

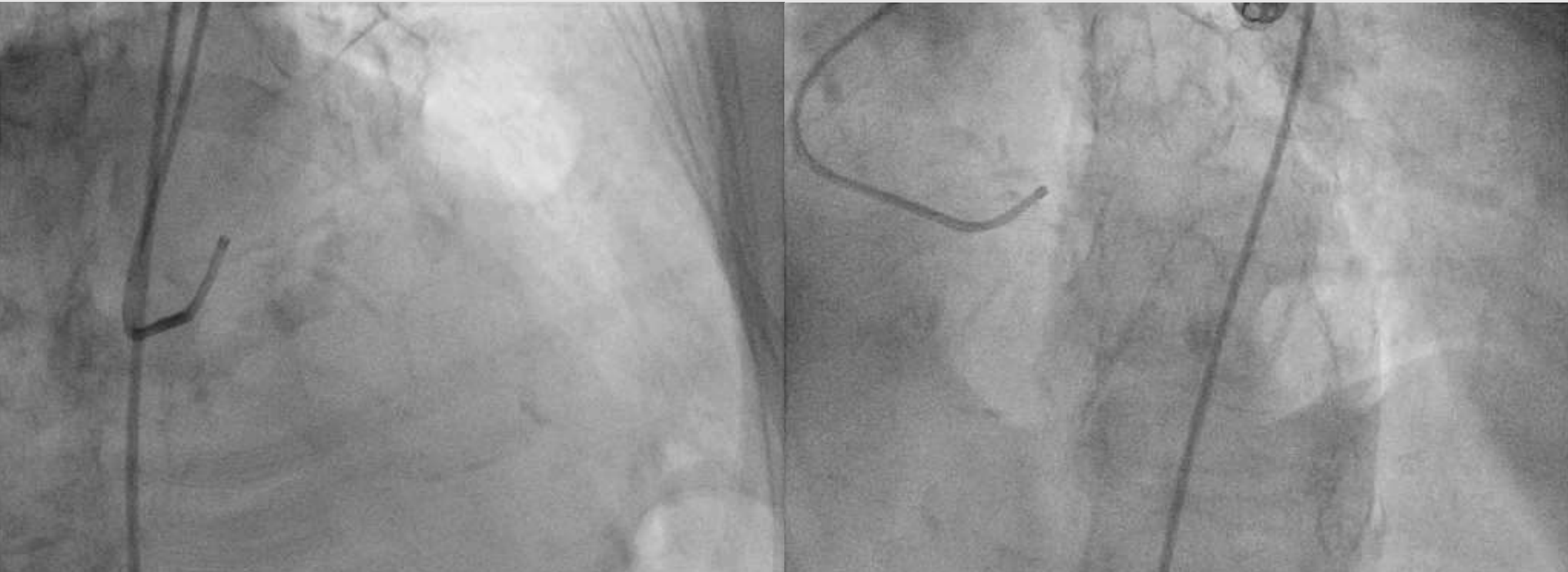
Close and Open

*Kevin Kwok
Queen Elizabeth Hospital
Hong Kong*

Case history

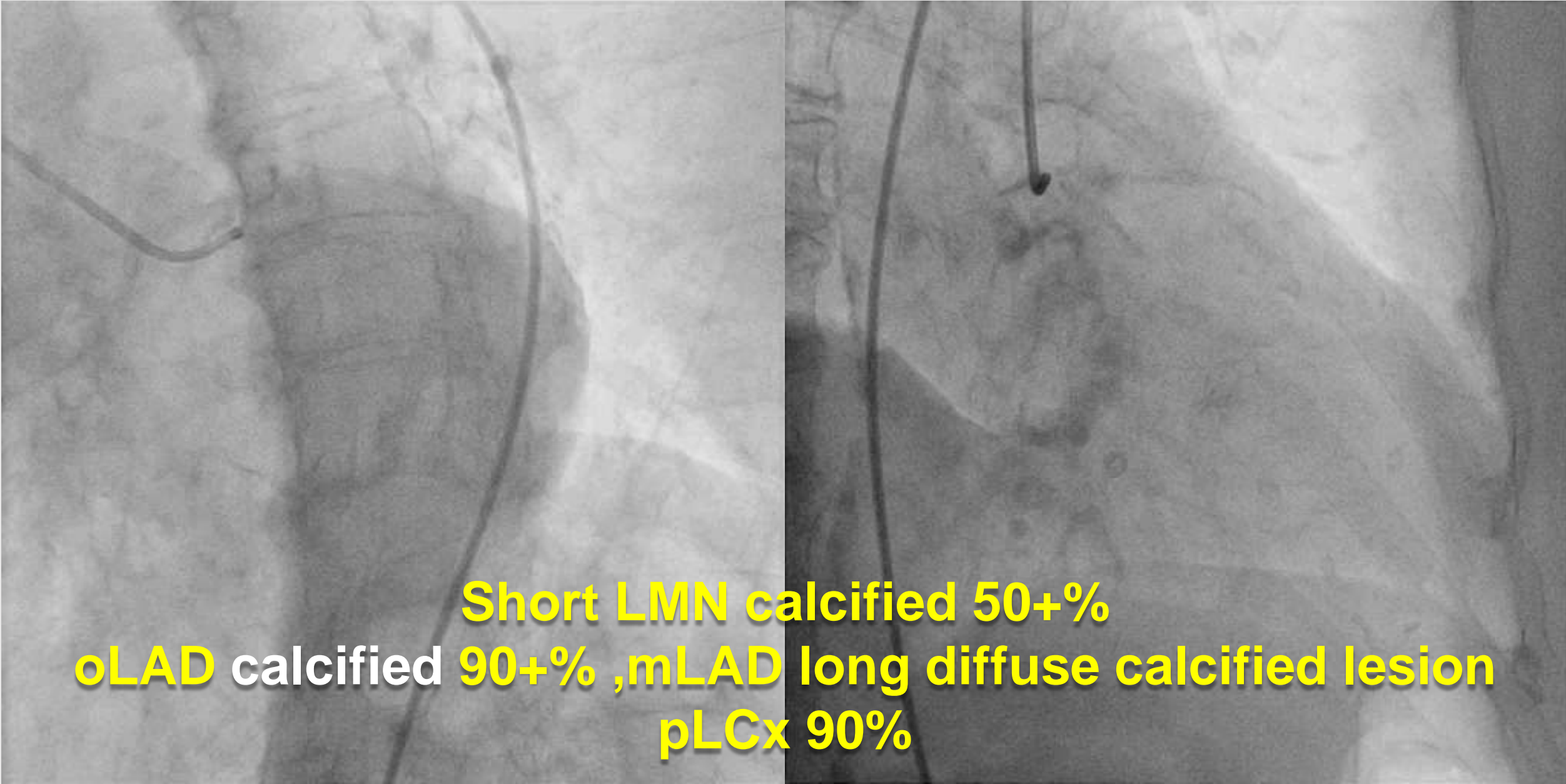
- 85/F
- DM, HT, Hyperlipidaemia
- **ACS** & CHF
- ECG - T wave inversion anterior and lateral leads
- Raised cardiac enzymes
- Echo **LVEF 25-30%** global hypokinesia, mild MR
- Persistent anginal symptoms despite maximal medical therapy (DAPT, LMWH, anti HF regime)

Coronary angiogram – LCA



Short LMN calcified 50+%
oLAD calcified 90+% , **mLAD long diffuse calcified lesion**
pLCx 90%

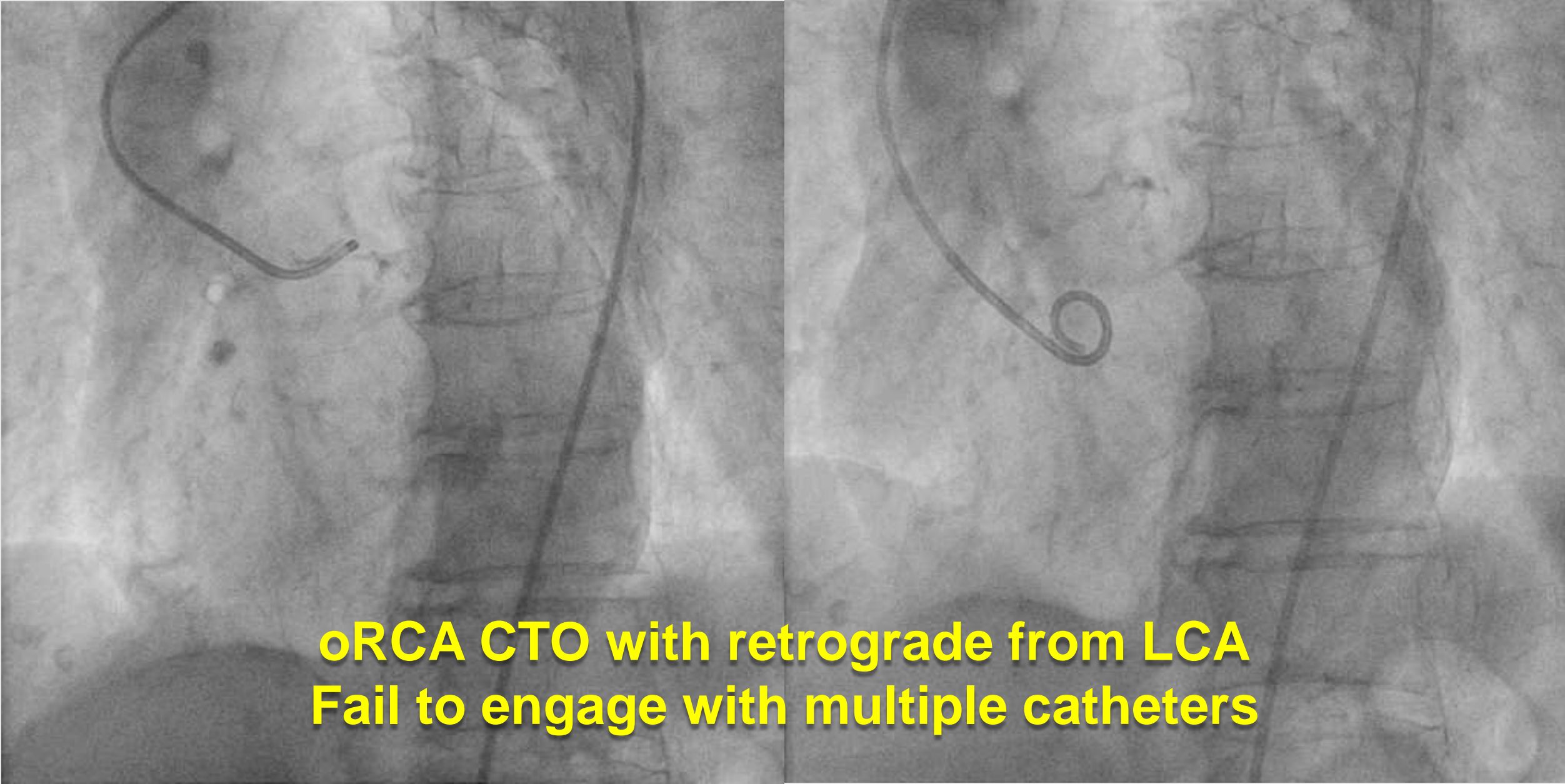
Coronary angiogram – LCA



Short LMN calcified 50+%

**oLAD calcified 90+%, mLAD long diffuse calcified lesion
pLCx 90%**

Coronary angiogram – RCA



oRCA CTO with retrograde from LCA
Fail to engage with multiple catheters

Summary



85/F, ACS/CHF, poor LVEF

LMN-3VD – Diffusely calcified LMN-LAD disease, pLCx focal disease, oRCA CTO with retrograde from LCA

SYNTAX score 41

How would you manage the patient?

1. Maximize medical treatment
2. Off table; stress test first then decide
3. Consult CTS for urgent CABG
4. Adhoc PCI to all lesions for complete revascularization
- 5. *PCI to LCA first, then staged PCI to RCA CTO***

Protected PCI Algorithm

LVEF <50%: Evaluate Algorithm

LVEF <40%: Recommend RHC prior to PCI

+2 Cardiac Index < 2.0 or PA sat < 55%

+1 Syntax score \geq 22

+1 EF < 25%

+1 Systolic < 100mmHg at baseline

+1 ACS presentation

+1 Planned Revascularization \geq 2 territories

+1 Likely Prolonged Ischemia

- Retrograde CTO
- Atherectomy

+1 Severe mitral regurgitation

+1 Decompensated state

- LVEDP >20
- Significant new orthopnea

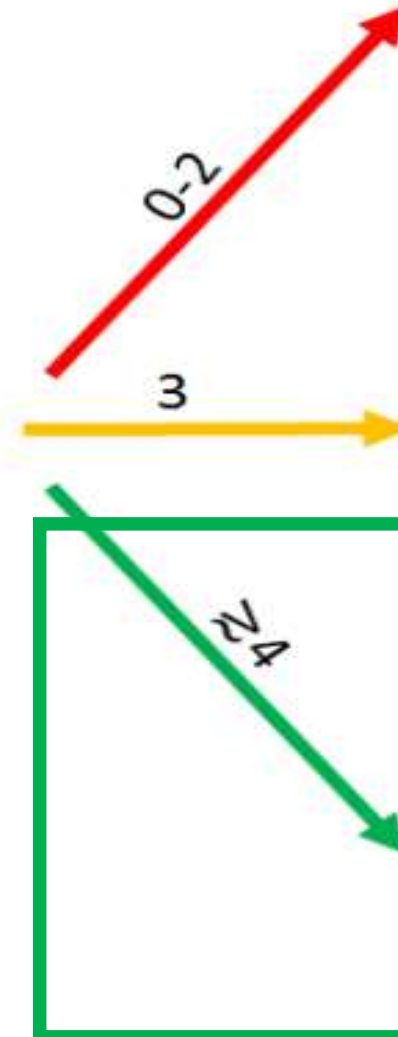
-1 High risk vascular injury / significant bleeding

-1 Hemoglobin < 8

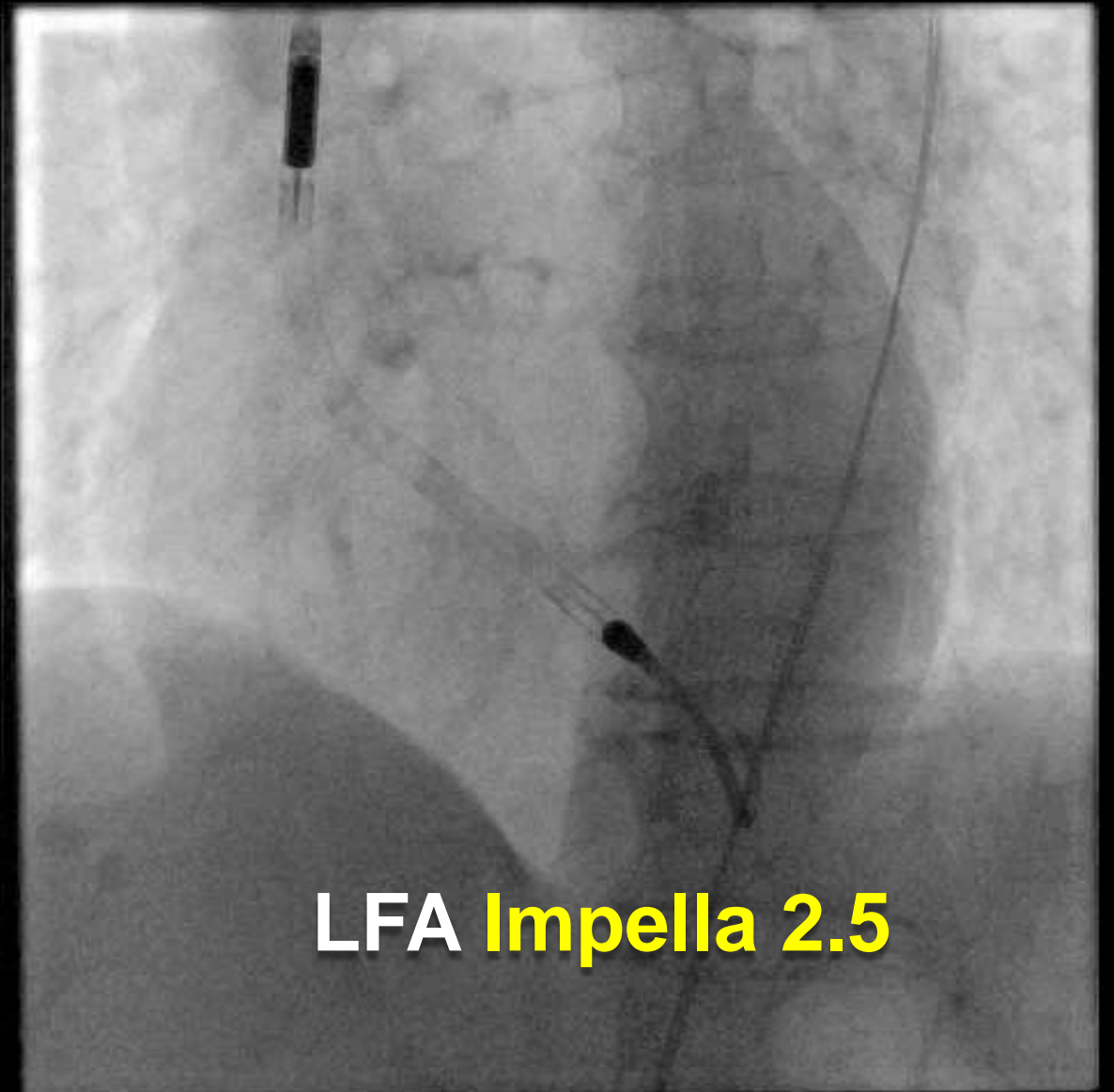
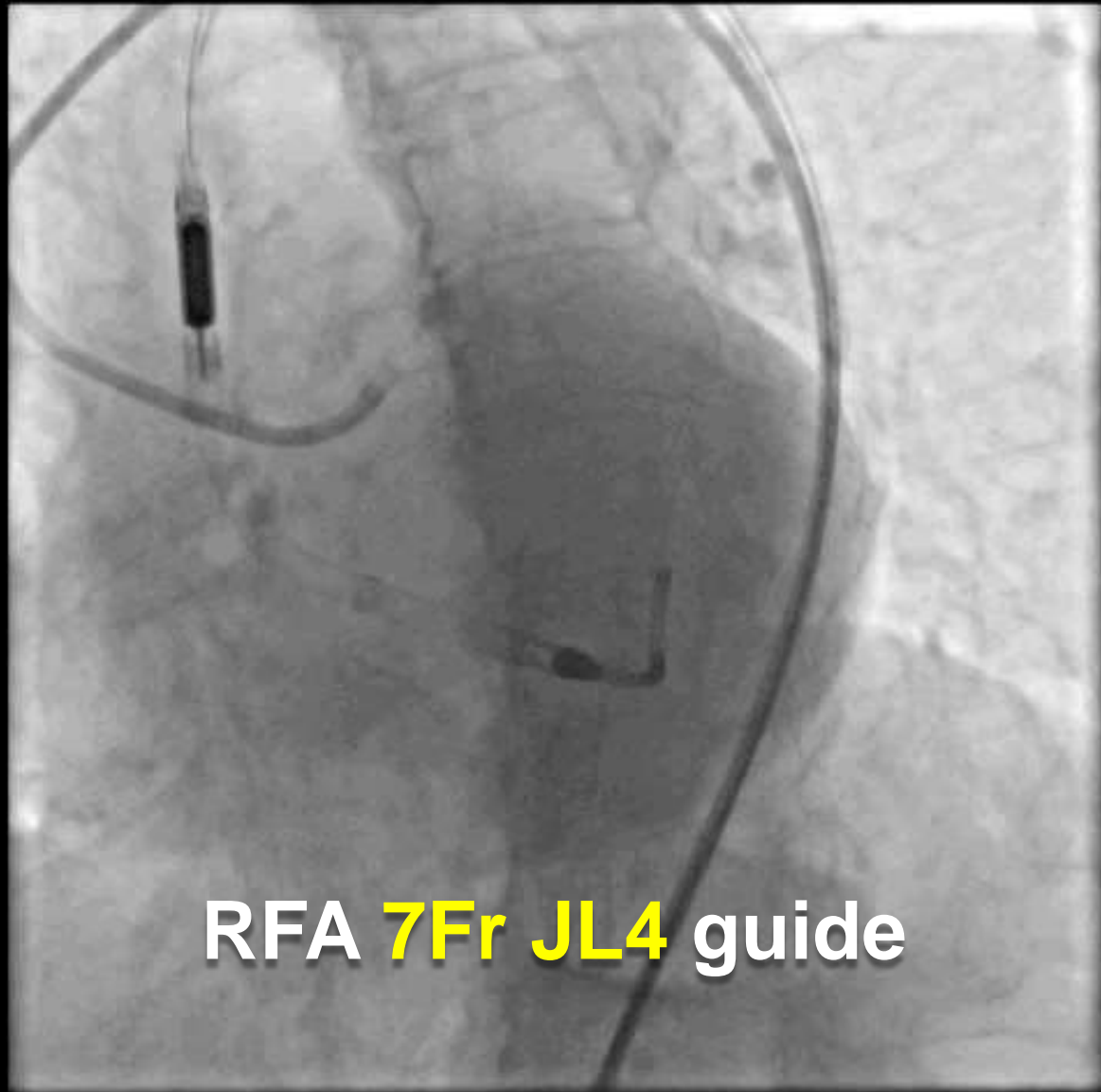
Unlikely to Need Support

