ISR with severe underexpansion

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Cath lab.

Contents

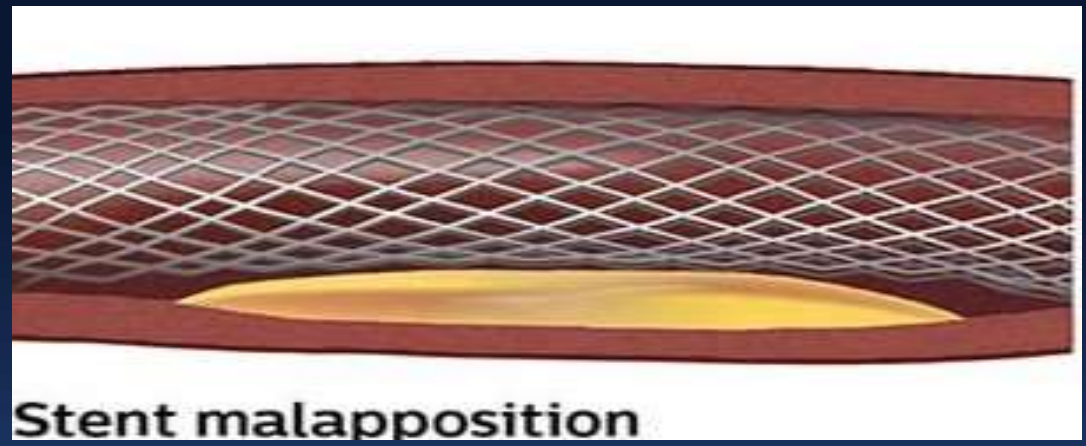
- In-Stent Restenosis
- Plaque modification
- ISR treatment option
- CASE

ISR (In-Stent Restenosis)

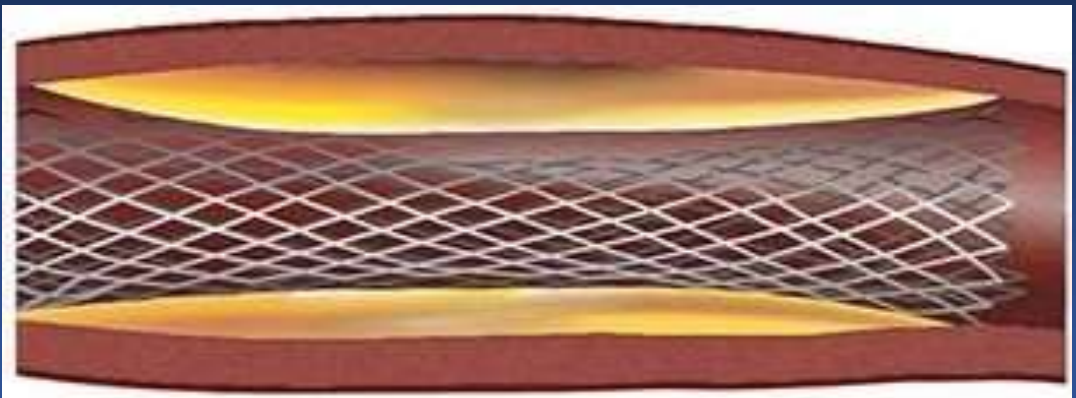
What causes restenosis in stents?

1 **Neointimal hyperplasia**
Mainly smooth muscle cell proliferation

2 **Neo-atherosclerosis**
Newly formed atherosclerotic changes within the neo-intima

