The post-CABG patient

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Jouw hart, onze zorg

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Data from RECHARGE registry

- Patients with previous CABG represented **17.4%** of the total study population (217/1249) and were:
  - **Older** (68.6±10.7 vs 65 ±8.6 years p<0.001)
  - **More comorbitidies**
    - Smokers (49.8% vs 34.2%, p<0.001)
    - Hypertension (72.4% vs 59.3%, p<0.001)
    - Hypercolesterolemia (78.3% vs 64.7%, p<0.001)
    - Diabetes (31.3% vs 25.5% p=0.09)
    - Previous MI (51.2% vs 36.6% p<0.001)
    - Chronic kidney disease (16.6% vs 10.5% p=0.01)
  - **Higher occlusion complexity**
    - J-CTO score: 2.89±1.23 vs 2.07±1.22, p<0.001
    - PROGRESS score: 1.43±0.87 vs 1.15±0.94, p<0.001
- **Lower Procedural Success: 71.9% vs 88.7% (p<0.001)**

Maeremans et al JACC 2016

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The PROGRESS group experience

- **35%** were CABG patients (176/496)

	prior CABG (n=176)	no-prior CABG (n=320)	p Value
Age	68±9	64±10	<0.001
Diabetes	49%	38%	<0.05
Hypertension	93%	89%	0.08
Dyslipidemia	97%	93%	0.14
prior MI	44%	32%	<0.01
J-CTO score	3.12±1.03	2.41±1.21	<0.001
Technical Success	88.1%	93.4%	0.04

Christopoulos et al Am J Cardiology 2014

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Can J Cardiol. 2018 Mar;34(3):310-318. doi: 10.1016/j.cjca.2017.12.016. Epub 2017 Dec 26.

Long-Term Outcomes of Percutaneous Coronary Intervention for Chronic Total Occlusion in Patients Who Have Undergone Coronary Artery Bypass Grafting vs Those Who Have Not.

Azzalini L[1], Ojeda S[2], Karatasakis A[3], Maeremans J[4], Tanabe M[5], La Manna A[6], Dautov R[7], Ybarra LF[8], Benincasa S[1], Bellini B[1], Candilio L[1], Demir OM[1], Hidalgo F[2], Karacsonyi J[3], Gravina G[6], Miccichè E[6], D'Agosta G[6], Venuti G[6], Tamburino C[6], Pan M[2], Carlino M[1], Dens J[9], Brilakis ES[10], Colombo A[1], Rinfret S[11].

Post-procedural Complications rates

Variable	Overall (n=2058)	Post-CABG (n=401)	CABG-naïve (n=1657)	p-value
Major complication	40 (1.9%)	15 (3.7%)	25 (1.5%)	0.004
Any perforation	134 (6.5%)	48 (12.0%)	86 (5.2%)	<0.001
Perforation with need for intervention	27 (1.3%)	8 (2.0%)	19 (1.1%)	0.18
Tamponade	11 (0.5%)	1 (0.2%)	10 (0.6%)	0.38
Vascular complications	23 (1.1%)	4 (1.0%)	19 (1.1%)	0.80
Major bleeding	15 (0.7%)	4 (1.0%)	11 (0.7%)	0.48
Contrast-induced nephropathy	7 (0.3%)	3 (0.7%)	4 (0.2%)	0.12
Stroke	8 (0.4%)	3 (0.7%)	5 (0.3%)	0.20
Periprocedural myocardial infarction	16 (0.8%)	8 (2.0%)	8 (0.5%)	0.002
In-hospital death	7 (0.3%)	3 (0.8%)	4 (0.2%)	0.12
Procedure-related death	4 (0.2%)	3 (0.8%)	1 (0.1%)	0.005

Azzalini L et al Can J Card 2018

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Clinical Outcome at 24 months follow-up

	Overall (n=1772)	Post-CABG (n=368)	CABG-naïve (n=1404)	p-value
Target-vessel failure	176 (10.4%)	55 (16.1%)	121 (9.0%)	<0.001
Cardiac death	40 (2.3%)	14 (3.8%)	26 (1.9%)	0.02
Target-vessel myocardial infarction	17 (1.0%)	7 (2.0%)	10 (0.7%)	0.04
Target-vessel revascularization	132 (7.6%)	41 (11.5%)	91 (6.6%)	0.002

Azzalini L et al Can J Card 2018

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Why should we consider post-CABG CTO patients “different”?

- **More complex** patients (more comorbidities…)
  - RECHARGE registry
  - PROGRESS registry
- Often **more calcifications** and **more complex** coronary pathology, due to **older** and **more advanced** coronary artery disease
- Grafts may represent additional:
  - **Possibilities**
  - **Risks**
- Complication management (Perforations)

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Why should we consider post-CABG CTO patients “different”?

- Additional issues from “personal experience”:

- **Access site**: patients with multiple procedures in the past, thus possibly more radial occlusions and more potential complications in the groin and also with more chance for peripheral arterial disease

  RECHARGE: 18% vs 12.9% (p=0.03)

  PROGRESS: 22% vs 15% (p=0.12)

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Why should we consider post-CABG CTO patients “different”?

- Additional issues from “personal experience”:

- If the CTO is at the level of or involving the anastomosis, the **anastomosis** itself can be an extra issue due to the stiches of the surgeon and the different anatomic-pathological substrate (no real intima-media layer?)

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Why should we consider post-CABG CTO patients “different”?

- Additional issues from “personal experience”:

- **Collaterals**: more complex collateral anatomy due to multiple collaterals coming from native arteries but also from bypassed arteries
  - Often “competitive” collaterals from different sources

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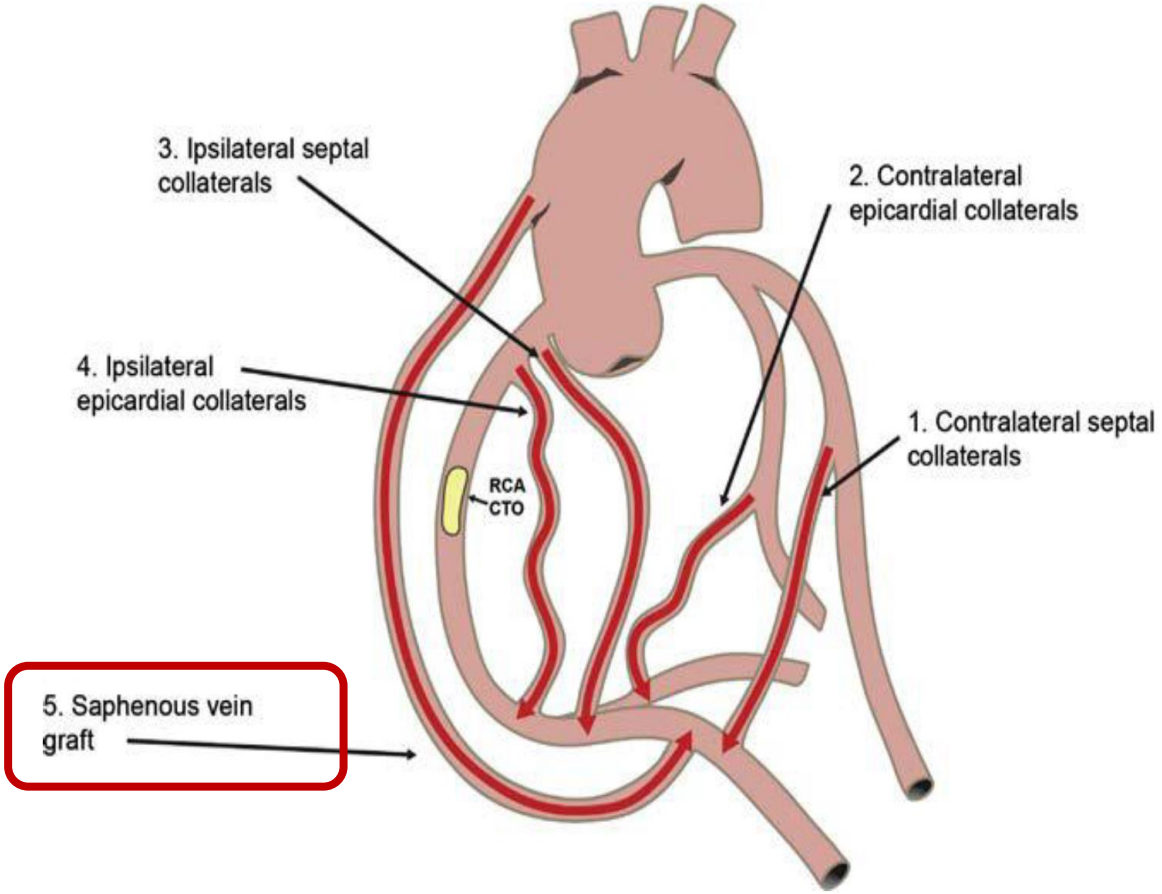
Grafts: 1- Anastomosis disease

Poorly predictable behaviour of the anastomotic disease



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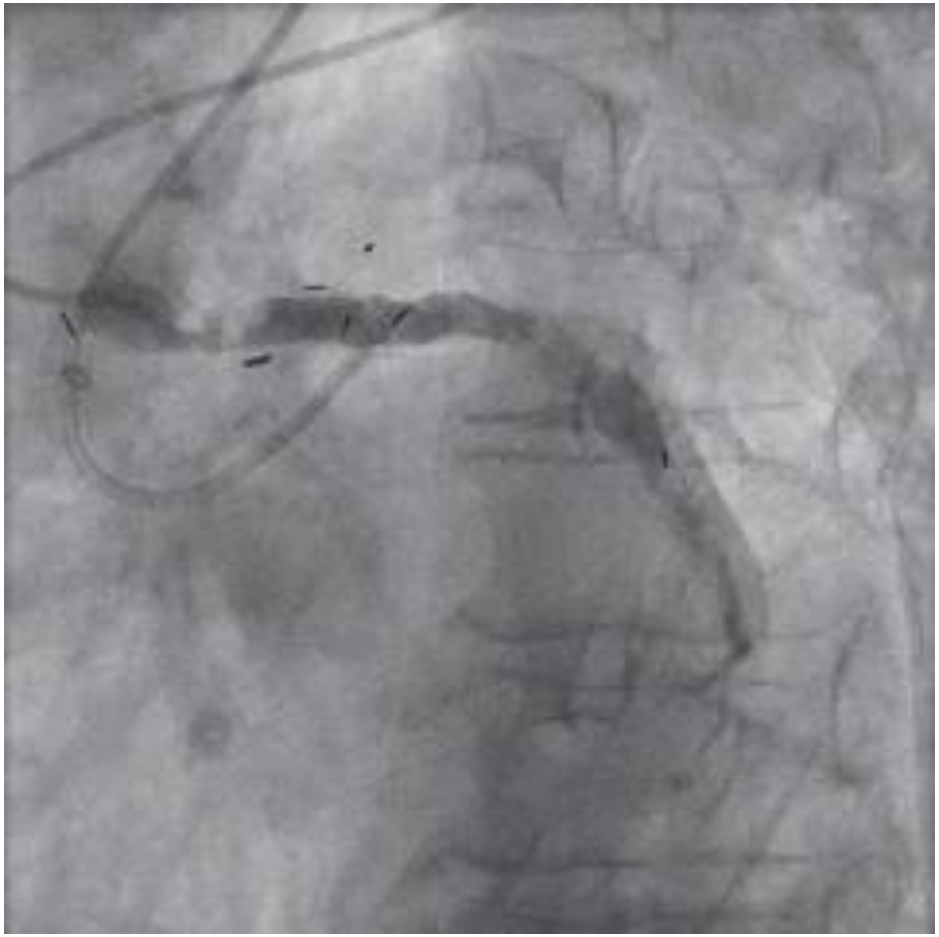
Case example

CTO CX with patent but extremely diseased SVG



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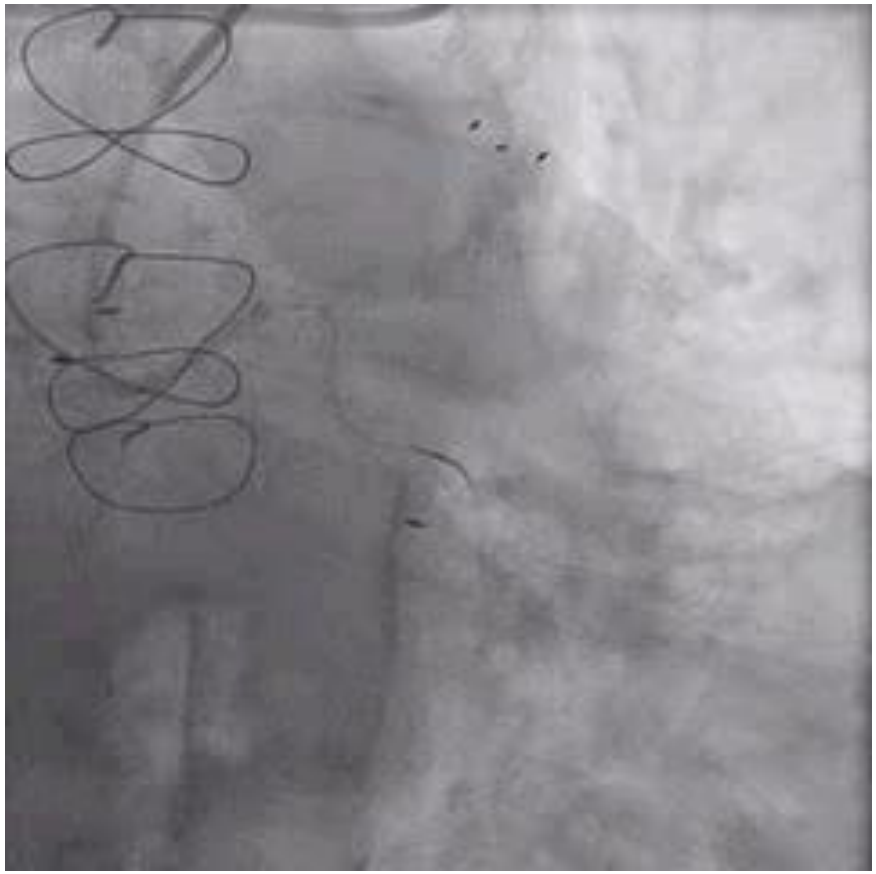
Plan: antegrade dissection re-entry