Consider Support

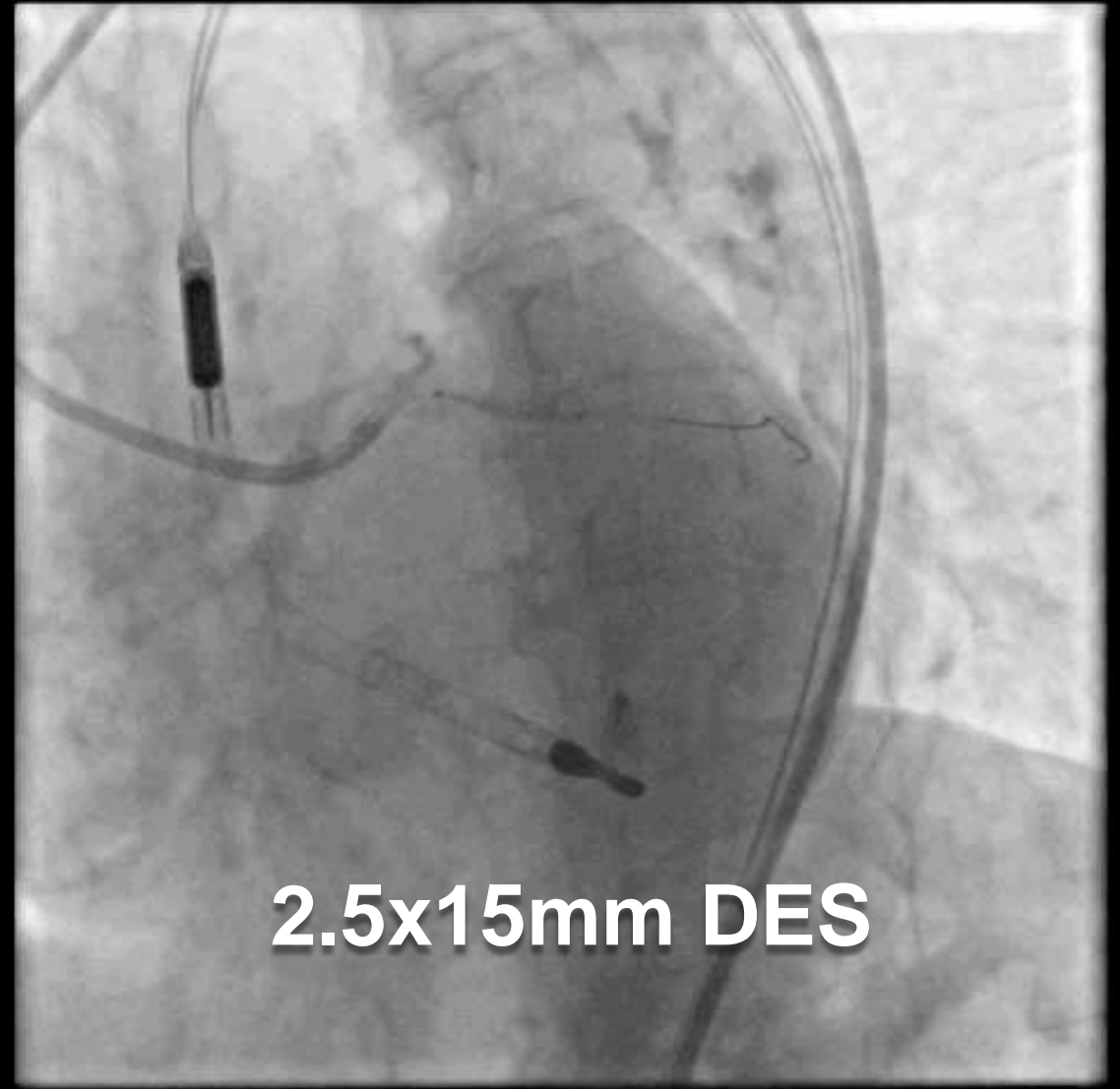
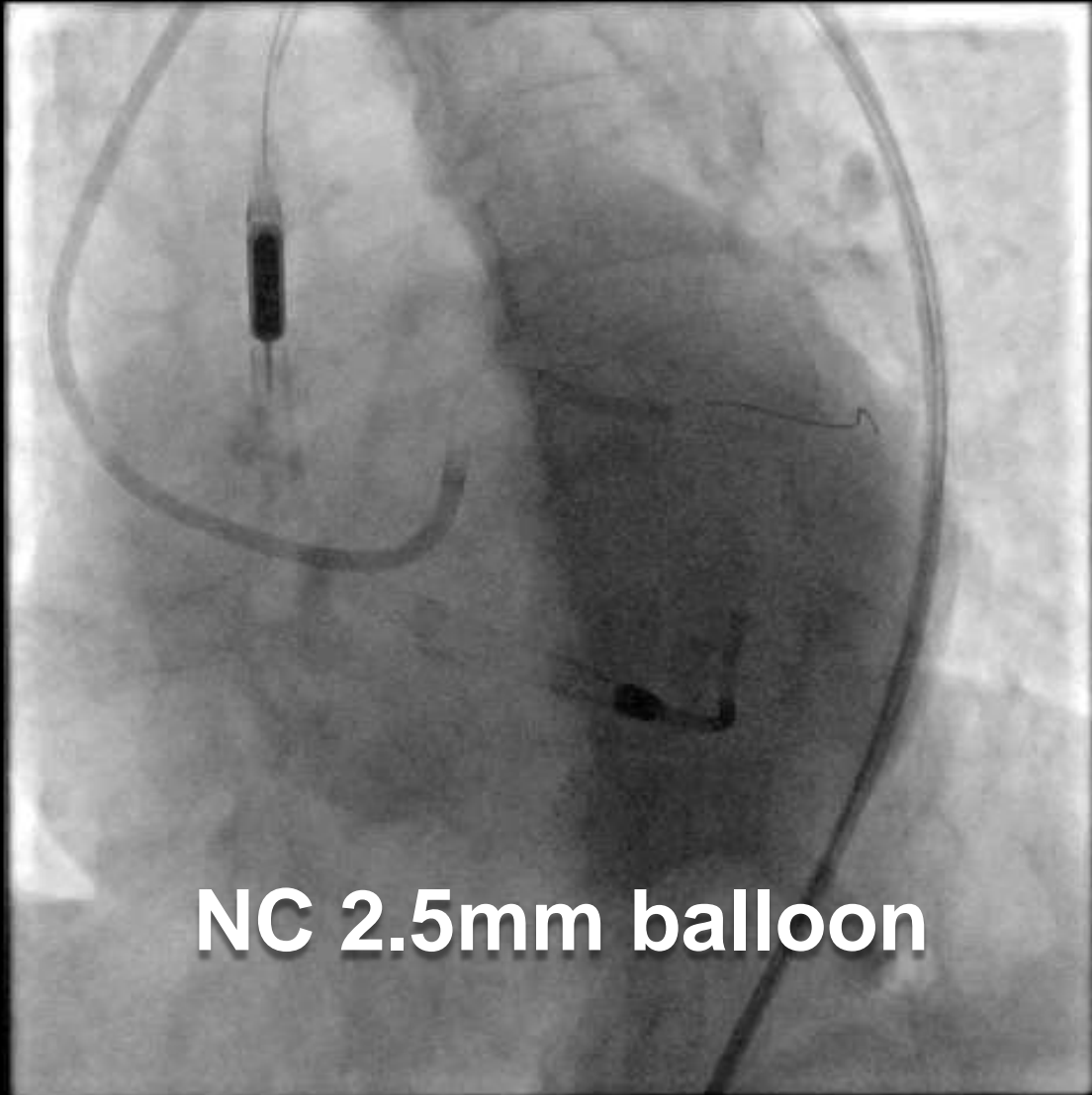
Strongly Consider Support



PCI strategy – Guide and MCS



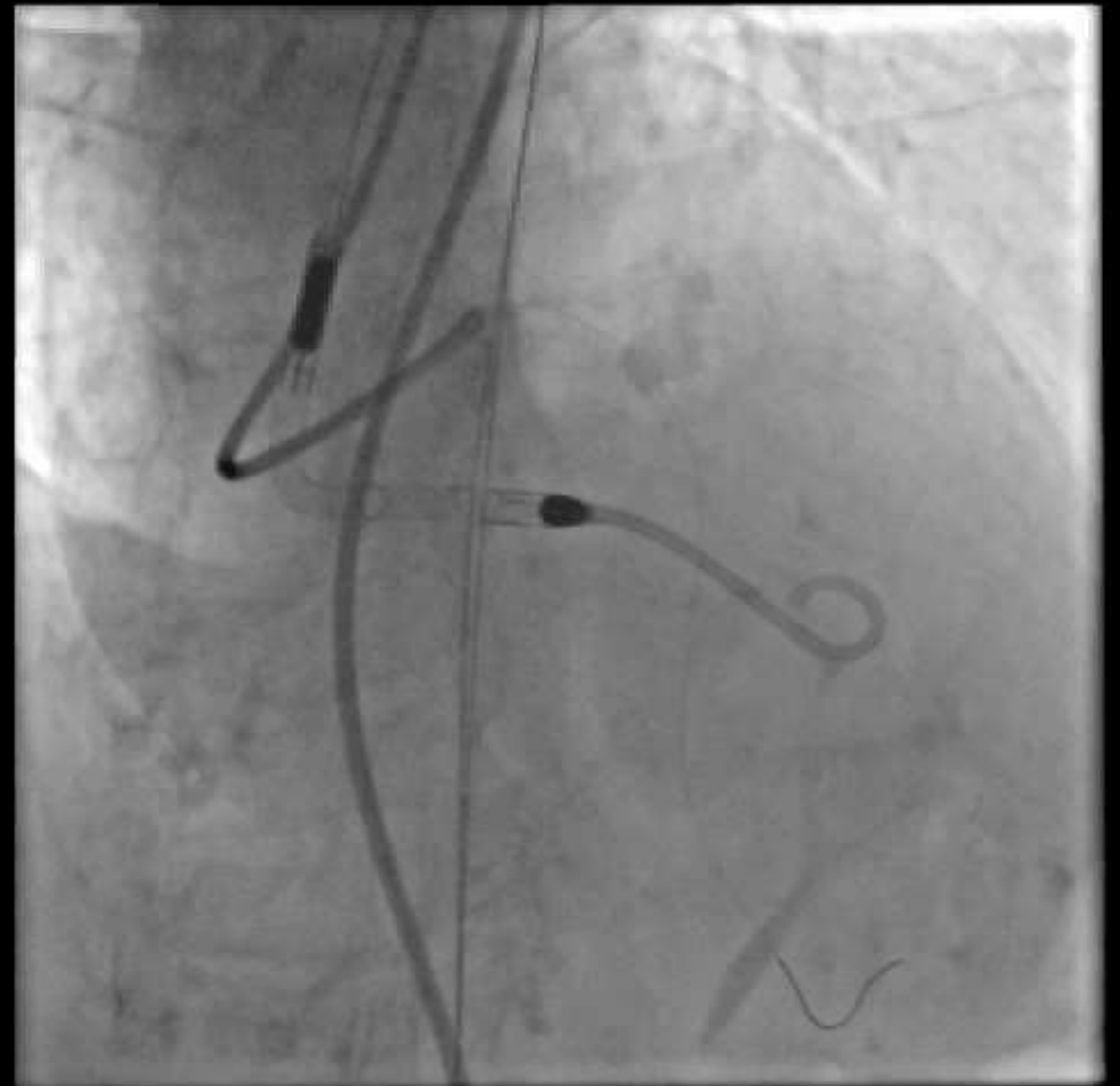
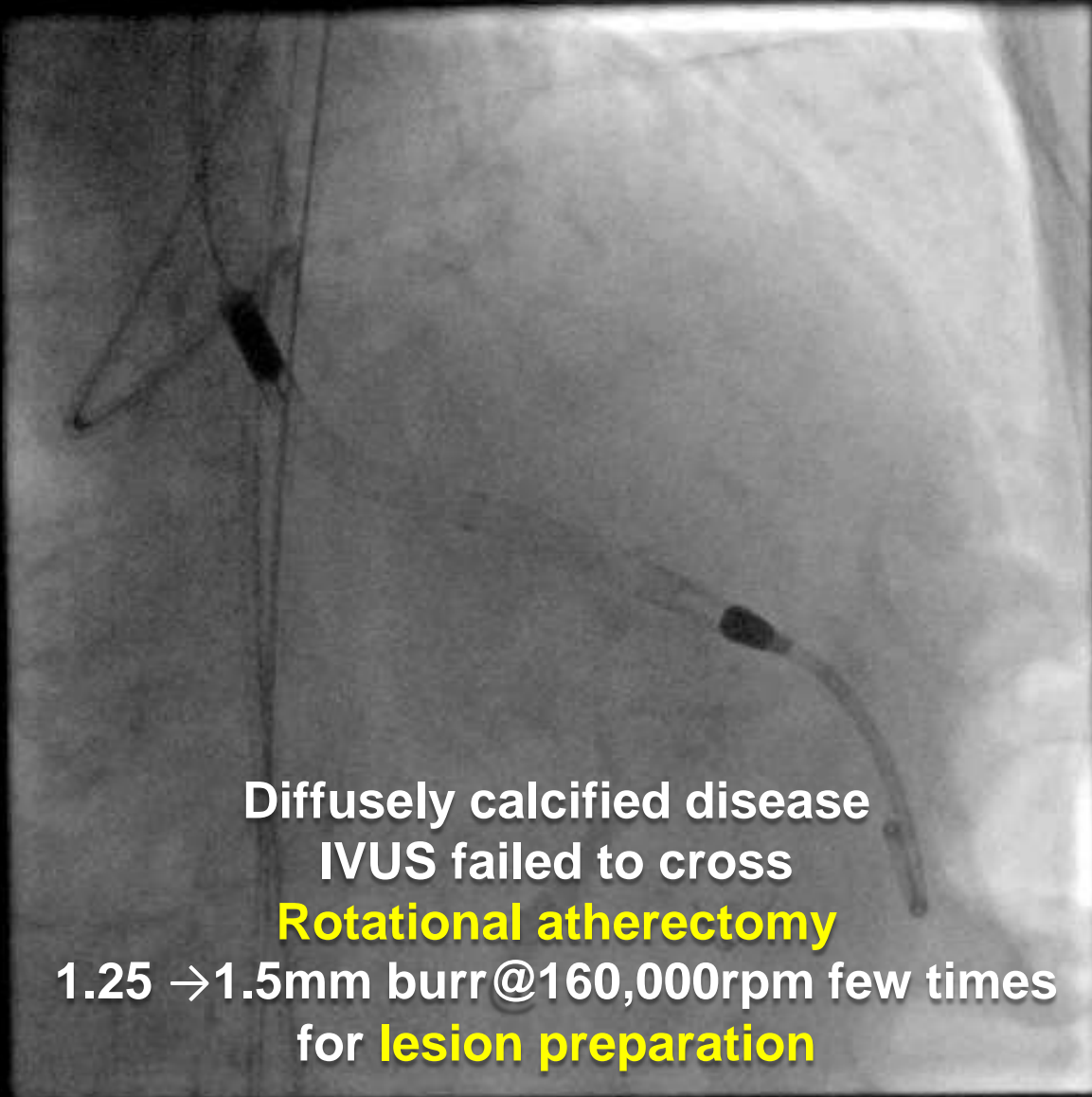
PCI strategy – *PTCS to LCx, then LMN-LAD*
(provisional as oLCx minor lesion)