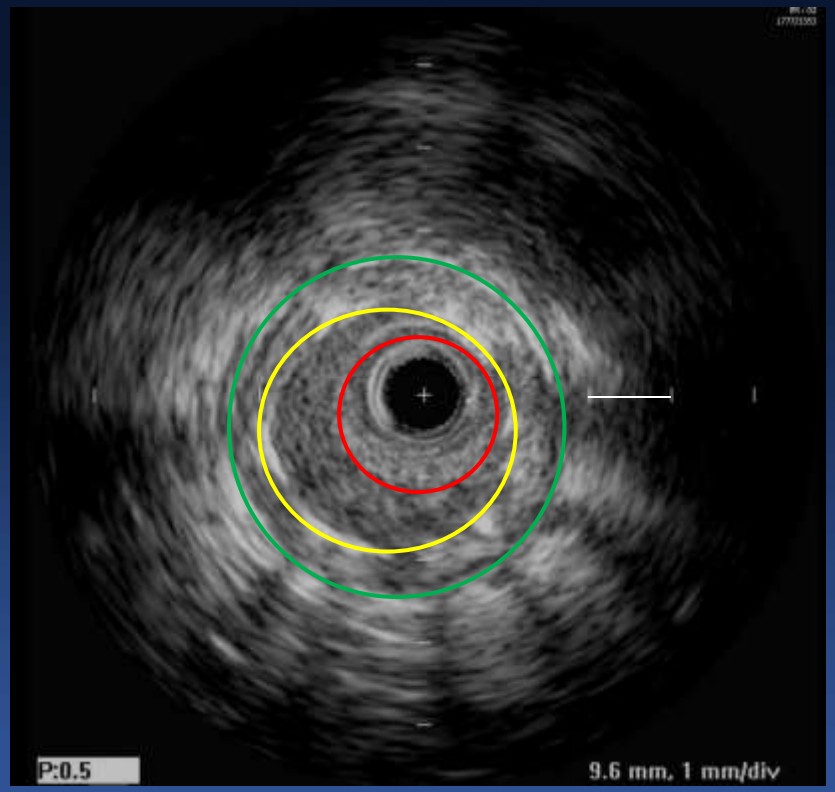


Stent malapposition



Stent underexpansion

Intimal hyperplasia



EEM area = 12.84

Stent area = 7.05

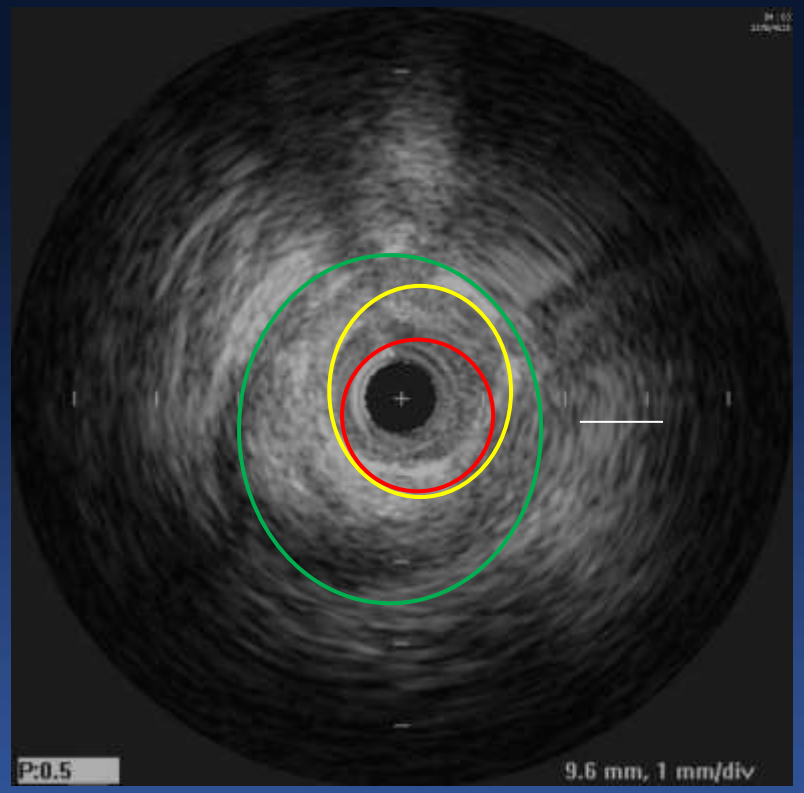
MLA = 2.79

IH = 60.4%

⇒ ISR d/t

Intimal hyperplasia

Stent under-expansion



EEM area = 11.94

Stent area = 4.35

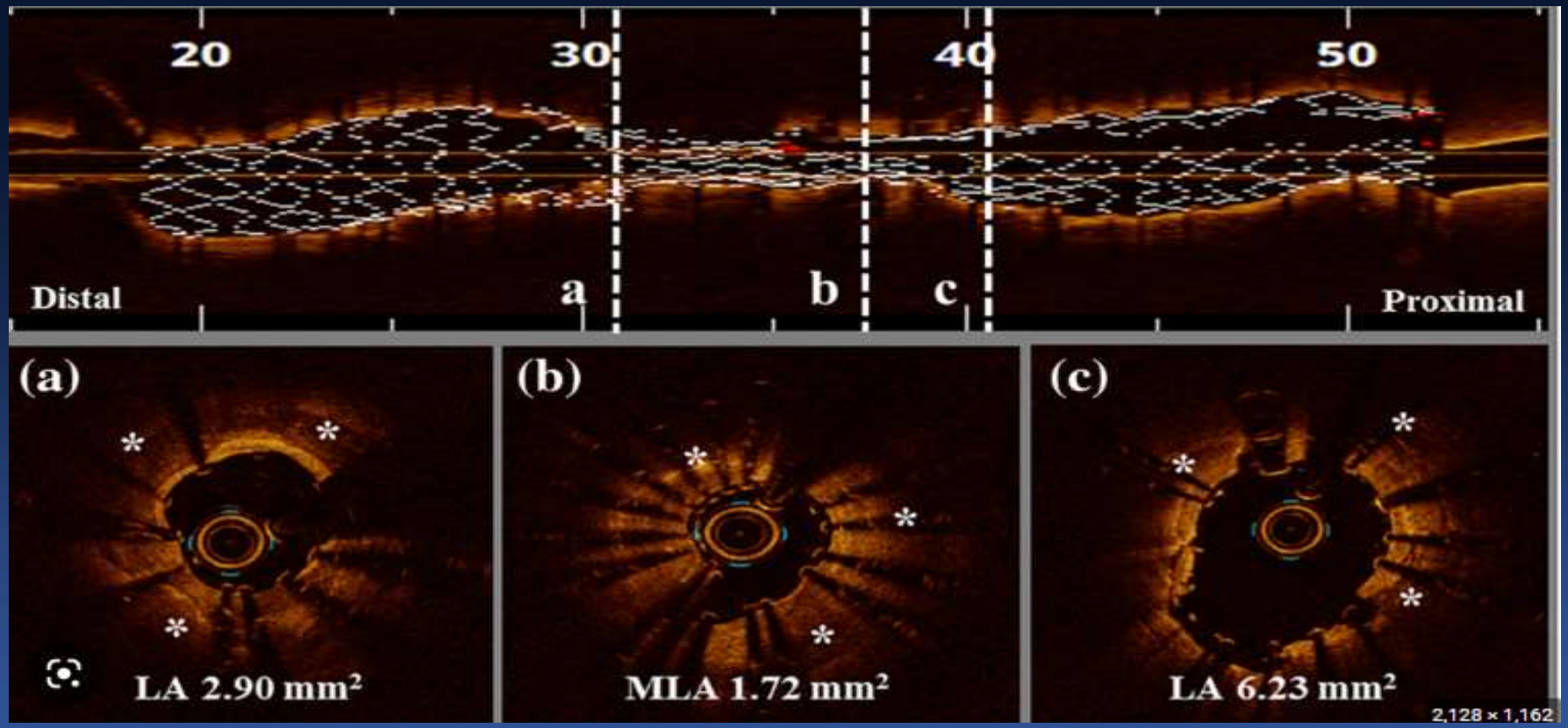
MLA = 2.56

IH = 41%

⇒ ISR d/t

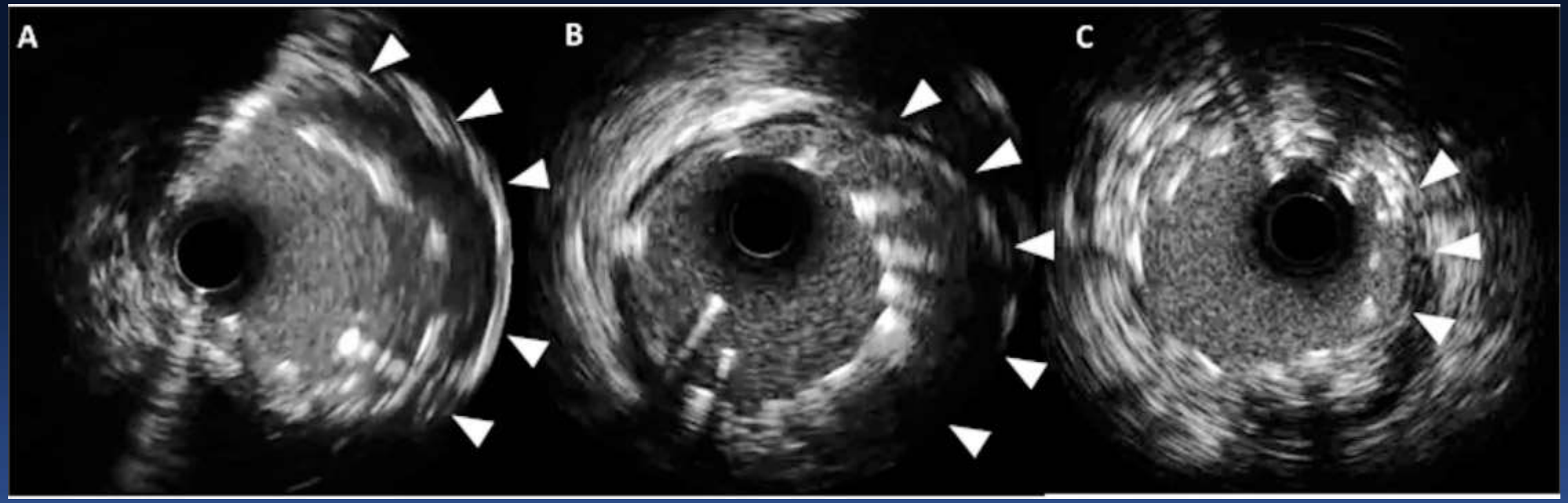
Stent under-expansion

Stent under-expansion



https://onlinelibrary.wiley.com/doi/full/10.1002/ccd.28641

Stent malaposition

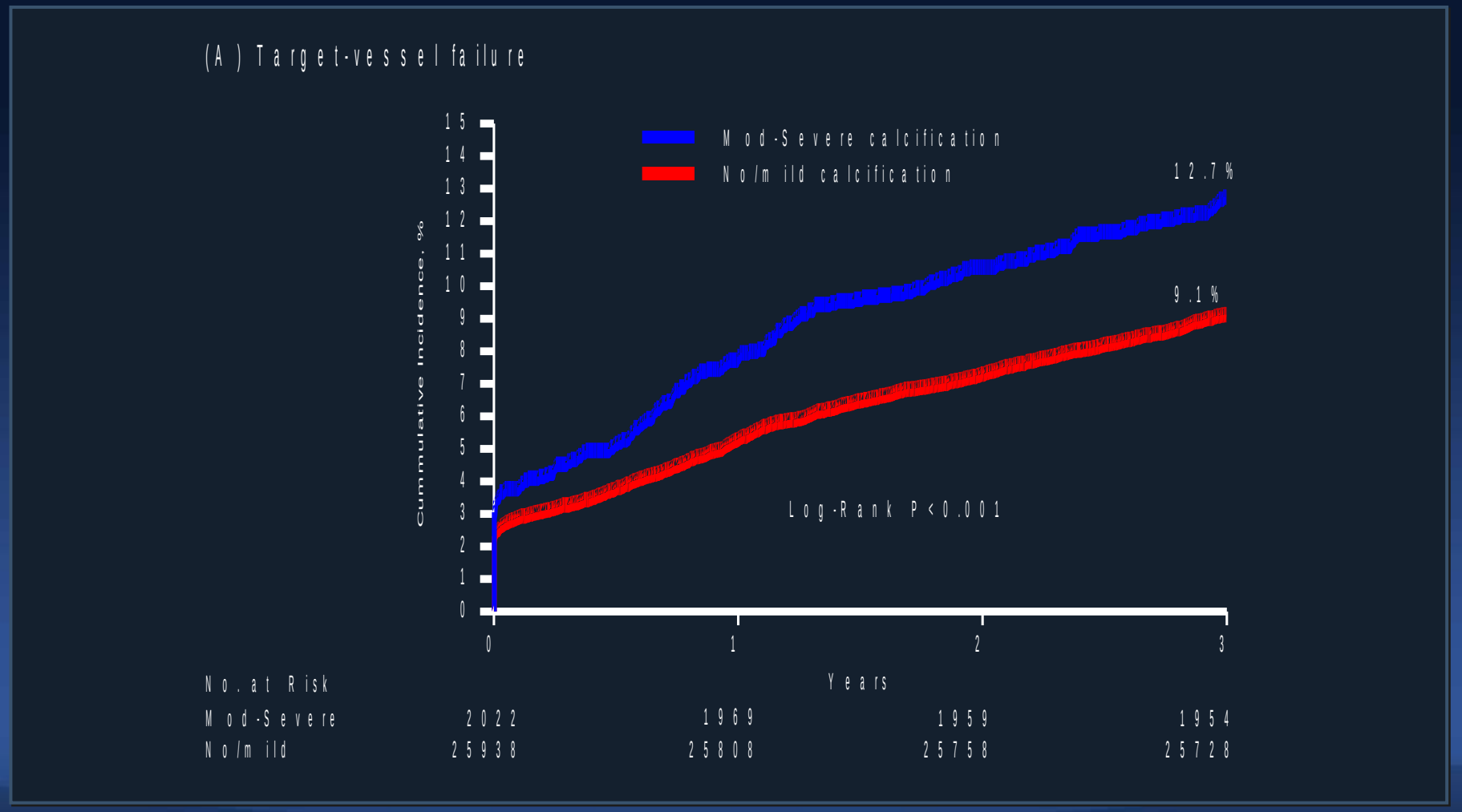


Plaque modification

Benefits of Plaque Modification

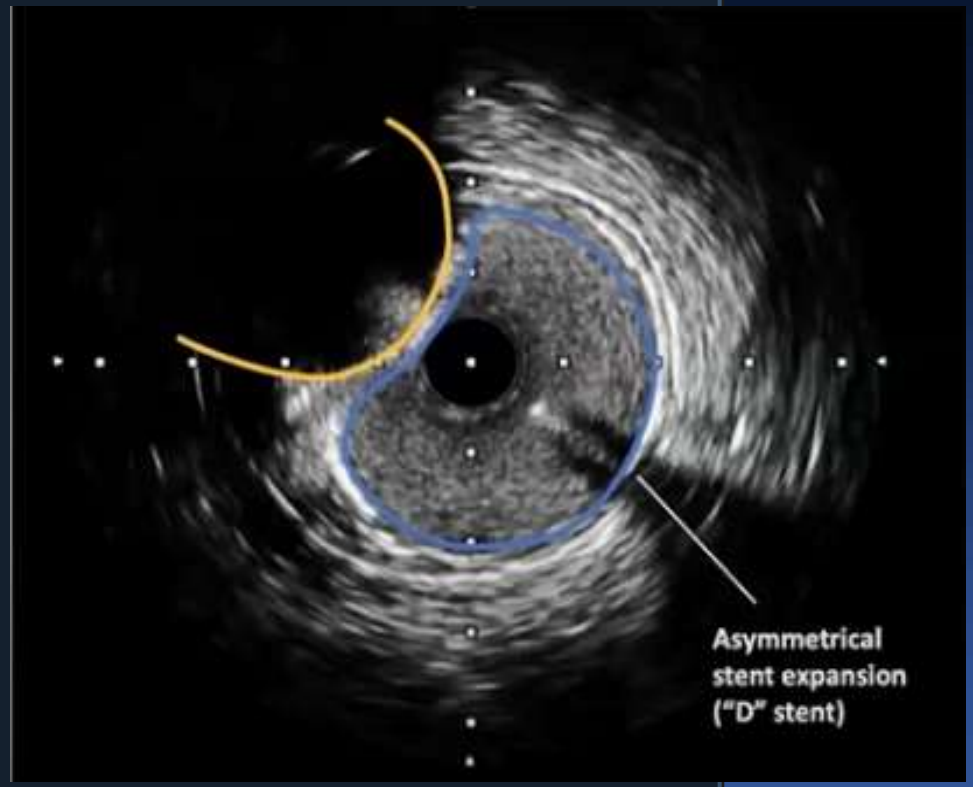
- Changes compliance in resistant lesions
- Helps minimize vessel trauma
- Reduces plaque burden and/or minimizes plaque shift

IRIS-DES, 3-year
Target-vessel failure (cardiac death, target vessel MI, ischemic driven TVR)



Calcification results in *Suboptimal Stent Results*

- ✓Impaired stent delivery
- ✓Decreased stent expansion
- ✓Malapposition
- ✓Stent asymmetry
- ✓Complications: dissection, perforations



IPSP

Imaging Guided PSP

Under the Intracoronary Imaging Guidance

Inspection of lesion characteristic by IVUS	**Selection of stent size and length by IVUS**	**Surveillance of stent outcomes**
Calcification Plaque burden and configuration Opening of side branch	Stent landing zone configuration Lesion length Reference vessel size	Stent apposition Stent area Procedural complications
P Pre-dilation	**S** Stent Sizing	**P** Post-dilation
Lesion pre-modification for stent delivery and expansion: High pressure balloon Cutting or scoring balloon Rota-ablation	Full lesion coverage Adequate stent size	Complete stent apposition Sufficient stent area No geographic miss No procedural complications

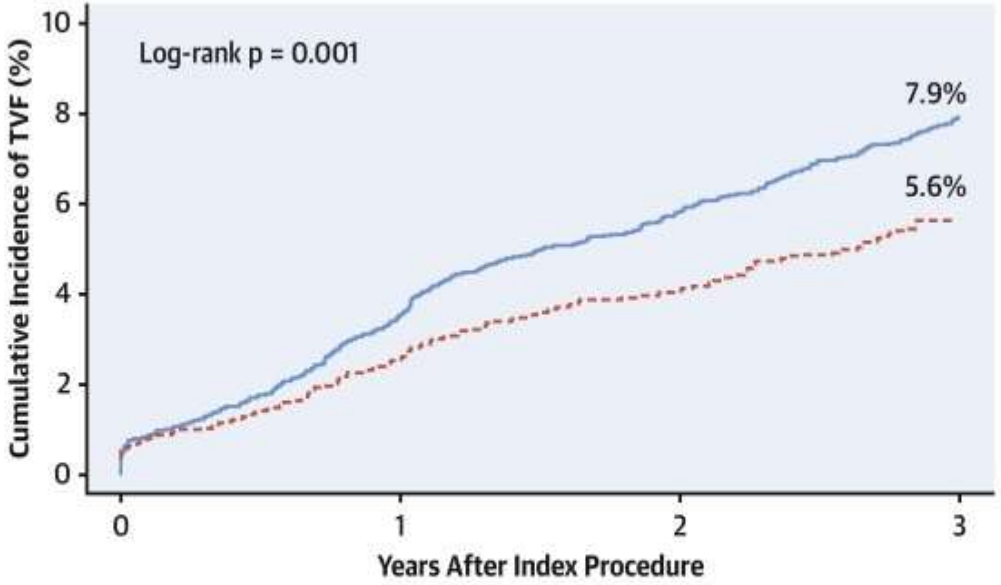
IPSP

Subgroup	No iPSP	iPSP	Hazard ratio (95% CI)	p value for interaction
	no. of patients with event/total no. (%)			
Overall	399/6151 (6.5)	156/3374 (4.6)	0.72 (0.60-0.86)	
Age				0.06
Age < 65	150/2984 (5.0)	80/1806 (4.4)	0.89 (0.68-1.17)	
Age ≥ 65	249/3167 (7.9)	76/1568 (4.9)	0.62 (0.48-0.80)	
Diabetes				0.46
No	225/4084 (5.5)	85/2278 (3.7)	0.68 (0.53-0.87)	
Yes	174/2067 (8.4)	71/1096 (6.5)	0.78 (0.59-1.03)	
Chronic Kidney Disease				0.38
No	350/5891 (5.9)	140/3245 (4.3)	0.74 (0.60-0.89)	
Yes	49/260 (18.9)	16/129 (12.4)	0.57 (0.32–0.99)	
Ejection Fraction				0.16
≤ 40%	66/504 (13.1)	10/8153 (6.5)	0.47 (0.24-0.92)	
> 40%	333/5647 (5.9)	146/3221 (4.5)	0.78 (0.64-0.95)	
Involvement of LMCA				0.89
No	373/5890 (6.3)	142/3181 (4.5)	0.71 (0.58-0.86)	
Yes	26/261 (10.0)	14/193 (7.3)	0.73 (0.38-1.41)	
Diffuse lesion				0.94
No	195/2932 (7.8)	66/1451 (5.5)	0.72 (0.54-0.95)	
Yes	204/3219 (8.1)	90/1923 (5.9)	0.71 (0.55-0.91)	
Bifurcation lesion				0.51
No	157/2689 (7.5)	49/1009 (5.9)	0.78 (0.57-1.08)	
Yes	242/3462 (8.3)	107/2365 (5.7)	0.69 (0.55-0.86)	
Severely calcified lesion				0.69
No	345/5576 (7.6)	142/3189 (5.5)	0.73 (0.60-0.88)	
Yes	54/575 (11.7)	14/185 (10.0)	0.82 (0.45-1.47)	
Multi-vessel disease				0.73
No	209/3862 (6.7)	89/2216 (5.0)	0.75 (0.58-0.96)	
Yes	190/2289 (10.3)	67/1158 (7.1)	0.70 (0.53-0.92)	
STEMI at index procedure				0.04
No	320/5198 (6.2)	148/3109 (4.8)	0.78 (0.64-0.95)	
Yes	79/953 (8.3)	8/265 (3.0)	0.36 (0.17–0.74)	

0.1 1 10

iPSP Better No iPSP Better

Primary Outcome: A Composite of Cardiac Death, Target-Vessel MI, or Target Vessel Revascularization



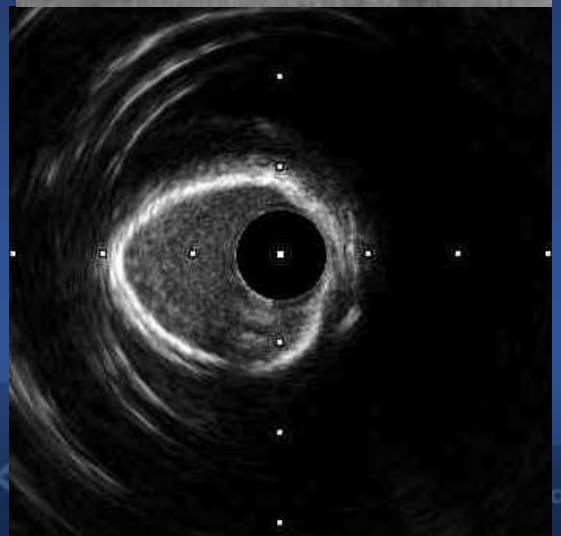
No. at risk:				
No iPSP	6,151	5,019	4,095	3,448
iPSP	3,374	2,796	2,221	1,966

Park, H. et al. J Am Coll Cardiol Intv. 2020;13(12):1403-13.