First knuckle wire ends up in a small branch, no connection with target vessel

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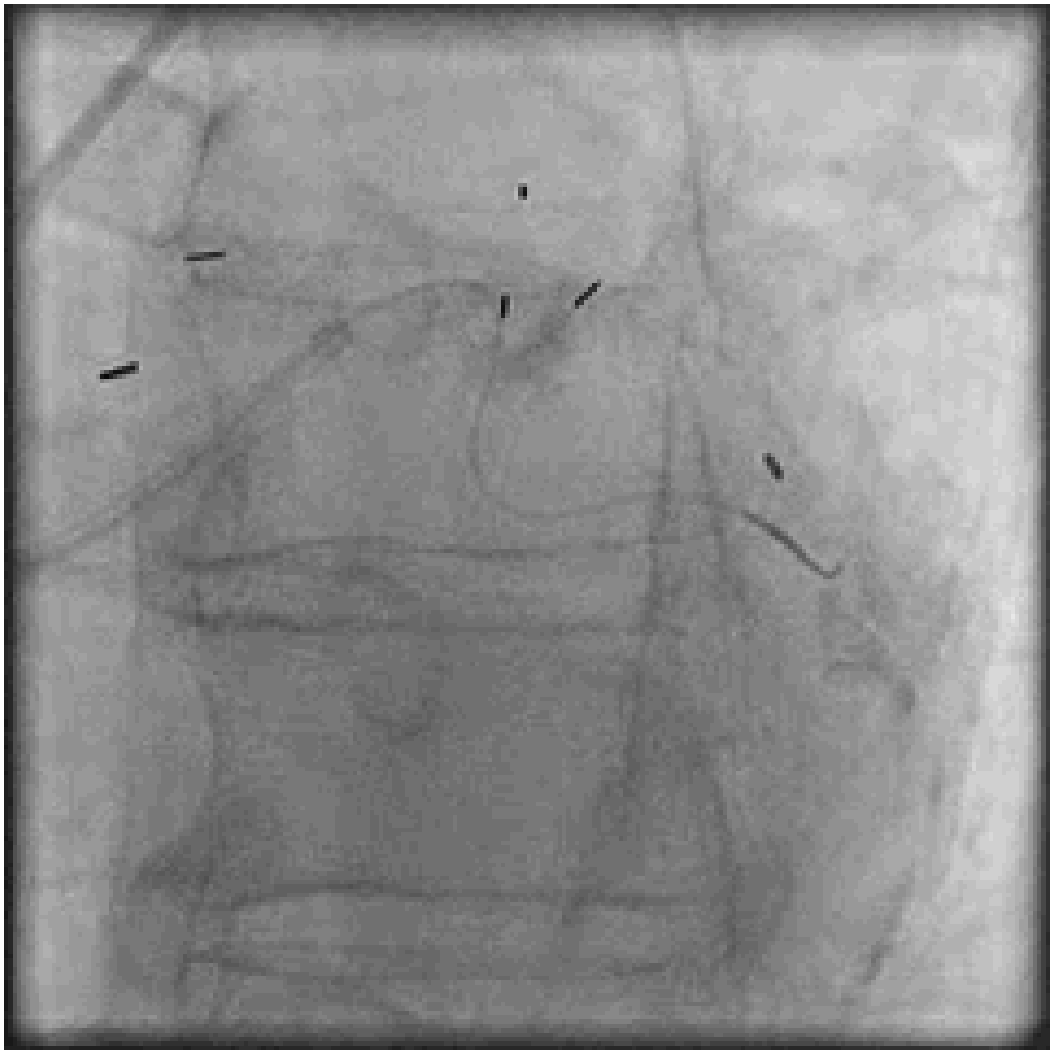
Plan: antegrade dissection re-entry



Wire redirection ends up in a small perforation

It seemed **impossible** to pass **safely** the **anastomotic region**

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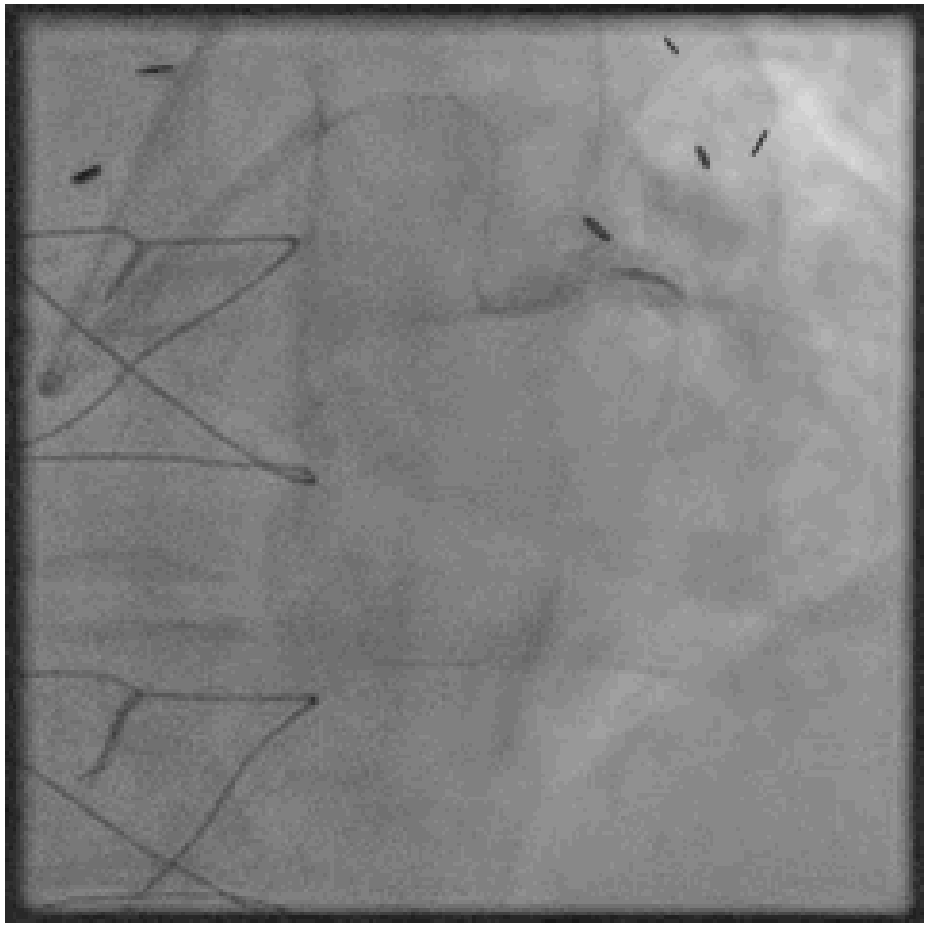
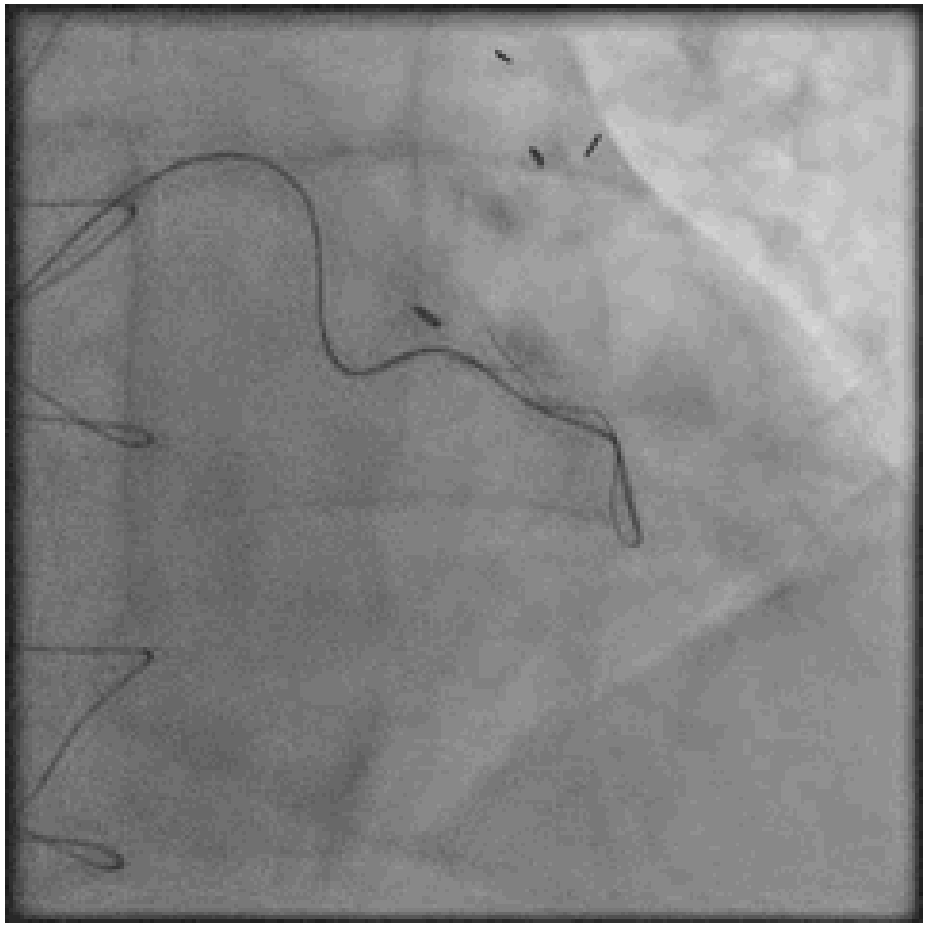
Plan: antegrade dissection re-entry



“New proximal cap” to try and remain in the vessel structure at the level of the anastomosis



New knuckle with “unintentional” STAR technique

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Plan: antegrade dissection re-entry

Final moderate result after stenting before the re-entry zone, to avoid losing the OM1

2 month control
patient totally asymptomatic

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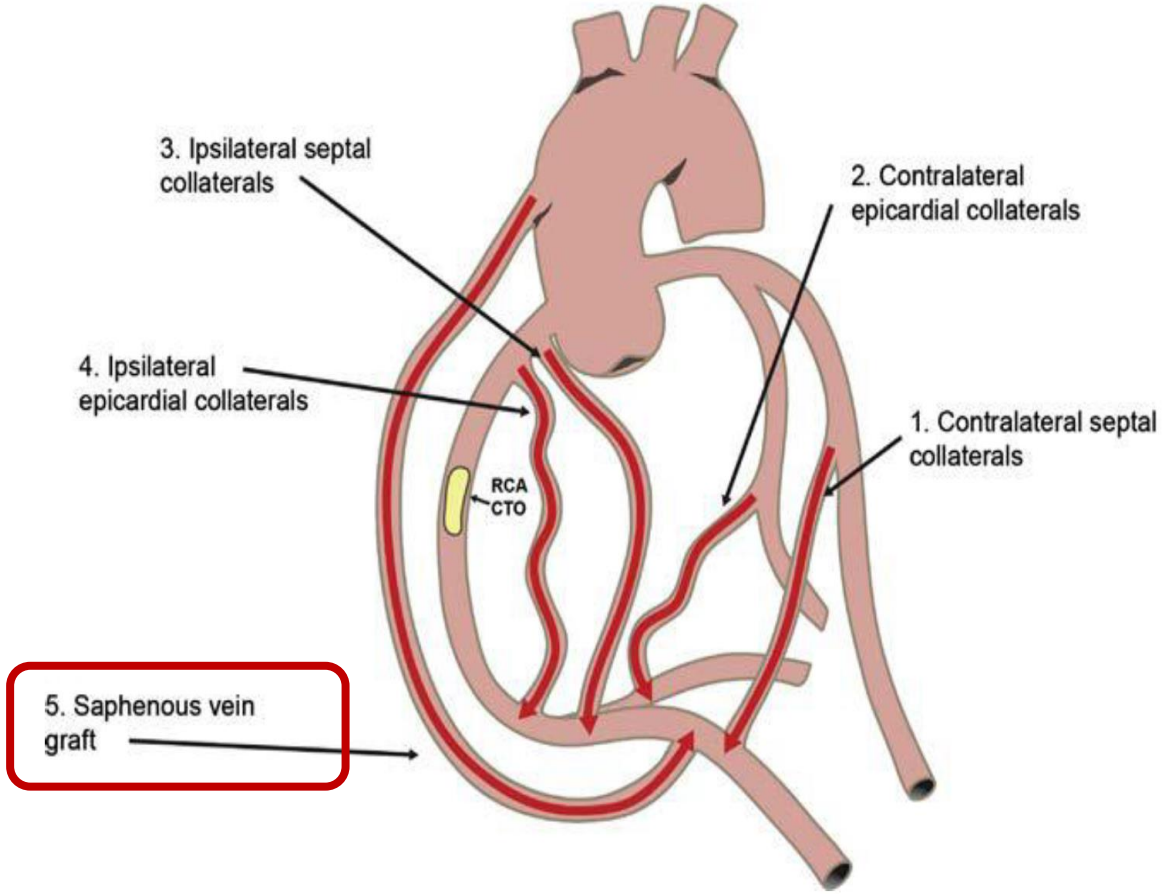
Grafts: 2- Additional collaterals options

Useful evaluation of both Saphenous Vein grafts and Arterial grafts before procedure

When occluded, useful evaluation of previous angiograms, if available

Even occluded graft can be valuable road-options for CTO intervention!