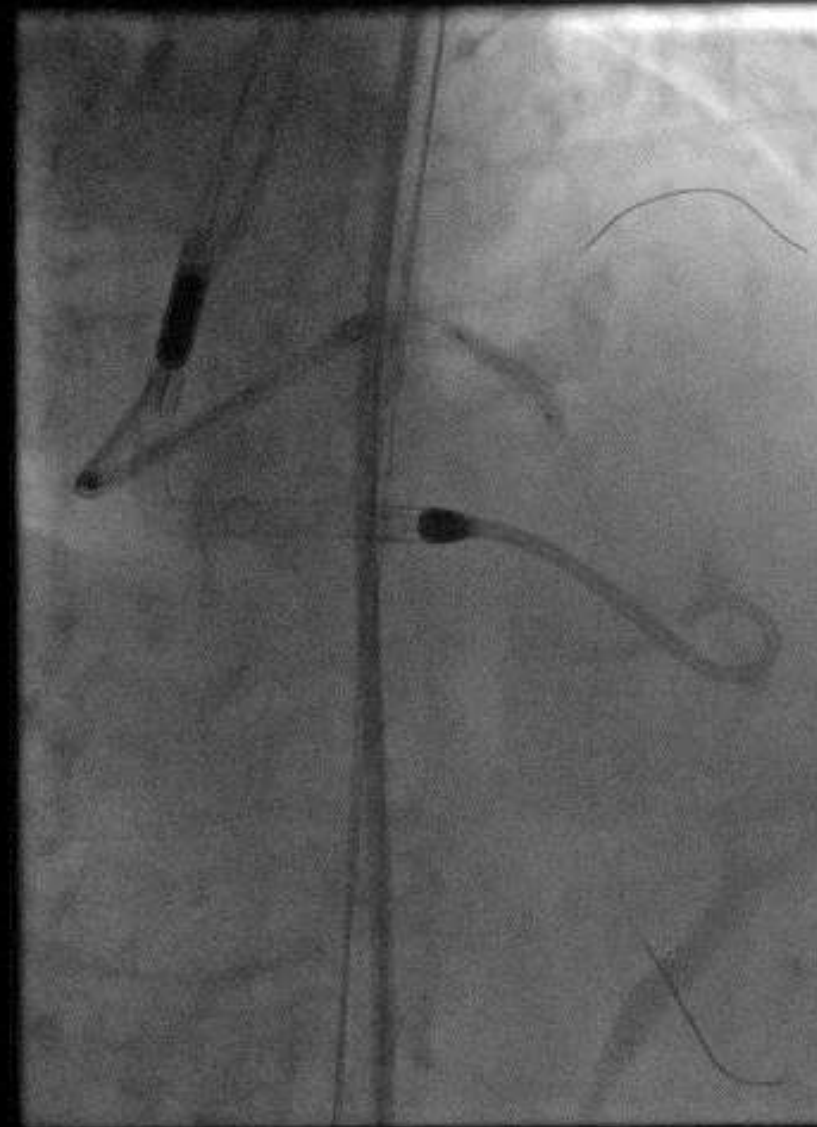
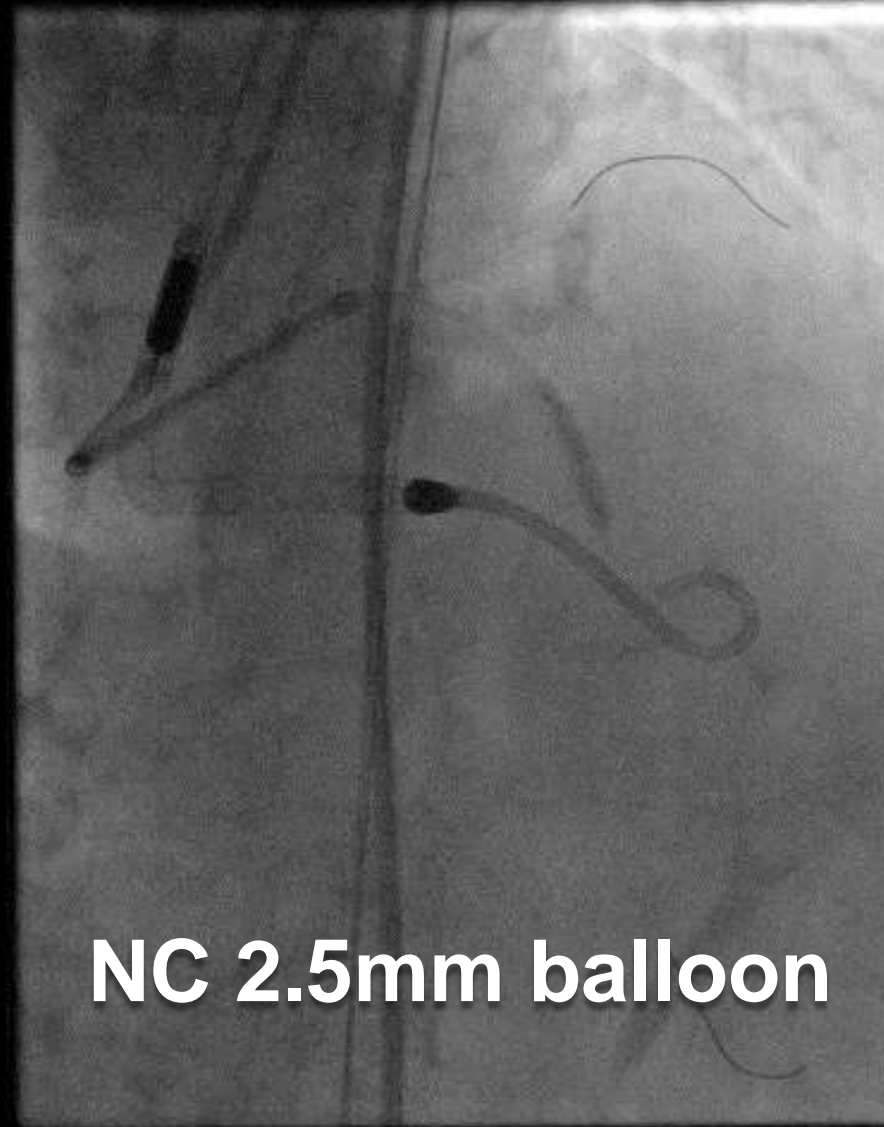
PTCS to LCx

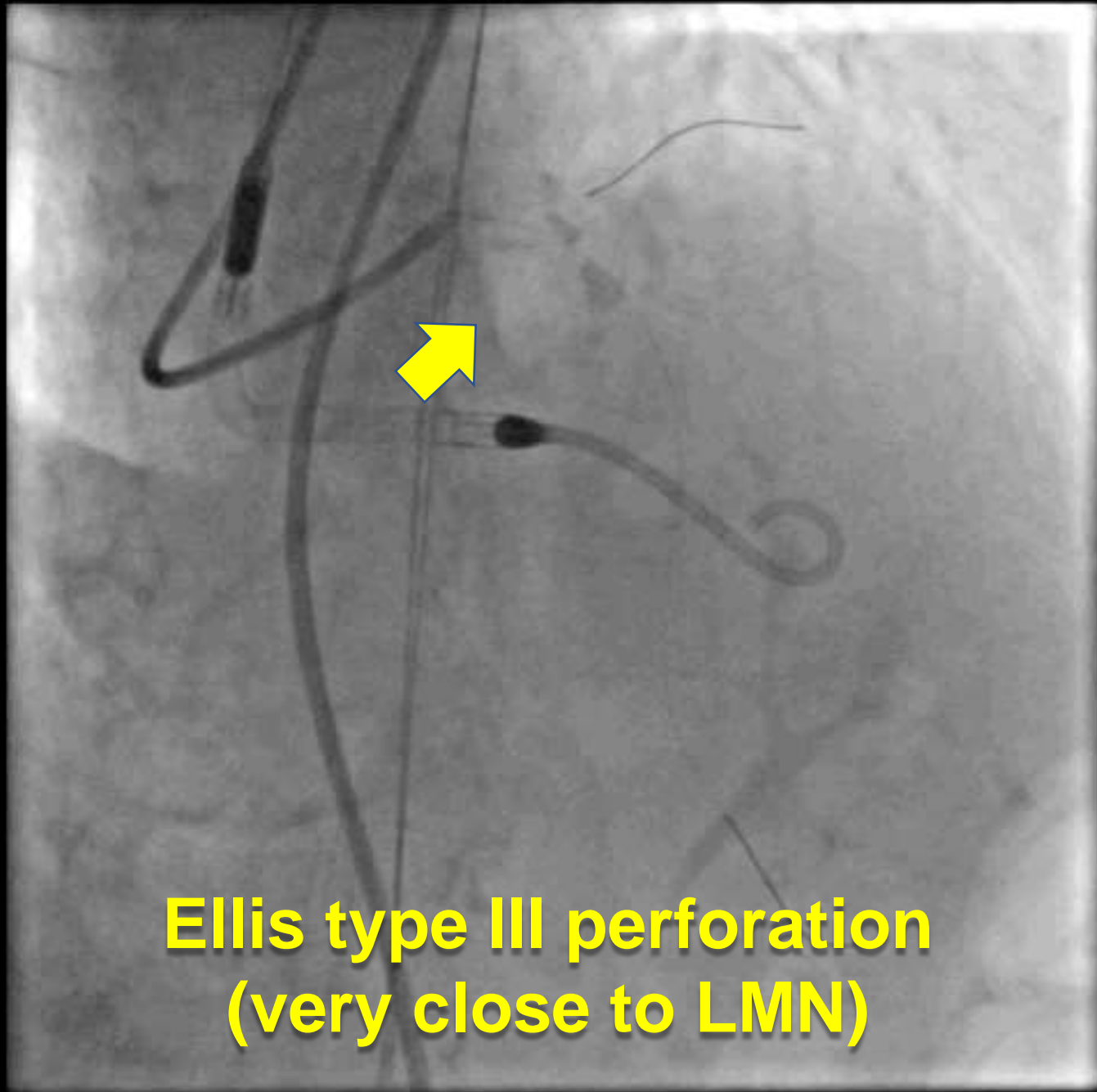


PCI to LAD



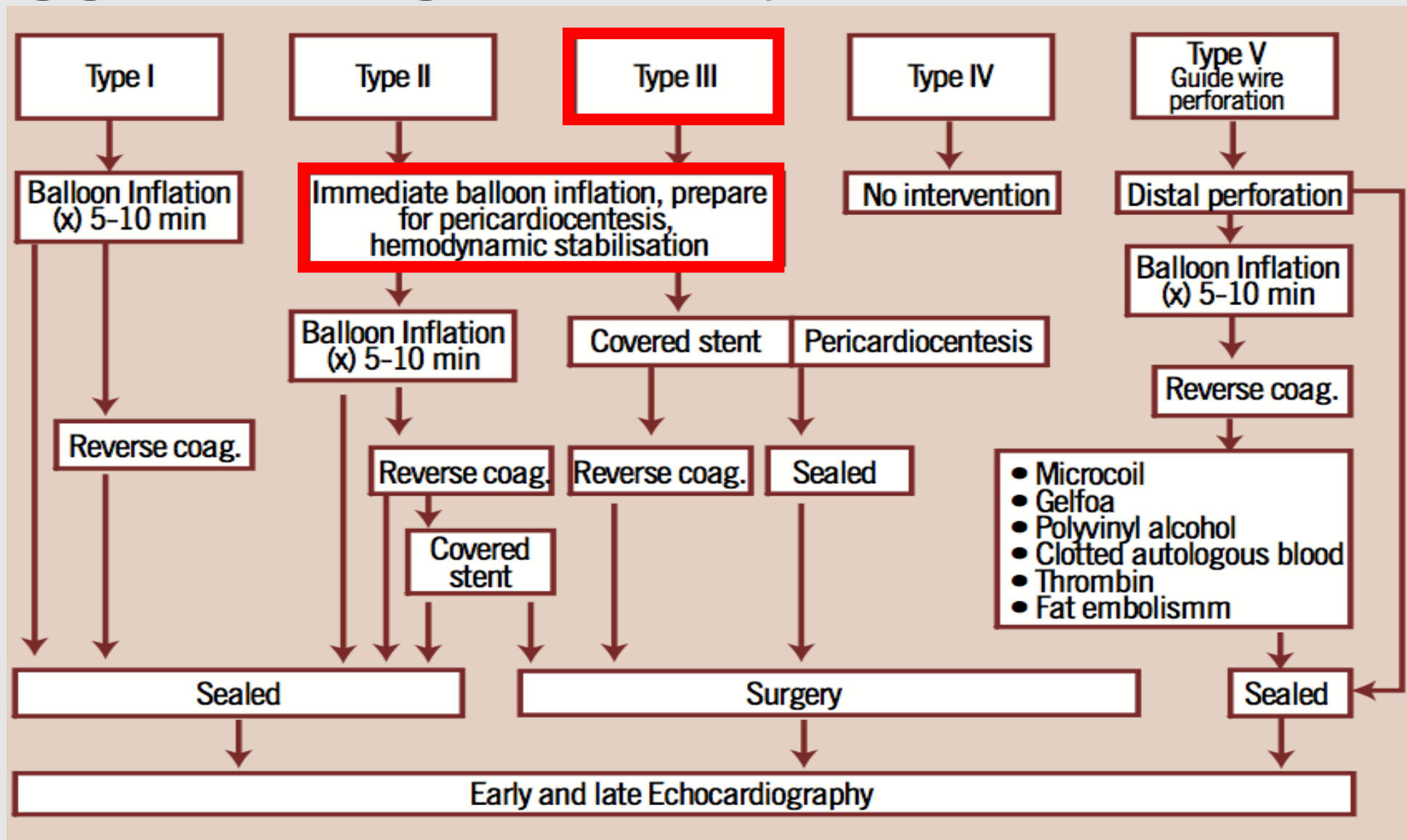
PCI to LAD



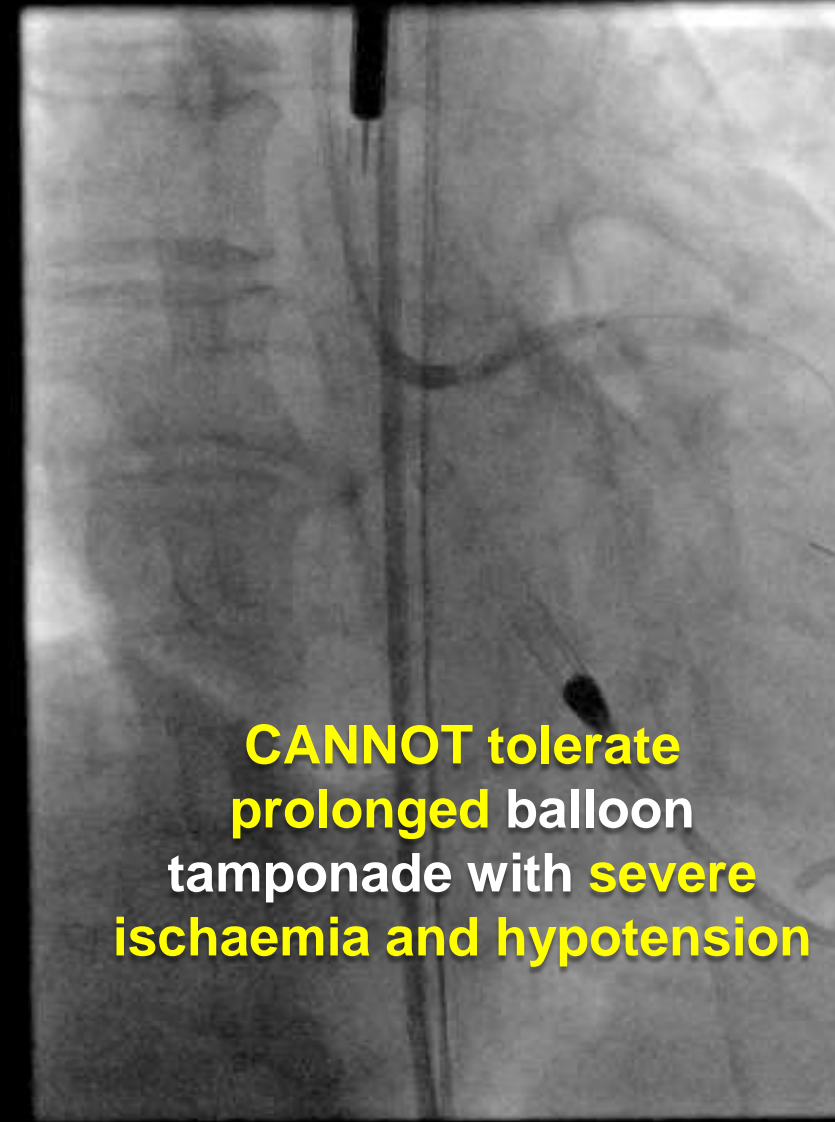
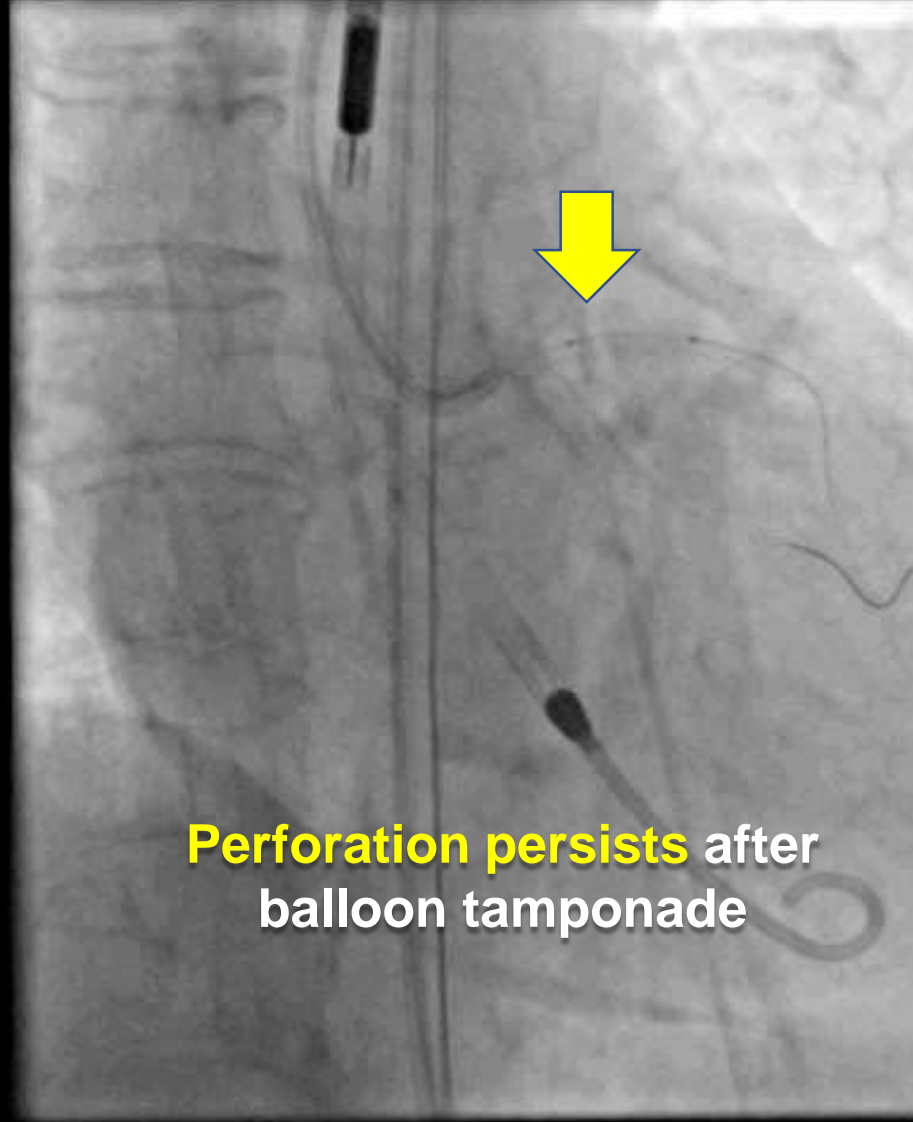
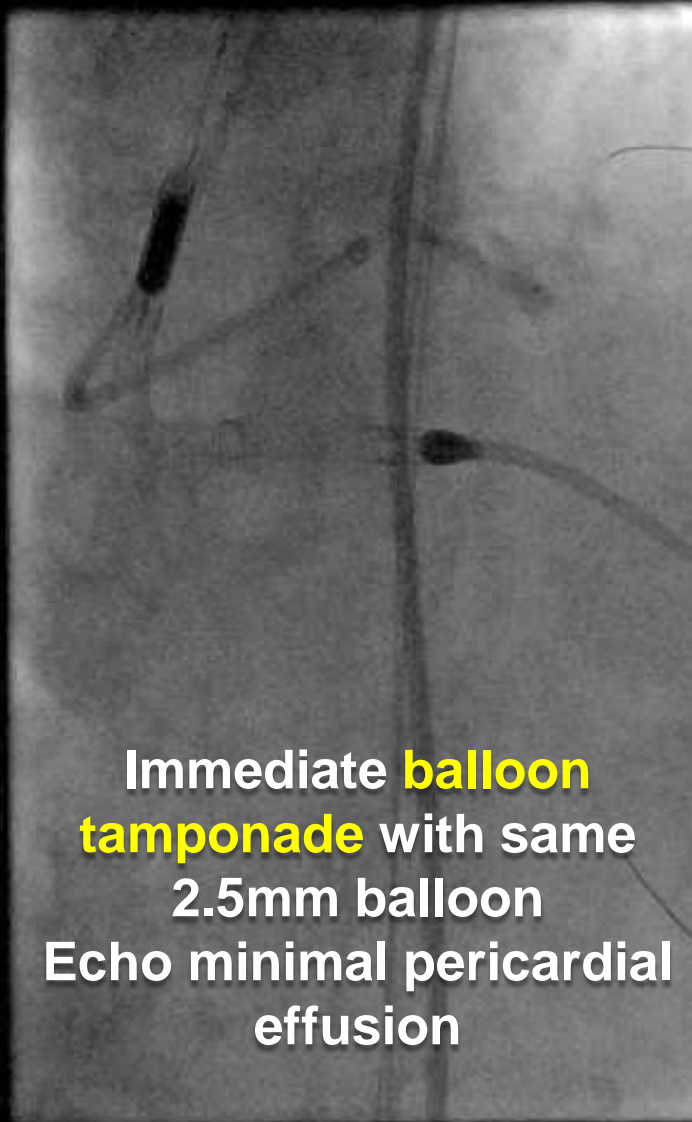


