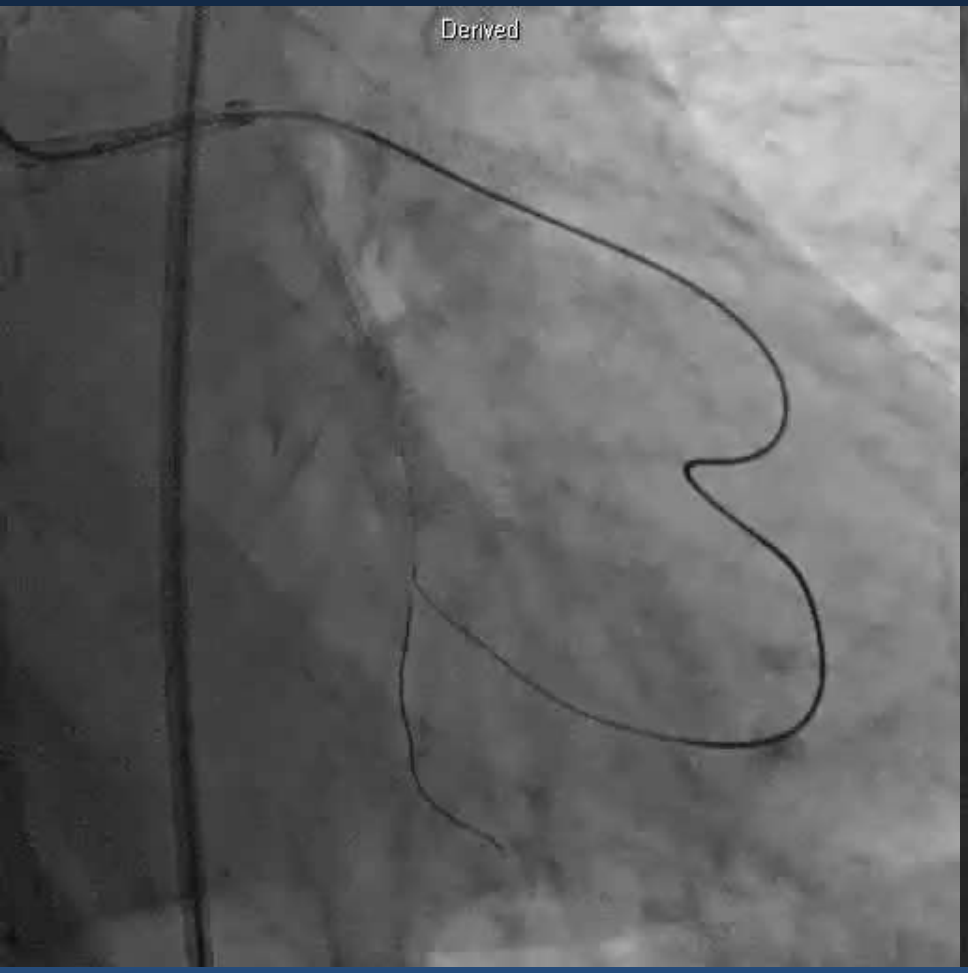


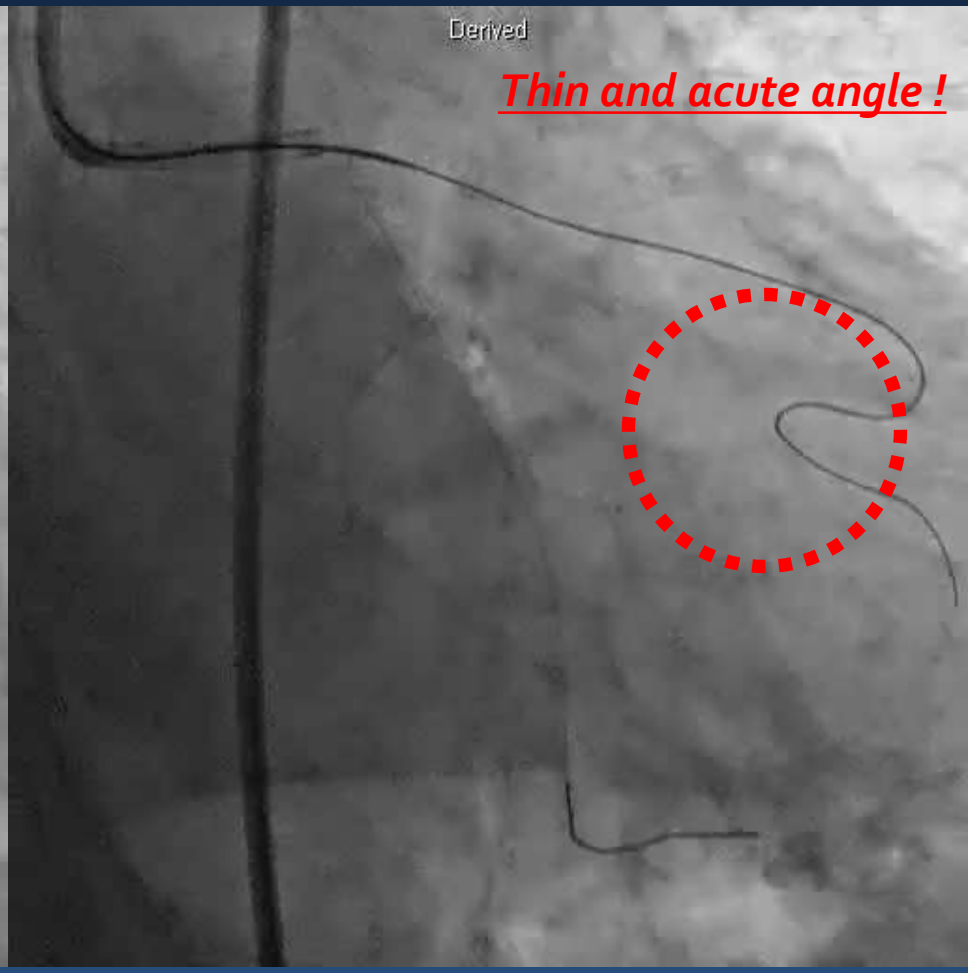


Finecross microcatheter + Fielder XT A

Distal flow confirmed by tip injection

Collateral Perforation !





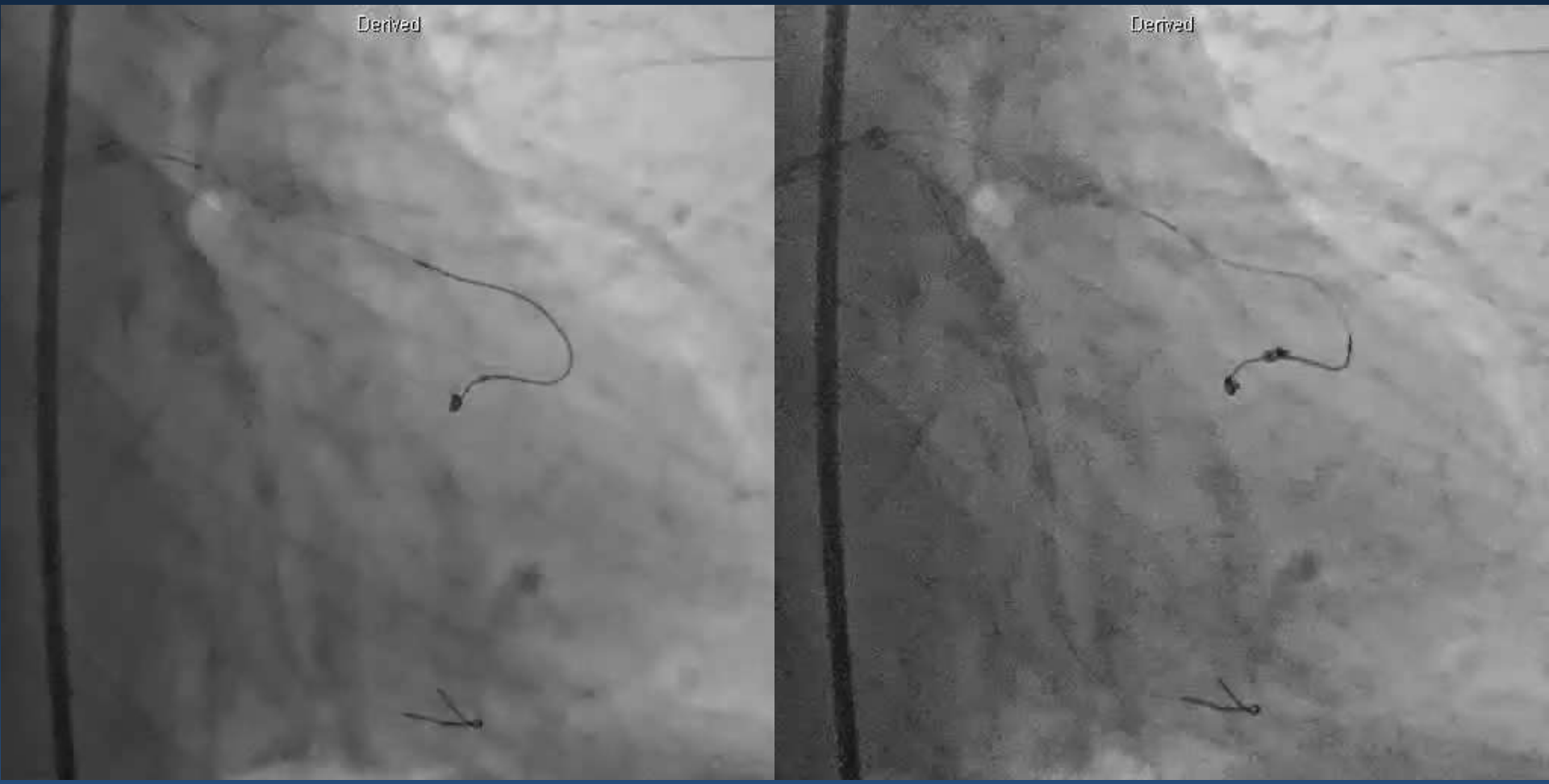
Synergy 2.5/38mm + 2.5/32mm

Fat vs. Coil Embolization

	Fat	Coil
Visibility	No (unless incubated with contrast)	Yes
Controlled delivery	No	Yes (if detachable coils are used)
Catheter needed for delivery	Any microcatheter	May need bigger microcatheter (0.018 inch) although any microcatheter can be used for neurovascular coils
Availability	Universal	Often limited
Cost	0	High