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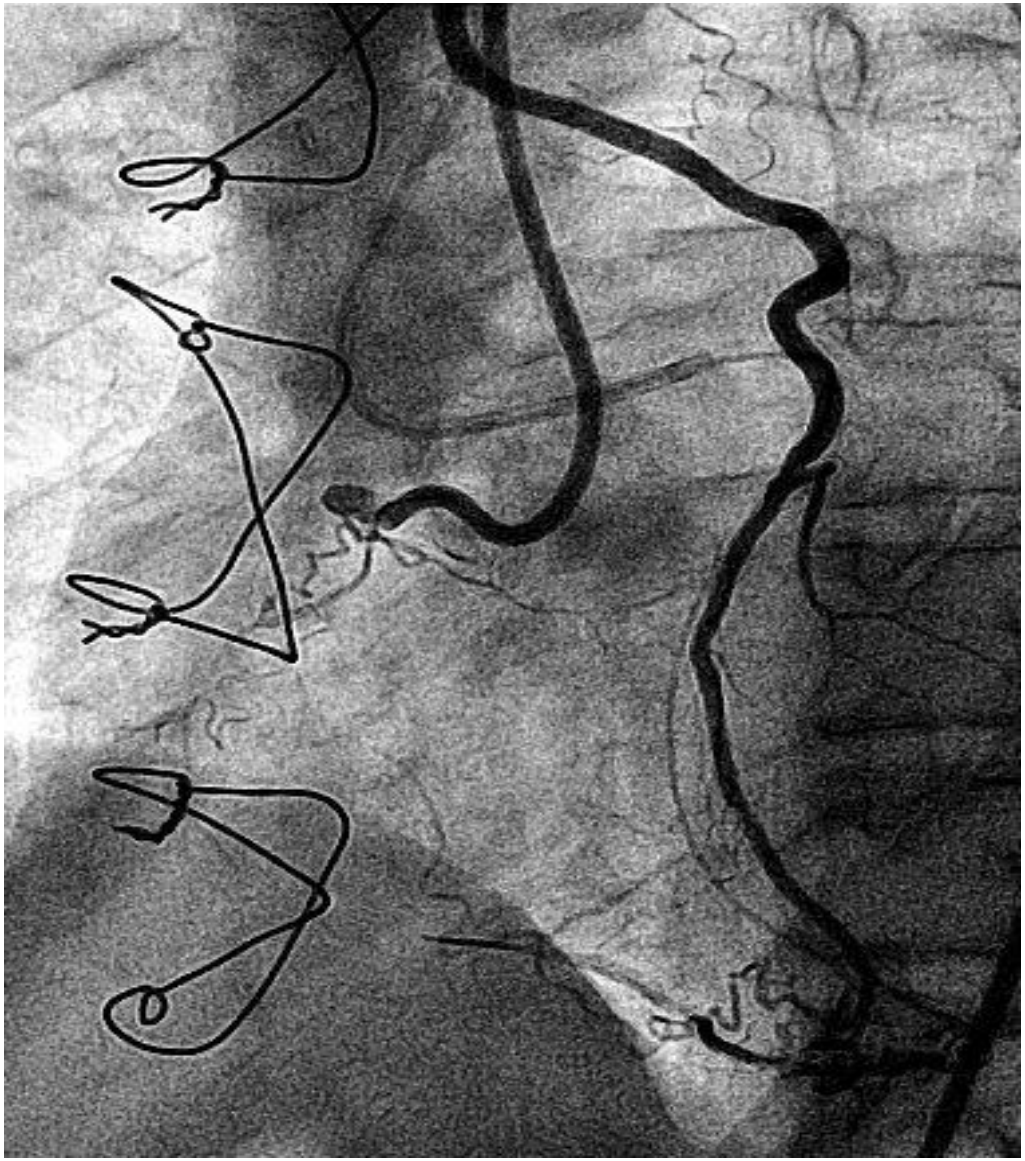
Case example: triple injection



Almost ostial CTO RCA, distal cap at the crux (J-CTO 4)

Right radial guiding 6F in LM for retrograde LAD-septal collateral passage of TurnPike to RDP (known connection from old angiogram)

Left radial guiding 6F for LIMA injection and visualisation of RDP via LIMA-LAD

Femoral guiding 7F in RCA for antegrade work

Final successful reverse CART

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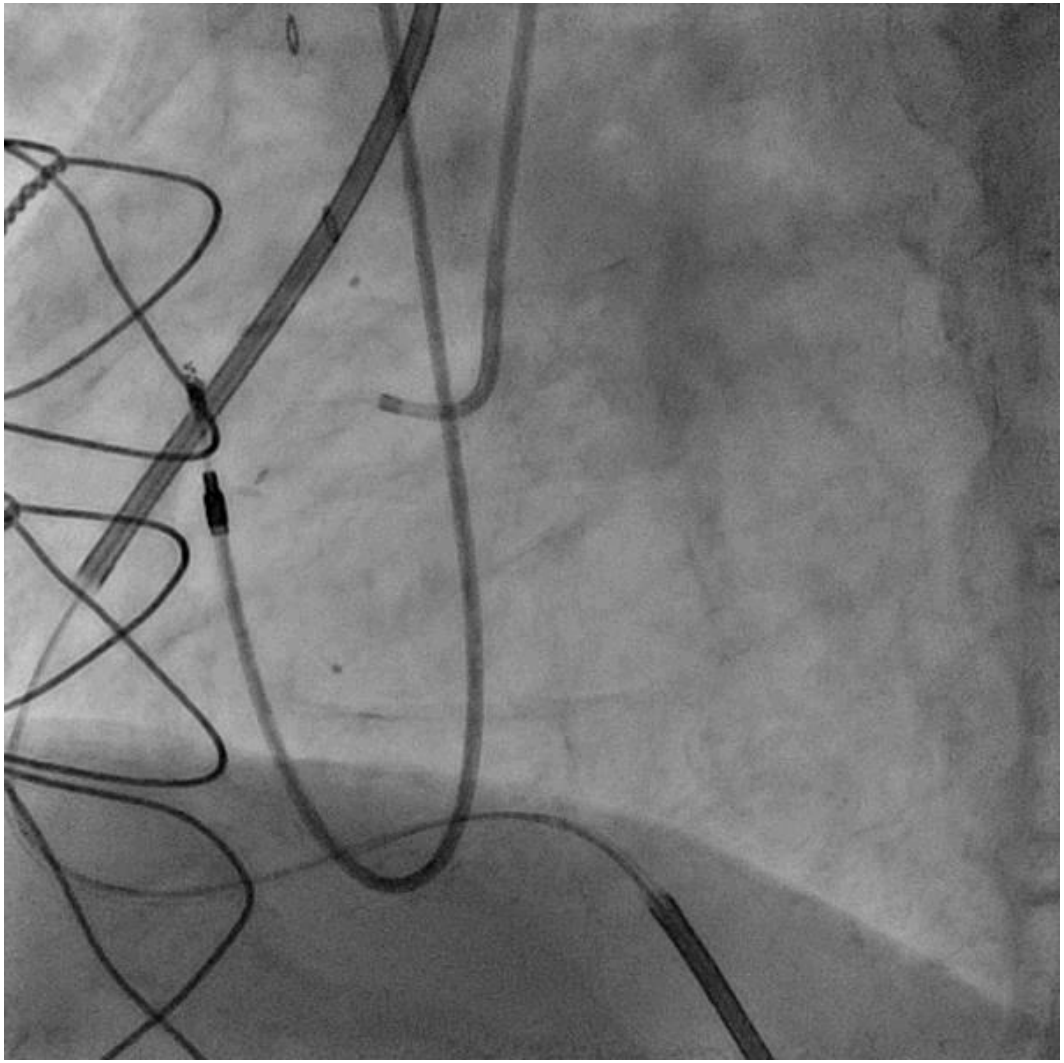
Case example



CTO proximal RCA

Some bridging collaterals to the mid-segment

Very diseased vessel before and after the CTO

No clear distal opacification

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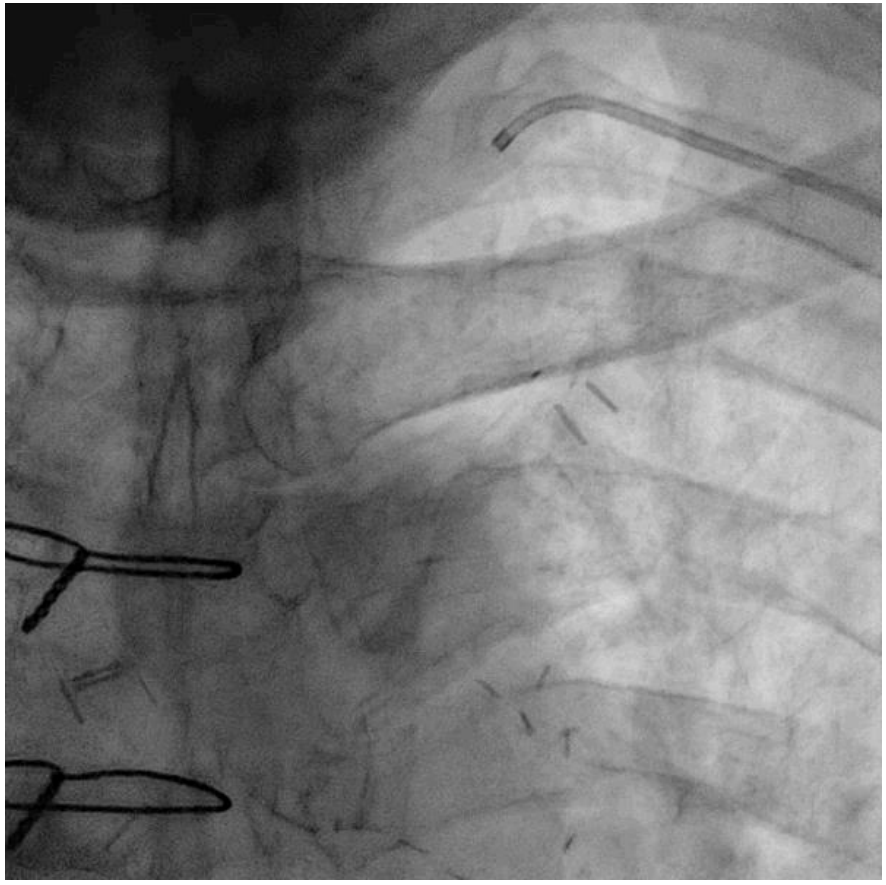
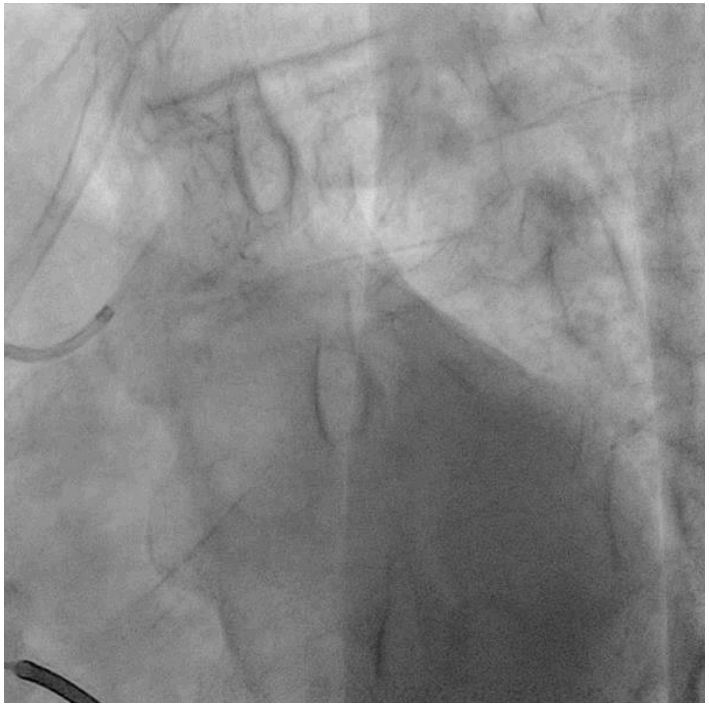
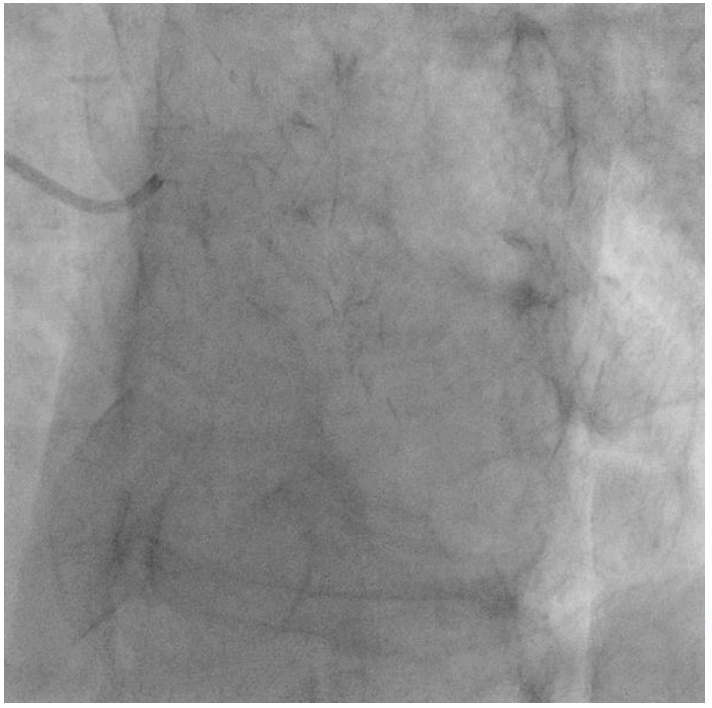