UNIVERSITY OF ULSAN COLLEGE MEDICINE
ASAN Medical Center

Image Guided

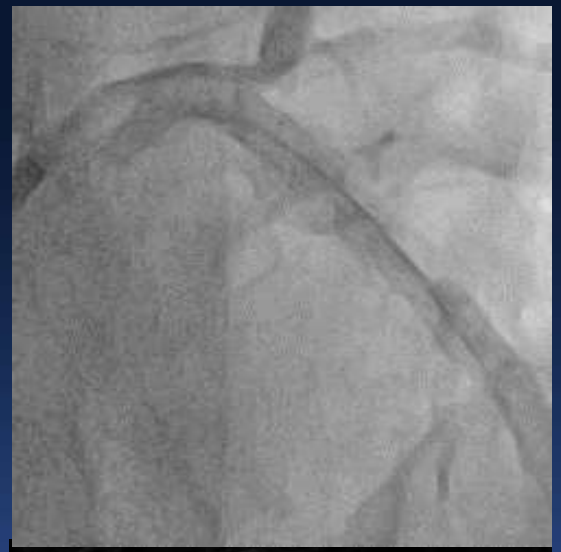
P

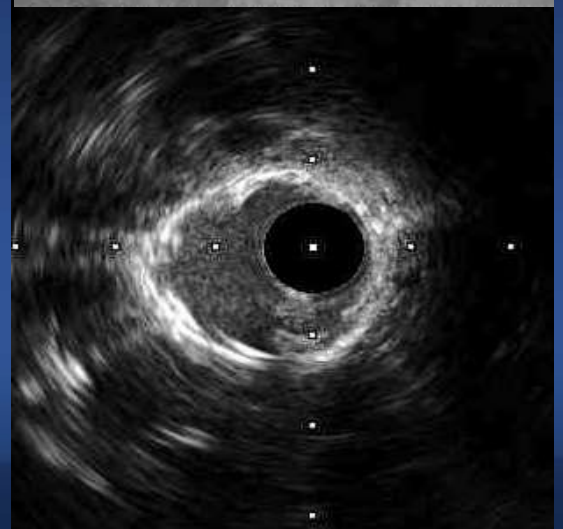


Cutting Ba

3.0/10

S

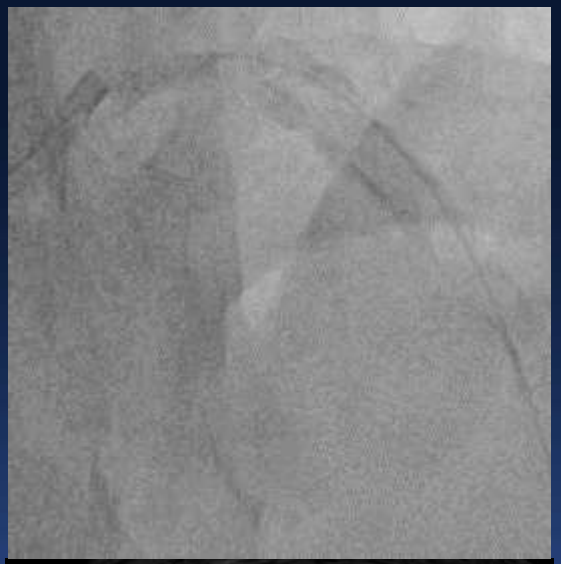


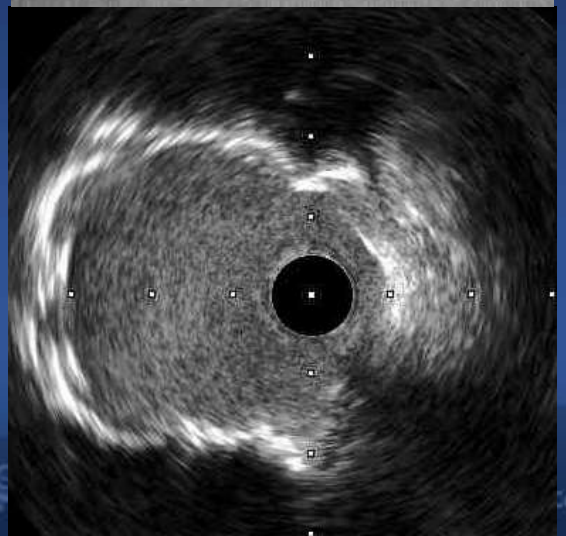


NC Ba

4.0/10

P



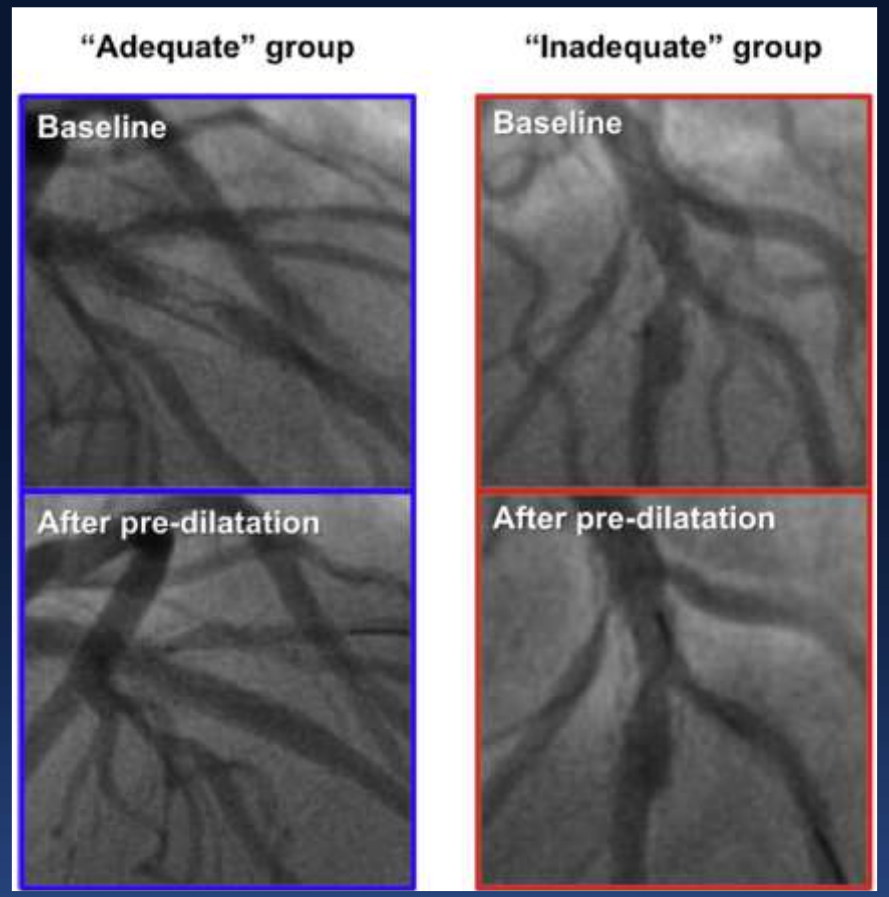


ISR TREATMENT

Am J Cardiol 2016;118:1460e1465

Impact of Angiographic Result After Predilatation on Outcome After Drug-Coated Balloon Treatment of In-Stent Coronary Restenosis

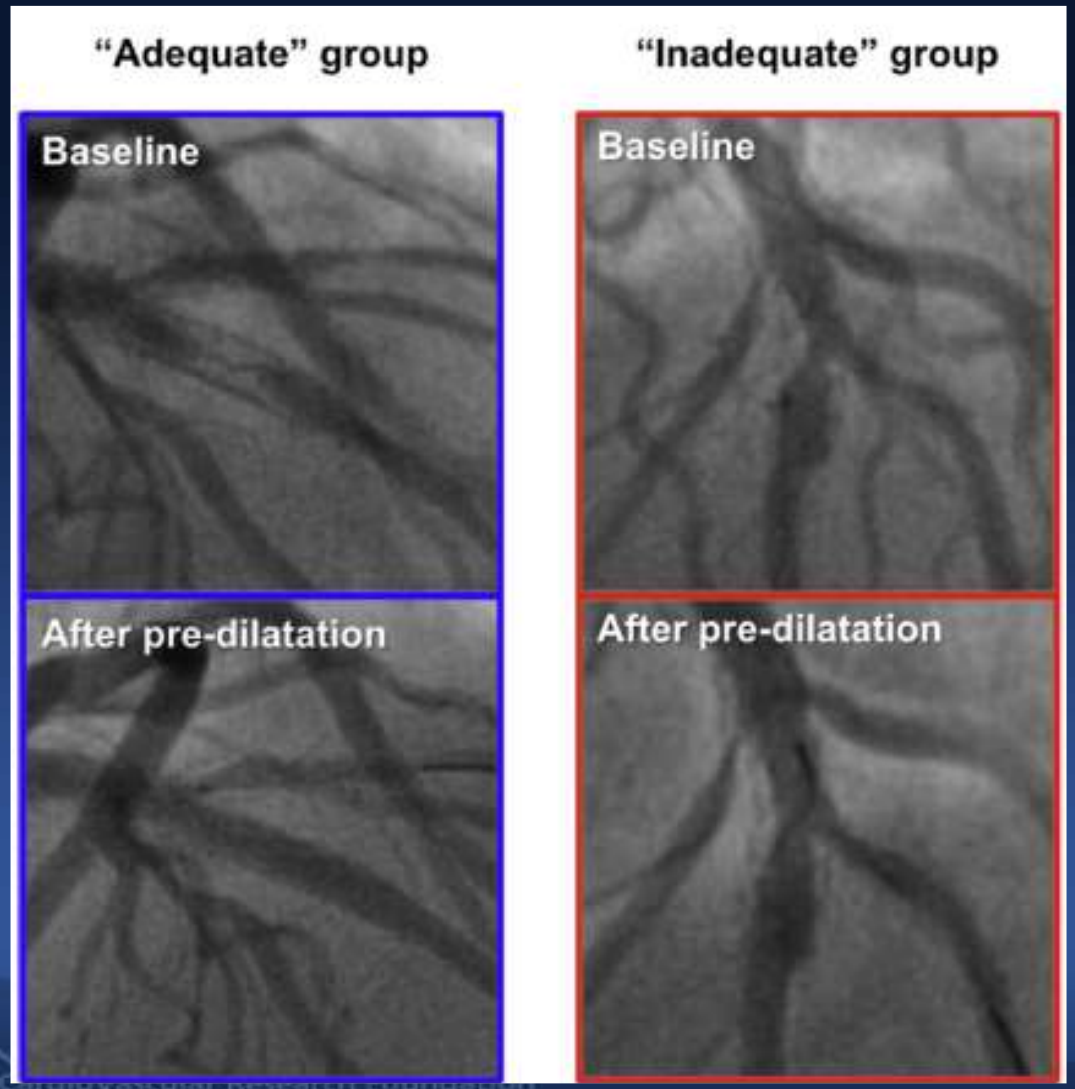
Akihito Tanaka, MD[a,b], Azeem Latib, MD[a,b], Richard J. Jabbour, MD[a,b,c], Hiroyoshi Kawamoto, MD[a,b], Francesco Giannini, MD[b], Marco Ancona, MD[b], Damiano Regazzoli, MD[b], Antonio Mangieri, MD[b], Roberto Mattioli, MD[d], Alaide Chieffo, MD[b], Mauro Carlino, MD[b], Matteo Montorfano, MD[b], and Antonio Colombo, MD[a,b,*]

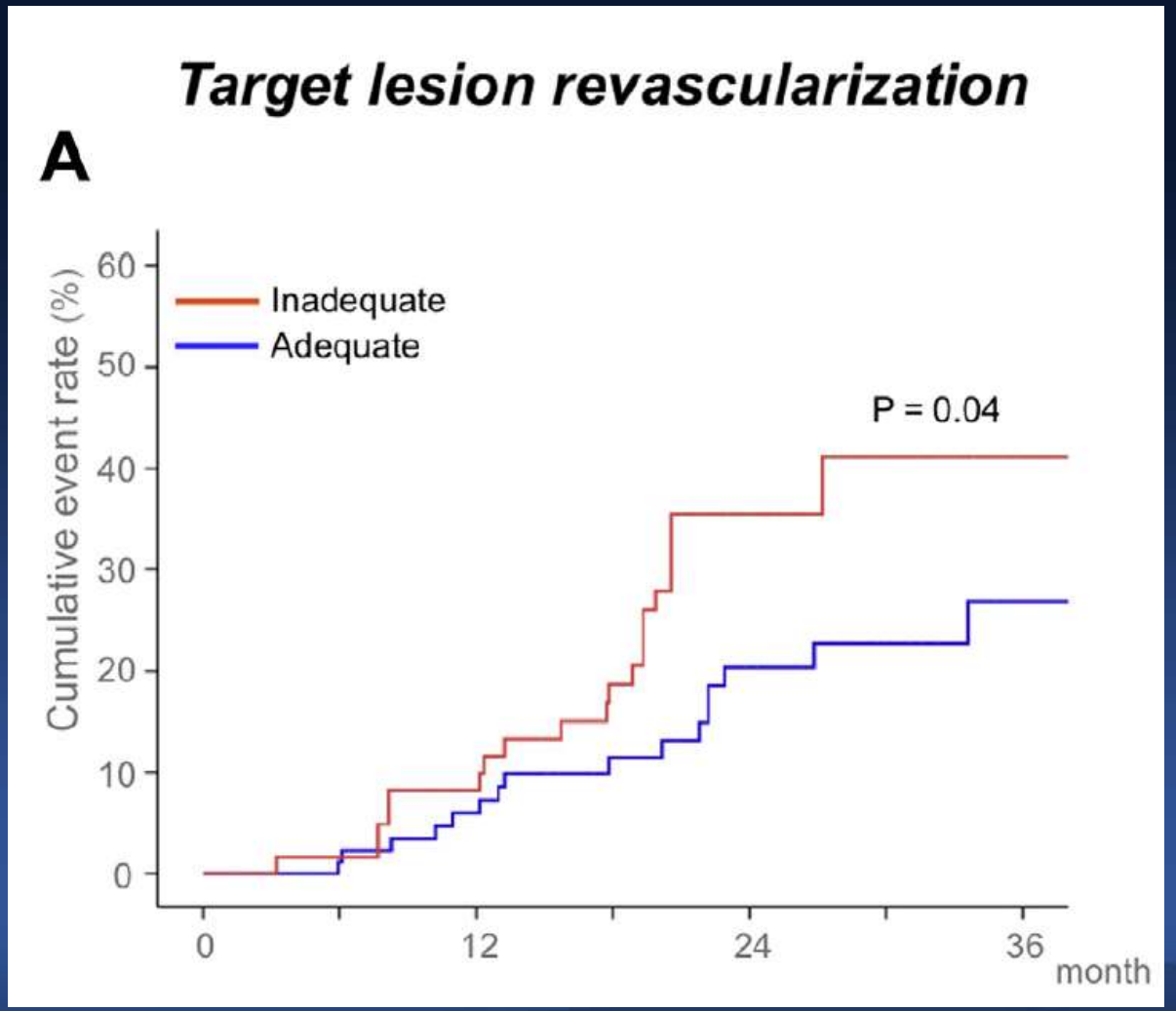


- Retrospective analysis of ISRs treated by DCB
- Classified as "Adequate" or "Inadequate" based on pre-dilation results:
- **"Adequate" (N=98):** TIMI 3, %DS ≤30%, NO major dissections
- **"Inadequate (N=68):** TIMI <3 or %DS >30% or major dissections