Emmanouil Brilakis. Manual of Chronic Total Occlusion Interventions 2nd edition

Coil embolization

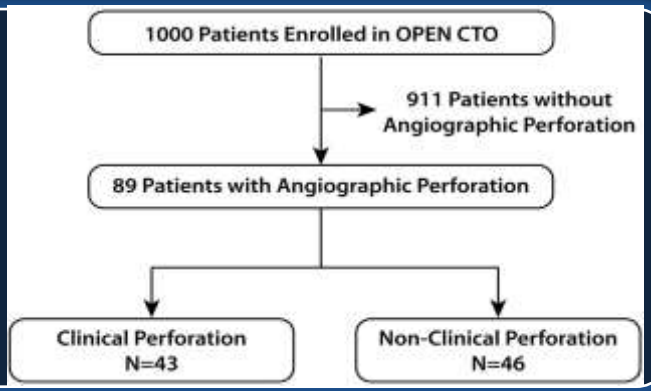


Renegade microcatheter + Interlock 2/60mm & 2/60mm

Final angiography

Perforations during CTO PCI

- OPEN-CTO study
- 12-center registry

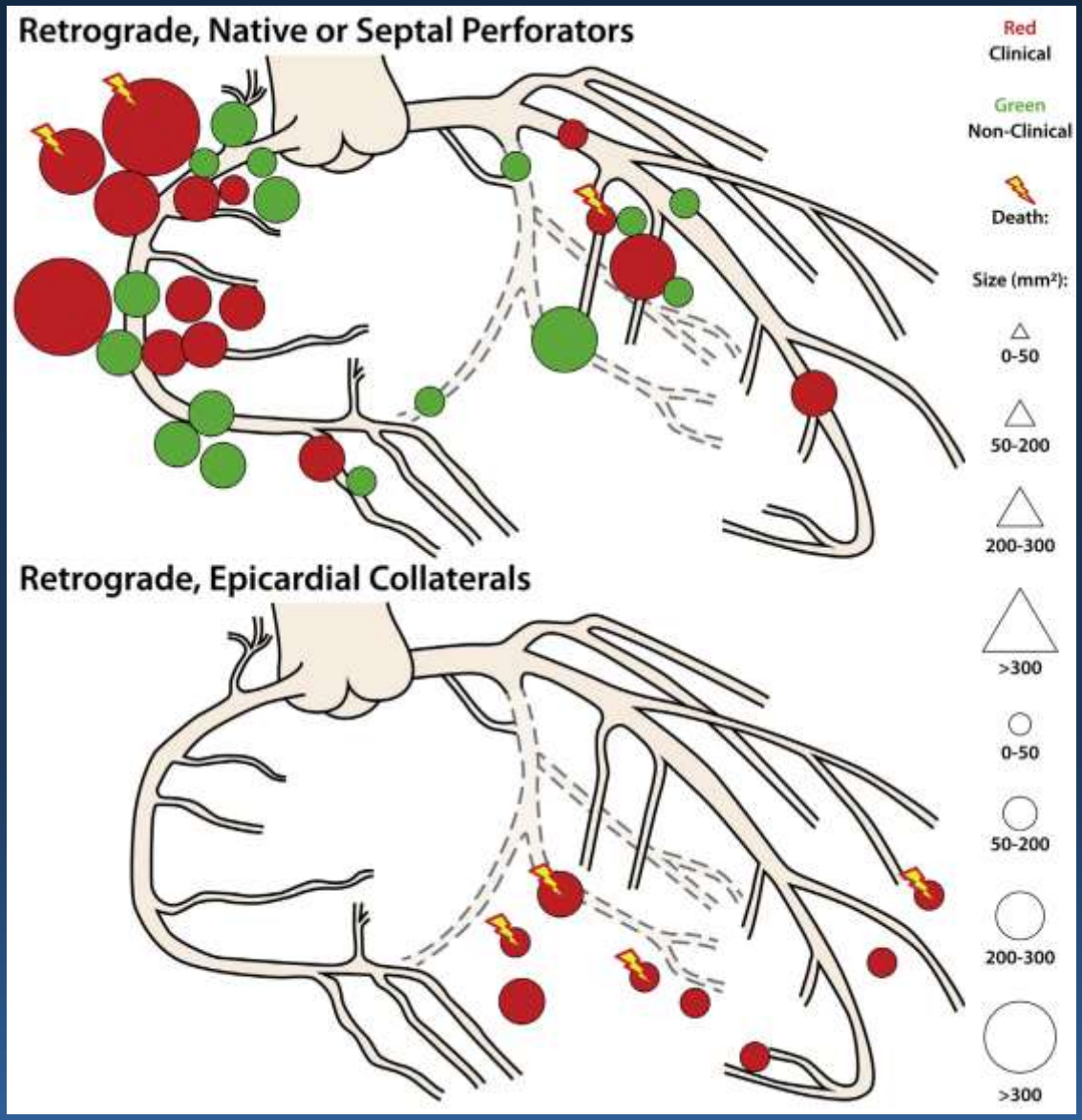


	Clinical (n=43)	Nonclinical (n=46)	P value
Size area, mm2	152.2 ± 199.5	66.4 ± 47.9	<0.01
Location			0.03
Proximal	9 (20.9)	9 (19.6)	
Nonproximal	24 (55.8)	35 (76.1)	
Collateral	10 (23.3)	2 (4.3)	
High-risk shape	*15 (34.9)*	*2 (4.4)*	*<0.01*
Staining	29 (67.4)	40 (87.0)	0.03
Epicardial	*8 (18.6)*	*0 (0.0)*	*<0.01*
Fast filling	32 (84.2)	22 (62.9)	0.04
Fast drainage	10 (23.3)	4 (8.7)	0.06

	Adverse event (n=25)	No adverse event (n=64)	P value
Size area, mm2	173.2 ± 155.2	83.2 ± 139.9	0.01
Location			<0.01
Proximal	7 (28.0)	11 (17.2)	
Nonproximal	10 (40.0)	51 (79.7)	
Collateral	8 (32.0)	2 (3.1)	
High-risk shape	*13 (52.0)*	*9 (14.3)*	*<0.01*
Staining	19 (76.0)	50 (78.1)	0.83
Epicardial	*6 (24.0)*	*2 (3.1)*	*0.11*
Fast filling	18 (85.7)	36 (69.2)	0.15
Fast drainage	4 (16.0)	10 (15.6)	1.00

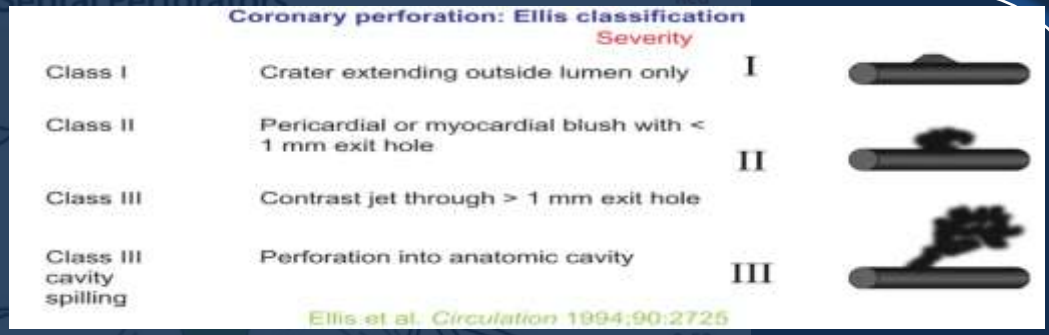
J Am Coll Cardiol Intv. 2019;12(19):1902-12

Perforations during CTO PCI



J Am Coll Cardiol Intv. 2019;12(19):1902-12

Size and location of perforations



Stephen G. Ellis:

"CTO PCI via epicardial collaterals should be the last technical option and be left to expert operators."