Collaterals to RDP via LIMA-LAD-septum

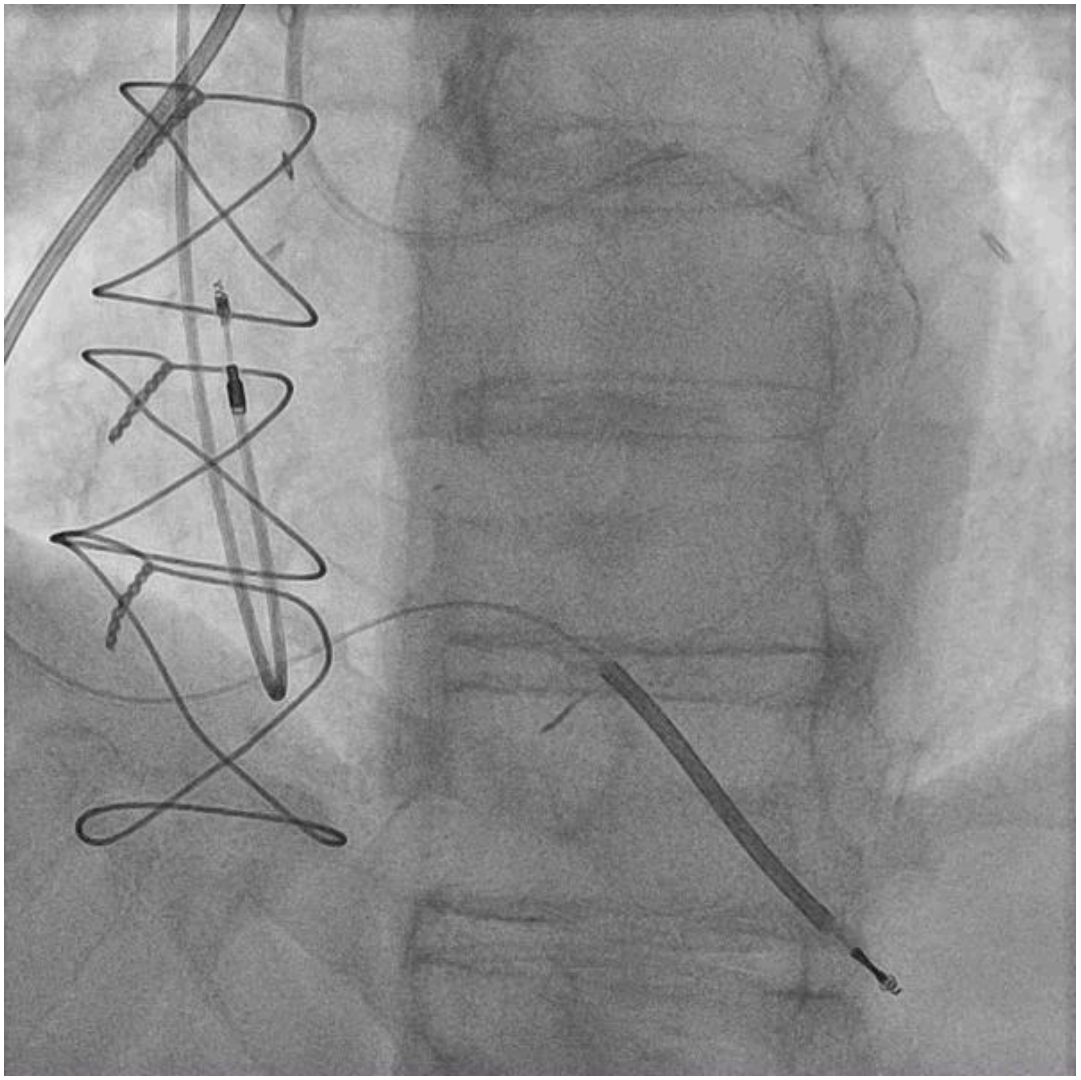
Collaterals to RPL via CX-epicardial collaterals in atrio-ventricular grove

No clear communication between RDP and RPL

Set up: left ulnar for LCA XB4 guiding, right ulnar for RCA AL1 guiding

Easy passage of the wire and Turnpike LP through CX-epicardials

Microcatheter injection: scanty appearance of RDP



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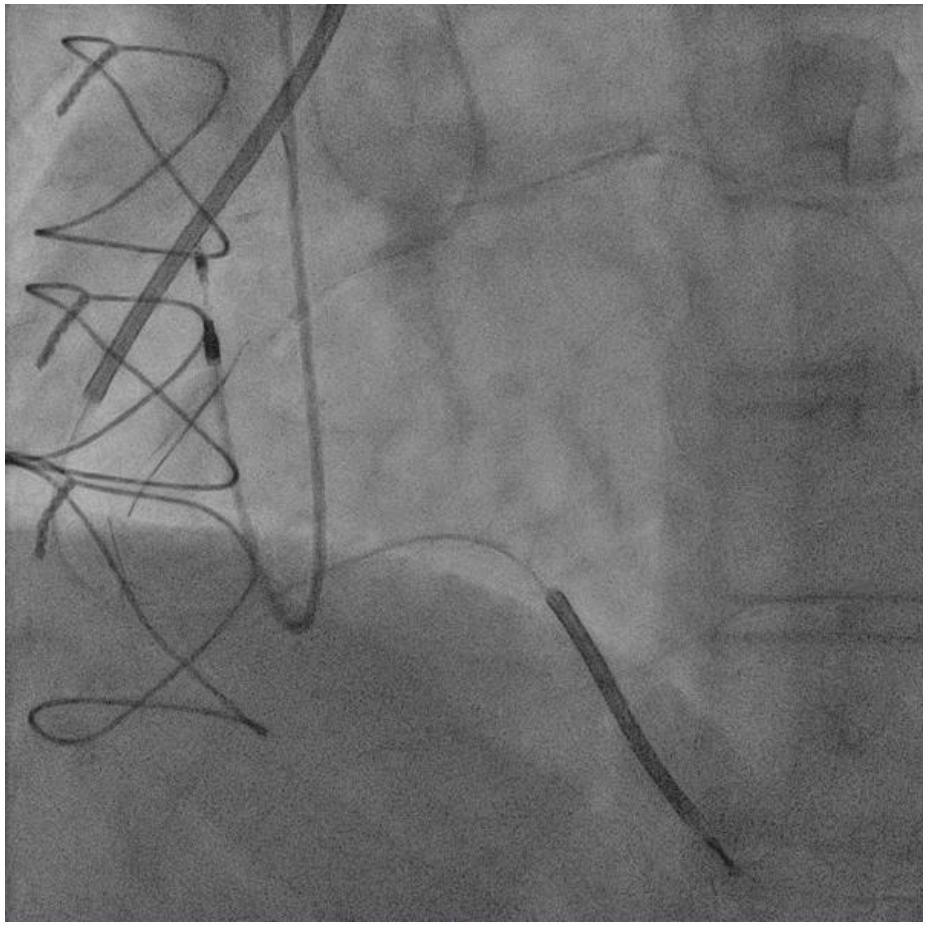
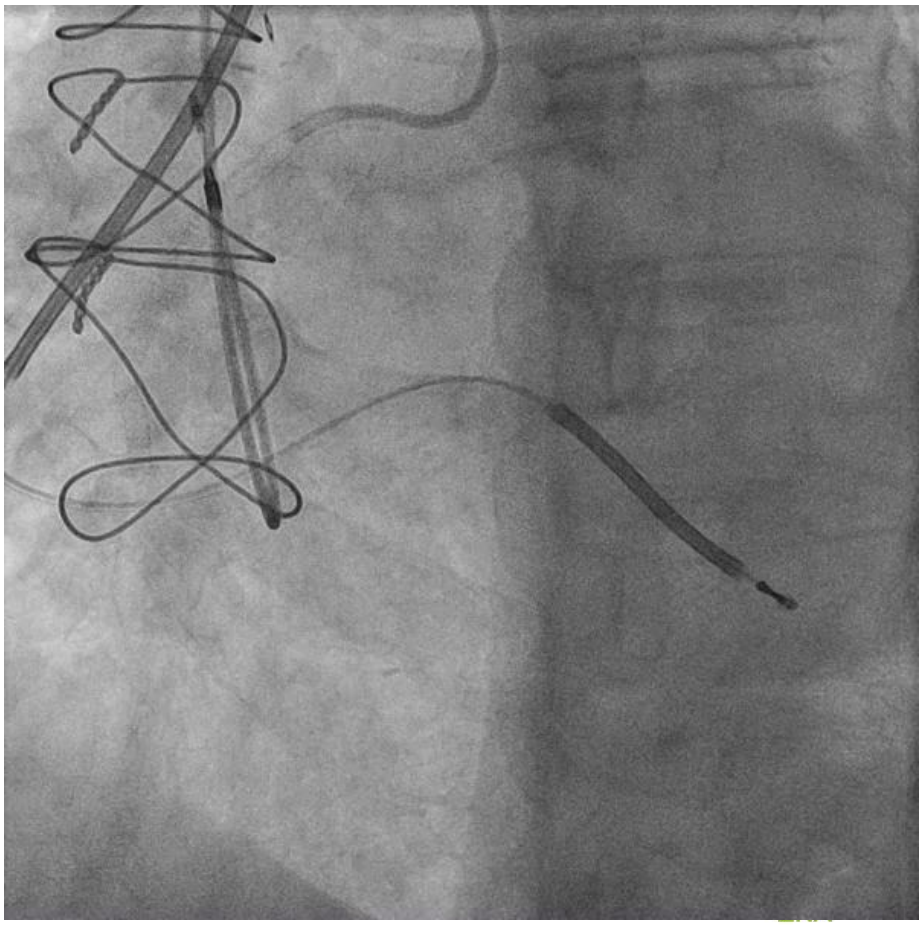
Easy passage of the retrograde wire to mid-RCA

Easy reverse CART

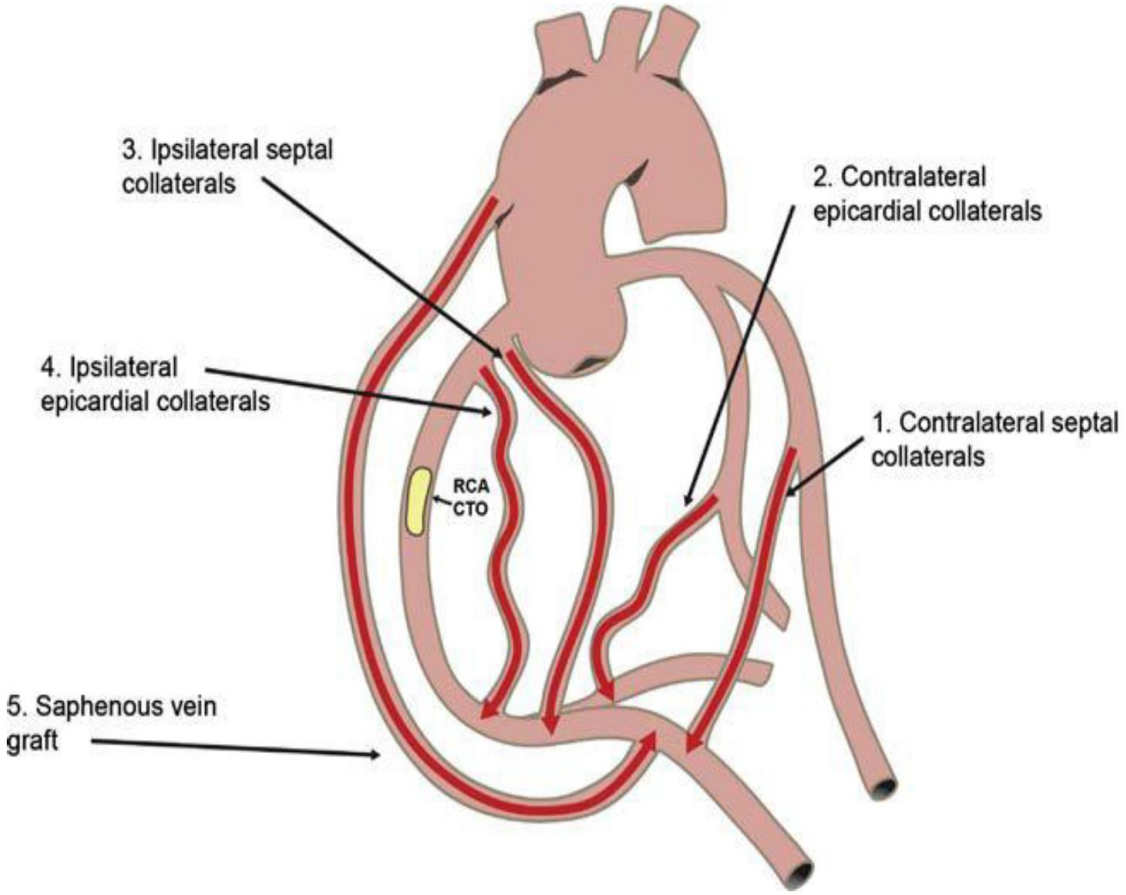
Finally 2 DES placed





Grafts: 3- Ending up in the grafts during retrograde procedures

During retrograde procedures the wire can be tracked easily in previously invisible “vascular” structures…



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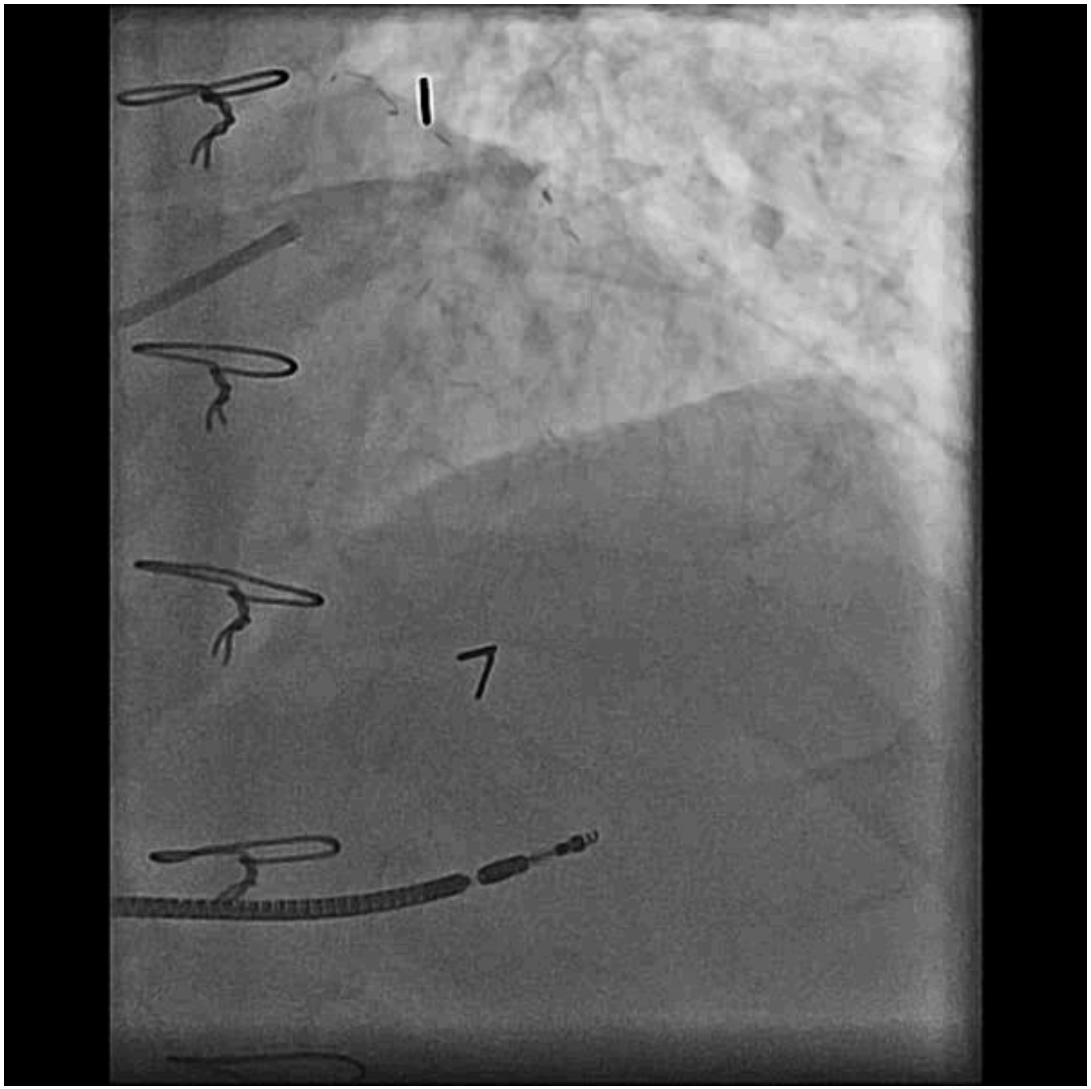
Case example