**Ellis type III perforation
(very close to LMN)**

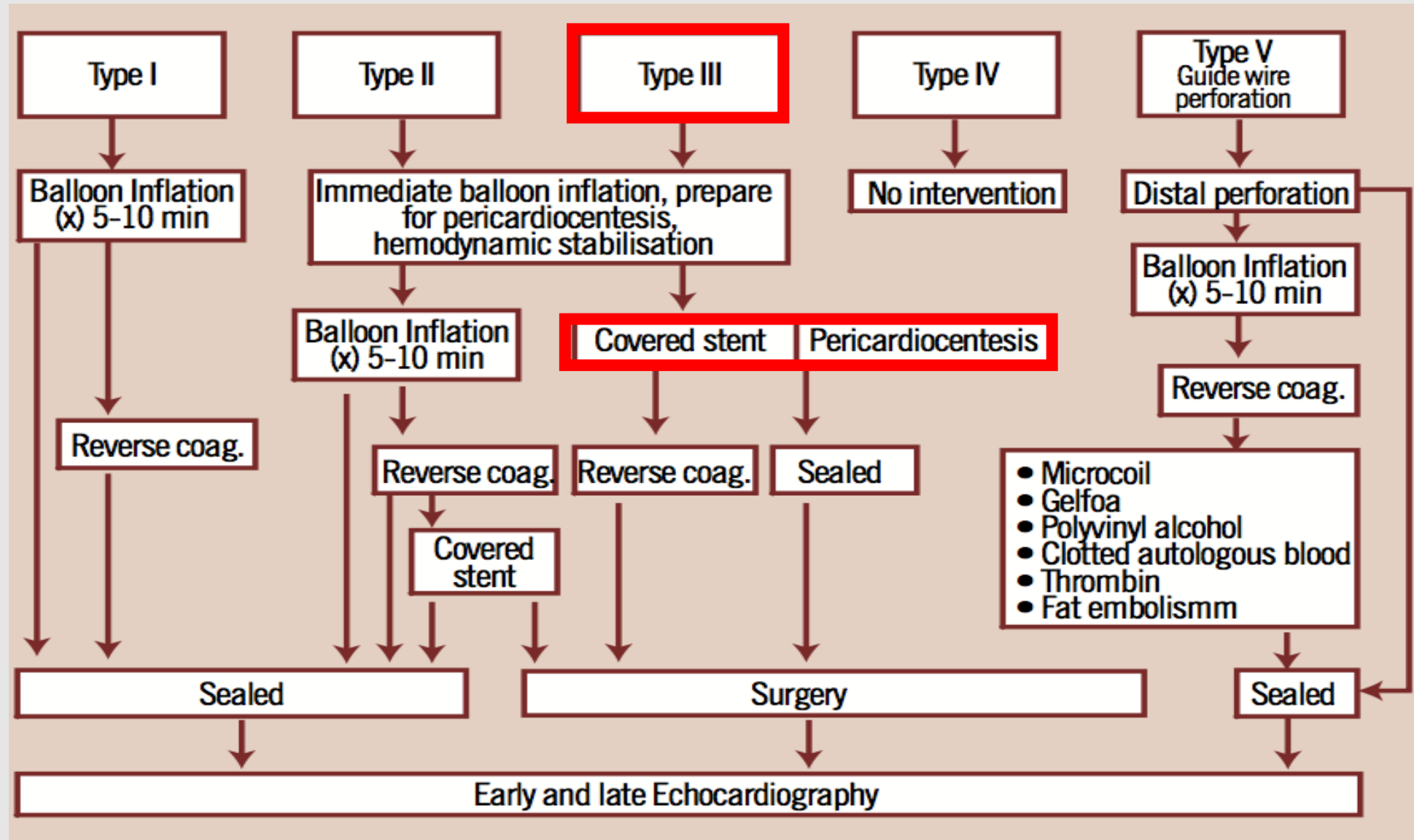
Suggested algorithm by PCR



Balloon tamponade

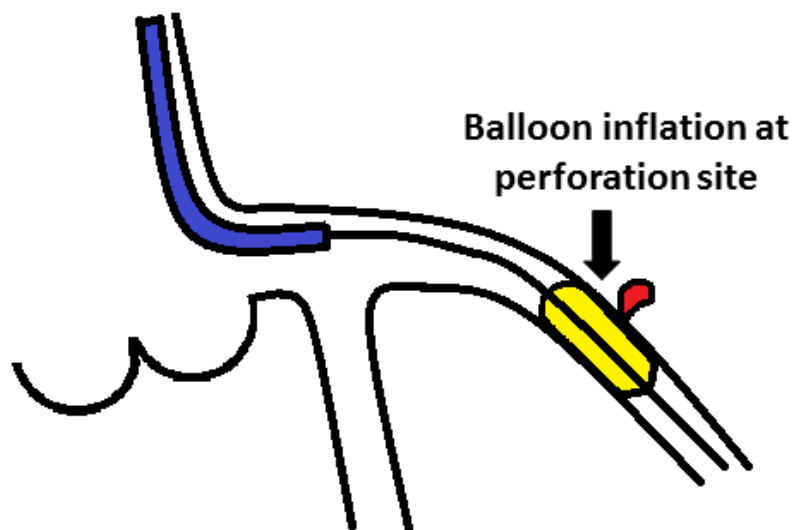


Suggested algorithm by PCR

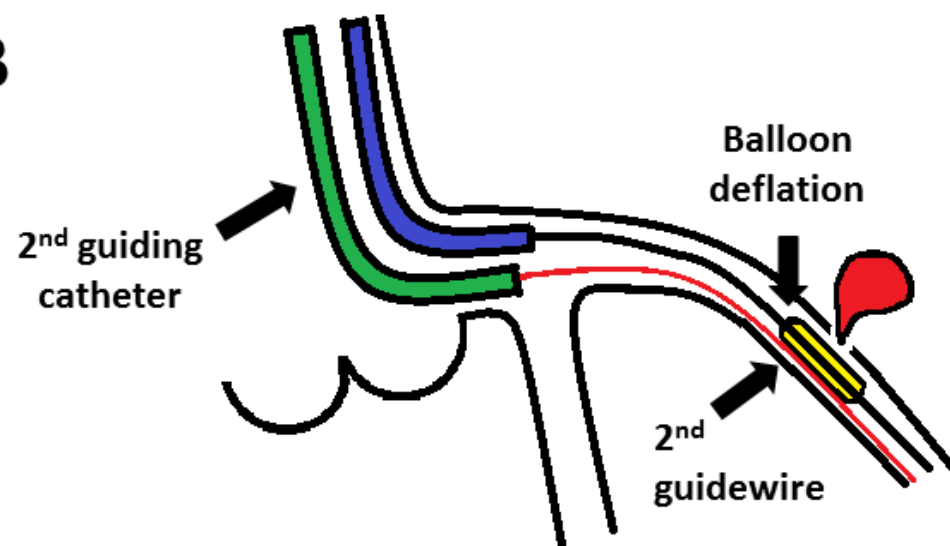


Double (ping-pong) guiding technique

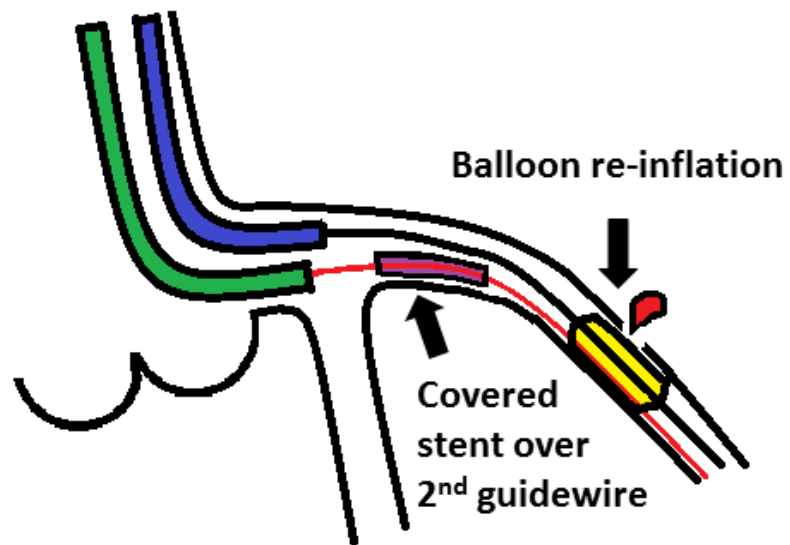
A



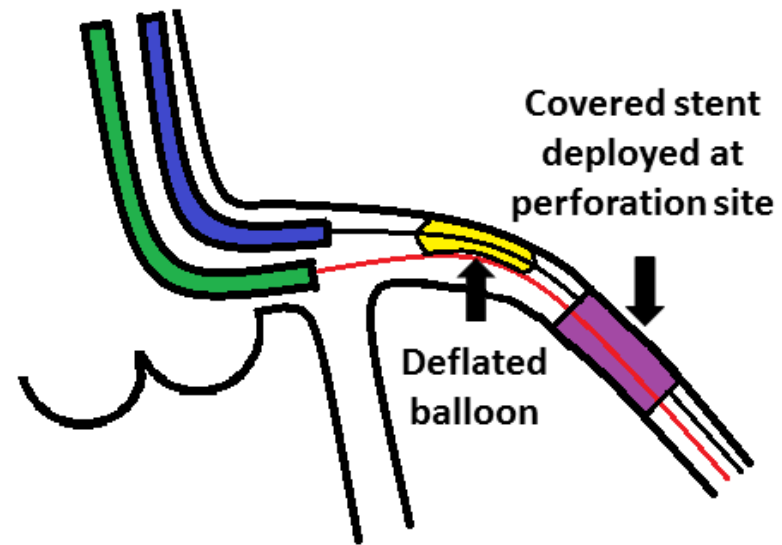
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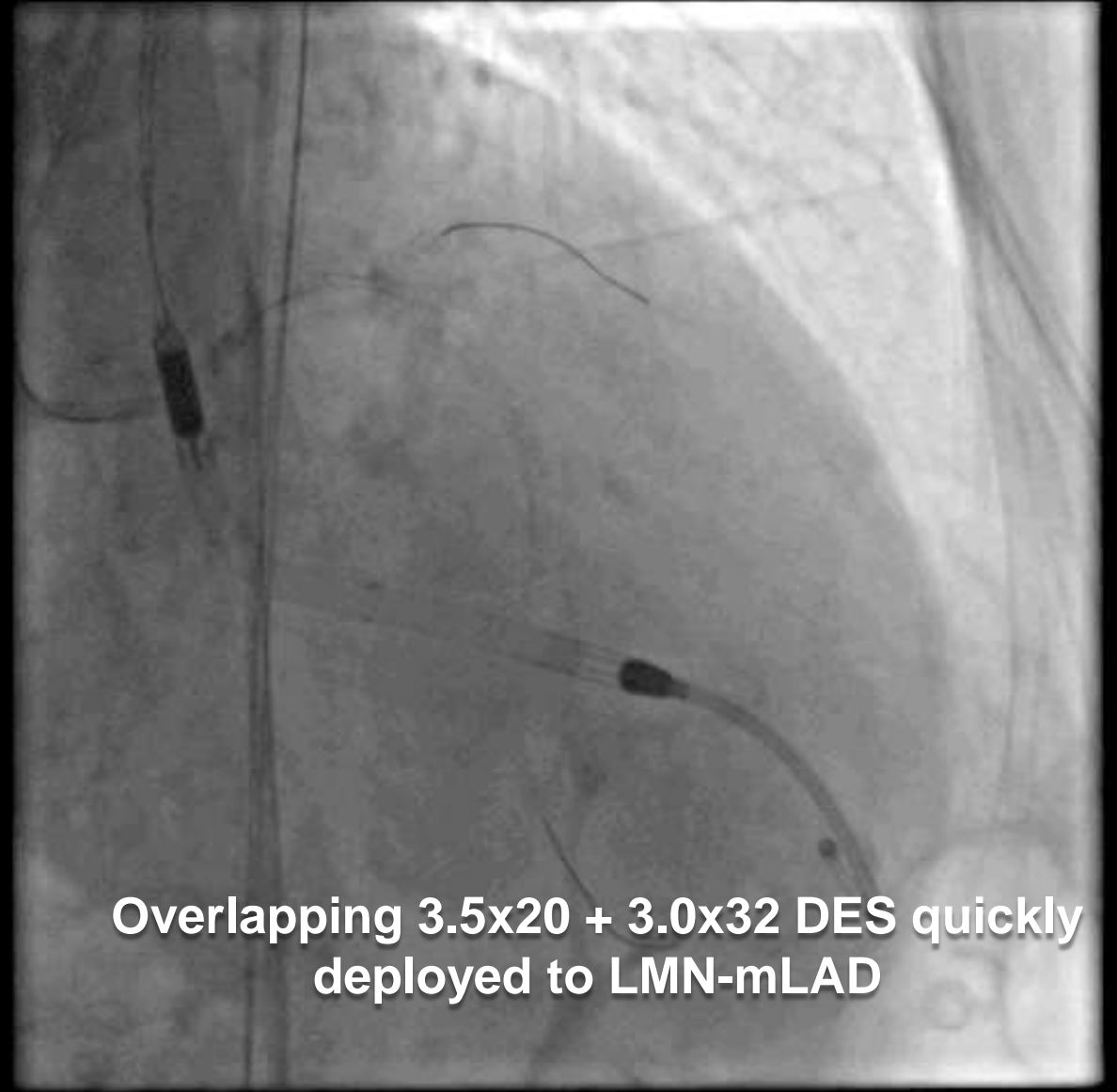
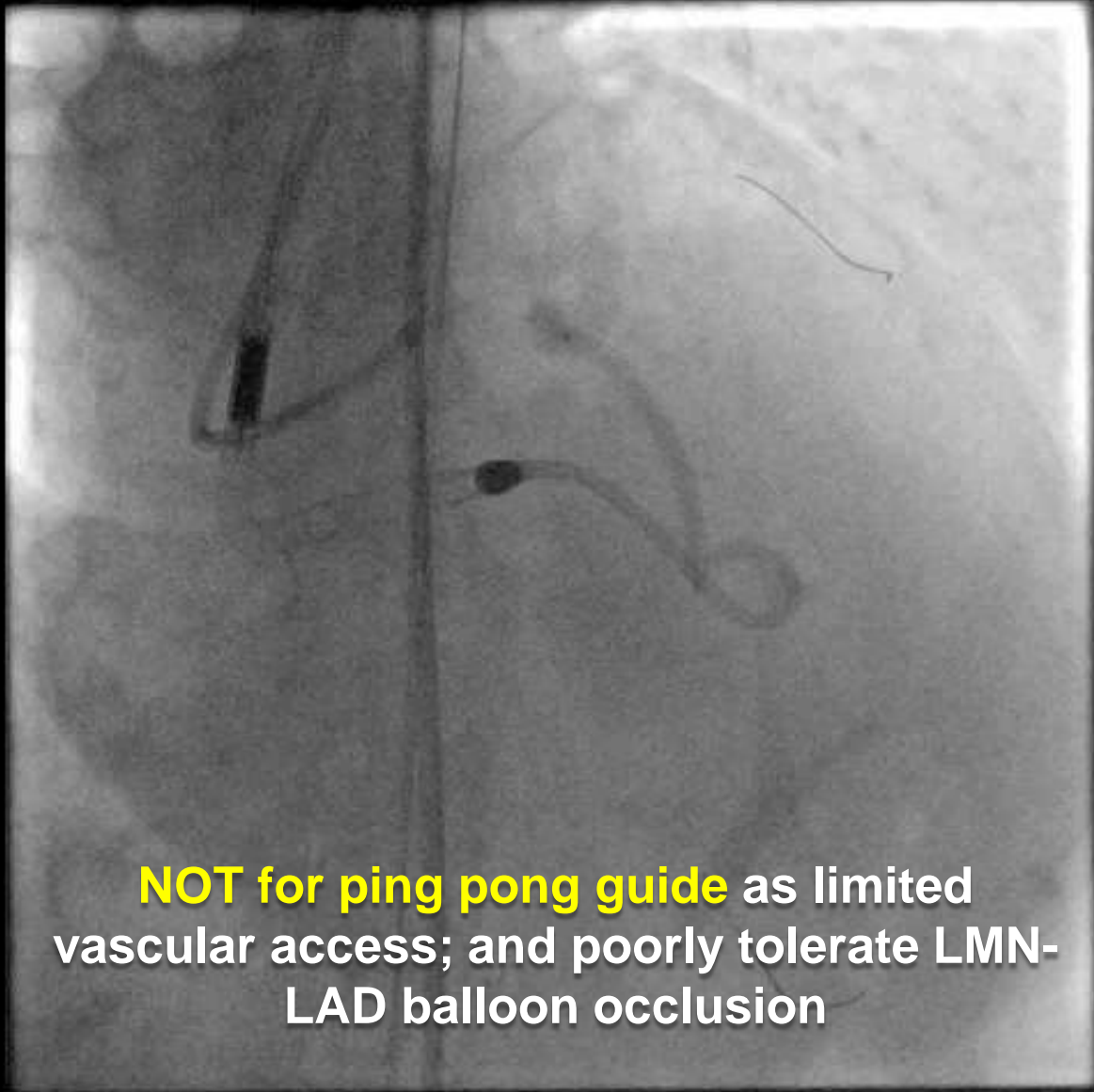
C