Lesson learned from DCB pre-dilatation in ISR

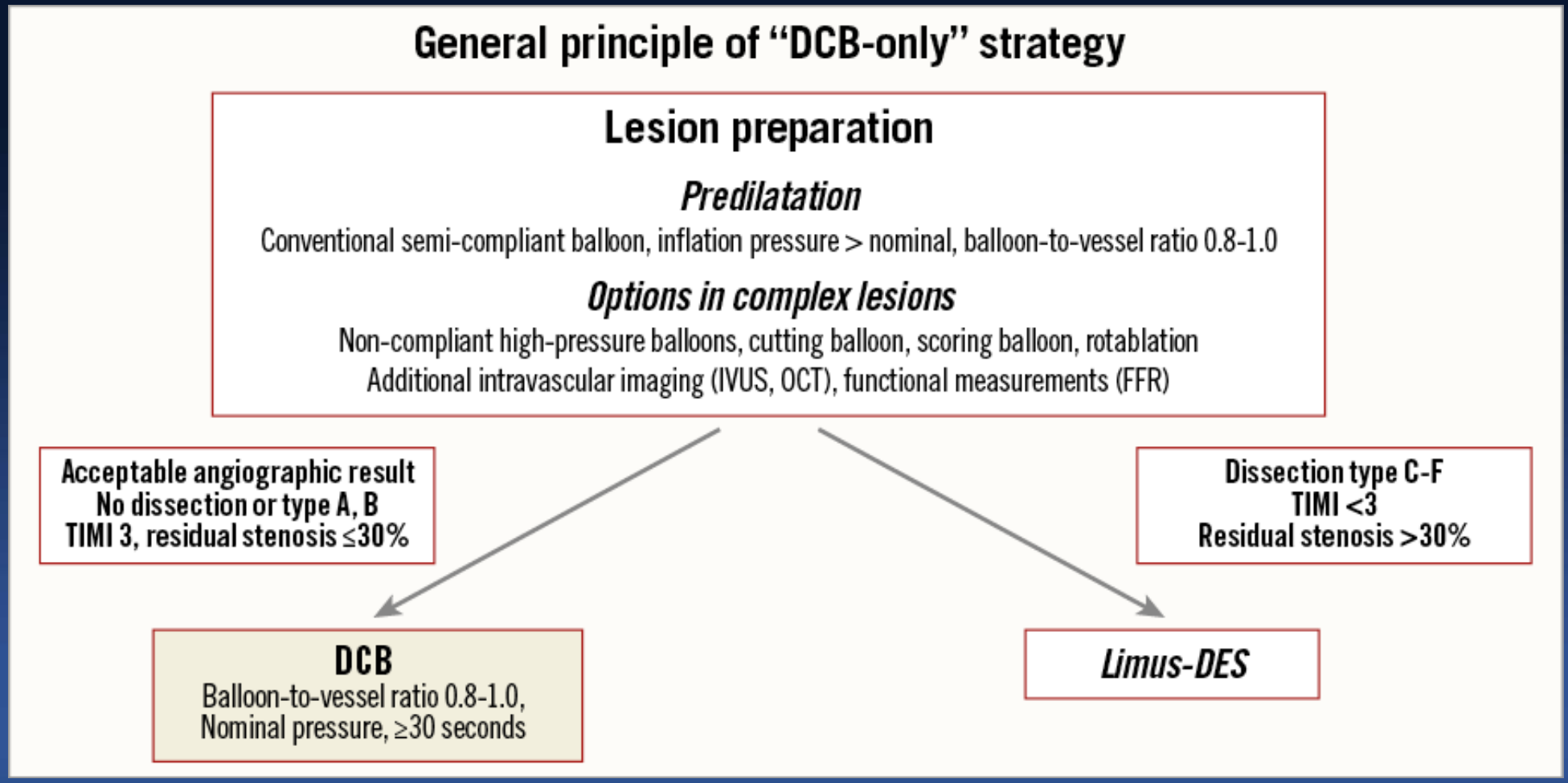
Suboptimal angiographic result of pre-dilation before DCB predicts TLR





Am J Cardiol. 2016 Aug 24. pii: S0002-9149(16)31366-2

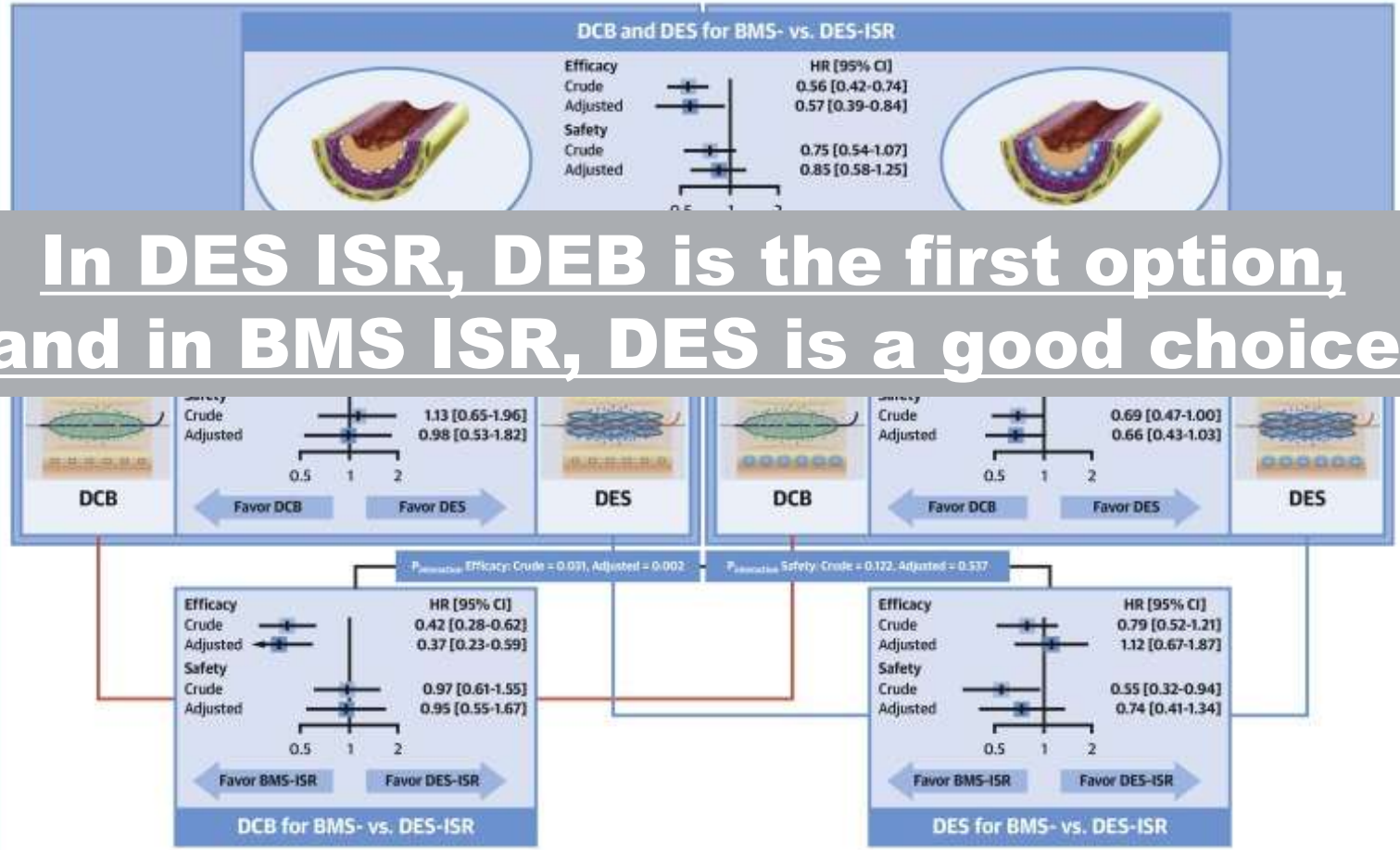
General Principle of DCB-only Strategy



Alfonso F., SchellerB. EuroIntervention2017;13:680-695

HOW TO TREAT ISR?

CENTRAL ILLUSTRATION: Efficacy and Safety of Drug-Coated Balloon Angioplasty and Drug-Eluting Stent Implantation According to In-Stent Restenosis Type



In DES ISR, DEB is the first option, and in BMS ISR, DES is a good choice.

Giacoppo, D. et al. J Am Coll Cardiol. 2020;75(21):2664-78.

CASE

Case Ⅰ : Patient information

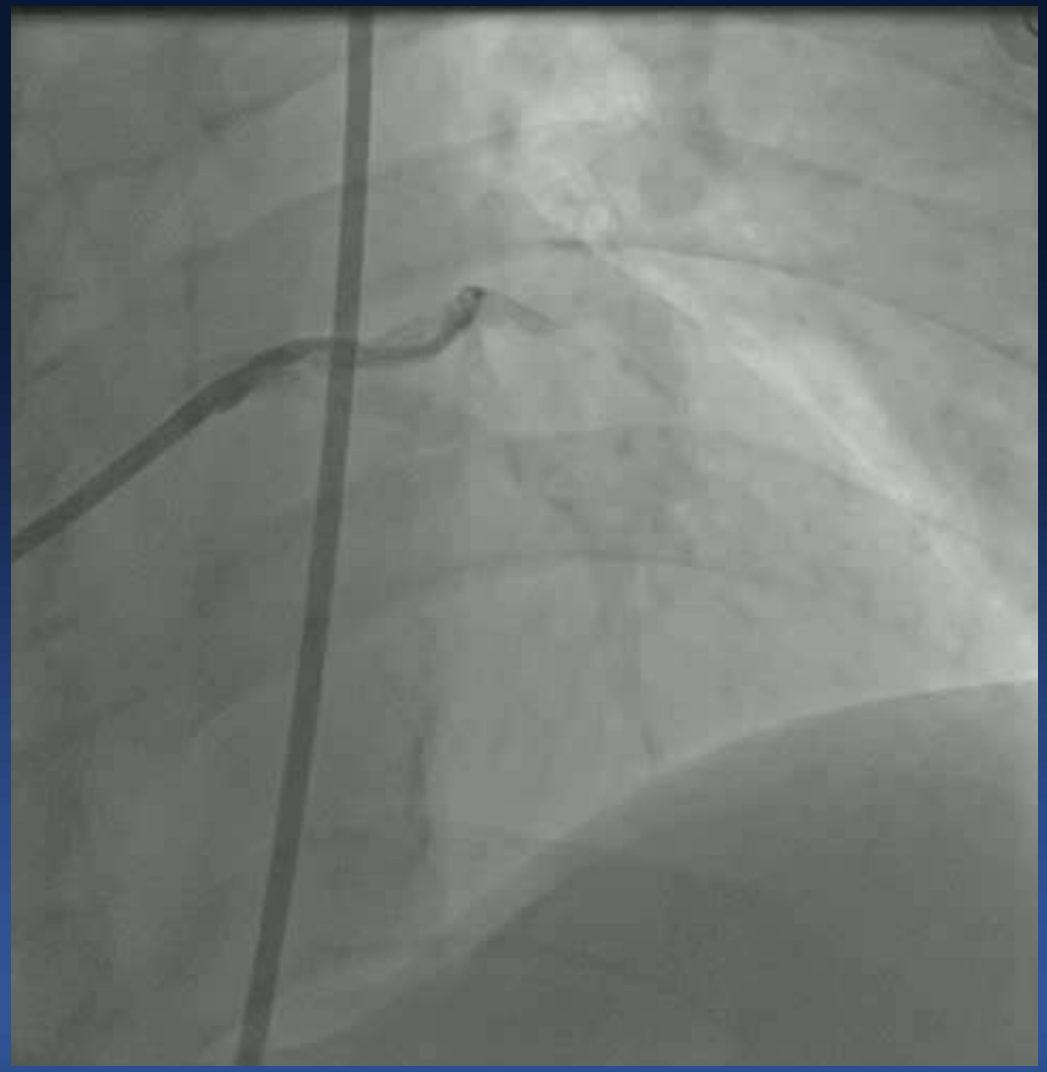
Brief Case Summary

A 67-year-old female with diabetes was admitted for effort chest pain and referred for abnormal results of coronary CT. Her CT at an external hospital demonstrated a severe stenosis at the mLAD and diffuse moderate stenosis at the 1st DI Ostium