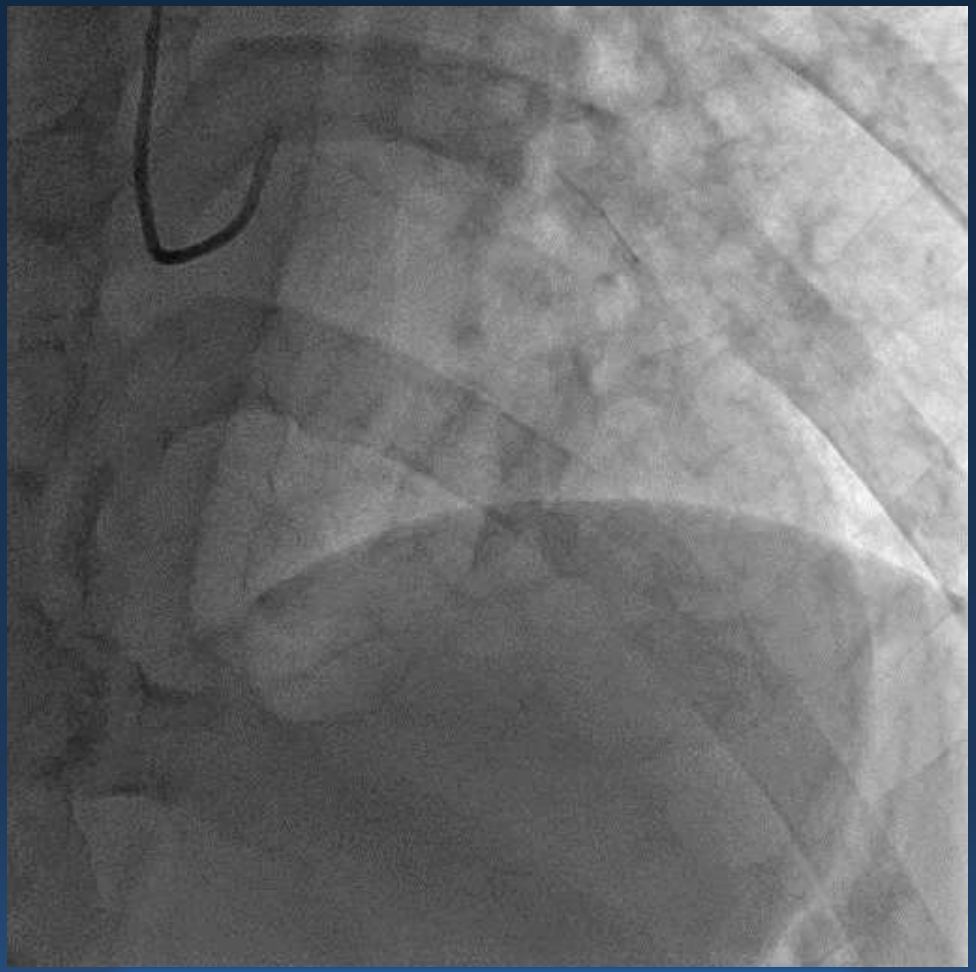
J Am Coll Cardiol Intv. 2019;12(19):1902-12