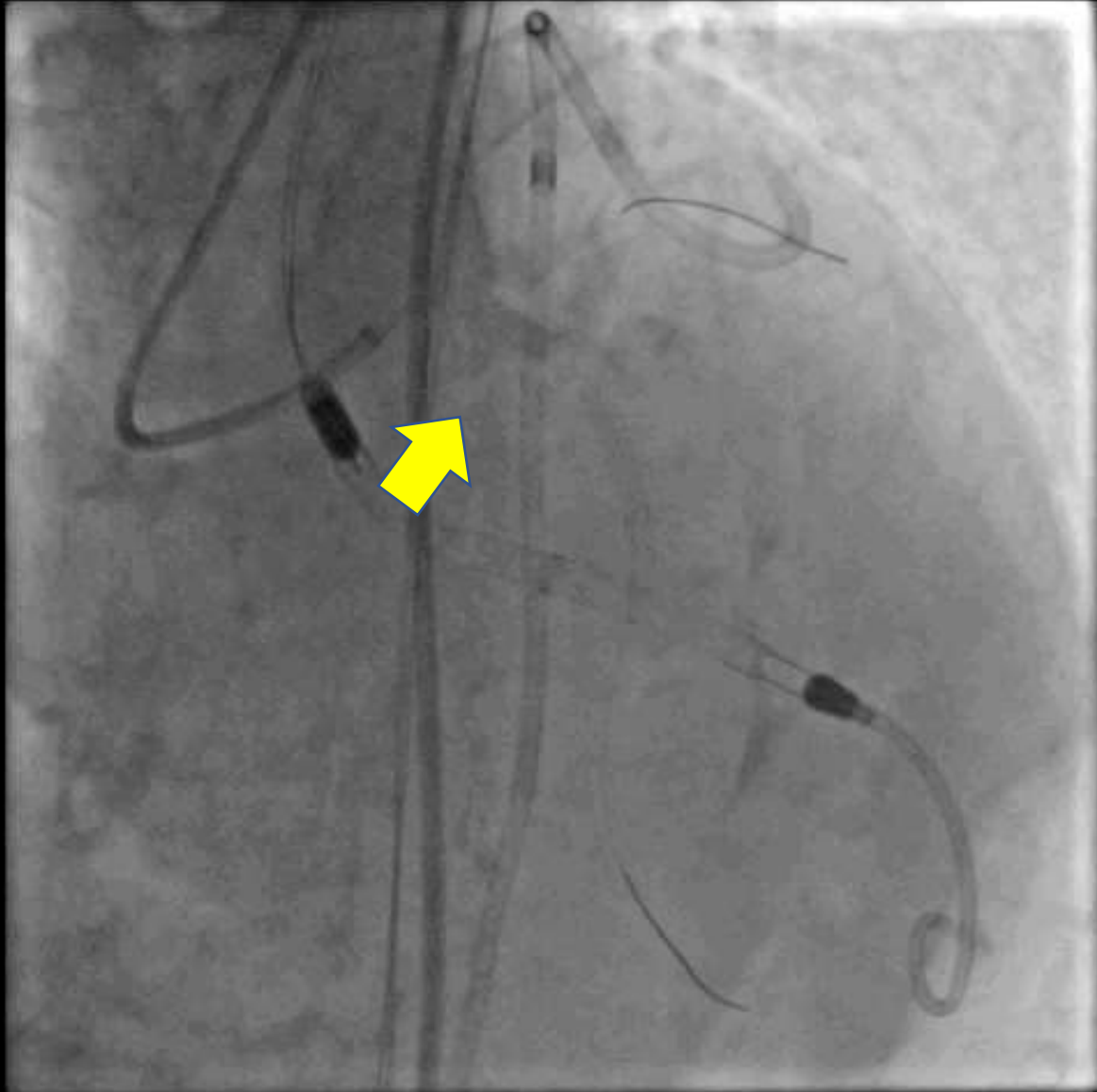
D



PTCS to LAD



Scenario get worse...



Persistent perforation after stenting

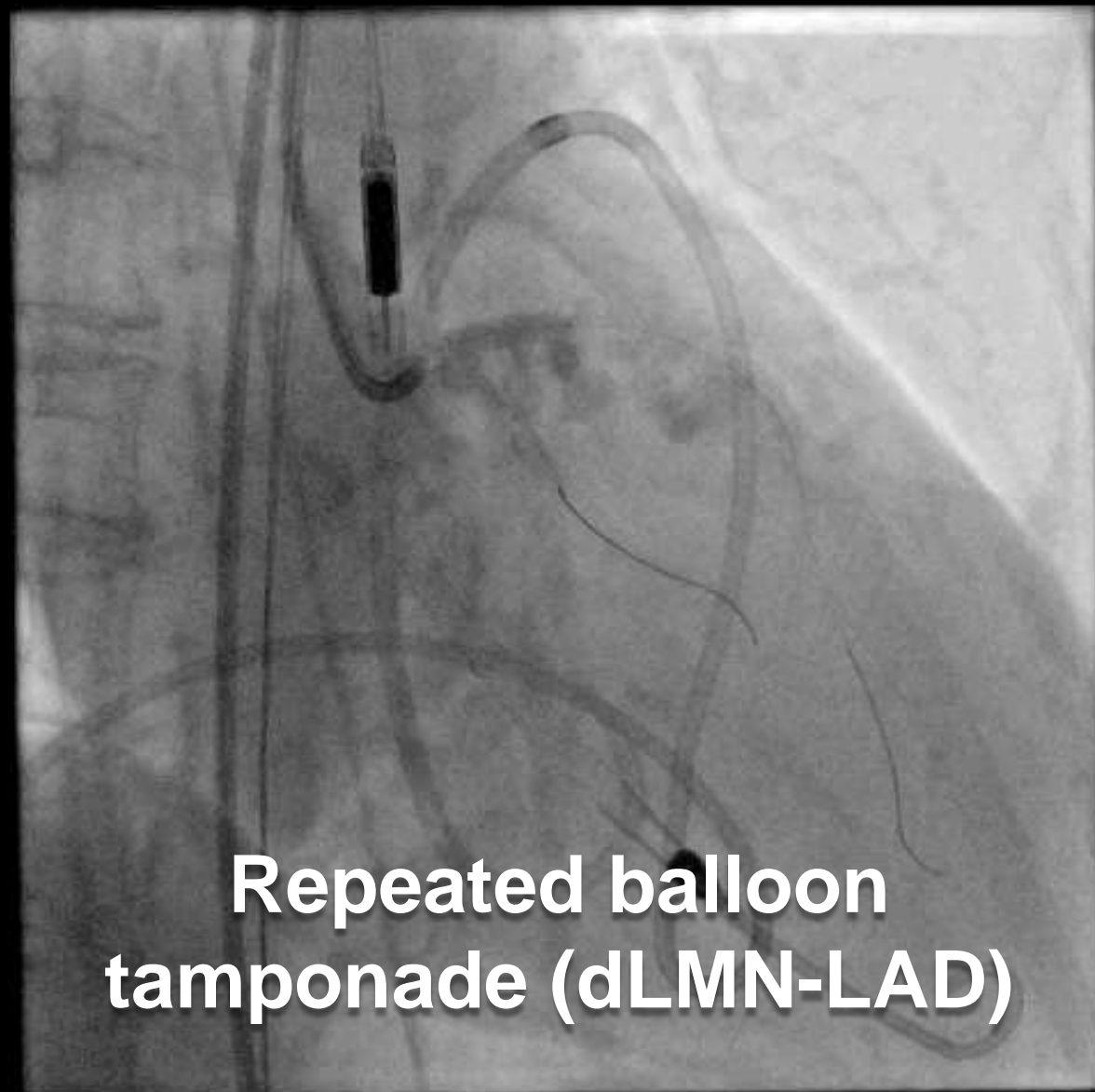
REPEATED balloon tamponade but tolerated poorly despite Impella support

Increasing pericardial effusion with near ***no intrinsic cardiac output*** (***full support by Impella*** and patient remain fully conscious)

Urgent pericardiocentesis - 300ml blood aspirated

Haemodynamic much stabilized

Rescue to LAD



**Repeated balloon
tamponade (dLMN-LAD)**

What would you do next?

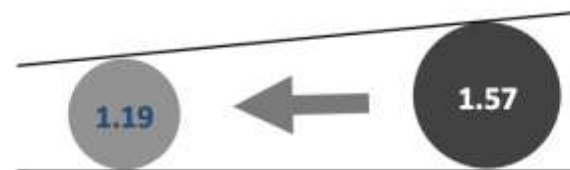
1. repeated balloon tamponade as far as tolerate
2. call surgeon for open heart surgery to repair the perforation and bypass the coronary
- 3. *stent graft across LMN knowing that the LCx would be closed***

Coronary covered-stent devices



Device name	PK Papyrus	GraftMaster	
Cover material	Polyurethane	PTFE	
Nominal Pressure	8 atm (7atm / ø4-5mm)	14 atm	
Rated Burst Pressure	16 atm	18 atm	
Device Design	Single Stent	Stent Sandwich	
Available Size Range	L	15 - 26mm	9 - 26mm
	ø	2.5 - 5.0mm	3.0 - 5.0mm

Crossing profile [mm diameter]