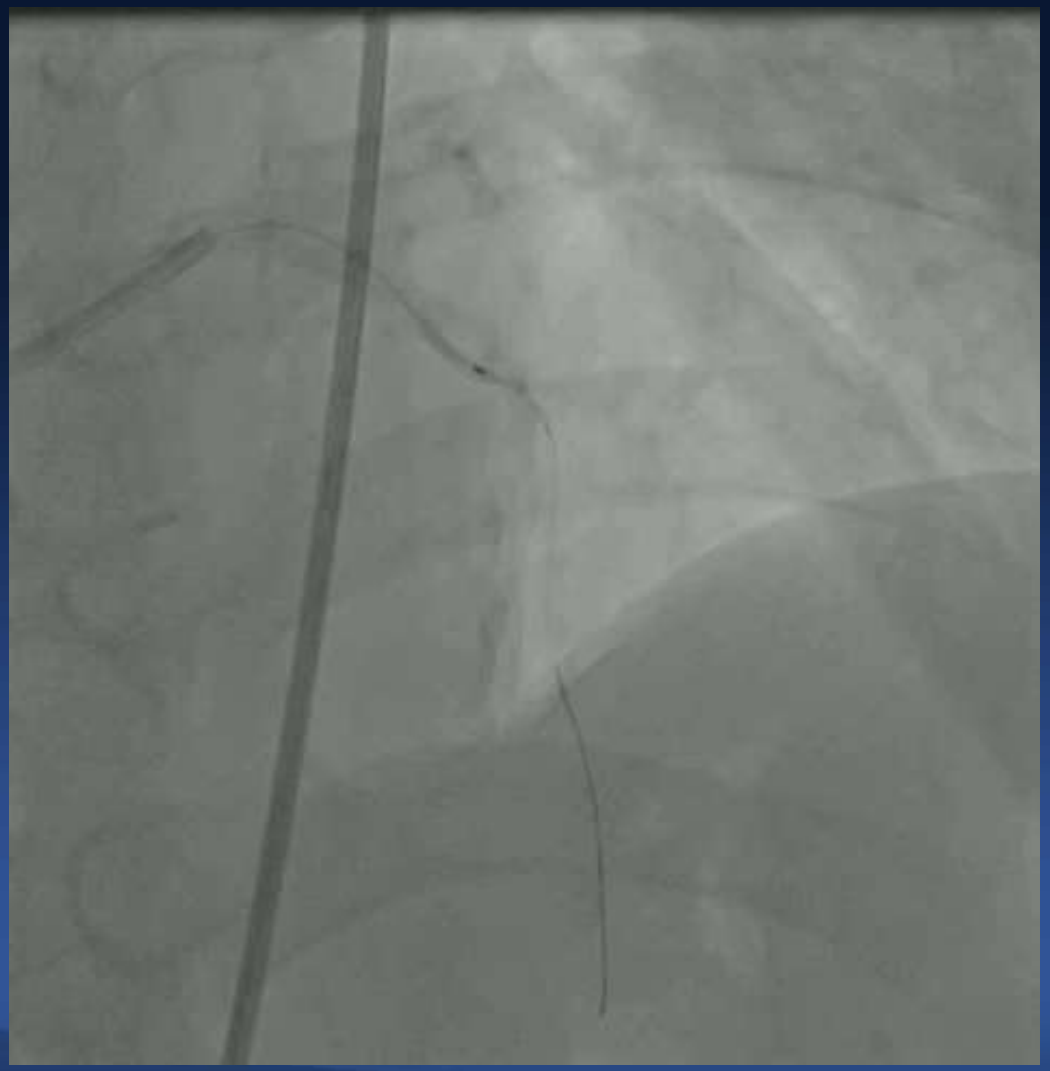
Past Medical History

- **Diabetes** : Y
- **Hypertension** : Y
- **Hyperlipidemia** : N
- **Smoking** : Y
- **Family History** : N
- **Age : 67**
- **Sex : Female**
- **Other: none**