Man, 59 year-old, silent ischemia and 2 times OHCA in the past

CABG after first OHCA (SVG-RCA and Y graft fLIMA-LAD fRIMA-OM)

Now after 2nd OHCA occlusion of LAD and CX and occlusion of the Y-graft fLIMA-fRIMA on LAD-CX, SVG-RCA good open

Failed attempt to open antegradely LAD, scheduled for retrograde attempt



Chung, Agostoni CRM 2015

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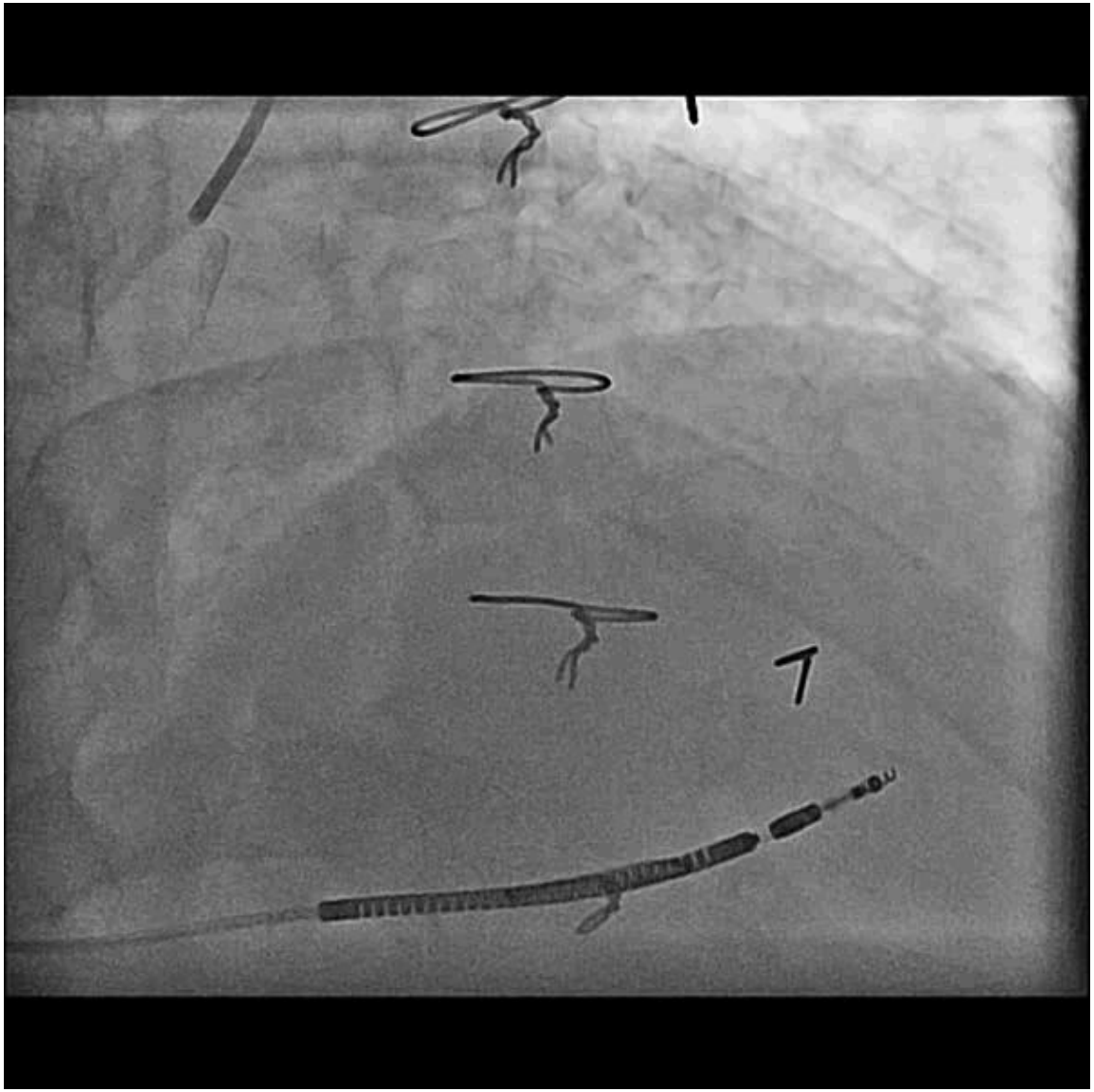
Scanty collaterals from SVG-RCA to LAD

good epicardial collaterals to CX



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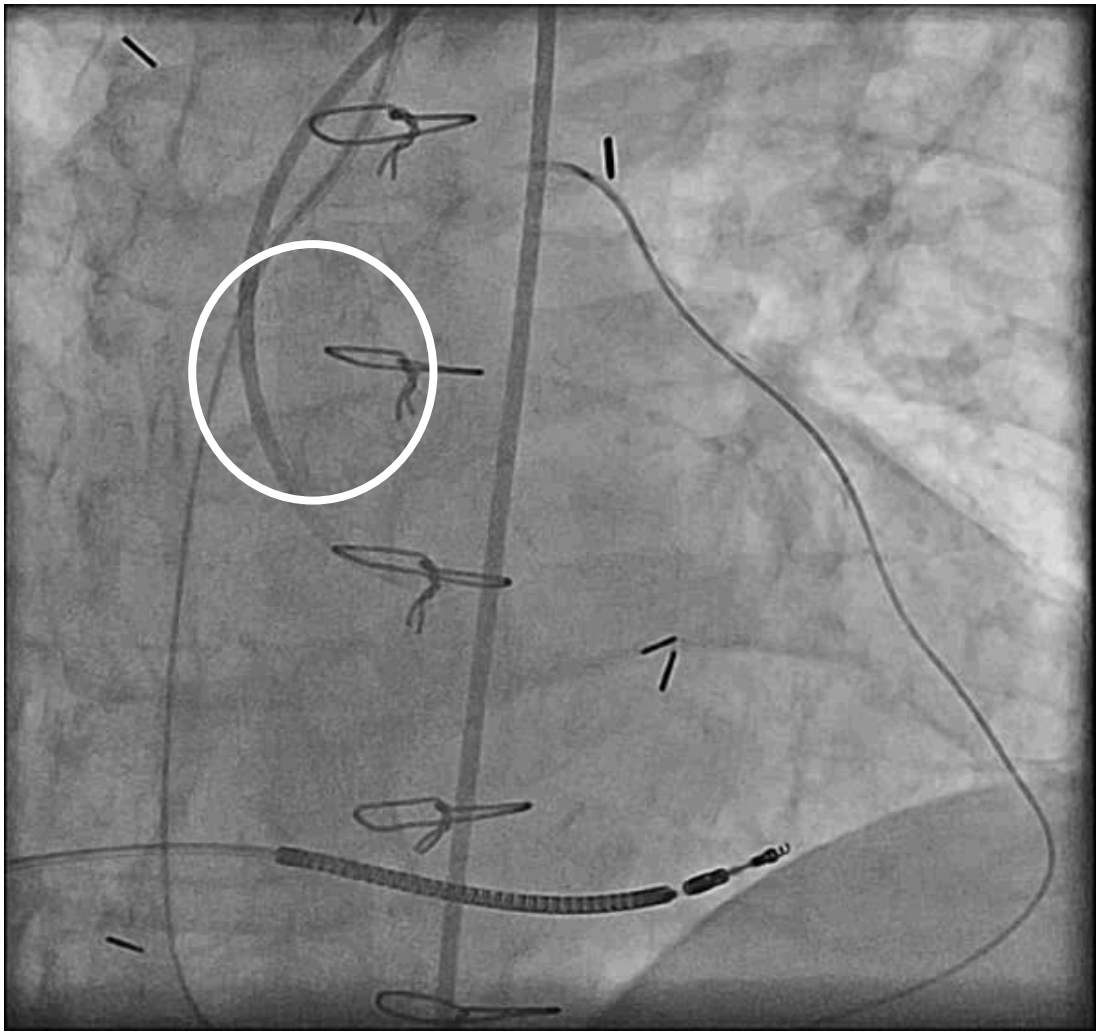
Easy passage of the wire through collaterals but wire in a strange position (however it did not “feel“ out of a vascular structure). Retrograde injection in the Y graft fLIMA-fRIMA on LAD-CX (still open, only aortic anastomosis closed)



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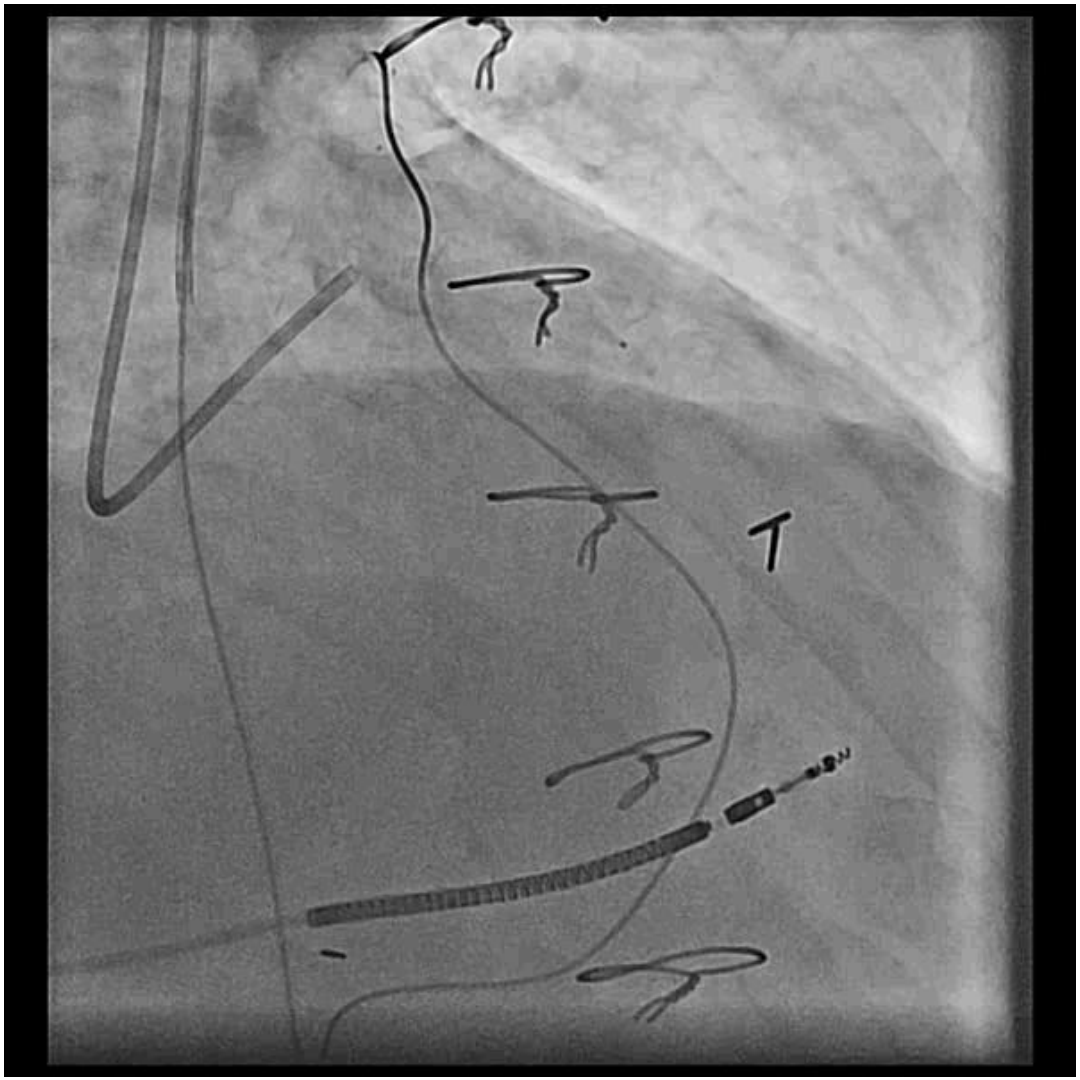
Still failed attempt to recanalize LAD (even with better visualization via Corsair injection), but important information for surgeons for ReDo CABG