PK Papyrus 3.0/15



GraftMaster 3.0/16



- 24% reduction in diameter
- 43% reduction in cross-sectional area

Data on file at BIOTRONIK

*4.5 and 5.0mm diameters are 6F compatible

Stent

FE

m

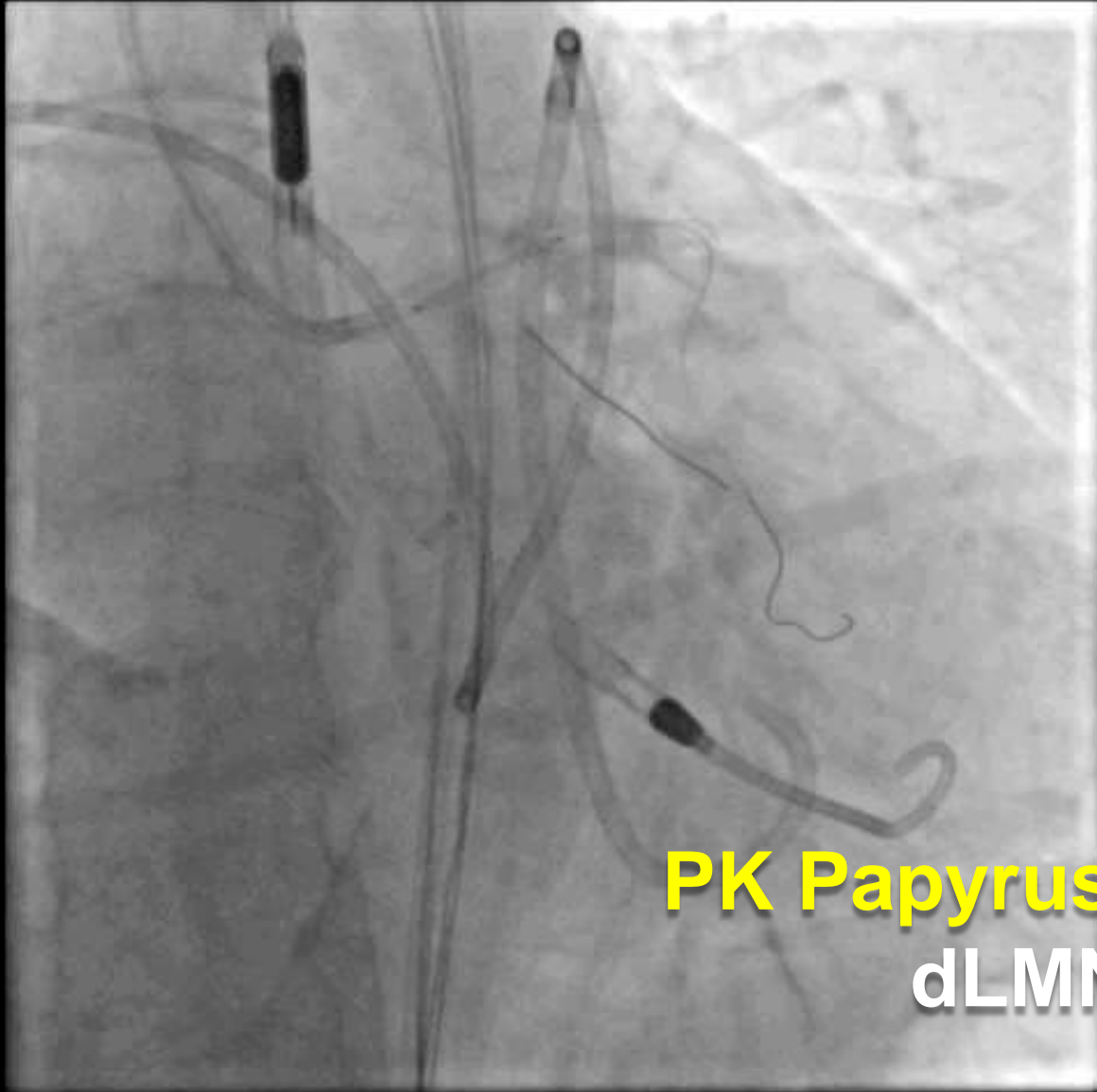
tm

ndwich

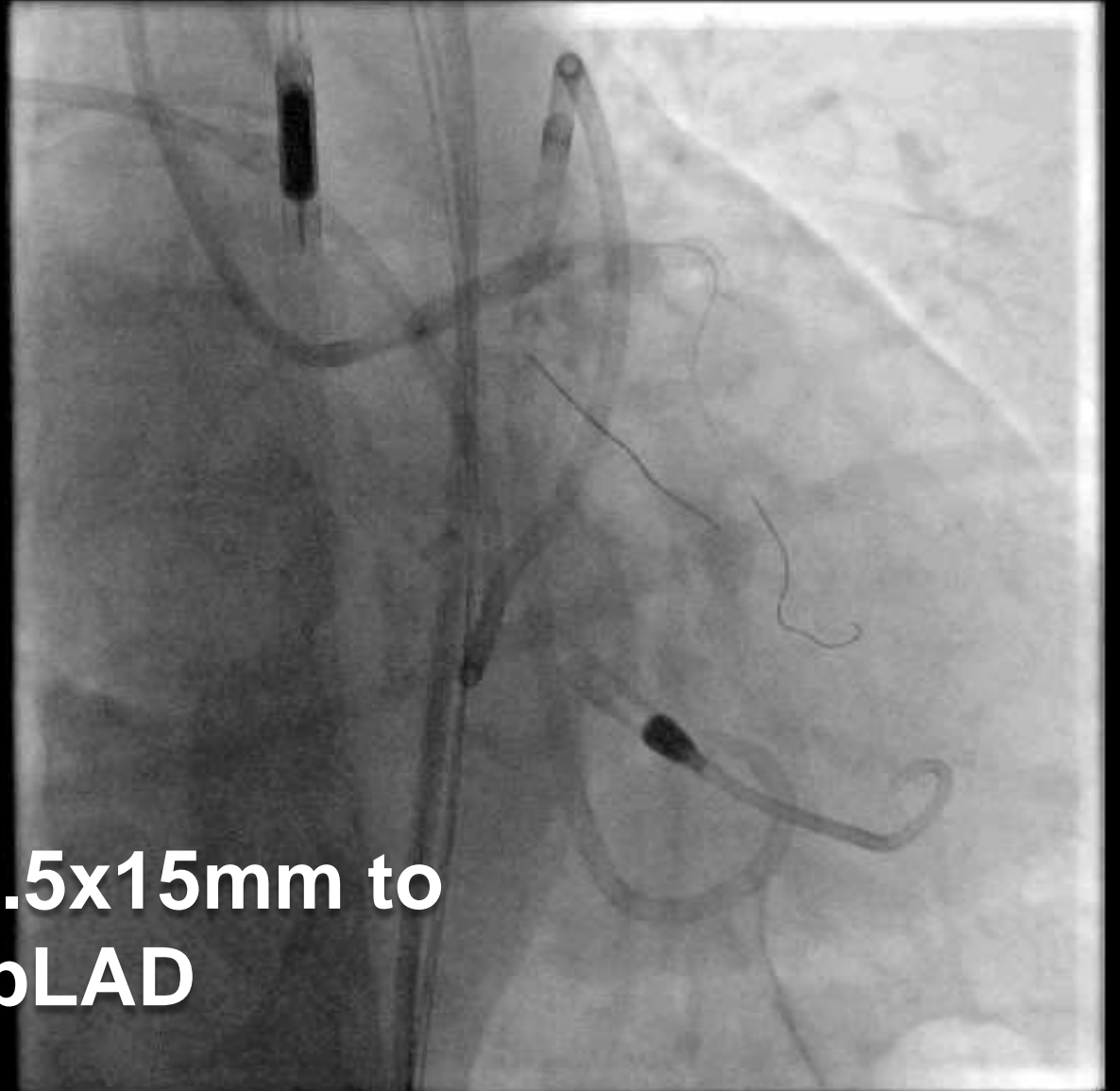
mm

.0mm

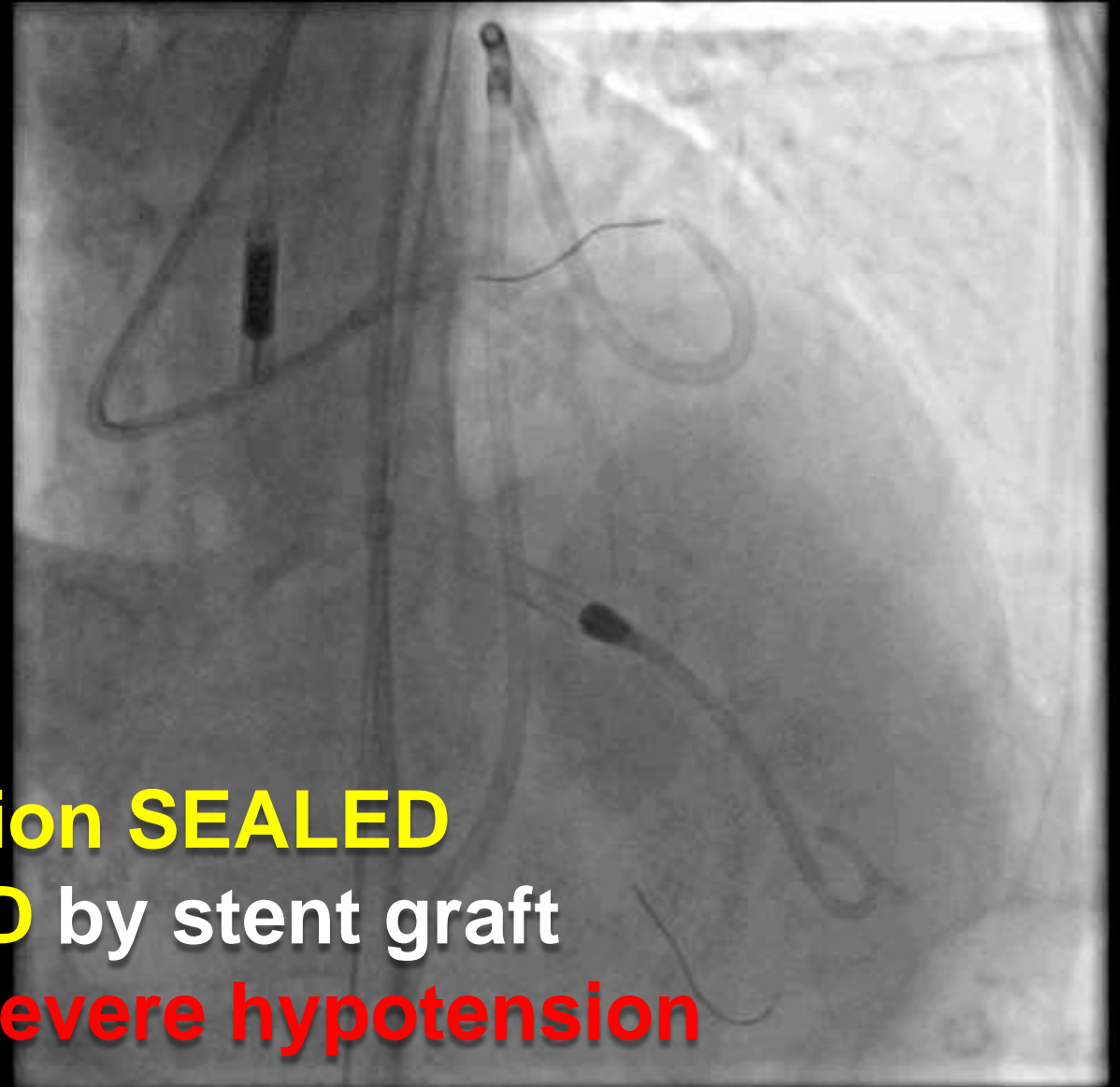
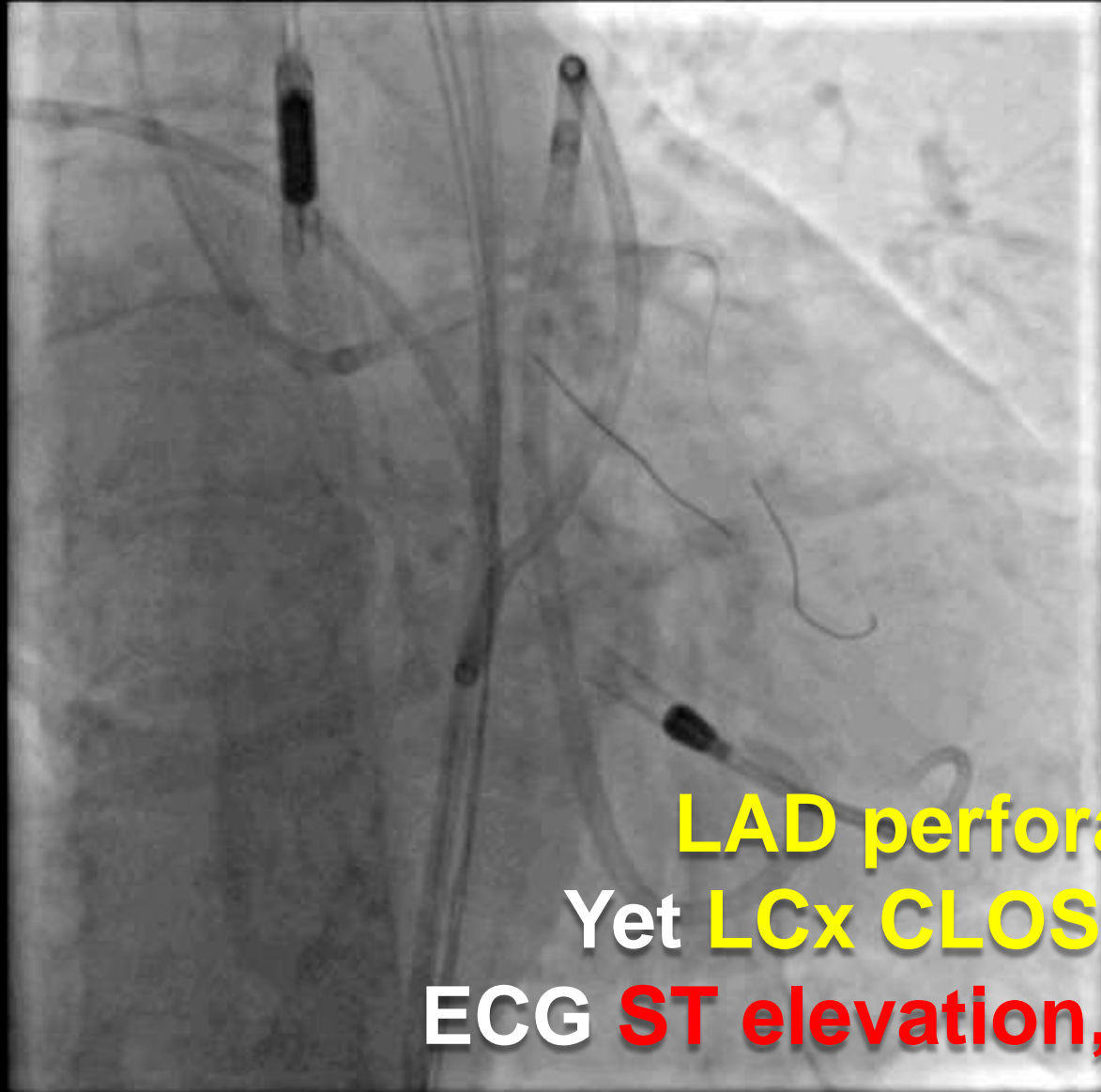
Deploy stent graft



**PK Papyrus 3.5x15mm to
dLMN-pLAD**



Post stent graft

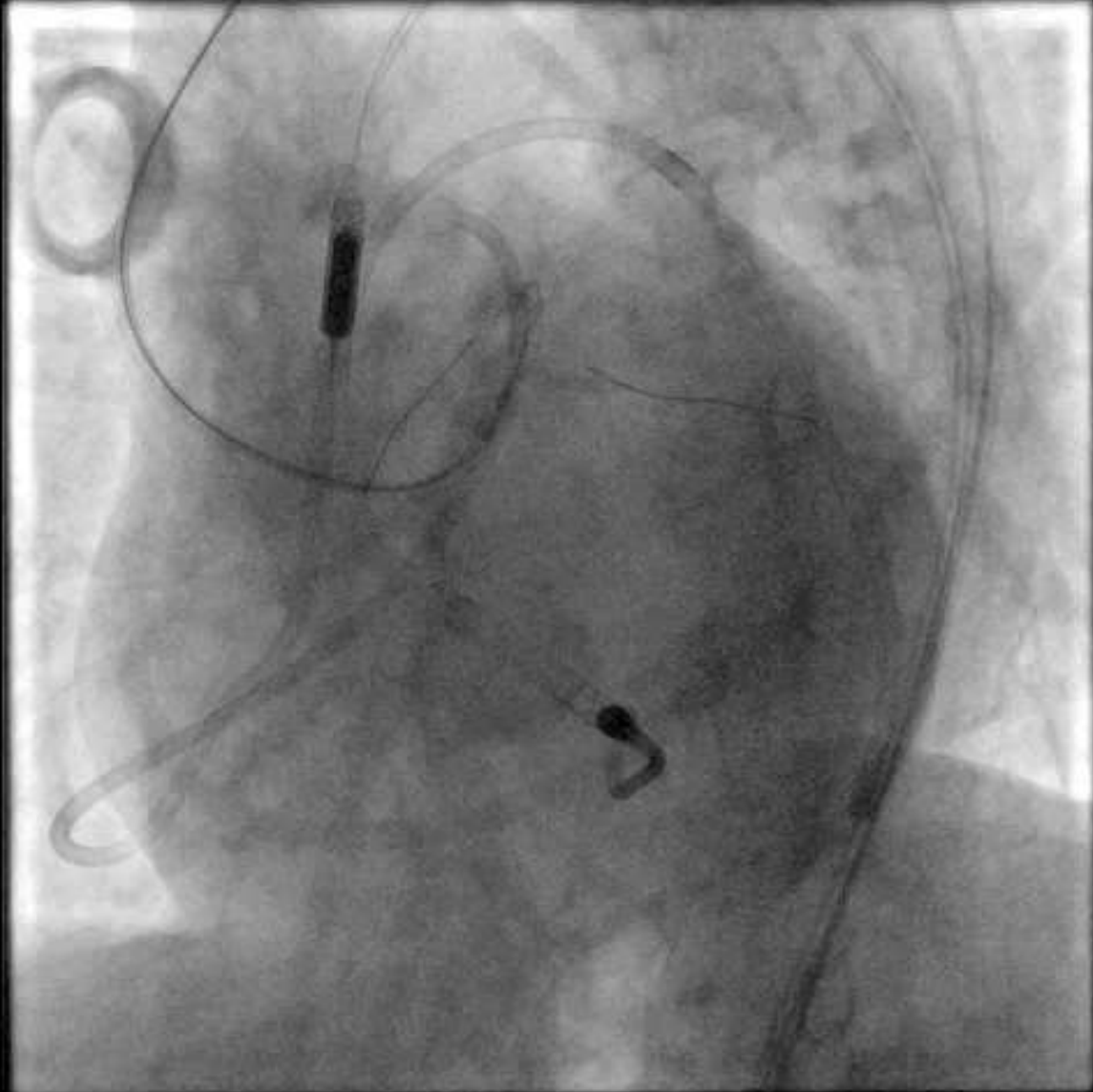


LAD perforation SEALED
Yet LCx CLOSED by stent graft
ECG ST elevation, severe hypotension

What would you do next?

1. Observe as LAD perforation sealed off already
2. Call surgeon for urgent CABG to OM and RCA
3. Try to reperfuse LCx by using small balloon over jailed LCx wire
4. *Try puncture the stent graft with stiff wires to LCx; then ballooning and stent across covered stent*

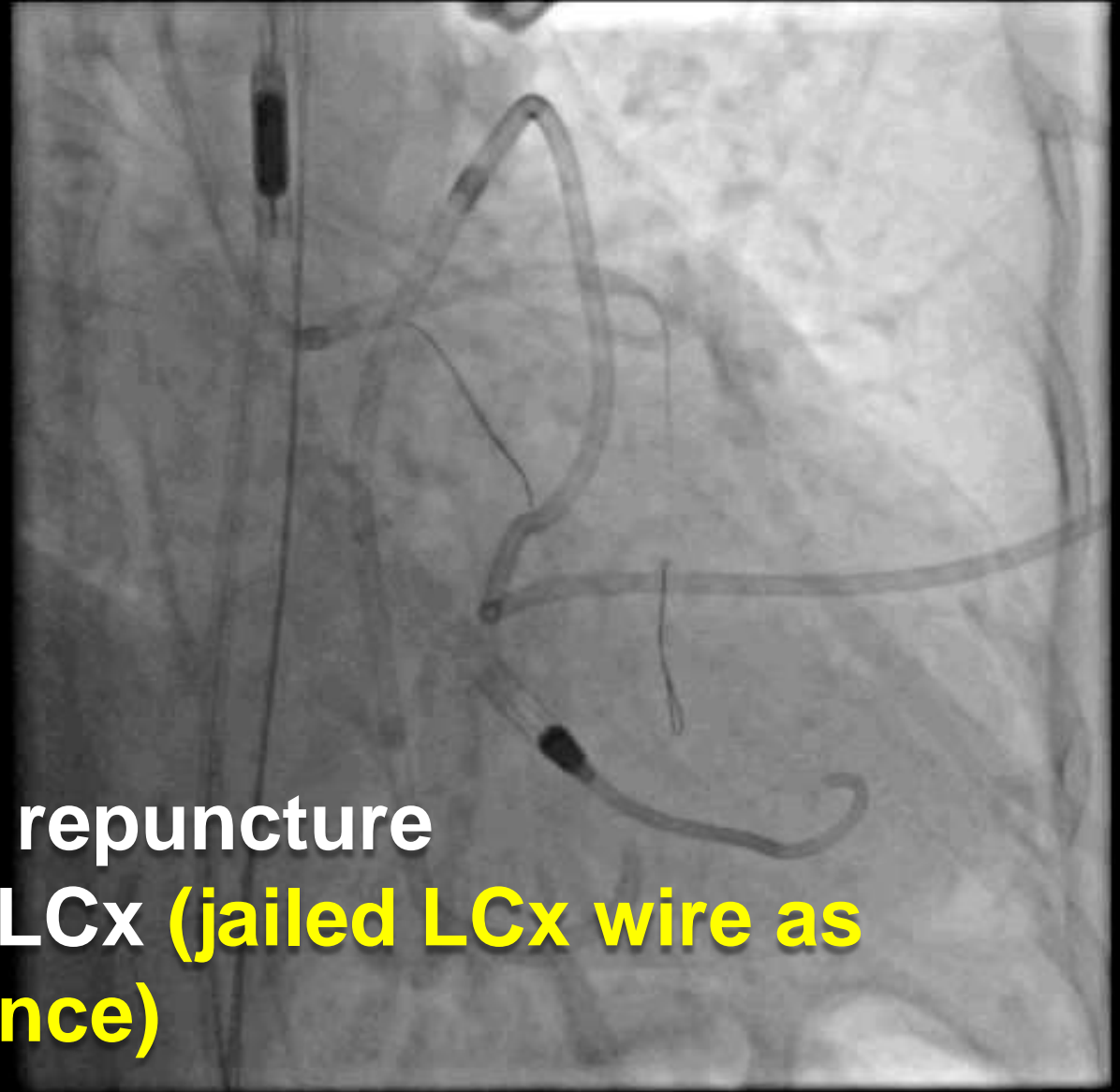
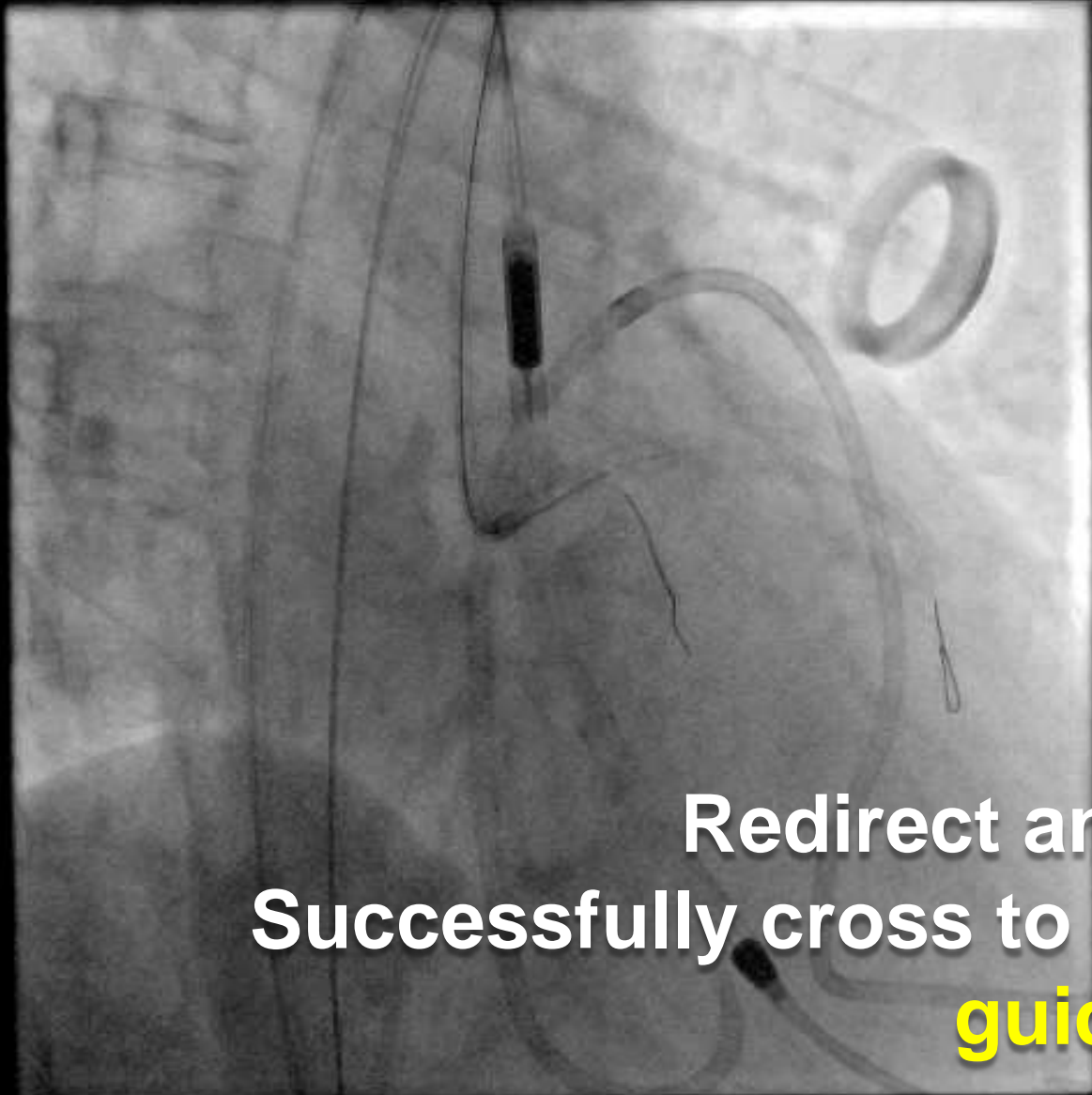
Wire puncture through stent graft to LCx