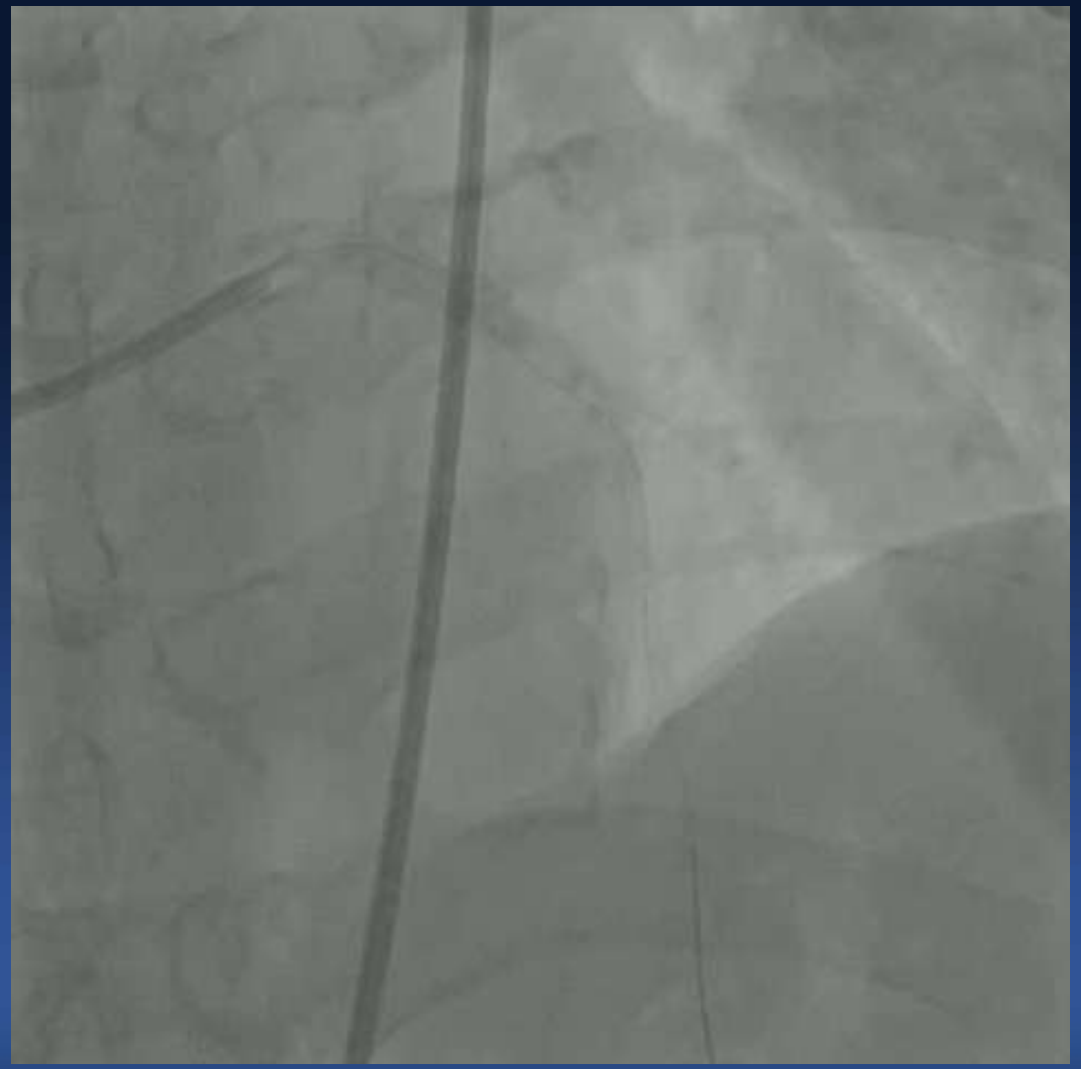
Other hospital Pre



Other hospital Pre dilation



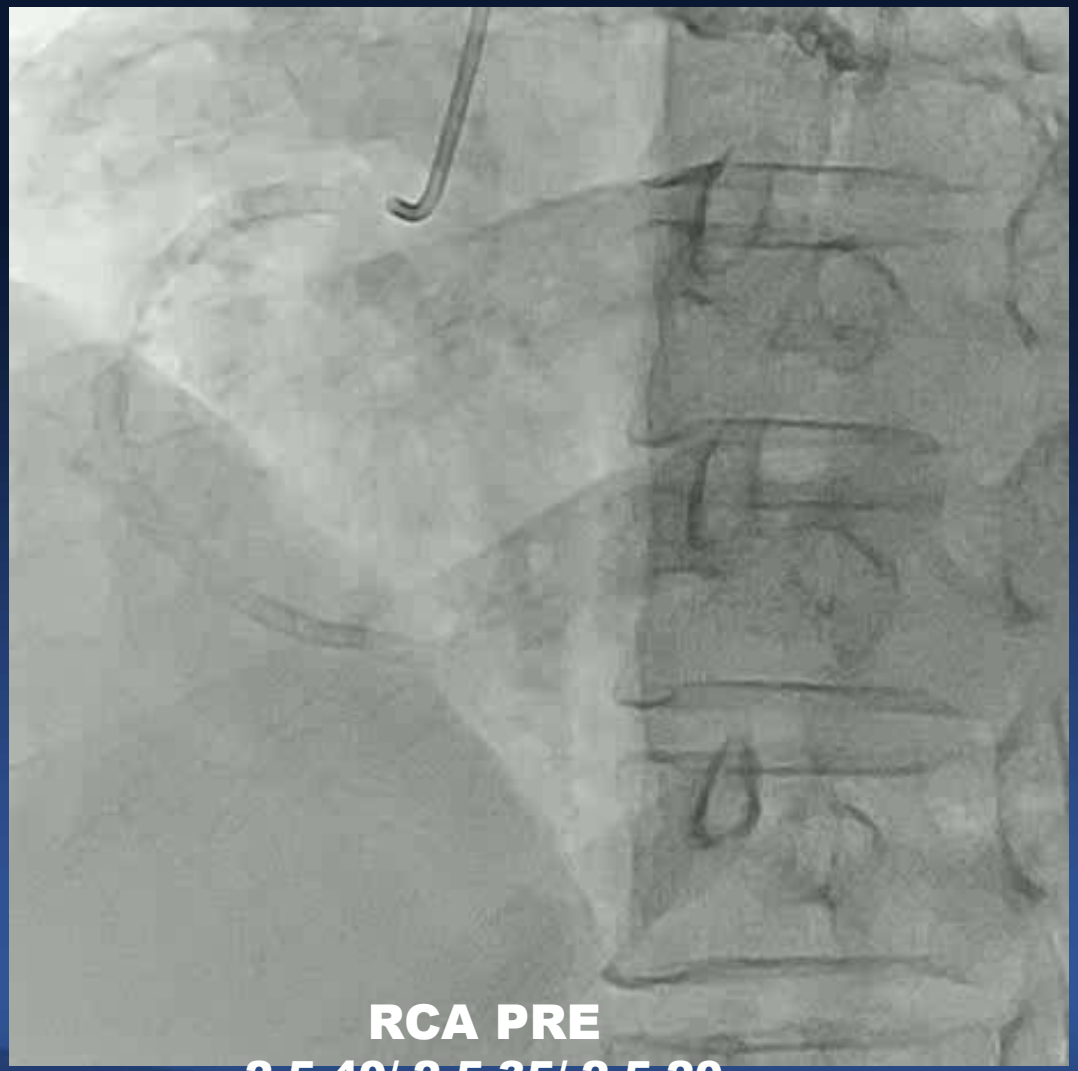
Other hospital Post Ba



Other hospital Stent

2.0/ 20

PRE

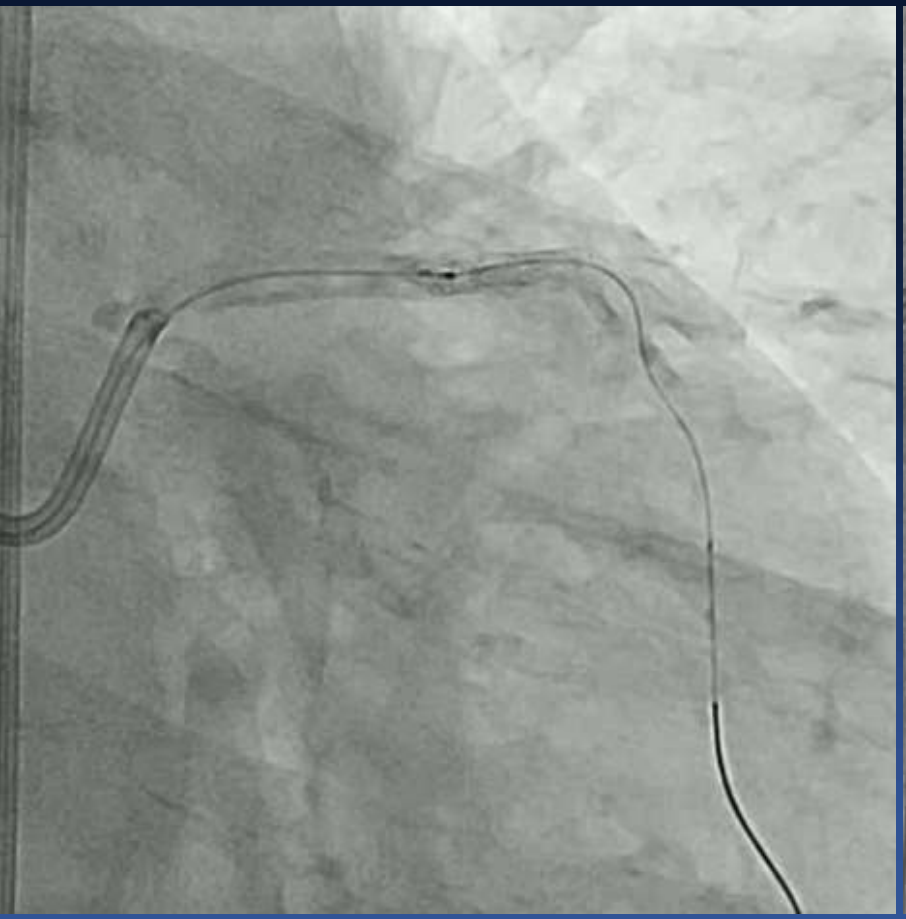


RCA PRE
2.5 40/ 2.5 35/ 2.5 20

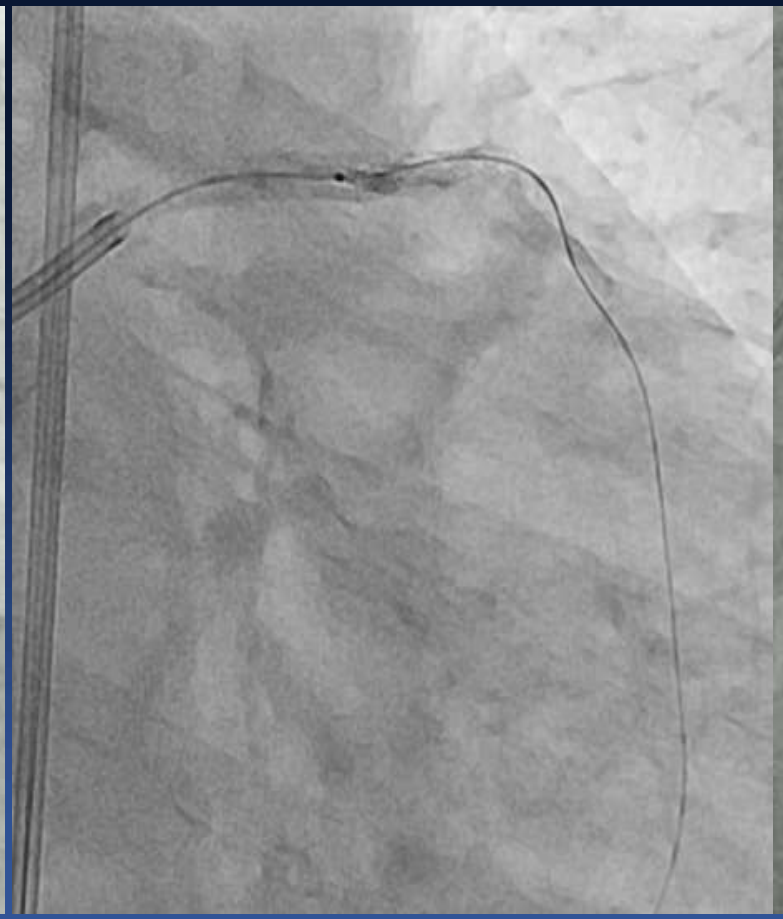
LCX PRE

LAD PRE

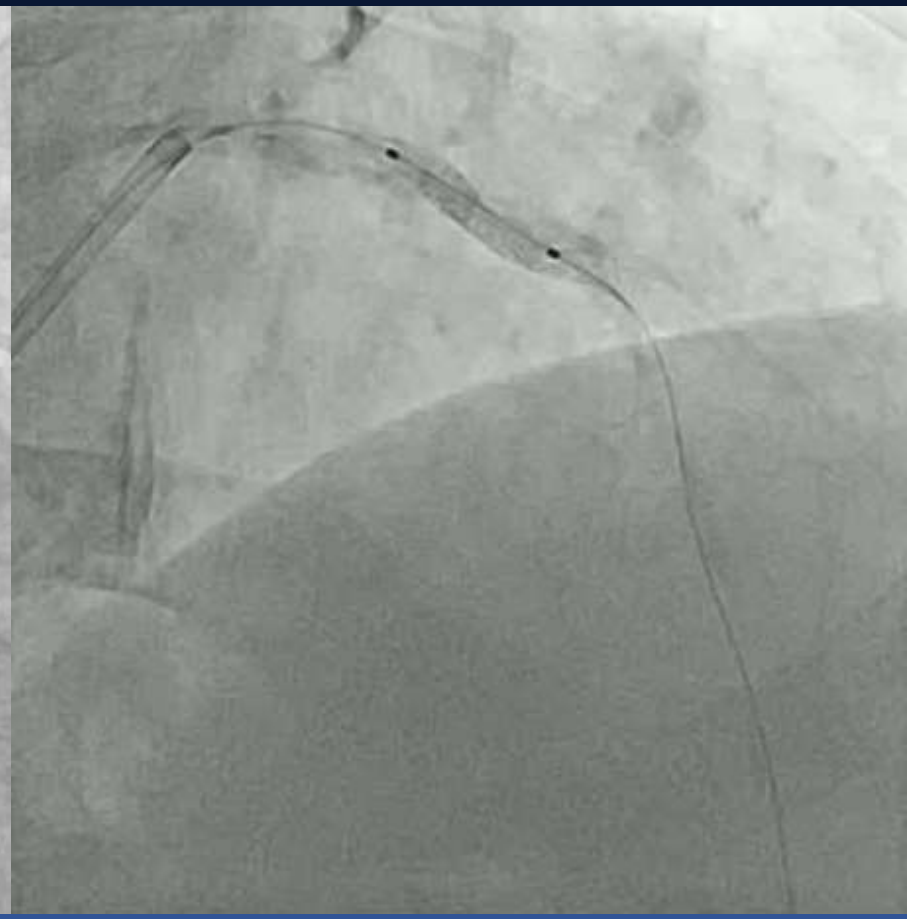
PRE BALLOON



1.0

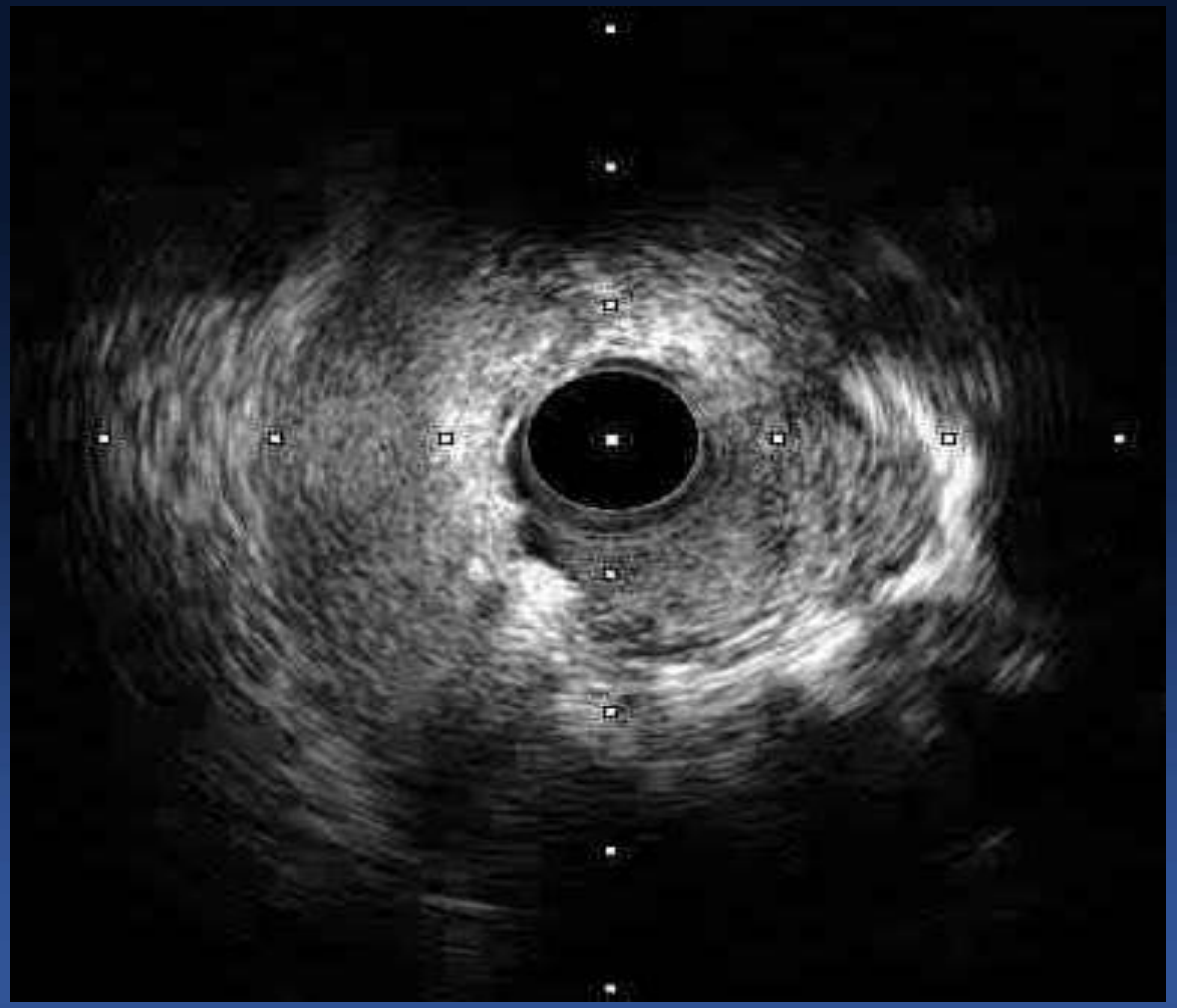


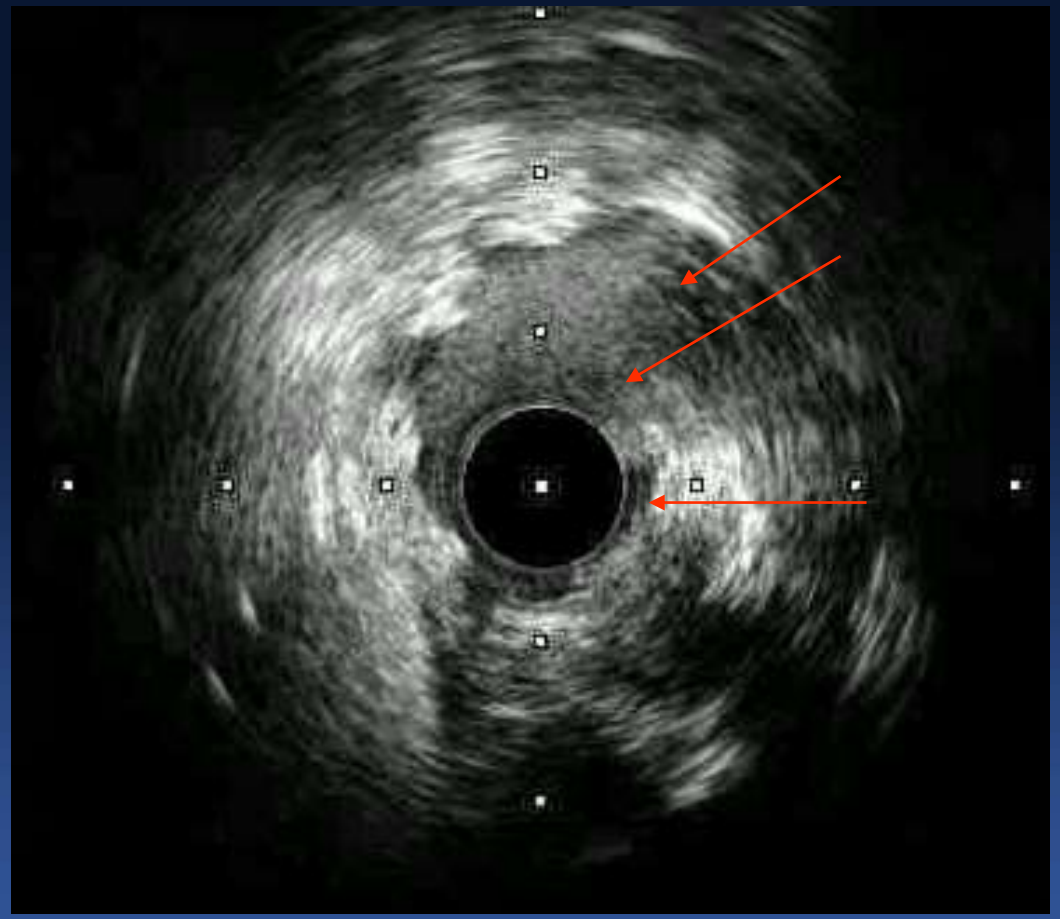