Chung, Agostoni CRM 2015

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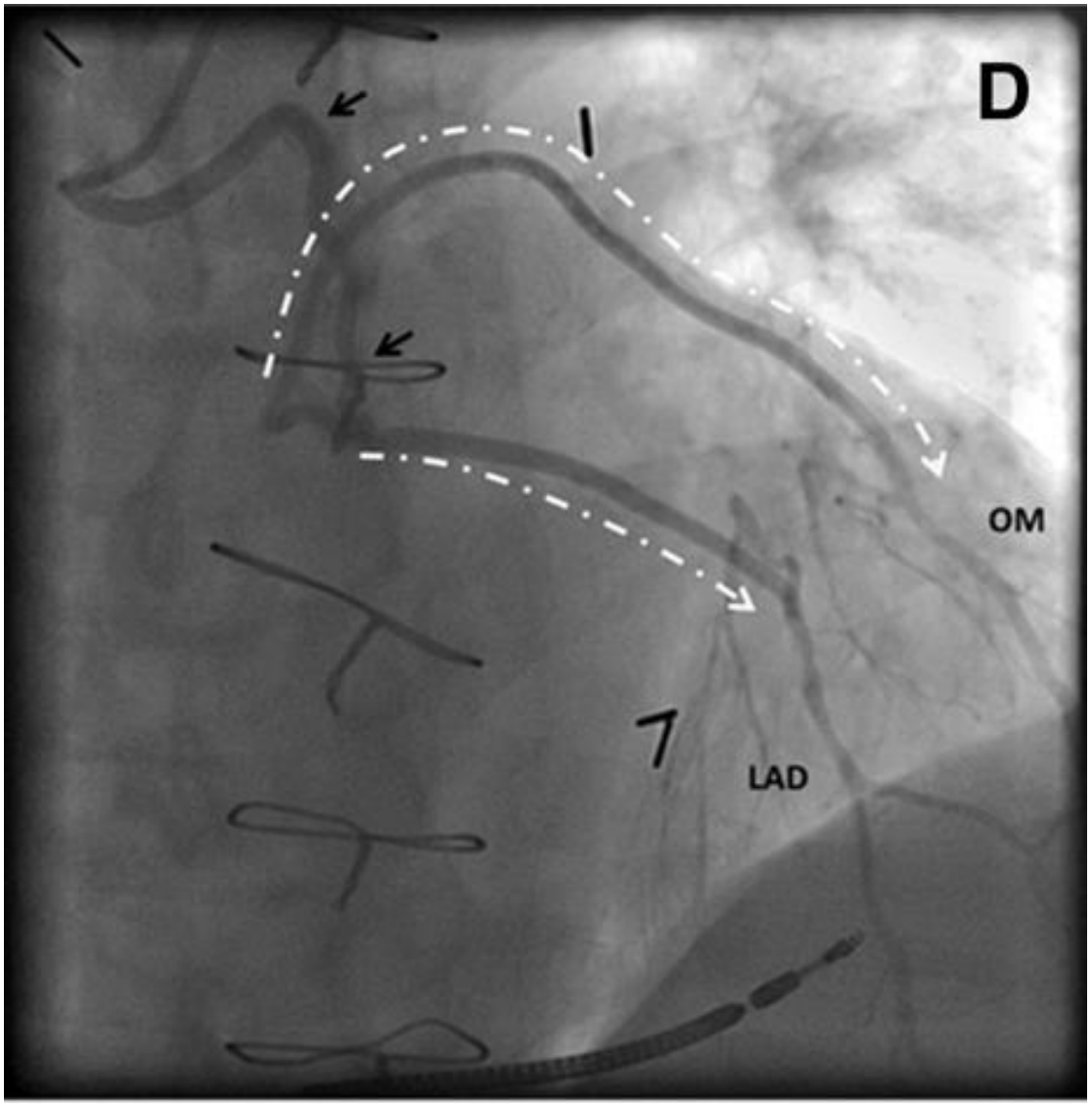
Angio control 3 months after re-do CABG:

off-pump radial graft from the aorta to the freeRIMA-freeLIMA Y construction



Chung, Agostoni CRM 2015

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Grafts: 4- Issues with Internal Mammary grafts

- For Antegrade access to the LAD:
  - Dissections
  - Graft occlusion during intervention (due to “stretching” effects of catheter extension, guidewires, microcatheters or other devices)
- When used for retrograde options:
  - Dissections
  - Graft occlusion with anterior ischemia
  - Consider devices length! (manual catheter shortening may be necessary)

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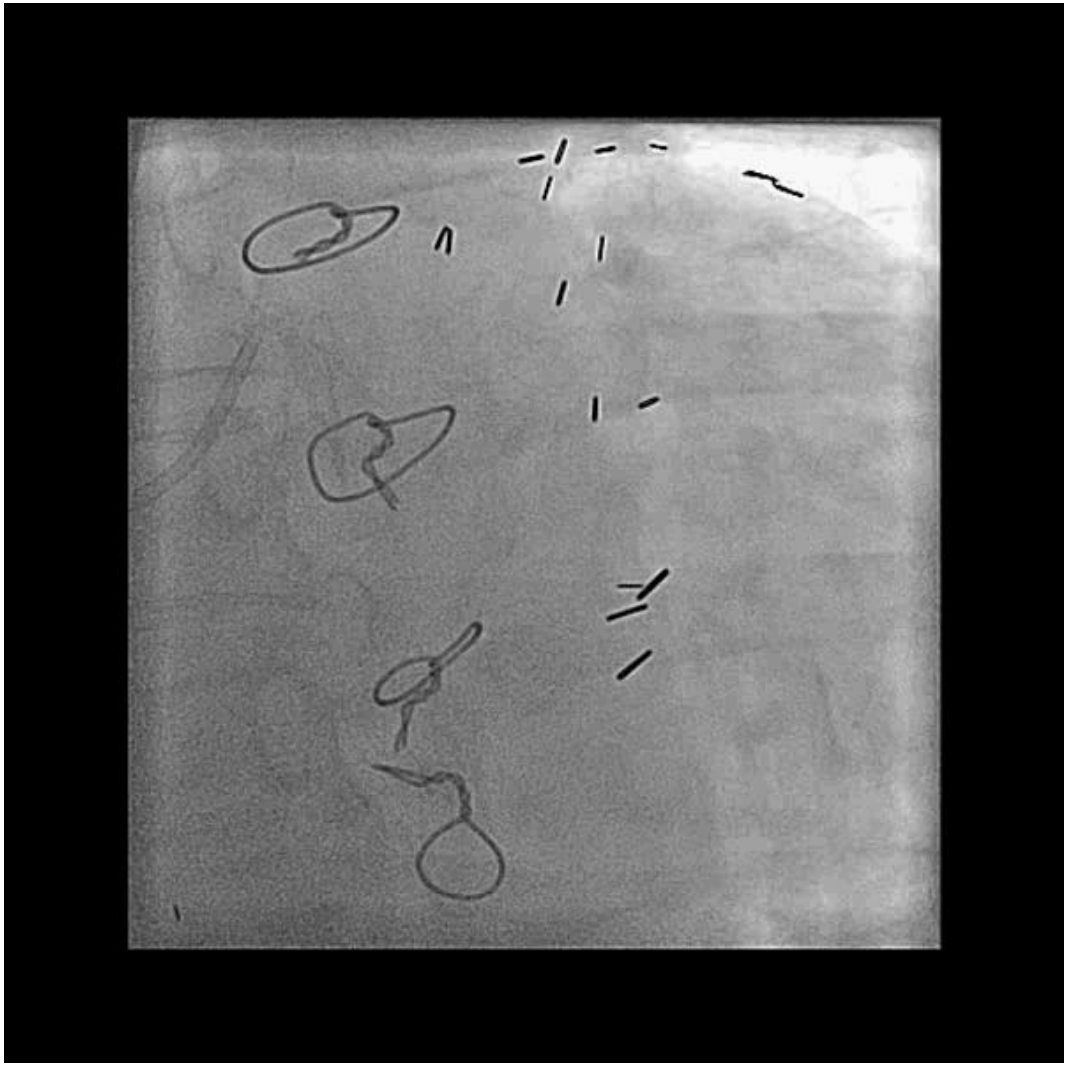
Case example

Man, 65 year-old, stable angina post-CABG

OM and SVG-OM occluded, proven lateral ischemia



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Collaterals to OM via LIMA-LAD

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Wire antegrade subintimal

Corsair via LIMA for retrograde attempt (shortened IMA guiding catheter)

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Attempt to reach with a wire the distal cap through the Corsair parked in the distal OM branch via the LIMA and epicardial apical collaterals

Progressive anginal symptoms and arterial pressure drop during these maneuvres

What is going on?

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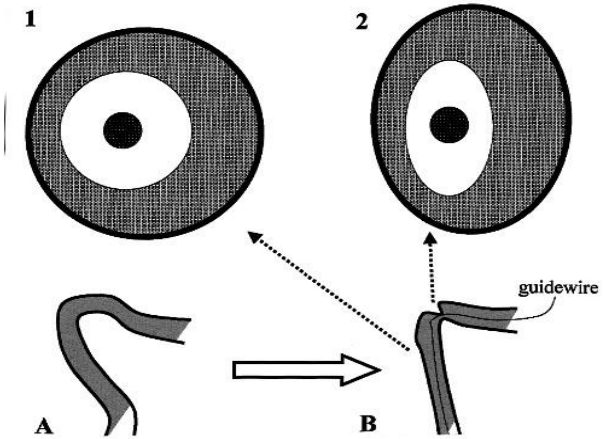
After retrieval of all, improvement…

"Pseudostenoses" (Corsair in a tortuous LIMA causes folding of the vessel)



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Perforations

- Previously considered less relevant, because pericardial adhesions formed after sternotomy, may potentially prevent immediate tamponade
- On the contrary, prior CABG may result in loculated hematomas - often slower in development - potentially causing localized tamponade and sudden cardiogenic shock (few hours after the procedure)
- This localized compression can be extremely difficult or even impossible to solve percutaneously (impossible to reach the hematoma with a needle)

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Case example

- 72 y.o. male with previous smoking habit and hypertension. CABG 10 years before (LIMA-LAD, SVG-RCA, SVG-LCx), presenting with recurrent severe stable angina

- At angiogram (performed in another hospital) evidence of SVG-RCA occlusion; old CTO in prox-mid RCA with good collaterals via LCx, distal CTO cap at the level of the crux

- Scheduled for elective retrograde procedure

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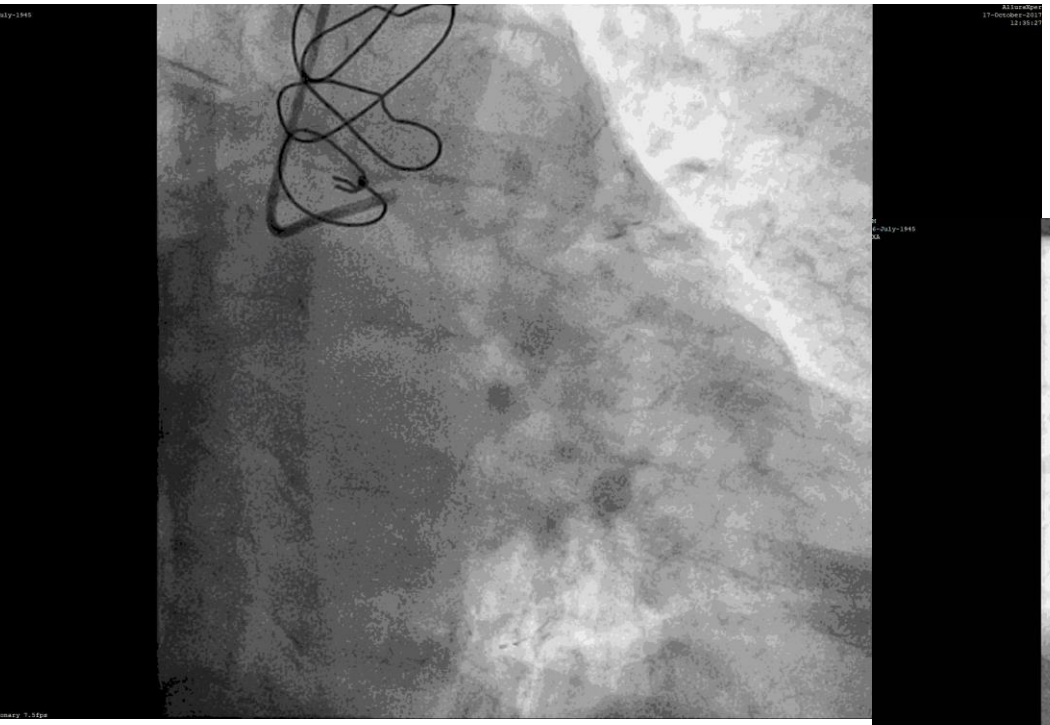
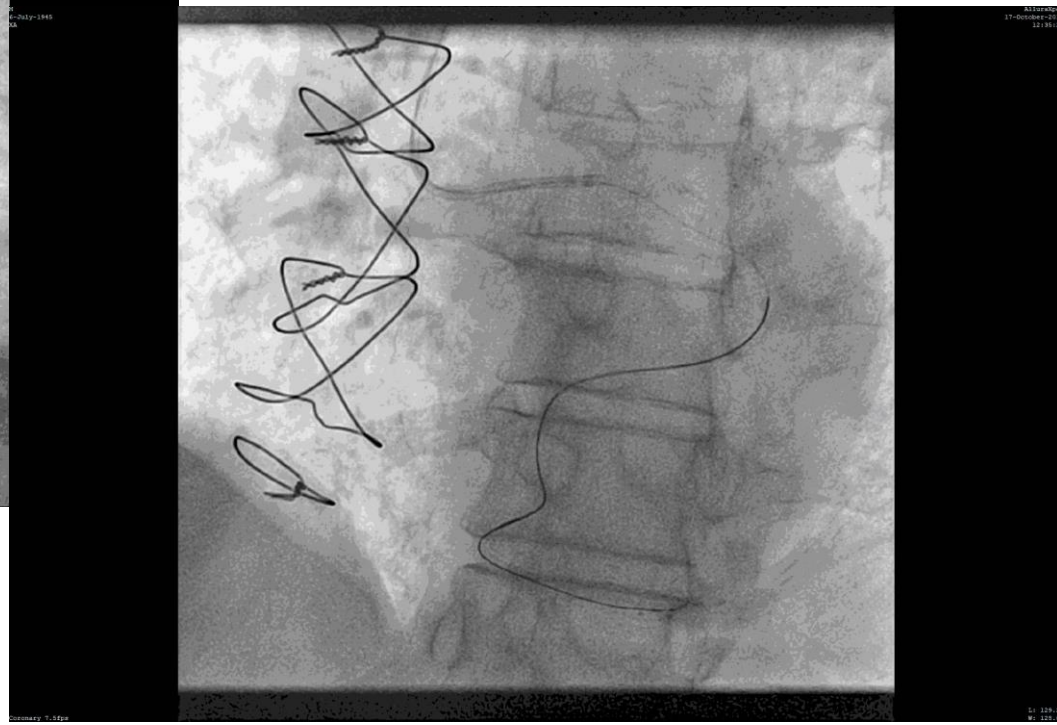
Direct Retrograde Approach