Tried 90 degree
Supercross/Conquest pro 9 –
FAILED

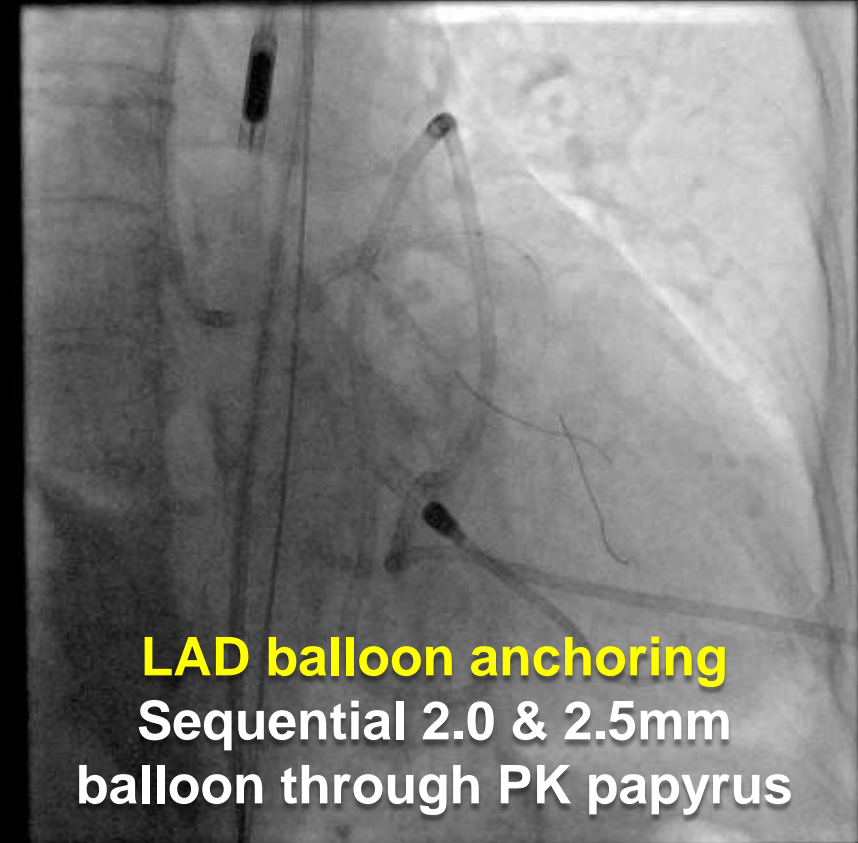
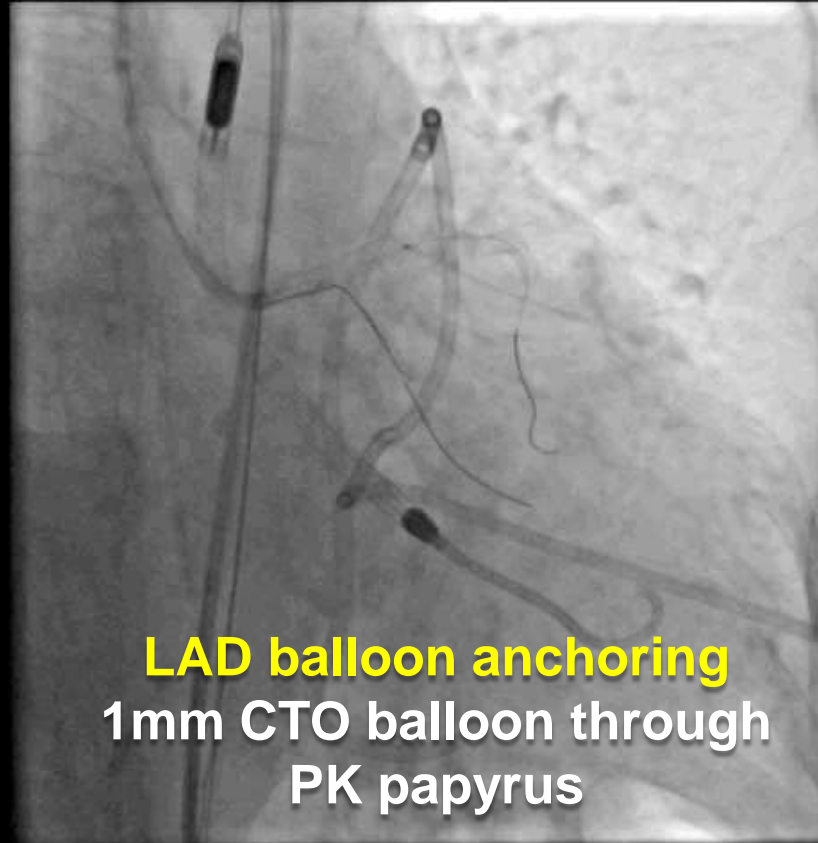
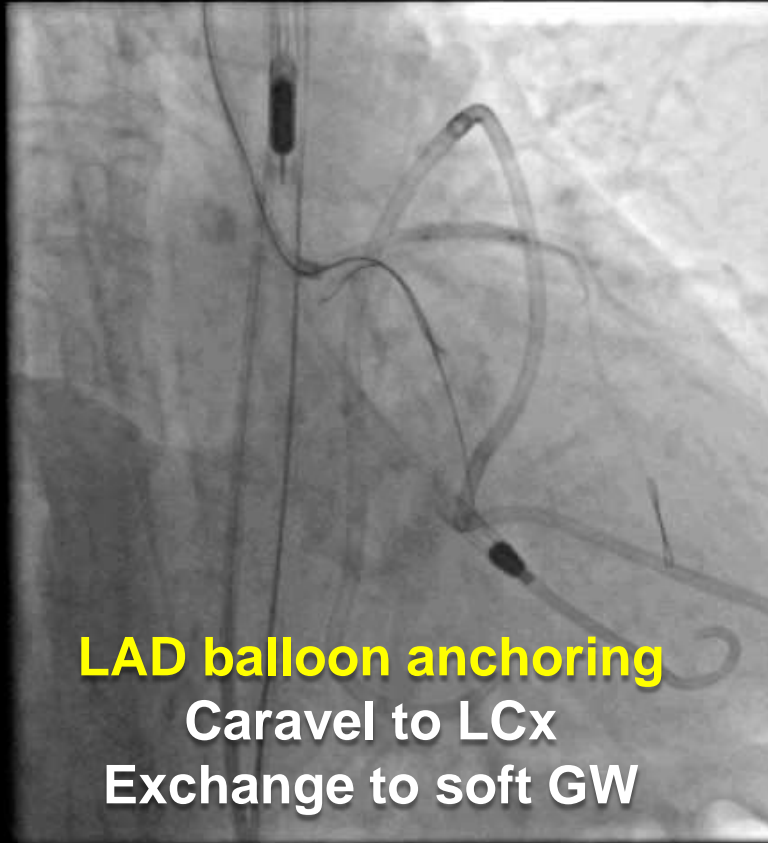
Tried Crusade/Conquest pro 12 –
*puncture several time to
previous perforation site*

Wire puncture through stent graft to LCx

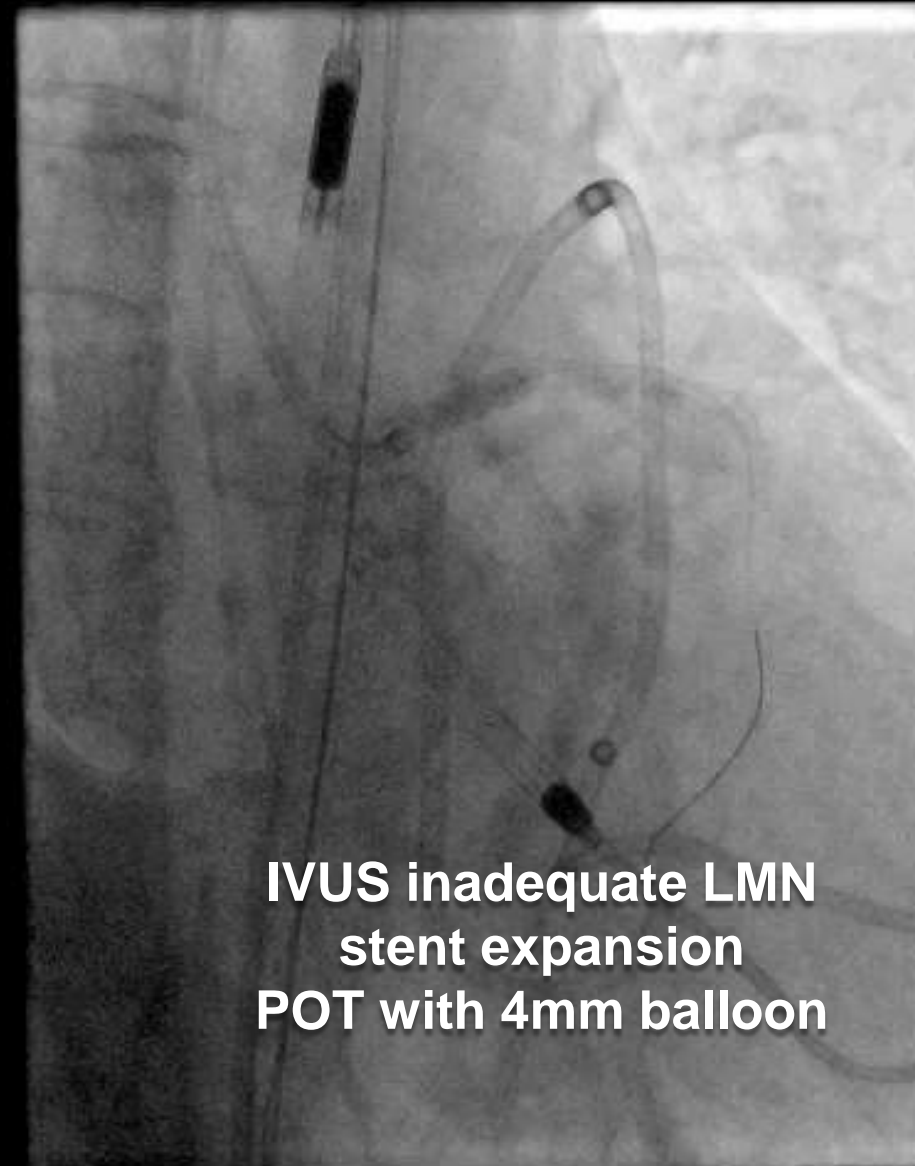
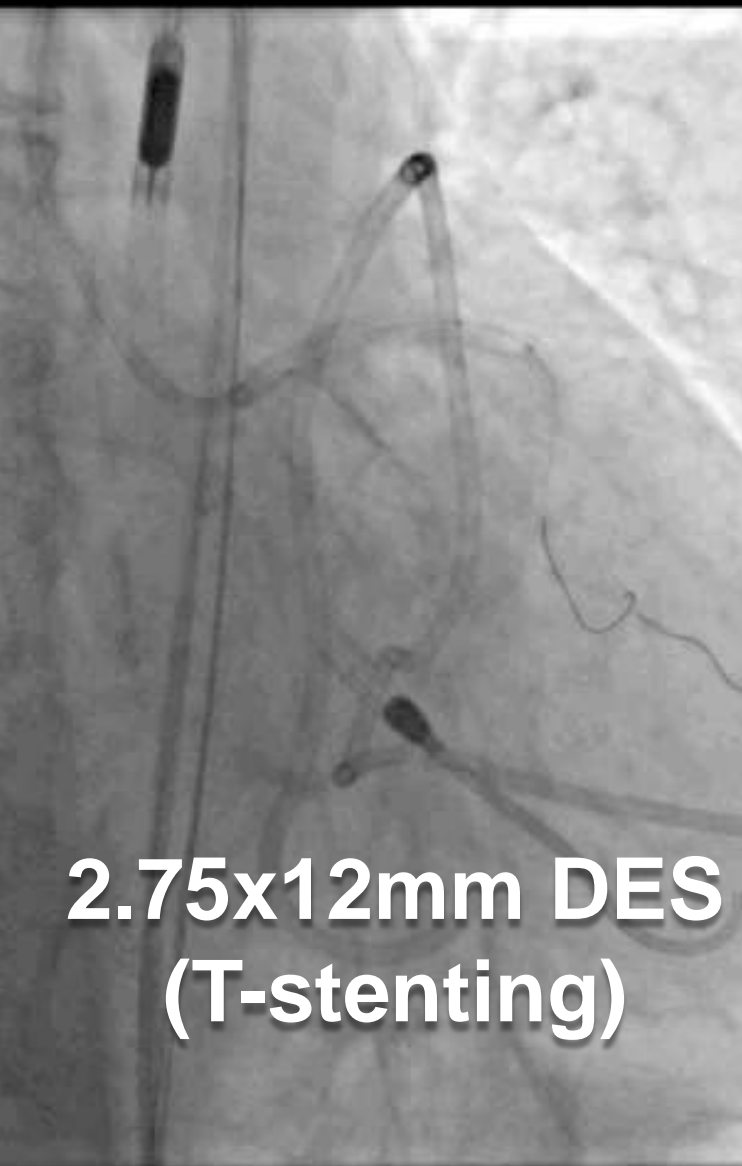


Redirect and repuncture
Successfully cross to mLCx (jailed LCx wire as
guidance)

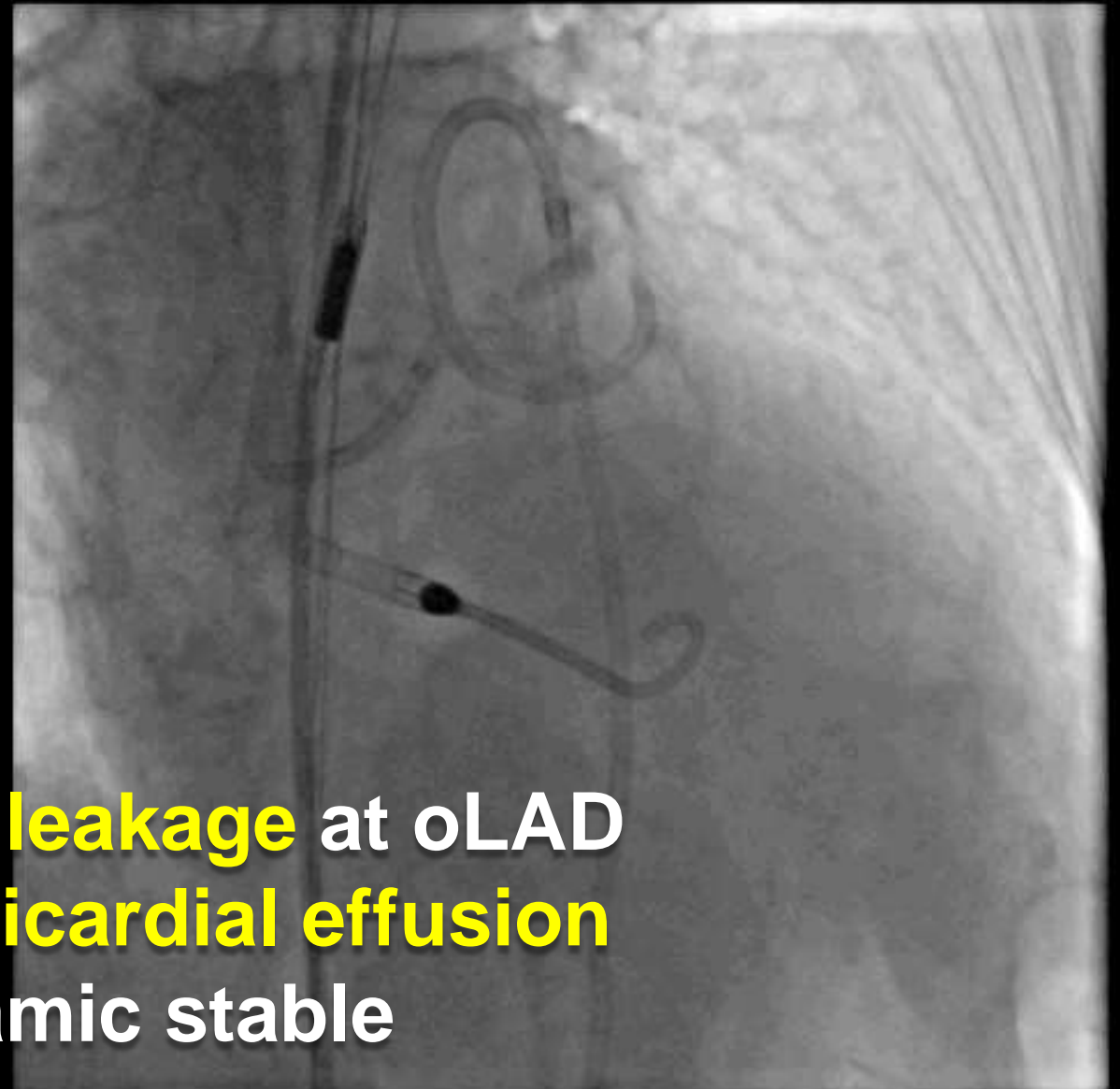
PTCA/S to LCx through covered stent



PTCS to oLCx, then FKB & POT



Final angiogram



Still **mild residual leakage** at oLAD
Echo **minimal pericardial effusion**
Haemodynamic stable

What would you do now?