1.5



2.0

PRE BA

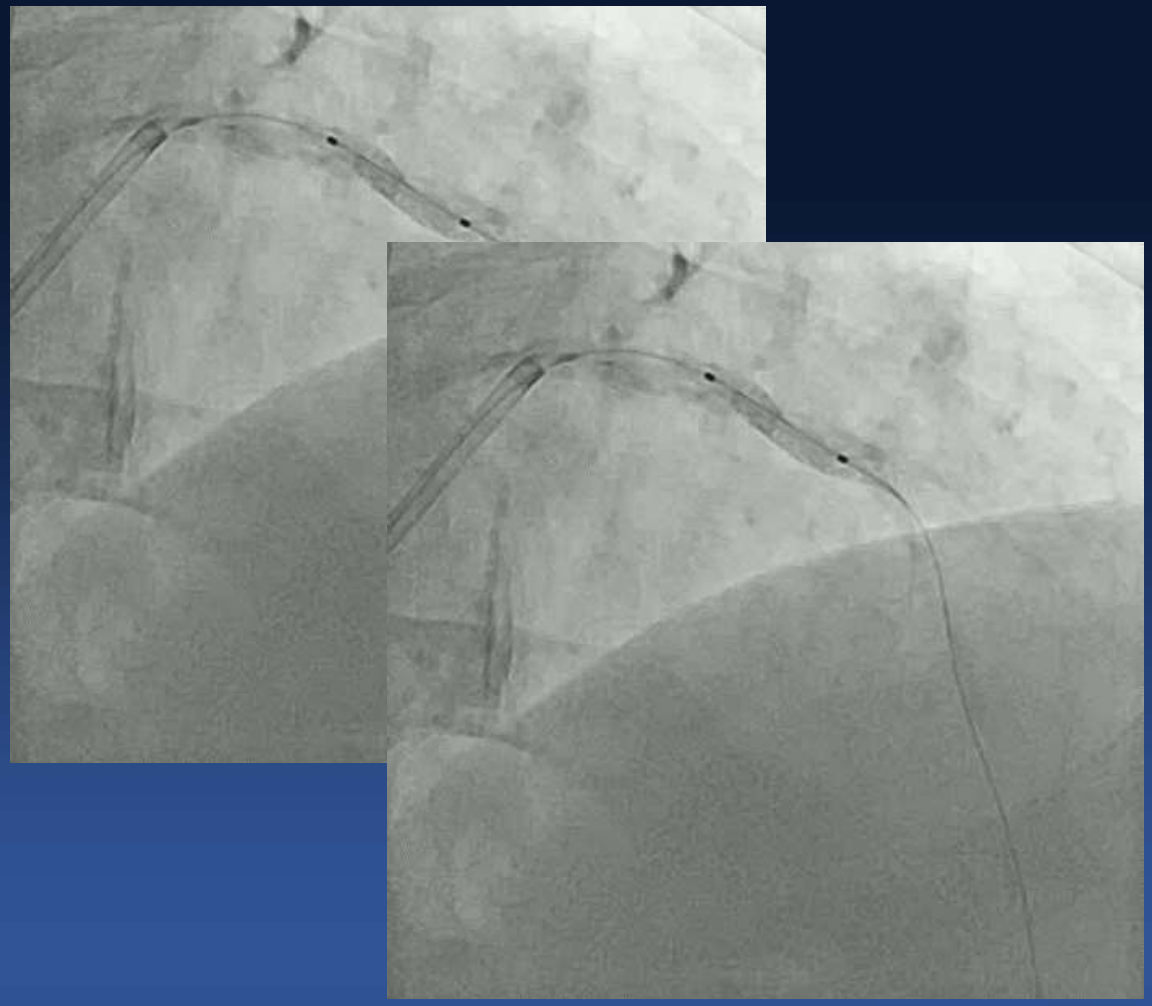




VESSEL SIZE= 3.72
STENT SIZE= 2.37

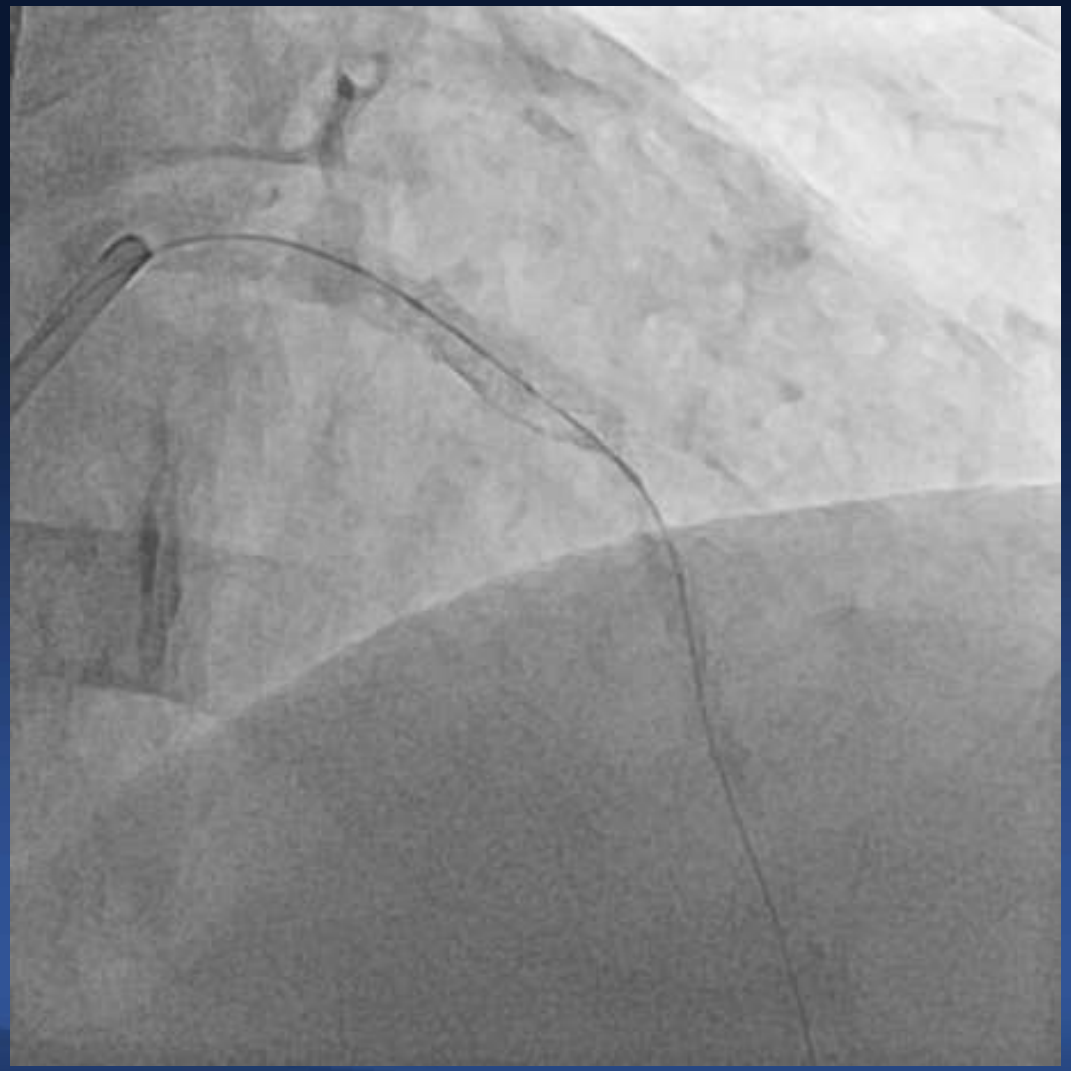
Several Times

2.75/15

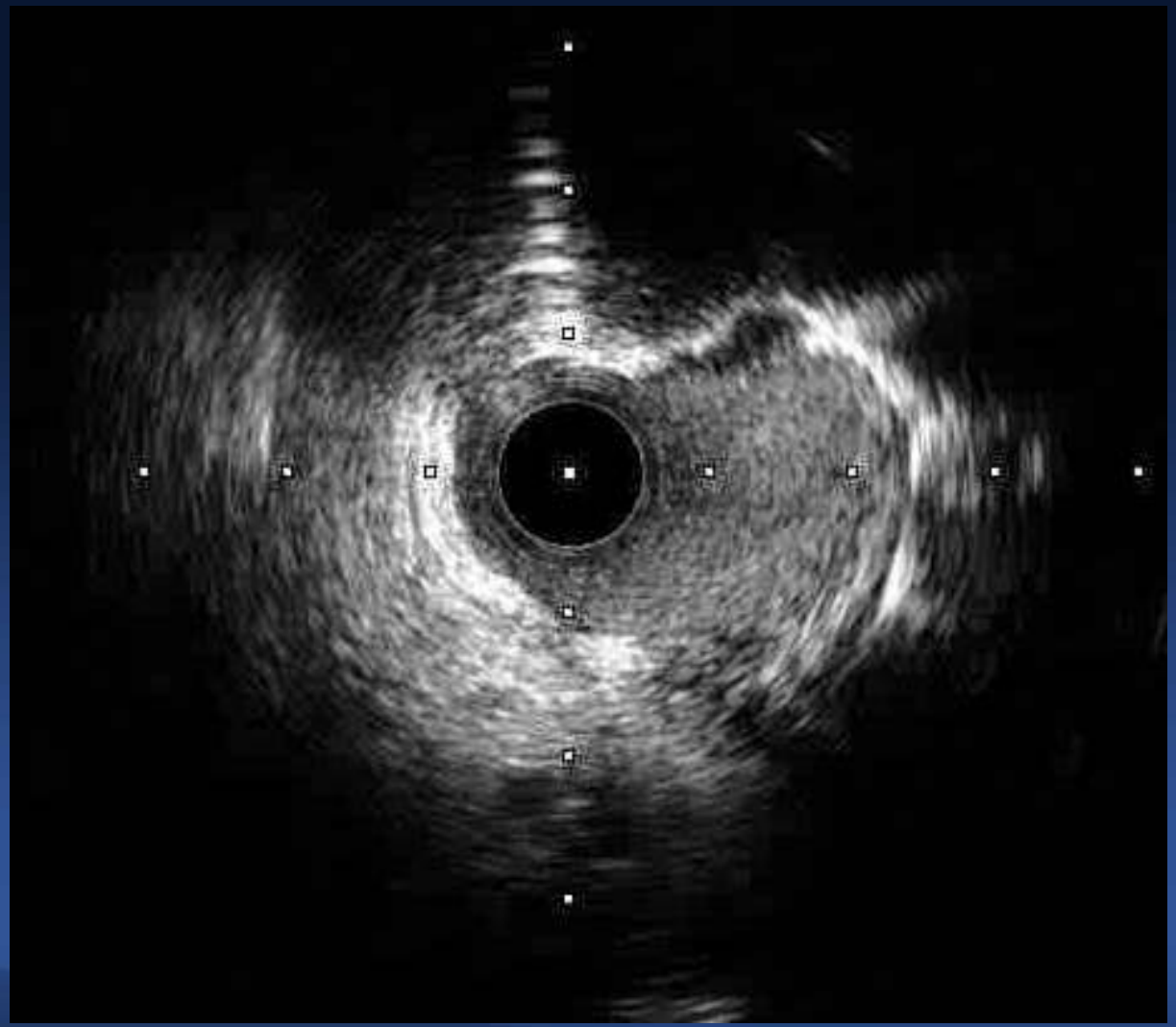


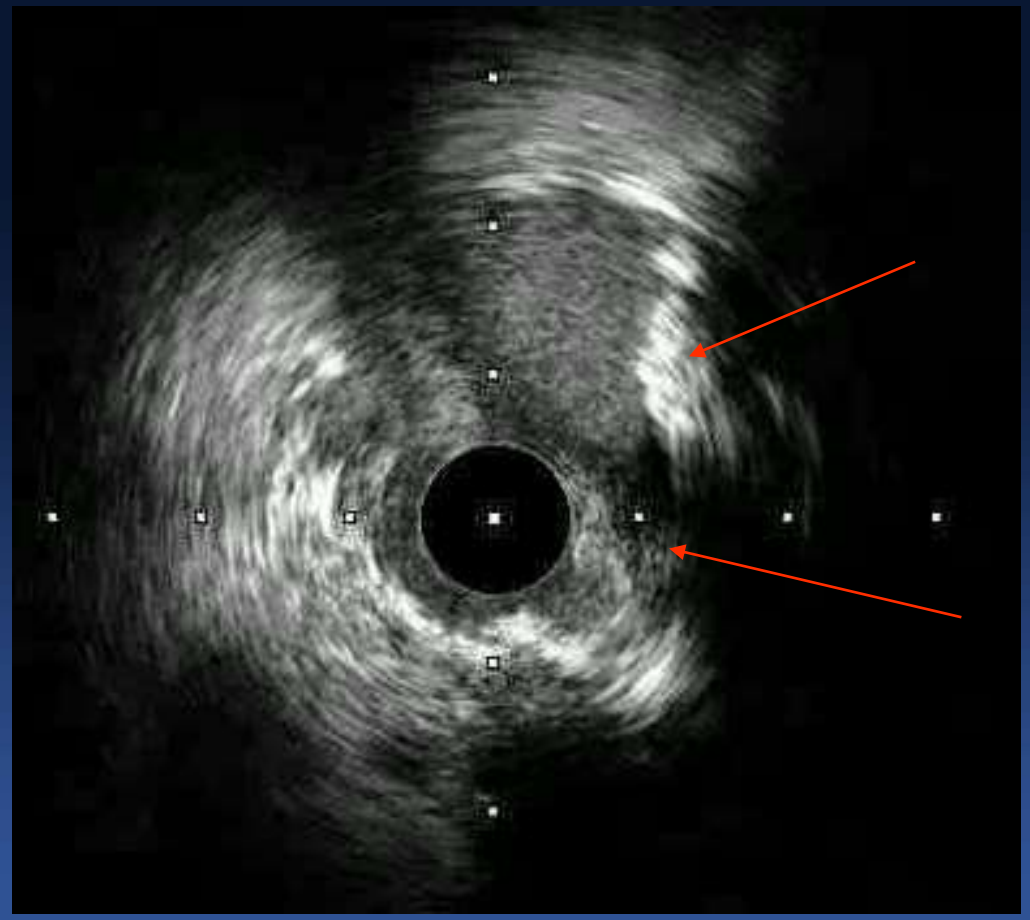
3.0/15

After ballon angio



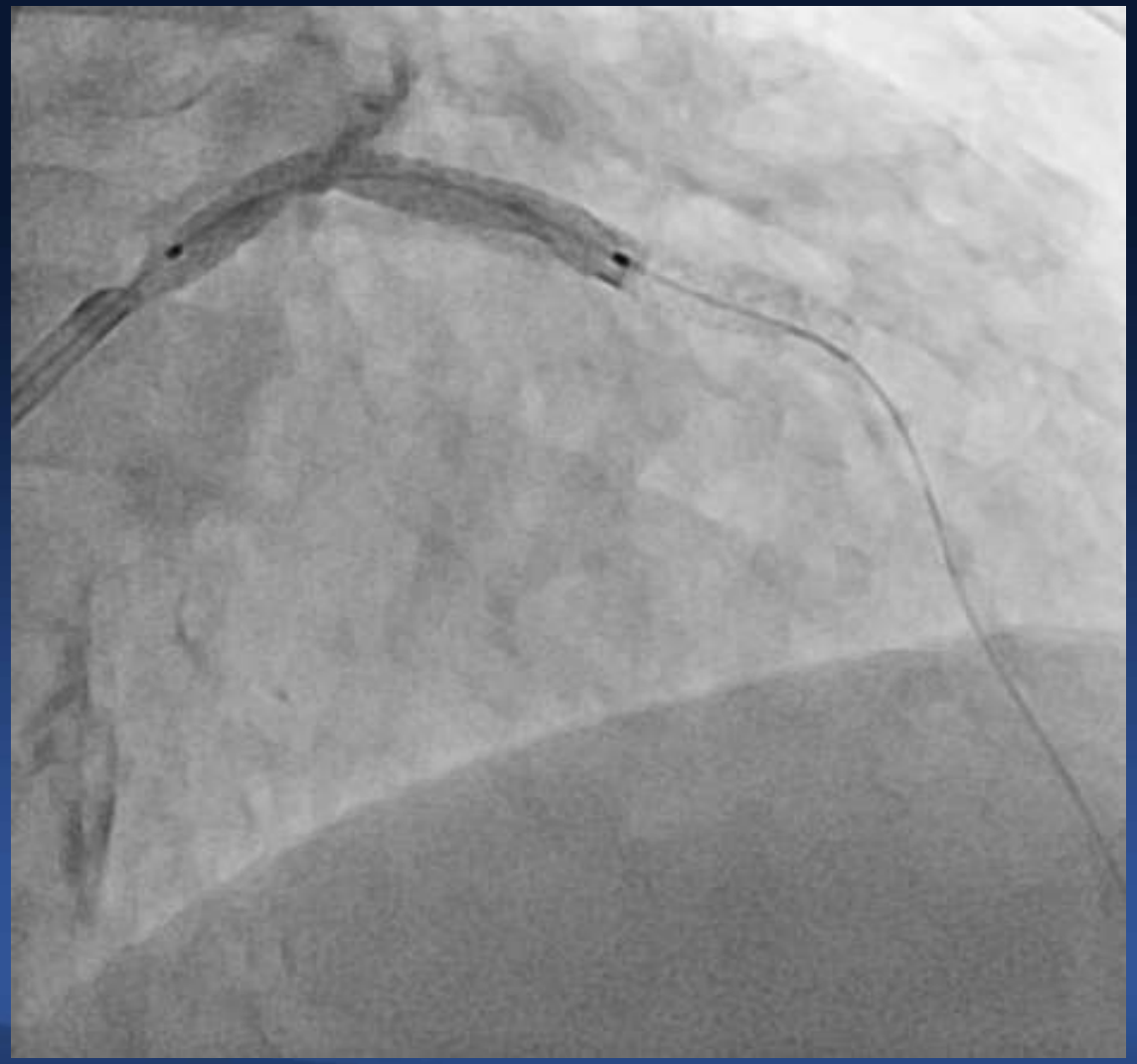
IVUS



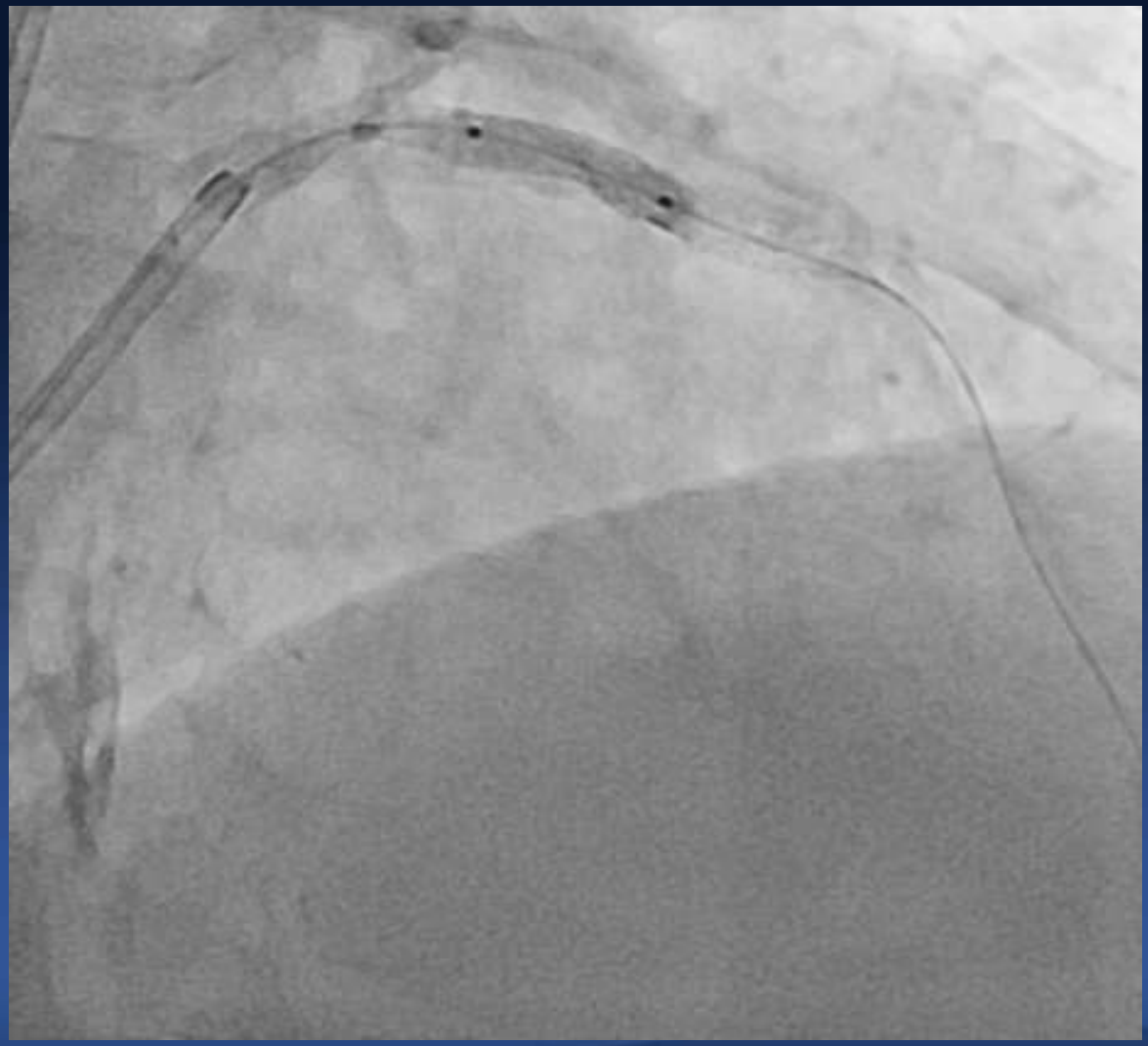


VESSEL SIZE= 3.72
STENT SIZE= 3.12

Proximal STENT



3.5/28

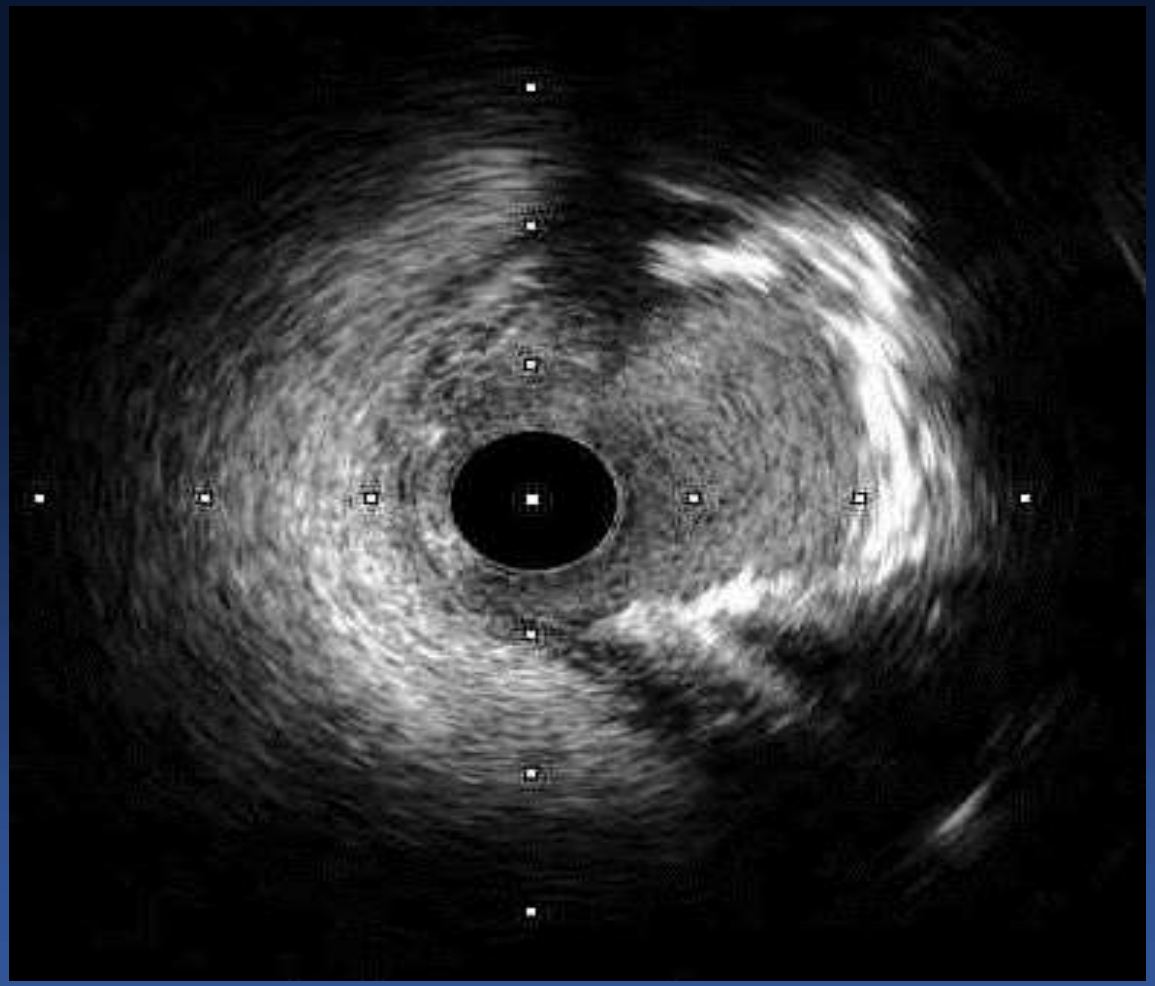