TurnPike LP – Fielder XT-R

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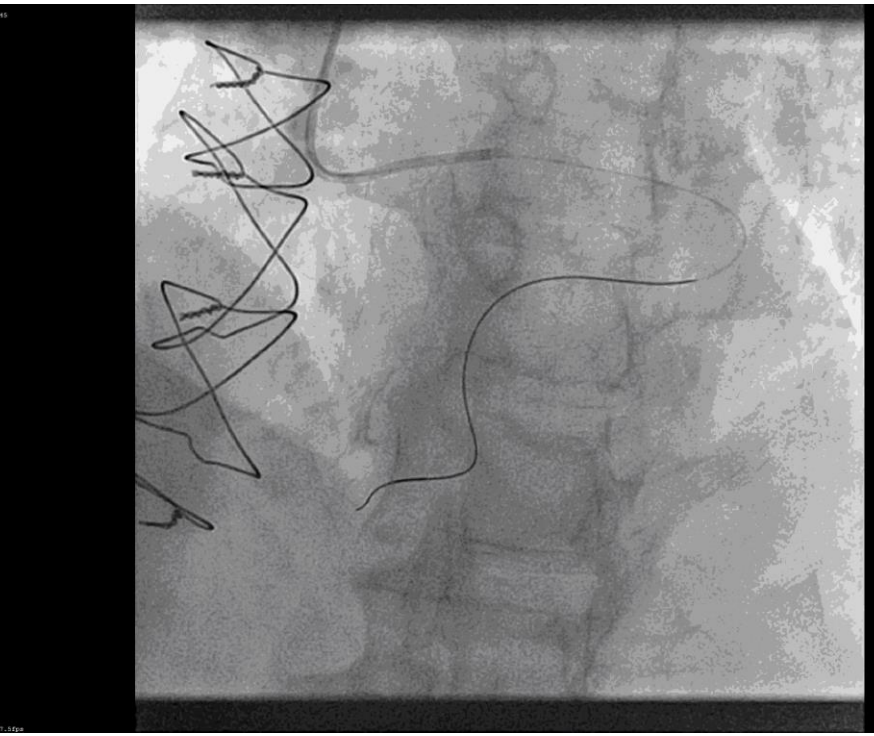
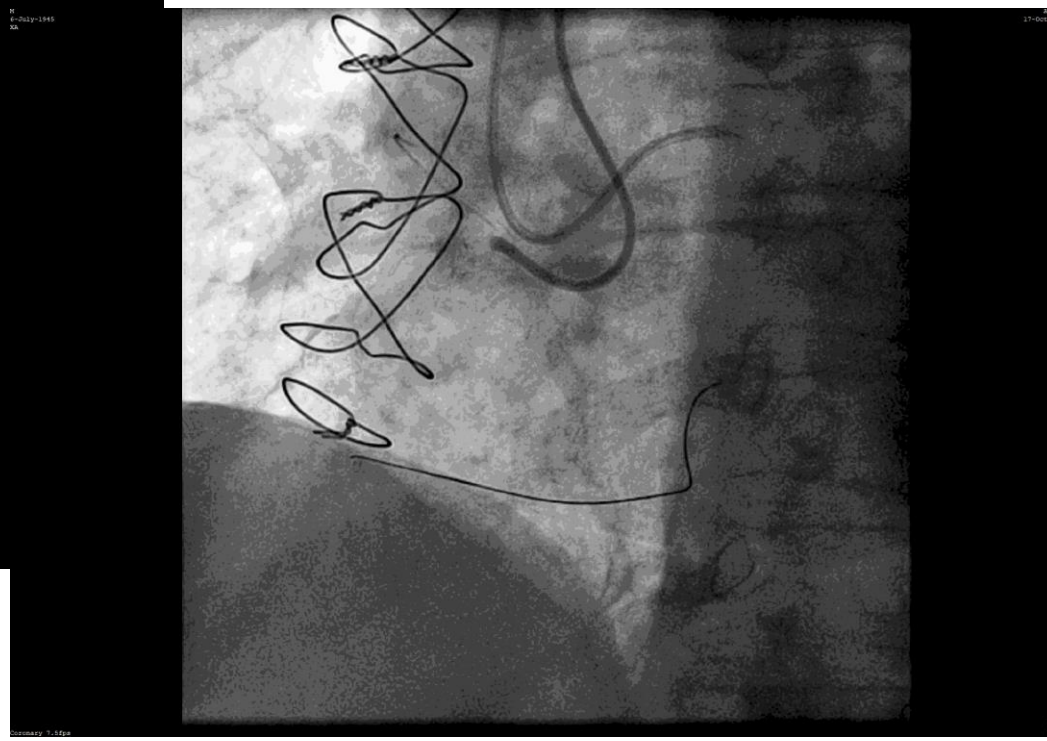
Distal Cap Penetration





The wire seems not to dance together with the vessel, microcatheter already pushed forward

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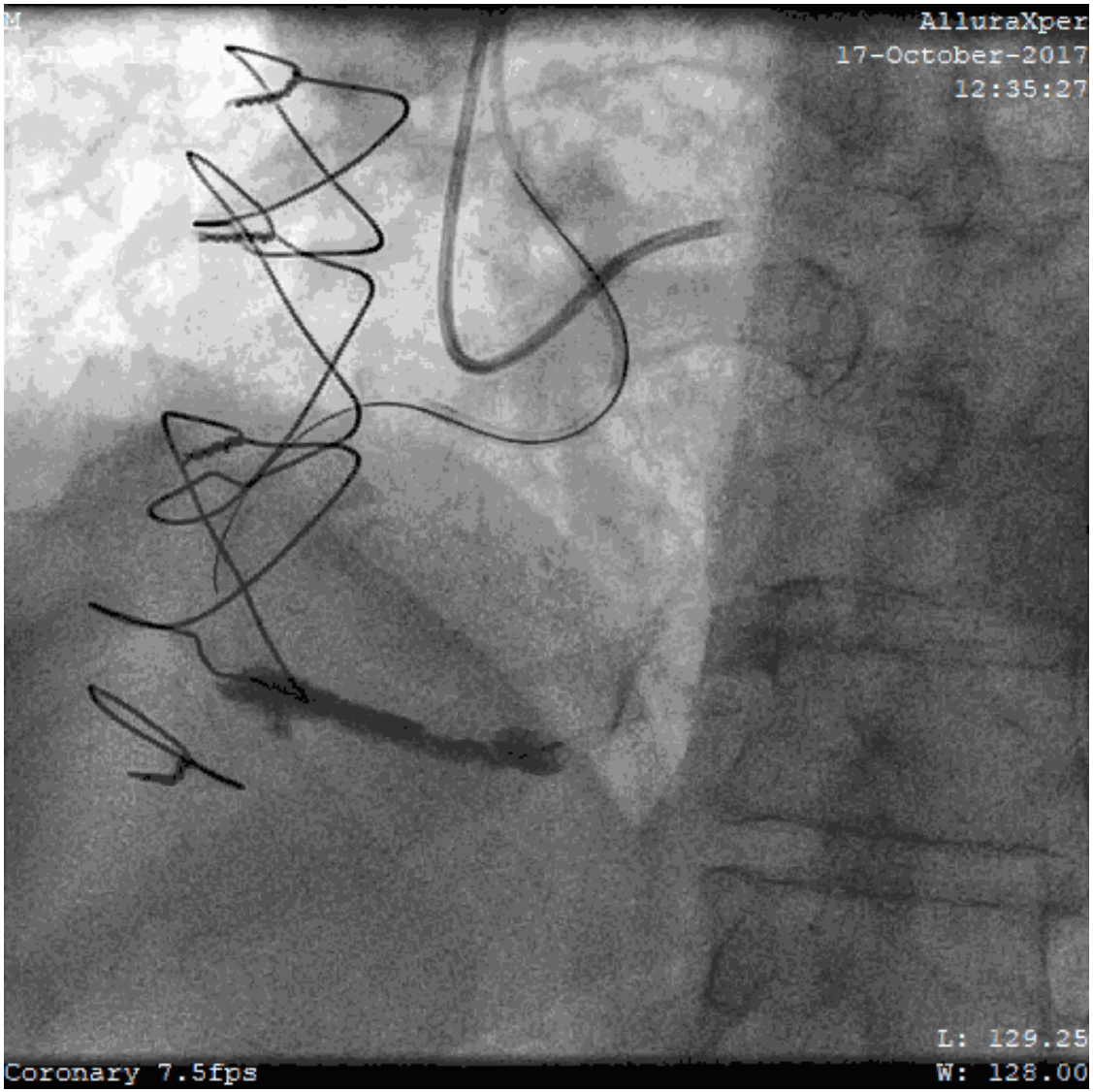
Tip injection via retrograde MC



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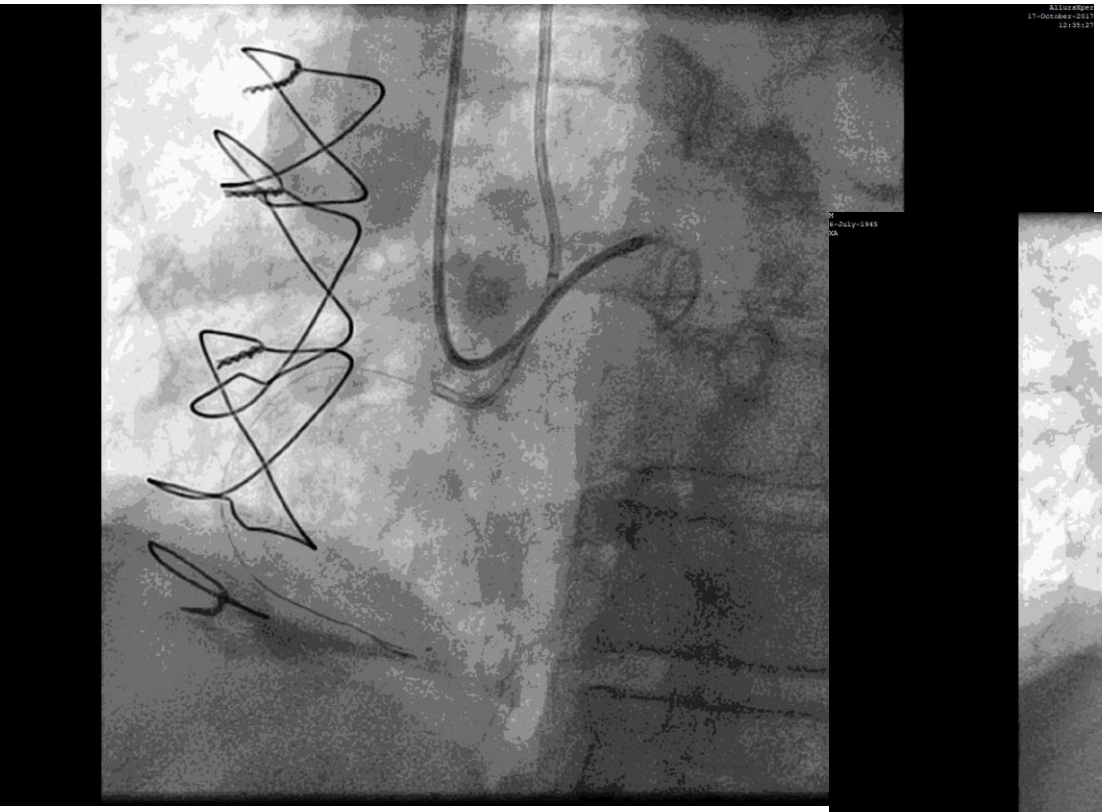
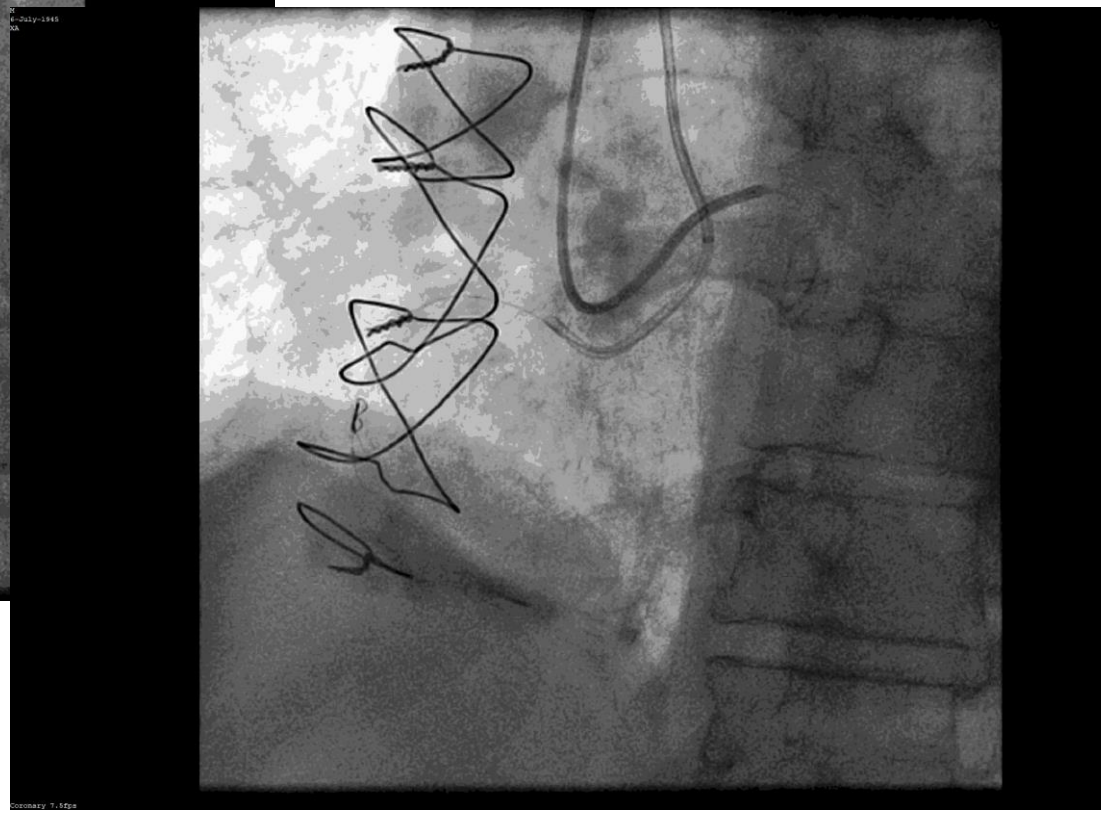
Switch to Antegrade approach