- 1. Conservative mx first as mild leakage*
- 2. Reverse all heparin and transfuse*
- 3. Call CTS for urgent surgery*
- 4. Wait and see; for surgical exploration if deterioration*
5. Deploy MORE covered stents; re-puncturing GWs to LCx and then put more stent; more high pressure/bigger balloons, FKB etc (repeat ALL STEPS again!)

Outcome

- Echo - minimal pericardial effusion, no tamponade
- To CCU for close monitoring, *heparin reversal*, transfusion of RC and platelets
- Notify surgeons
- ACT – satisfactory
- Persistent drainage of fresh blood from drain *>100cc/hr*
- Discussed with surgeons – *emergency operation for hemostasis* (no need CPS)

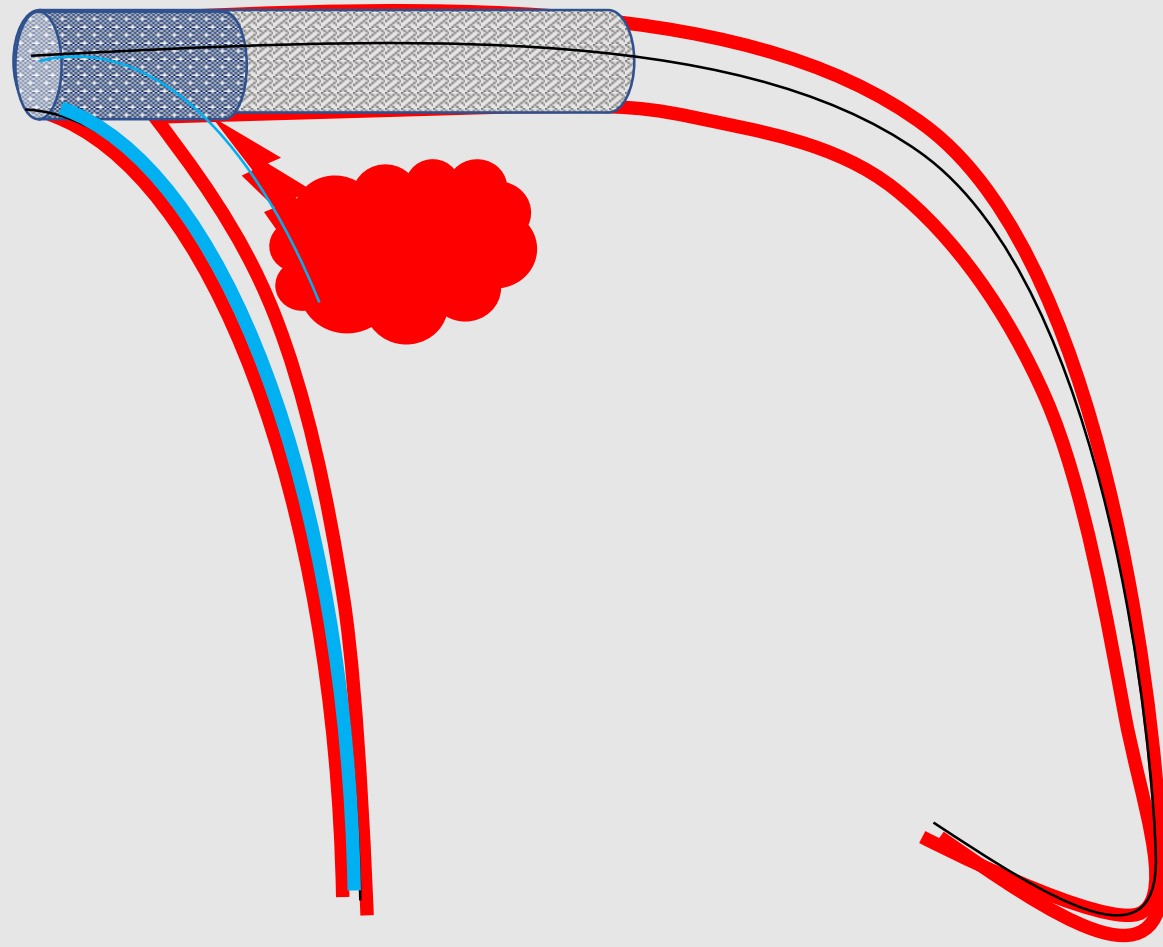
Intraoperative findings

- Heart edematous and friable; poor global LV function
- Minimal blood clots inside pericardial space with patent drain
- ***1mm perforation*** at very calcified pLAD ***with oozing***
- Severe diffuse oozing due to DIC, ***extremely difficult haemostasis***

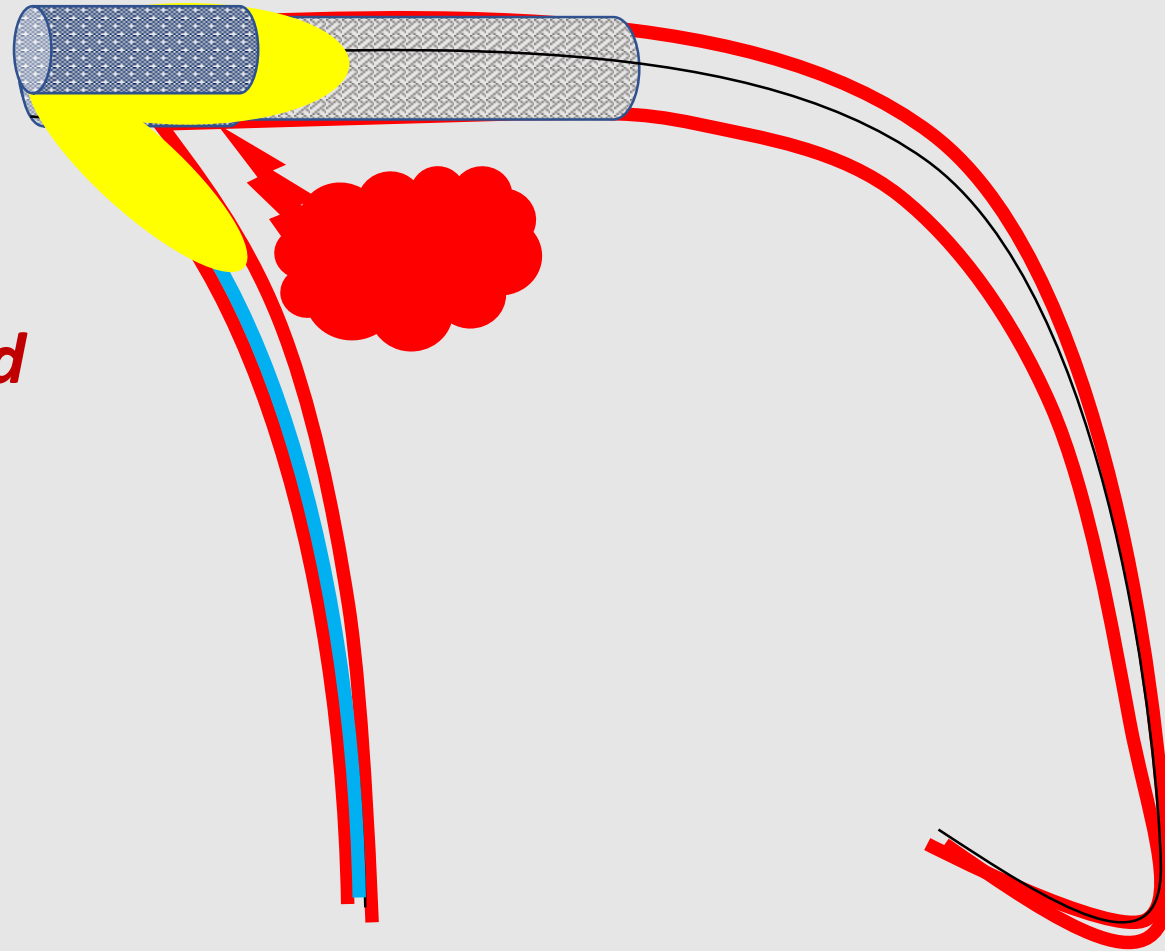
Post operative

- No more active bleeding from drain
- ***DIC***
- Acute kidney injury on dialysis
- Persistent cardiogenic shock
- Severe sepsis, metabolic acidosis
- ***Multi-organ failure***
- Succumbed on day 2 post PCI despite maximal support

Recap



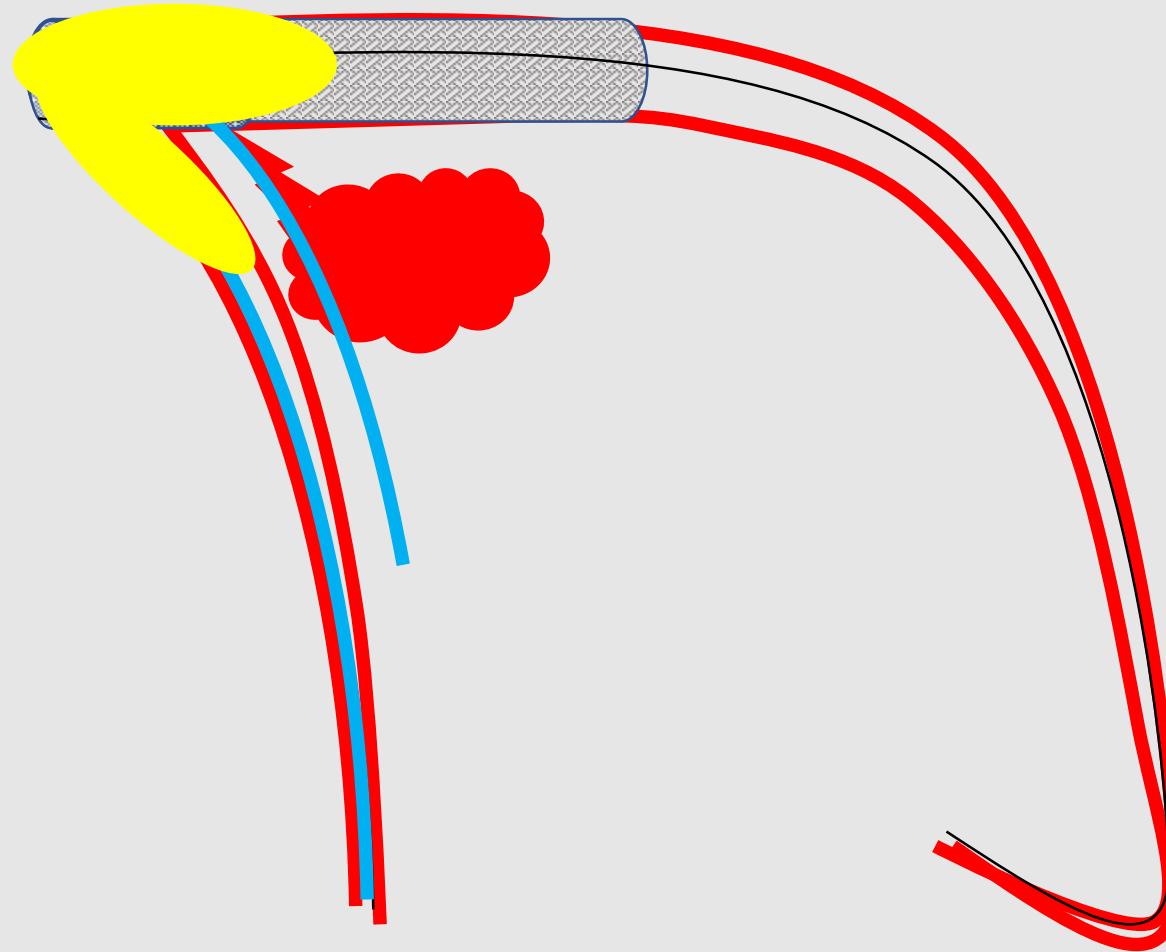
What had gone wrong?



ballooning and stenting
through the covered stent

disruption of graft apposition
and result in rebleeding

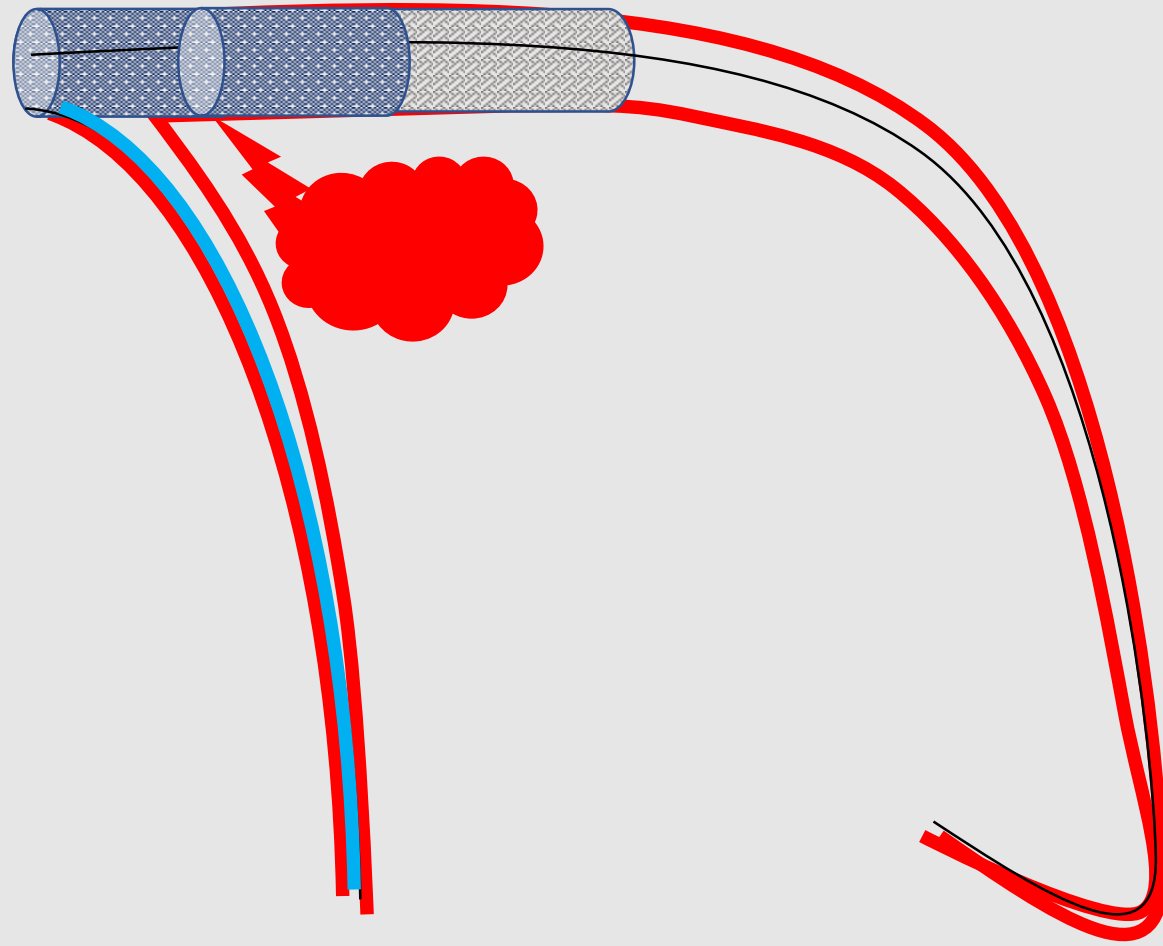
What had gone wrong?



*inadvertent
puncture* of
thin stent graft
materials

high pressure
with larger
balloon may
*enlarge the
hole and
cause
persistent leak*

Hindsight



Lessons to learn

- ***Know your patient well***
 - Protected PCI (e.g. Impella assisted) is beneficial for selected high risk PCI
- ***Respect the anatomy***
 - Never underestimate any calcified lesion
 - Even after rotablation, perforation can still occur following subsequent lesion preparation
- ***Prepare for the worst***
 - anticipate and prepare for rescue measure of perforation
 - Immediate balloon tamponade should be the first rescue; buy times for planning and reassessment
 - Perfusion balloon (if available) may be considered for prolonged tamponade
 - In some cases with severe perforation, double guiding technique

Lessons to learn

- ***Understand your gadgets***

- New generation covered stents: low profile, easily deliverable and effective
- Apply CTO techniques: stiff GWs with microcatheter support (e.g. supercross, crusade, cavarel) is feasible to re-open the blocked branch by the covered stent

- ***Stay alert; do not get excited too early***

- Exercise extreme caution in subsequent ballooning and stenting through the covered stent; might lead to disruption of graft apposition and rebleeding
- Avoid inadvertently puncturing of thin stent graft materials; subsequent high pressure with larger balloon may enlarge the hole and cause persistent leak

- ***Call our dear friend if necessary***

- For persistent case with unsatisfactory result after covered stent, timely surgical exploration with haemostasis is our last resort

The end