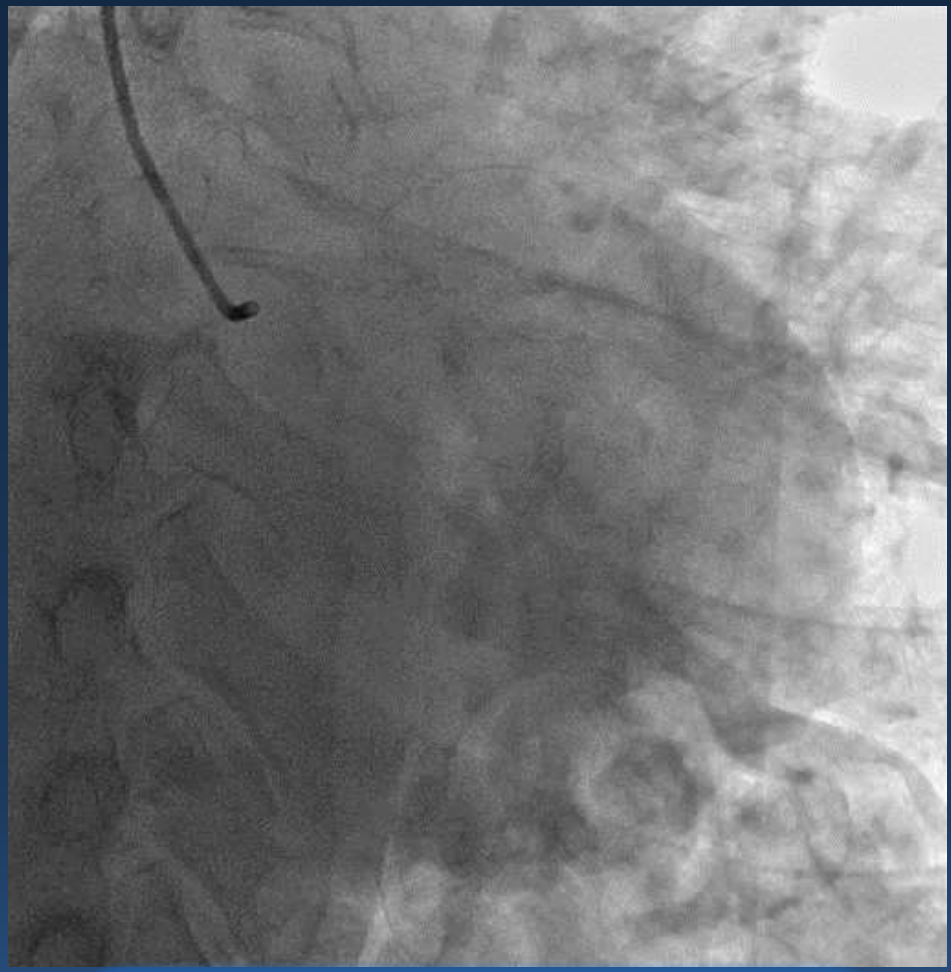
Case #2

- M / 58
- C/C: Dyspnea
- DM / HTN (+/+)
- Current Smoker(40Year)
- Echo: EF 30%

  Ischemic insult of RCA territory

CAG

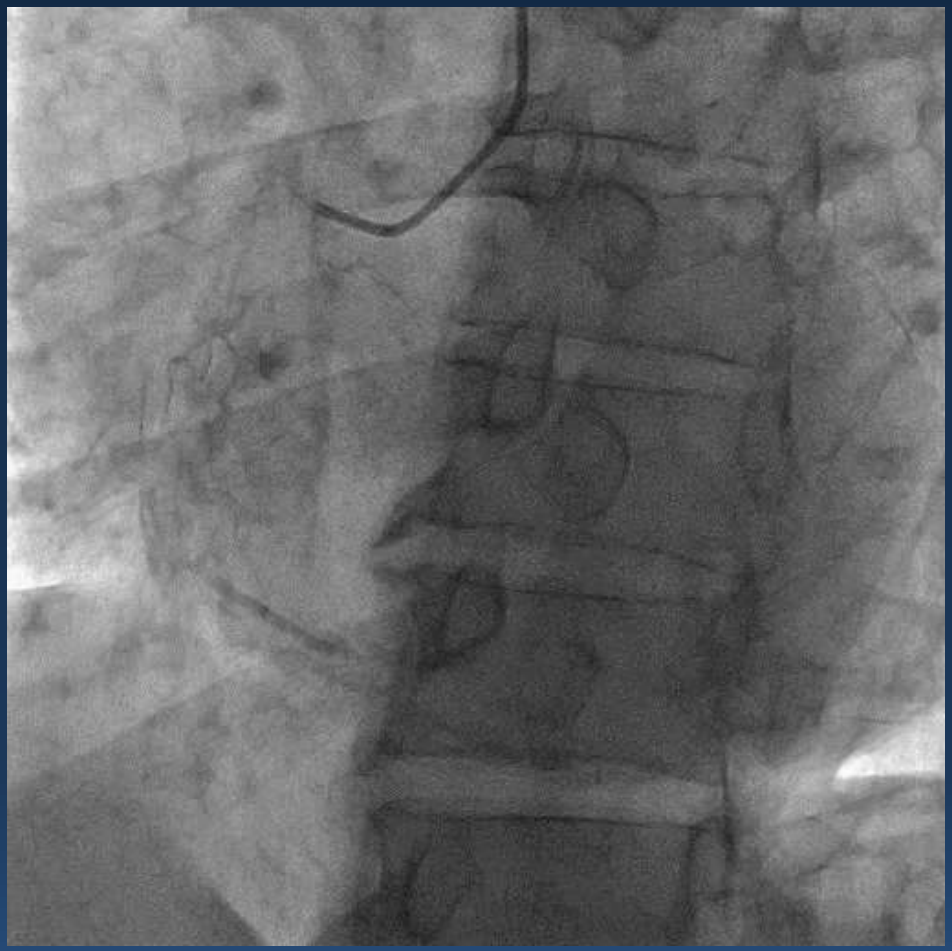


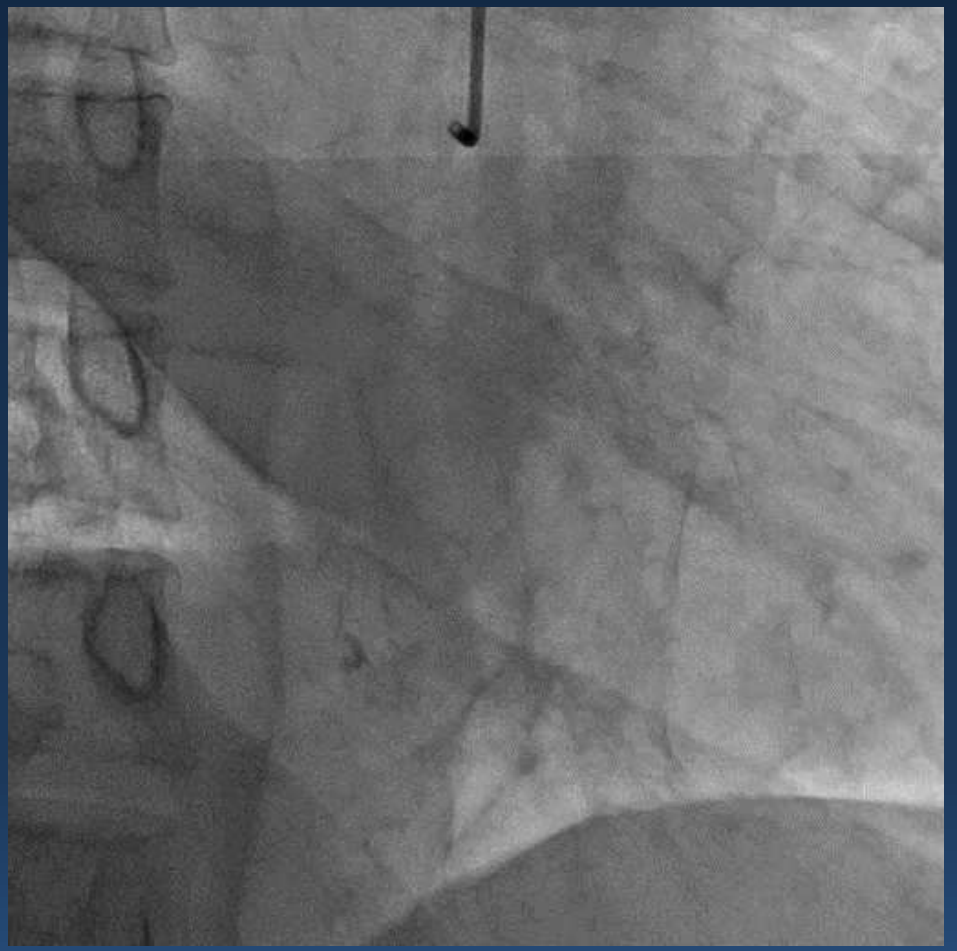


p-mLAD diffuse eccentric steosis
Collateral to RCA

Hypoplastic LCX

CAG

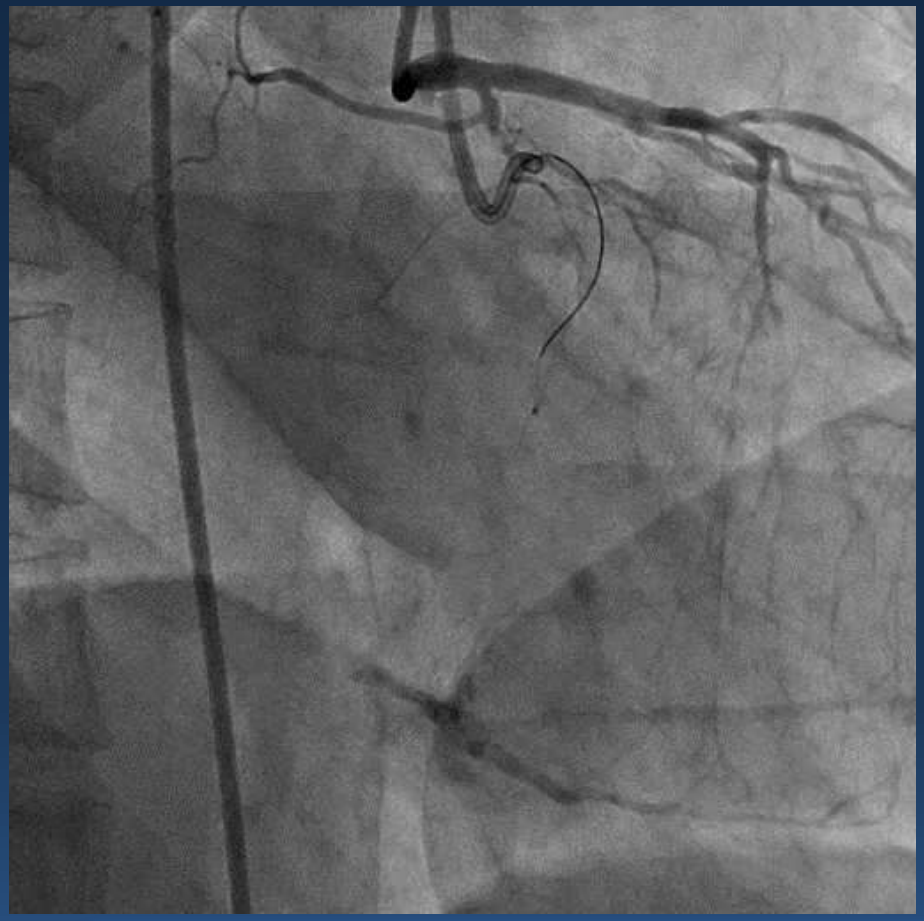


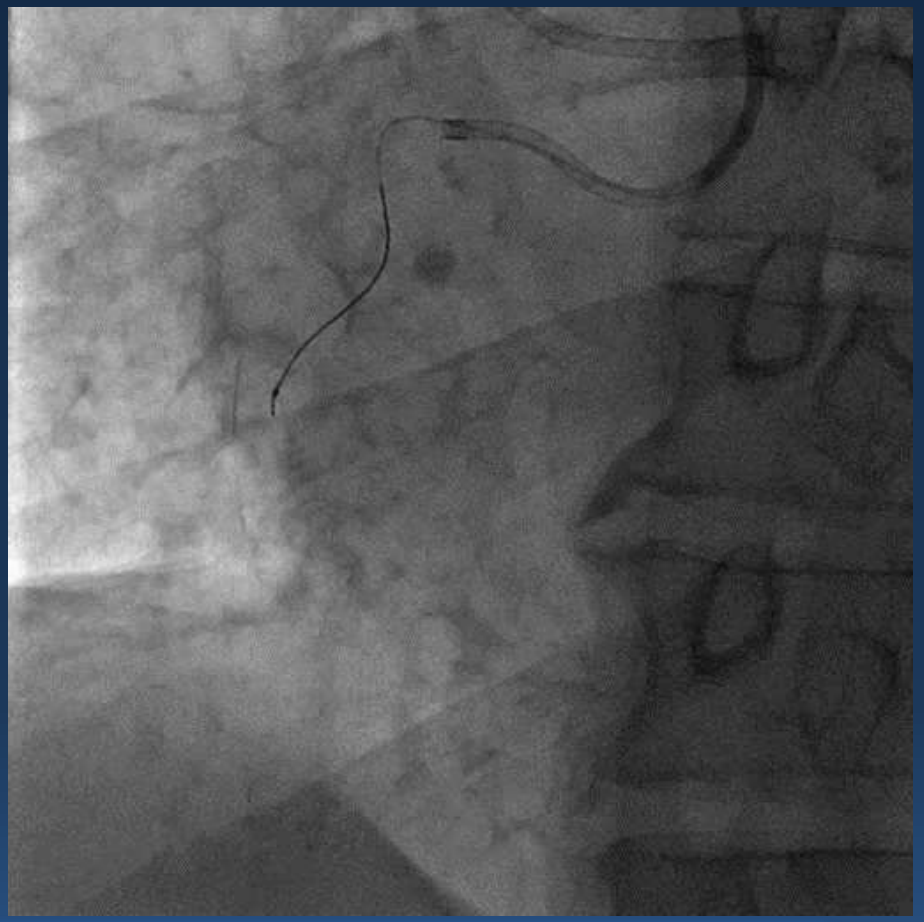


m-dRCA chronic total occlusion(CTO)

PCI on RCA CTO lesion

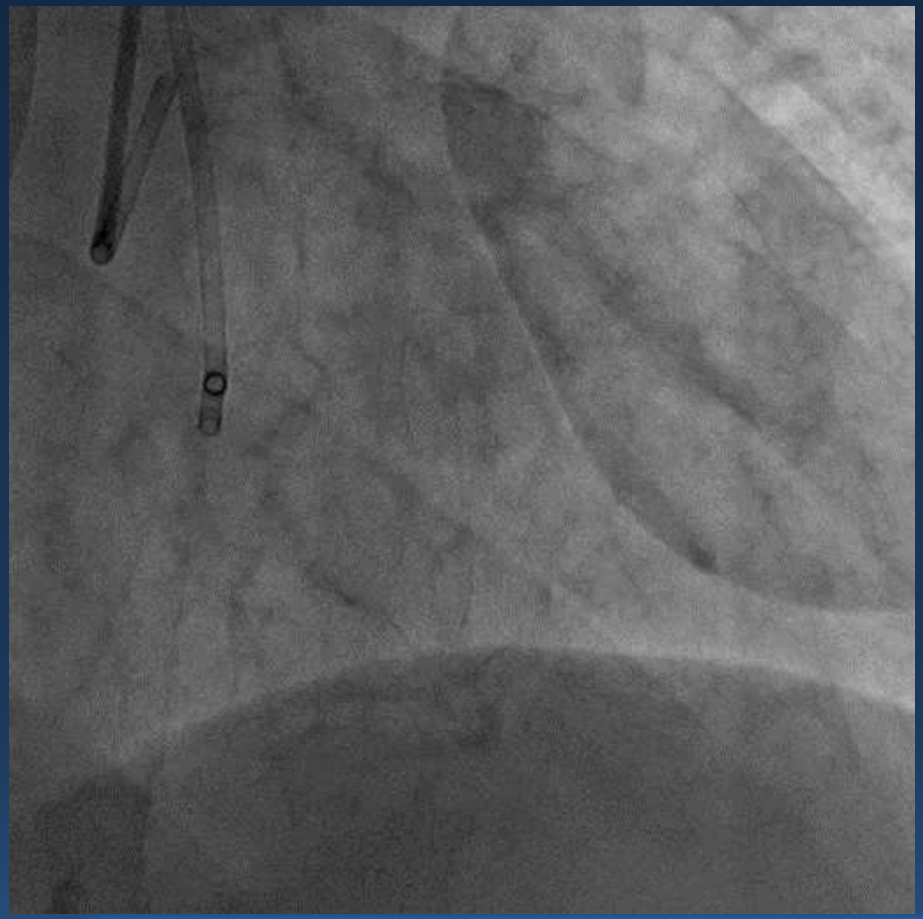
GC : 8Fr AL1 SH(Rt. femoral a.) & 6Fr XB 3.5 SH(Rt. radial a.)