Antegrade wire always sub-intimal

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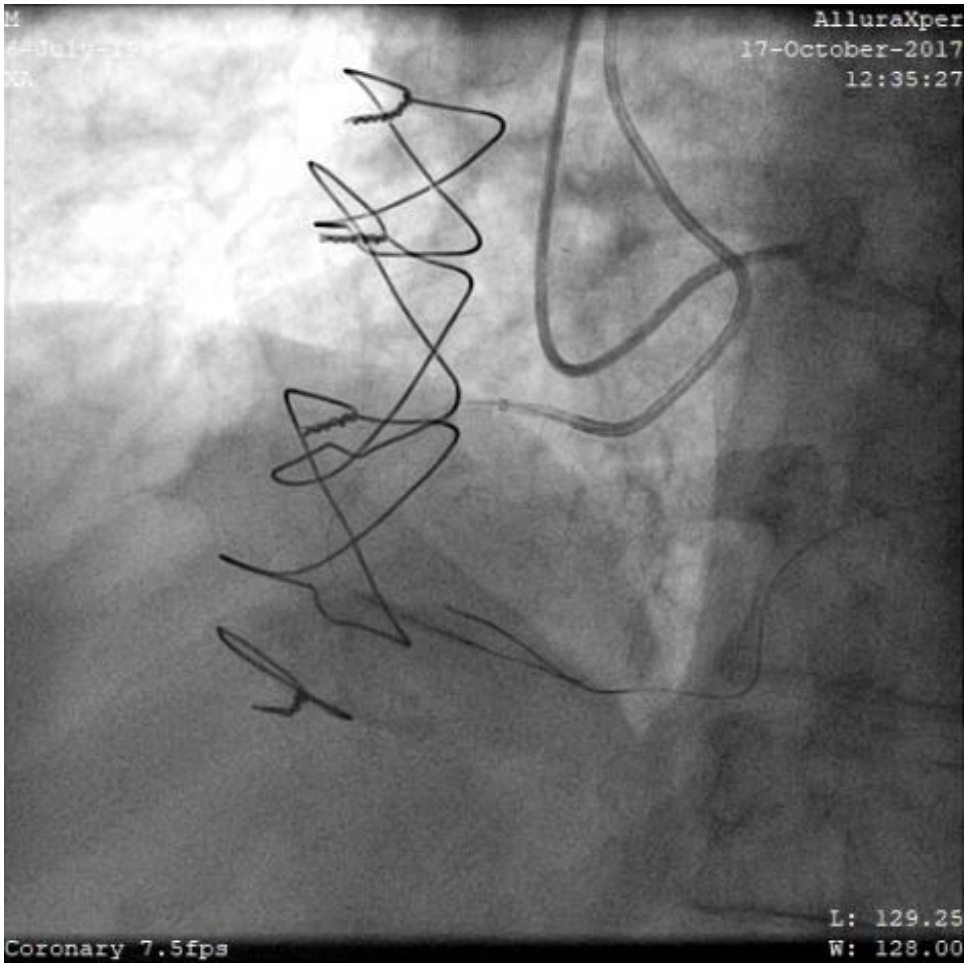
Attempt for new retrograde distal cap puncture guided by the antegrade wire



Again no “dancing togheter”, confirmed also by tip injection (thus second perforation)

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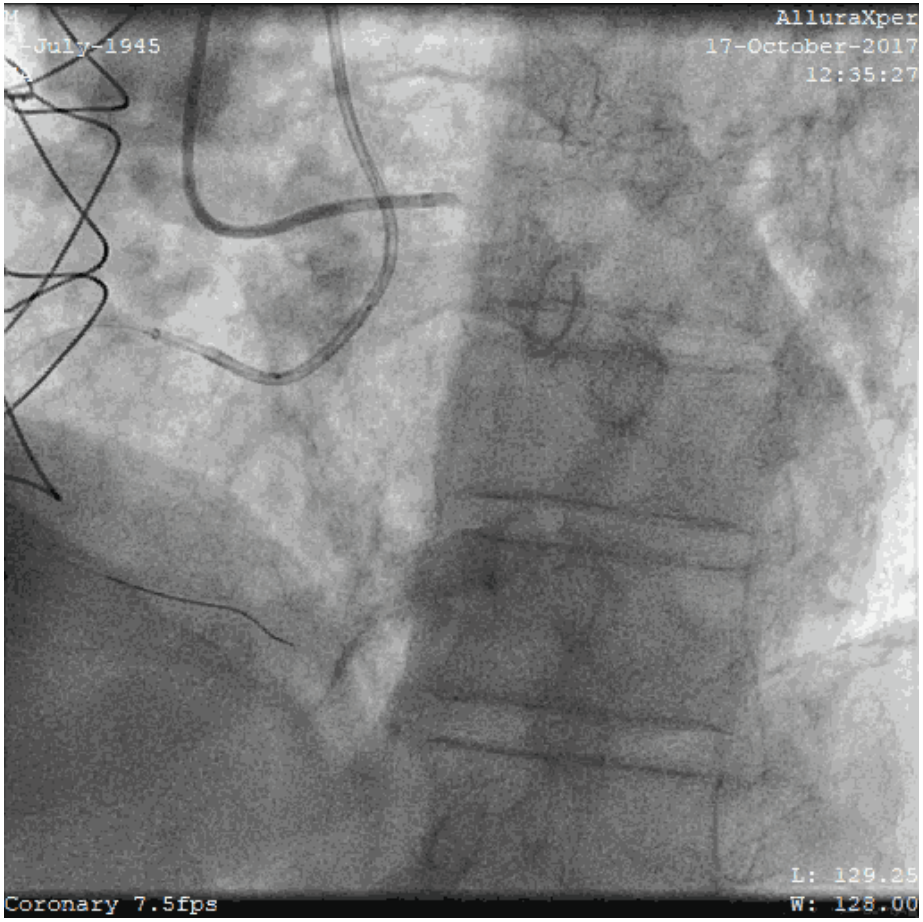
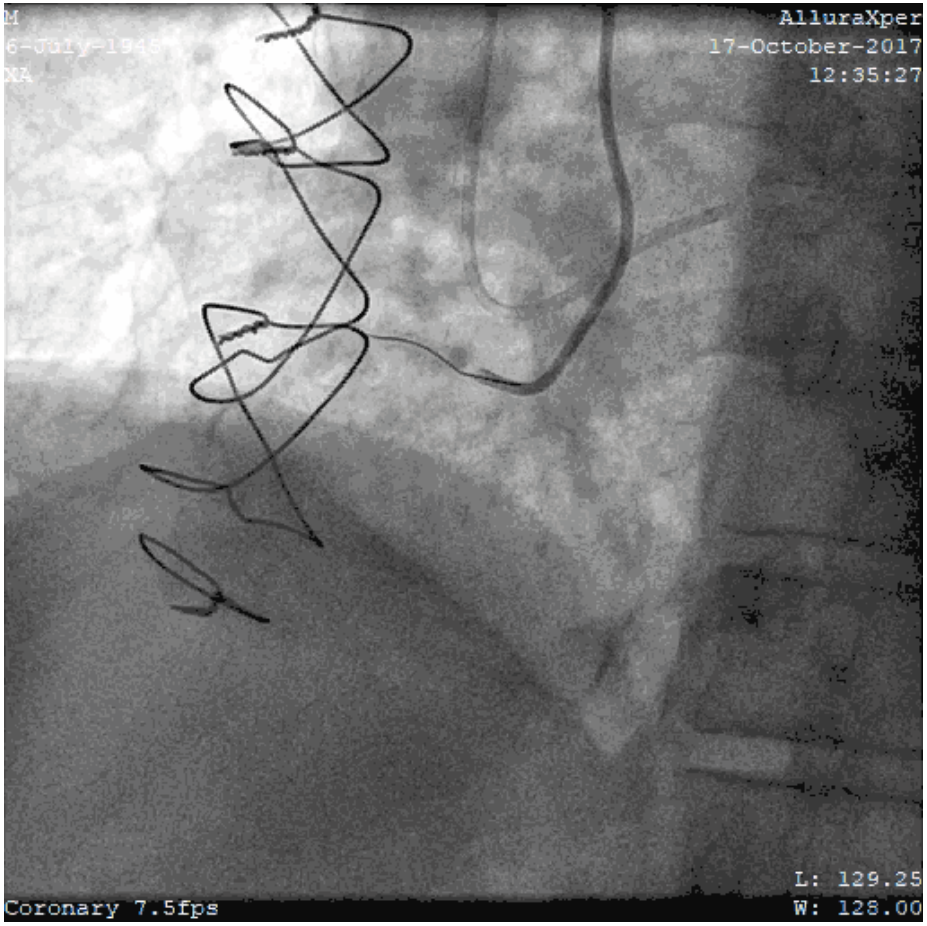
Patient hemodynamically stable no symptoms - STOP





Last injection, strange opacification of a small structure at the level of the prox-RCA

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Clinical outcome

- After the end of the procedure patients starts complaining **sever ripping chest pain**
- Immediate echocardiograms showed **no-pericardial effusion** and **no wall motion abnormalities**
- Patient transferred to the ICU for closer observation
- After **4 hours**, immediate **collapse** and refractory cardiogenic shock…
- Once again, **no visible pericardial effusion** with echocardiogram
- Urgent **CT scan** planned

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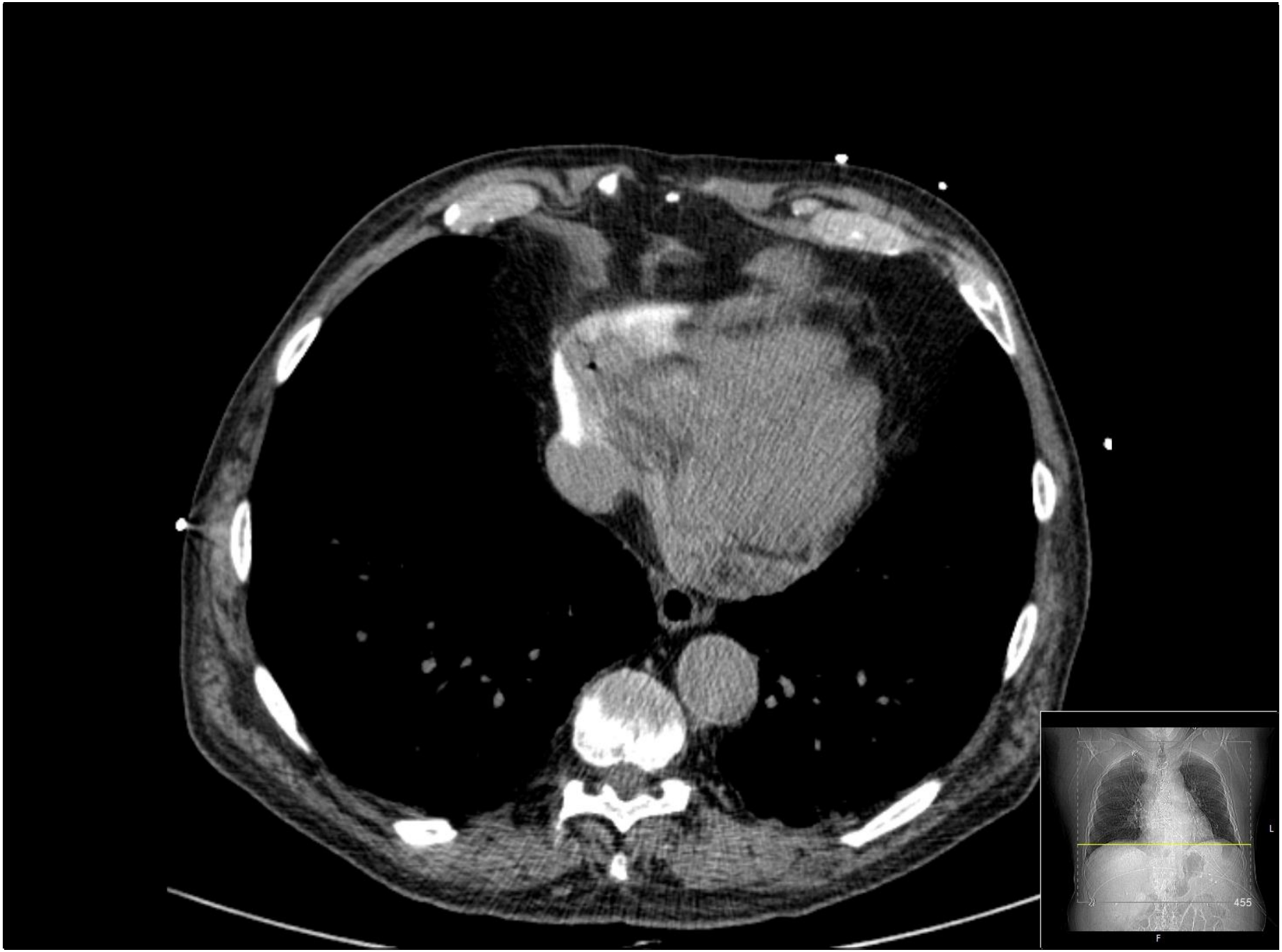
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Clinical outcome

- Evidence of **mass/hematoma high in the pericardium, compressing the right ventricle and the pulmonary artery**
- During the CT scan, again **collapse**, **reanimation setting**
- Attempt to perform “conventional” pericardial drainage unsuccessful
- Patient **died** a few minutes afterwards
- Most probably bleeding from the small structure visible at the level of the proximal RCA

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Take-home messages

- Post-CABG patients are a big group of our CTO-PCI candidates (15-35% in various registries)
- Often more complex and with more (peri-)procedural risks
- “A priori” chance of procedural success is lower
- Additional expertise may be necessary to set up the CTO-PCI properly and to manage possible complications
- Perforations with localized tamponade are probably the worst complication that can occur in the CTO world

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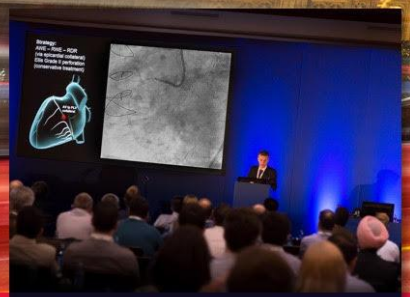
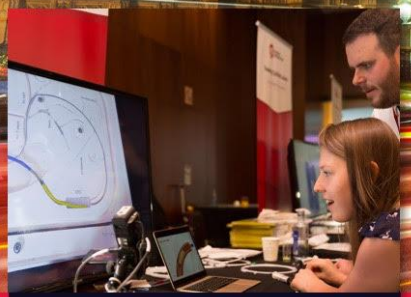
OPTIMAL

SIMPLIFYING MEDICAL EDUCATION

CTO LONDON 2019



300+ Delegates



Hands-on Sessions

25 International Faculty

8 Live Cases from Kings College

SAVE THE DATE: 6th / 7th June 2019