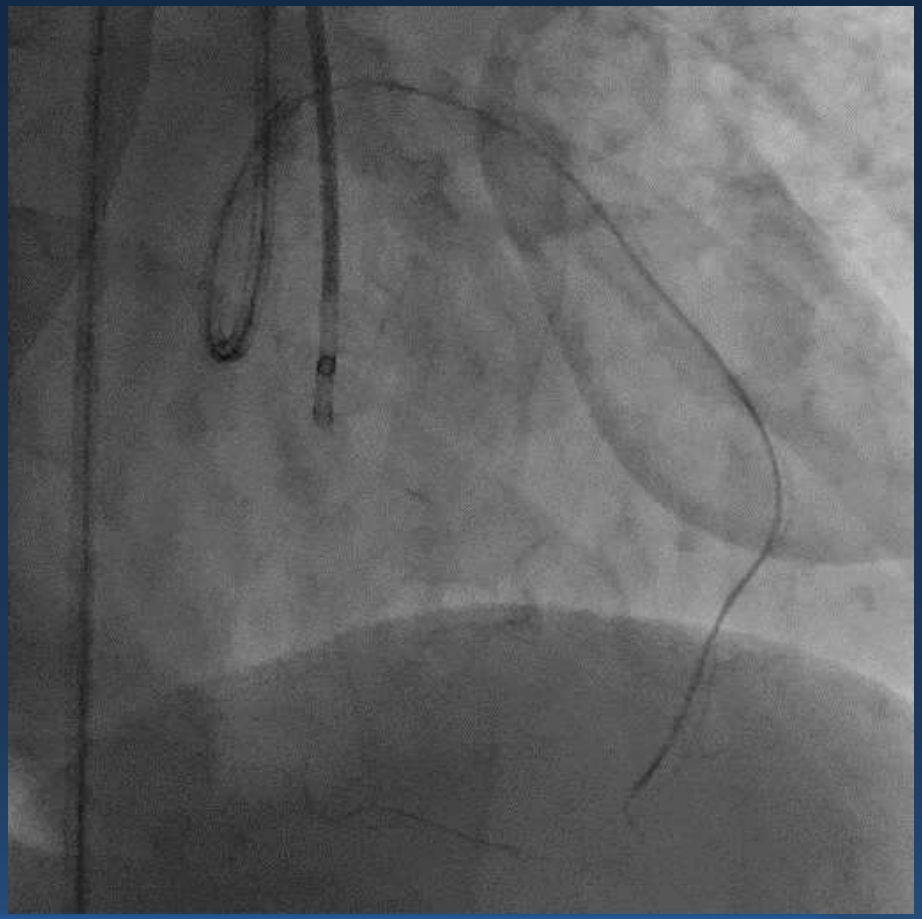




Antegrade wiring : Corsair 135cm + Sion black
Failed to pass by antegrade approach

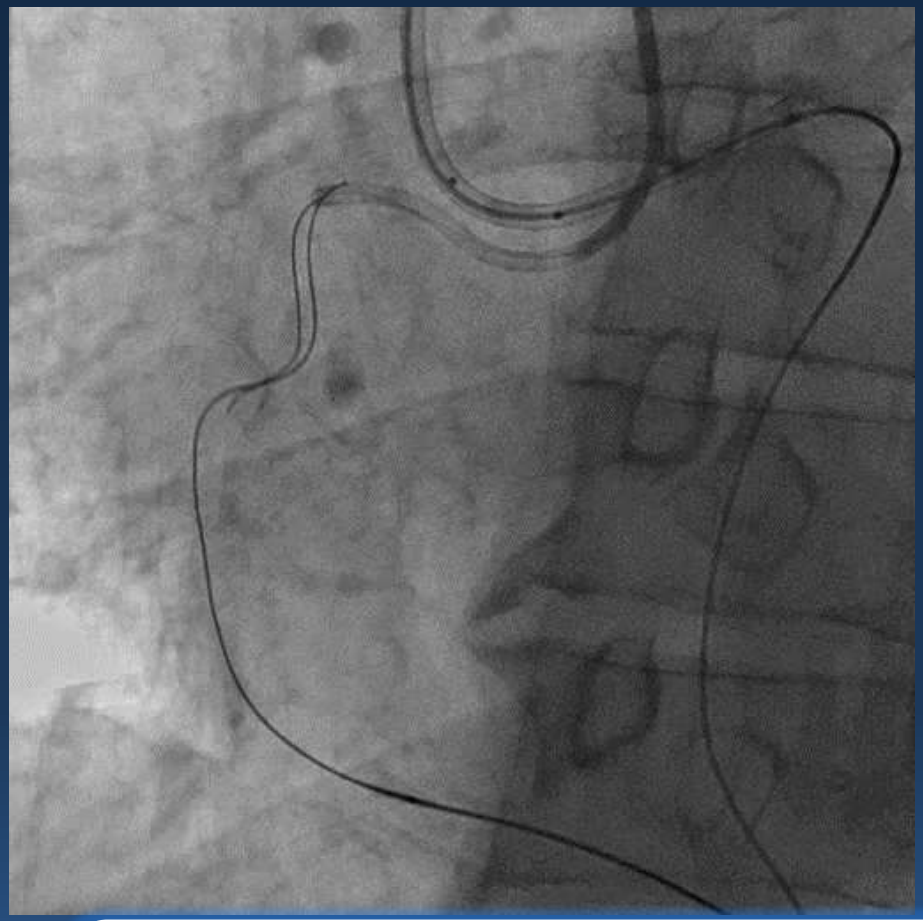
Septal Collateral Channel

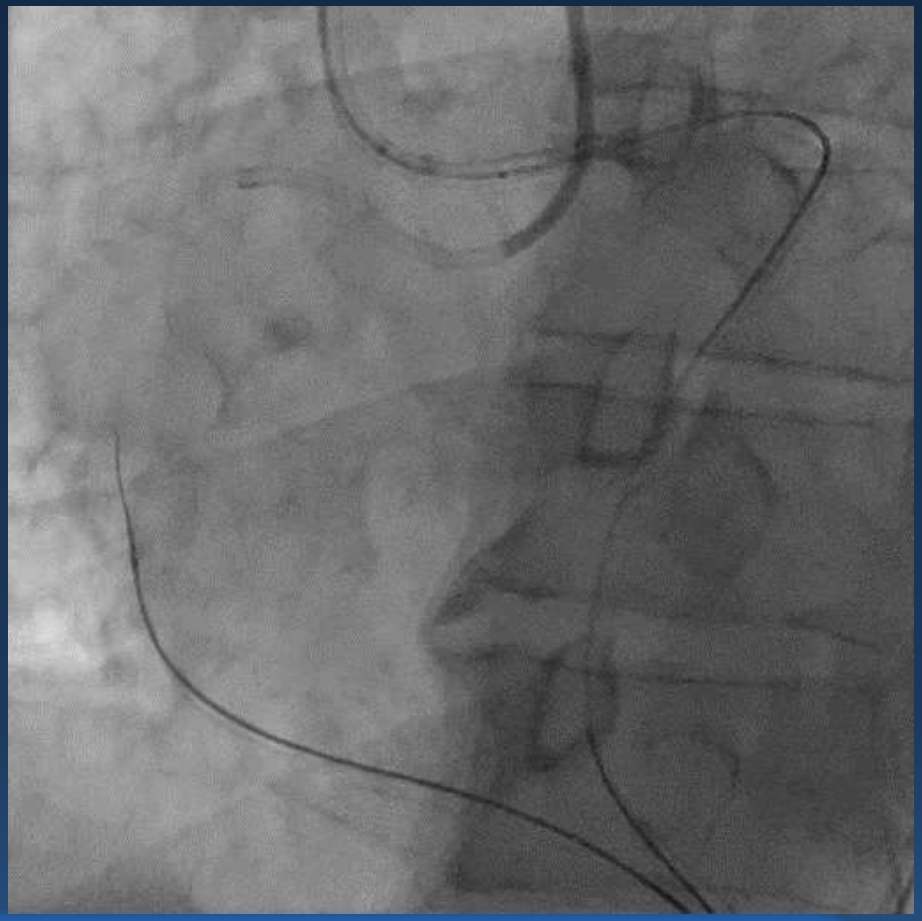




Caravel microcath. + Sion black & SUOH 03

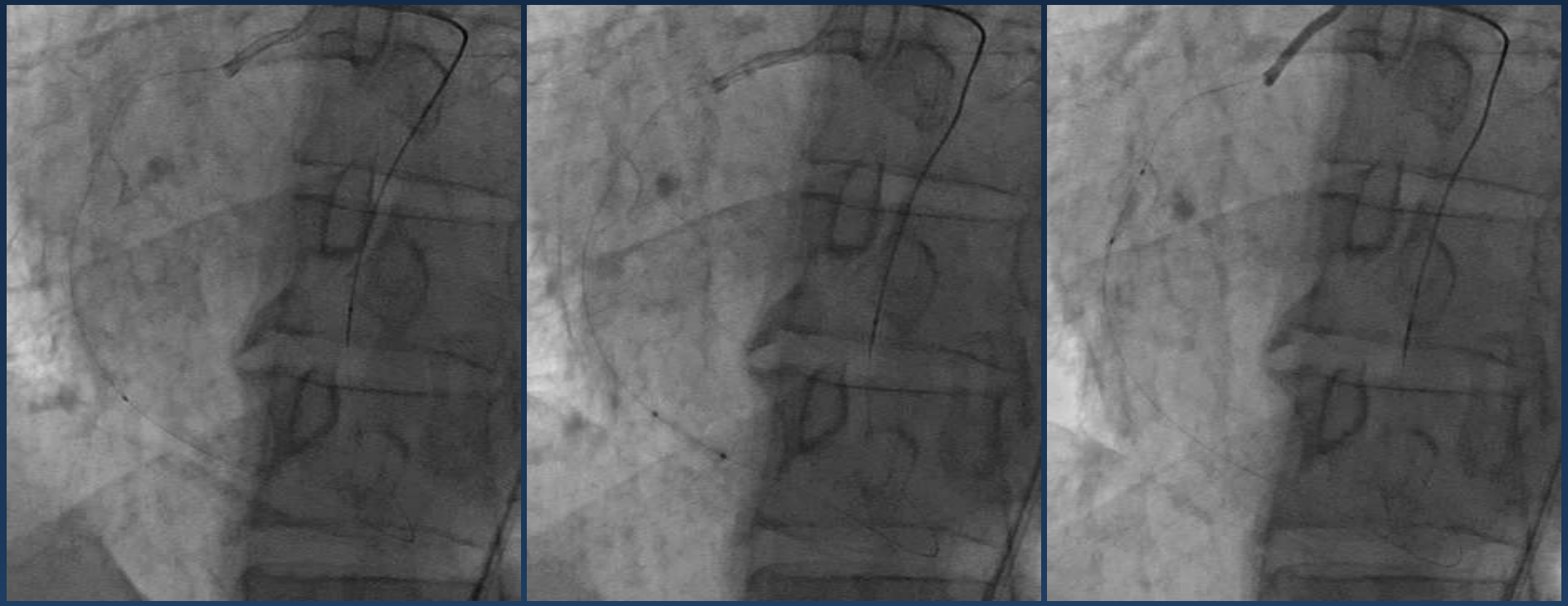
Retrograde wiring to septal channel





Caravel microcath. + Sion black &Fielder XT-R & Gaia Second

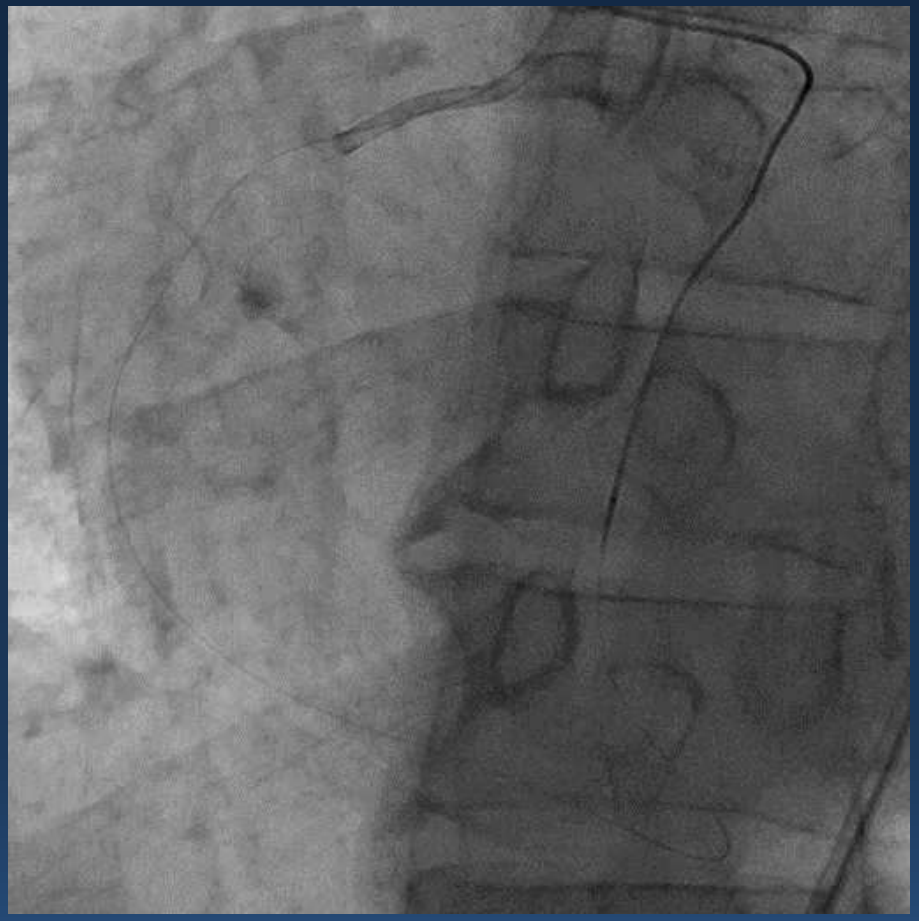
Retrograde wiring to septal channel

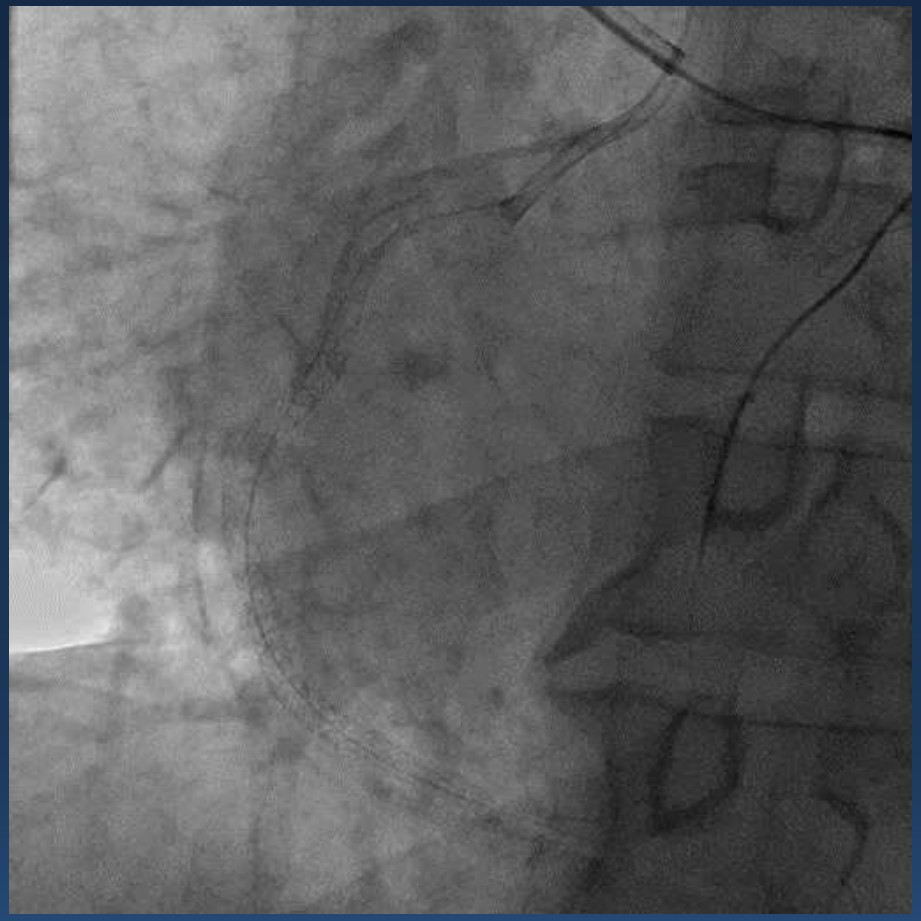


Wire externalization → RG3

Balloon : 1.0/6mm +2.5/15mm

PCI on RCA CTO lesion

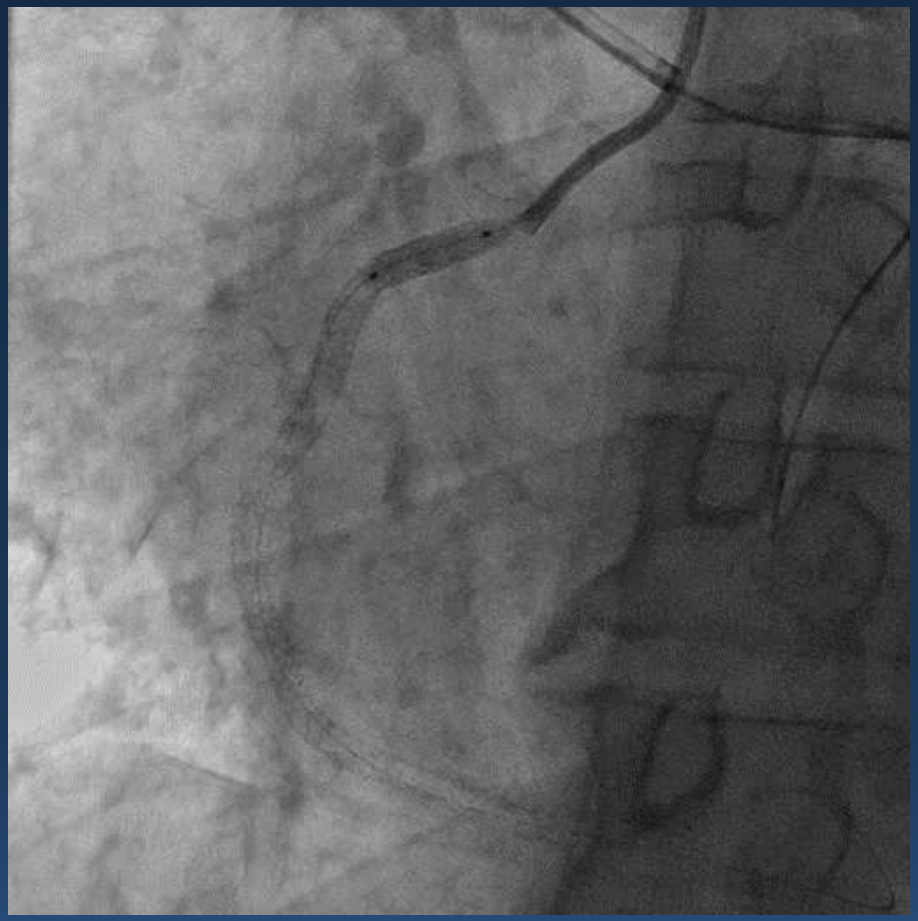


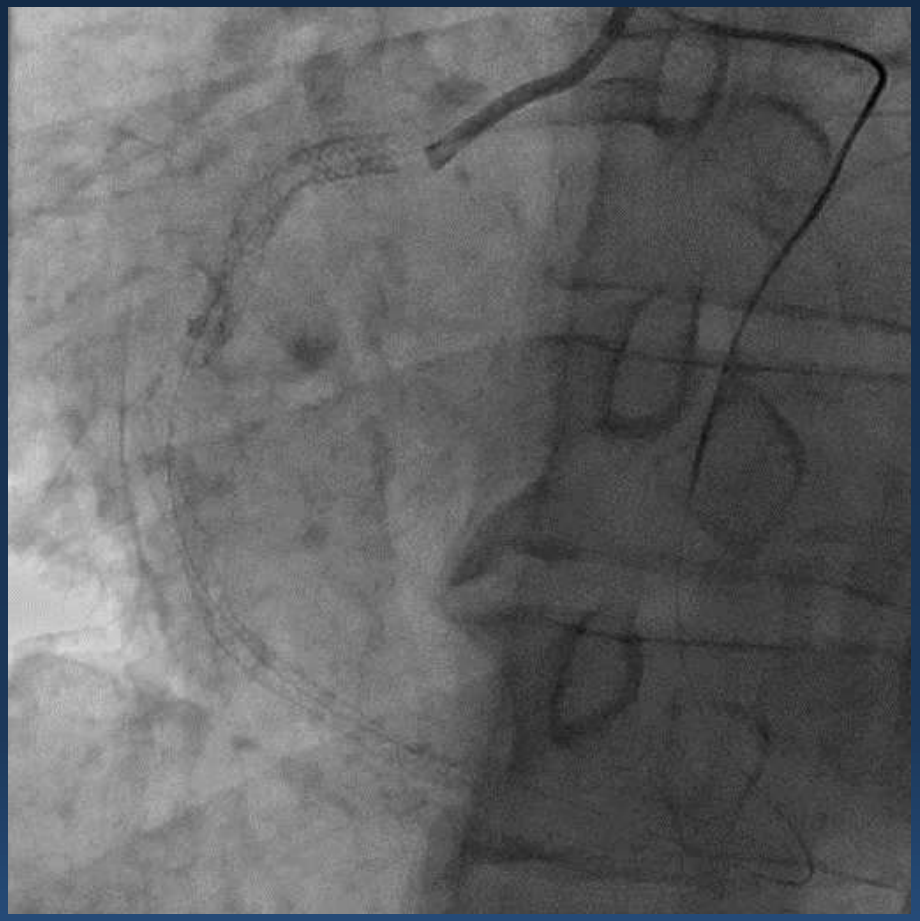


Stent : Synergy 3.0/38 + 3.5/38 + 4.0/28mm

Angiography & IVUS → osRCA dissection(+)

PCI on RCA CTO lesion

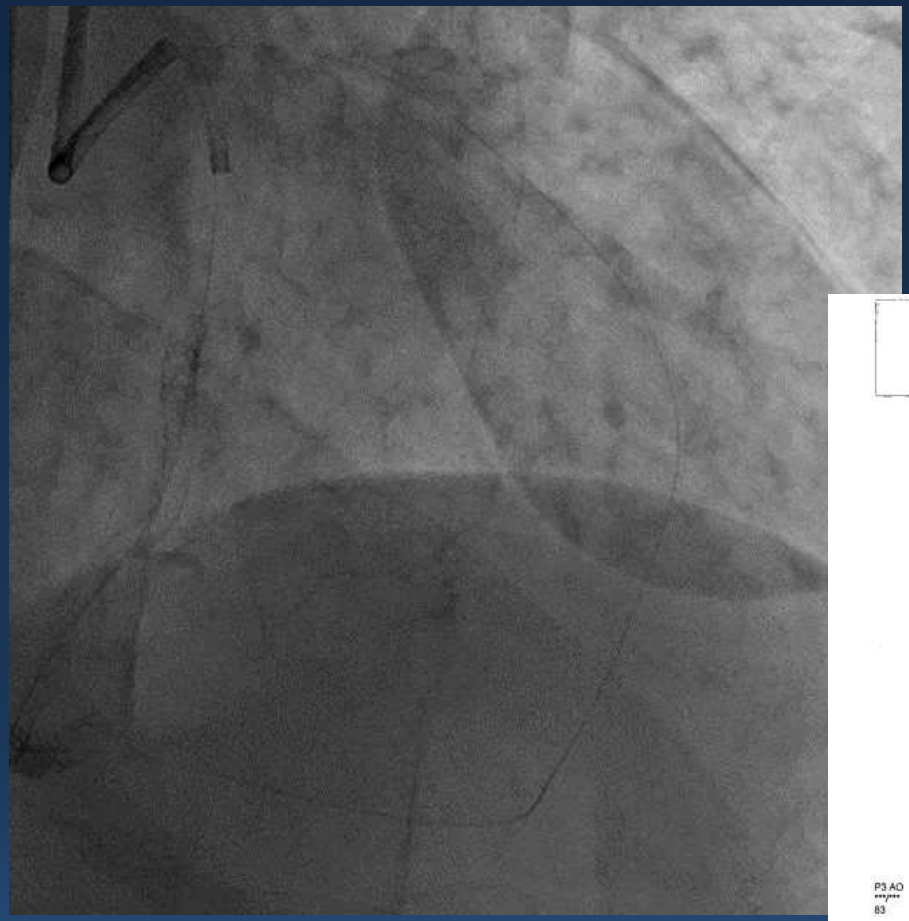


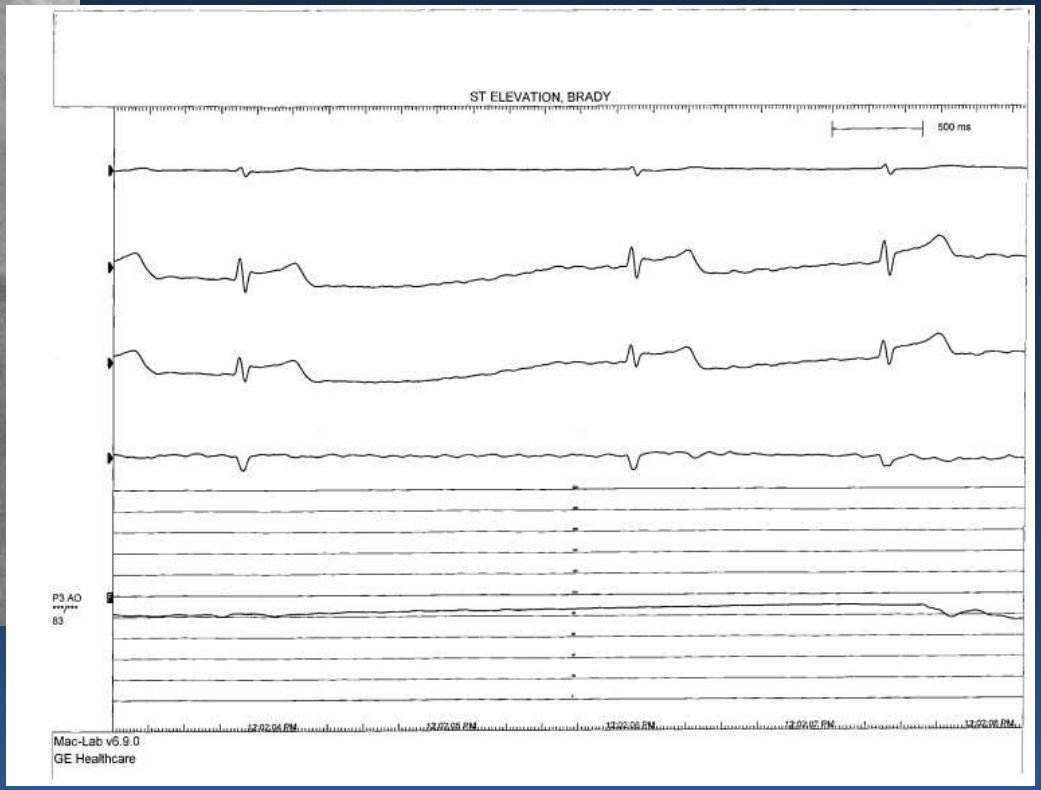


Synergy 4.0/12mm

Successful PCI on RCA CTO lesion

Collateral angiography

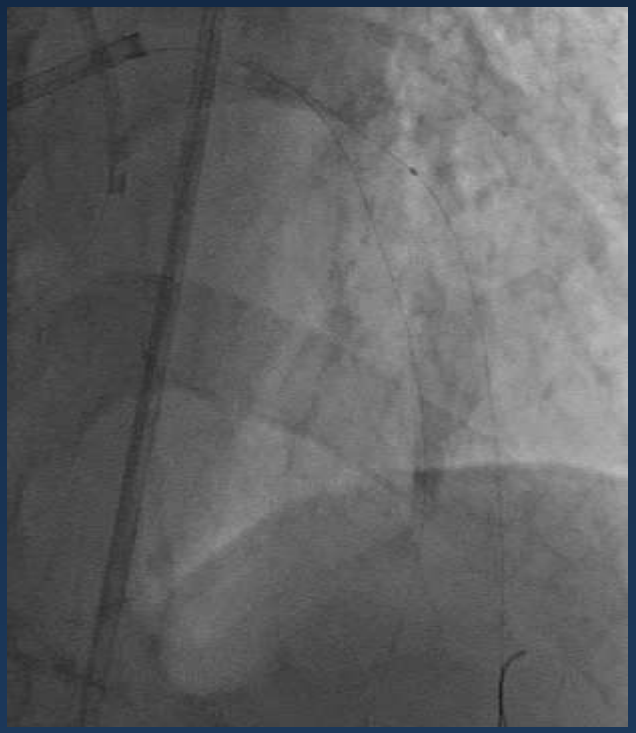




LAD acute total occlusion!!

Why did complications occur?

- Embolization by air in the injecto line or Guiding Catheter?
- Guiding Catheter induced Dissection?
- Coronary artery spasm?
- Thrombosis in Guiding Catheter?



Aspiration → 6Fr Thrombuster Catheter

Activated Clotting Time(ACT) < 100sec → Heparin 3000unit Inject

Why did complications occur?

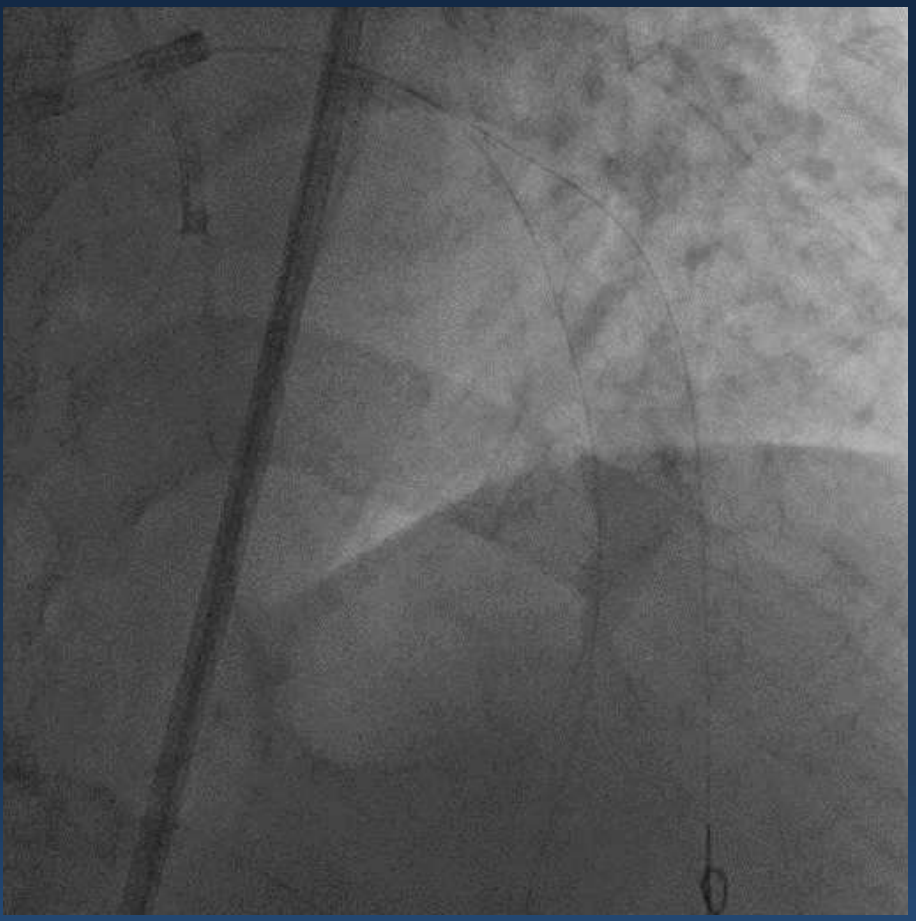
Embolization by air in the injecto line or Guiding Catheter?

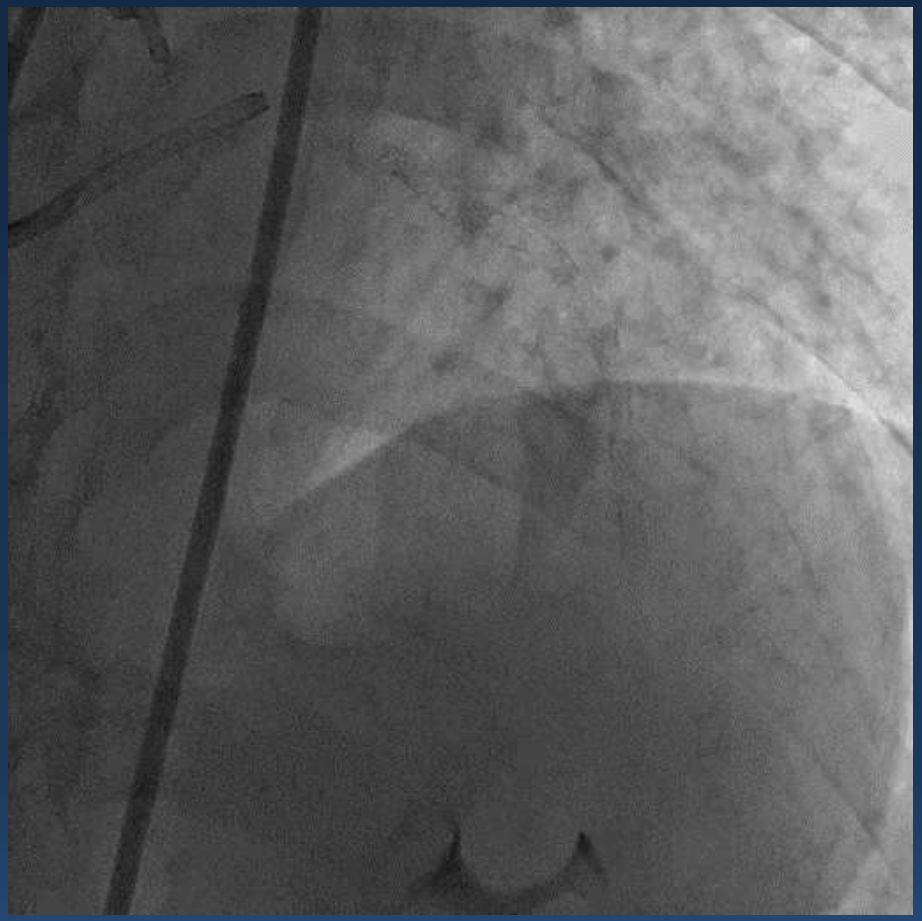
Guiding Catheter induced Dissection?

Coronary artery spasm?

Thrombosis in Guiding Catheter?
→ Due to Patient IV line dysfunction…

PCI on LAD lesion





Activated Clotting Time(ACT) elevation → ≥ 300sec
Stent : Synergy 3.0/38 + 3.5/32mm
Successful PCI on p-mLAD lesion

Prevention

Circulation
Volume 140, Issue 5, 30 July 2019; Pages 420-433
https://doi.org/10.1161/CIRCULATIONAHA.119.039797

American Heart Association.

WHITE PAPER

Guiding Principles for Chronic Total Occlusion Percutaneous Coronary Intervention

A Global Expert Consensus Document

Dual injection minimizes the risk for perforation by helping determine guidewire position. Placement of a safety guidewire in the CTO donor vessel can facilitate treatment if donor vessel injury occurs. Maintaining an activated clotting time of ≥300 to 350 seconds reduces the risk of donor vessel thrombosis; the activated clotting time should be checked at least every 30 minutes during the procedure. In case of perforation, covered stents and coils should be available to treat large vessel and distal vessel perforations, respectively. Preprocedural operator training in the proper use of these devices will ensure efficient use in the emergency setting. In case of epicardial collateral perforation,[43,91] embolization from both directions (using coils, thrombin, fat, etc) is often needed to achieve sealing.[92] Special attention should be given to patients with previous coronary bypass graft surgery, because perforation can result in life-threatening, difficult to access, loculated hematomas[93] or bleeding in the mediastinum or pleural cavities.

Take home message

- 합병증! 안 생기게 예방하는 것이 최고!
- 발생 시 잘 대처할 수 있도록 미리 준비!
- 똑같은 실수를 반복하지 않도록 주의하자!