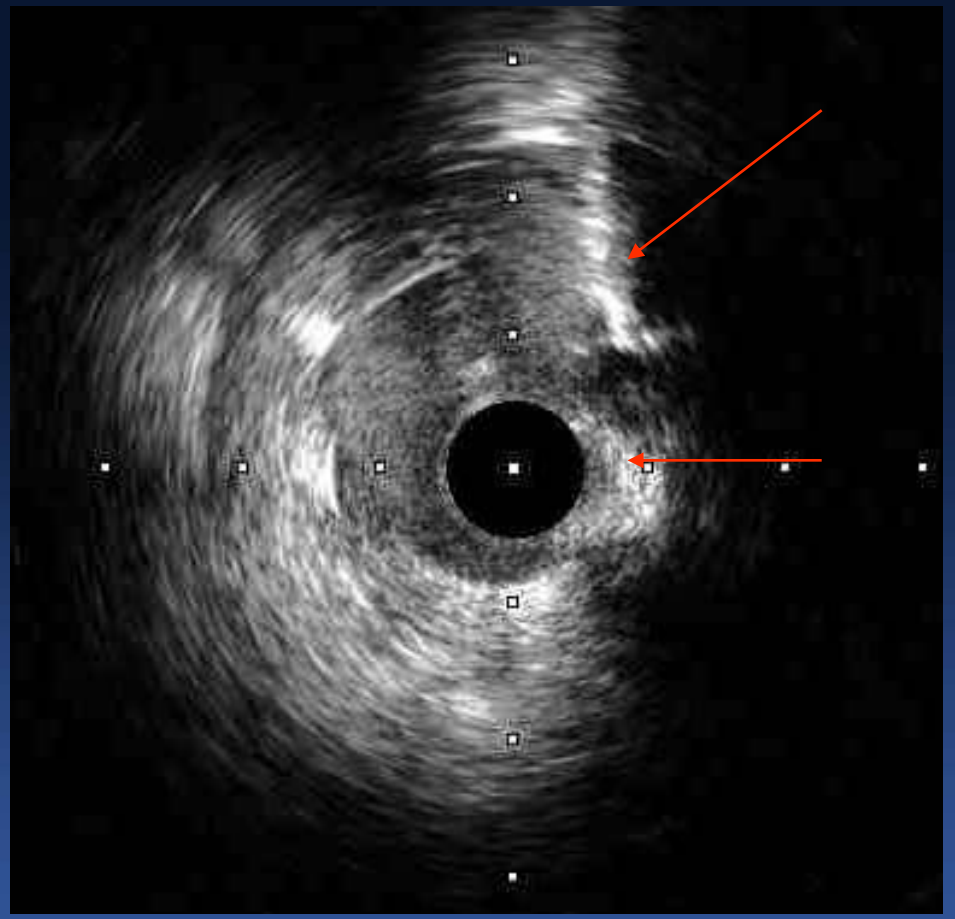
3.75/15

POST STENT

Final Angio

Final IVUS





VESSEL SIZE = 3.72
STENT SIZE = 3.15

- The reason for underexpansion is that the calcified plague was not pre-modification

- If we put a stent without pre-modification, it is difficult to do the procedure later.

- We should optimize the stent using the IPSP method as an image guid

Case II : Patient information

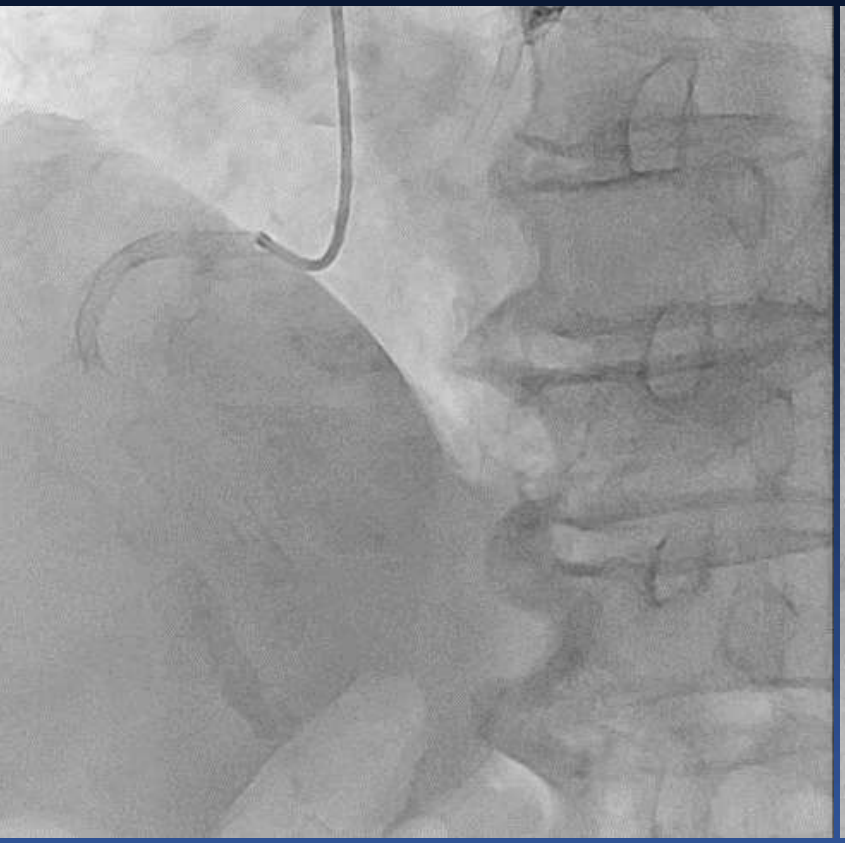
Brief Case Summary

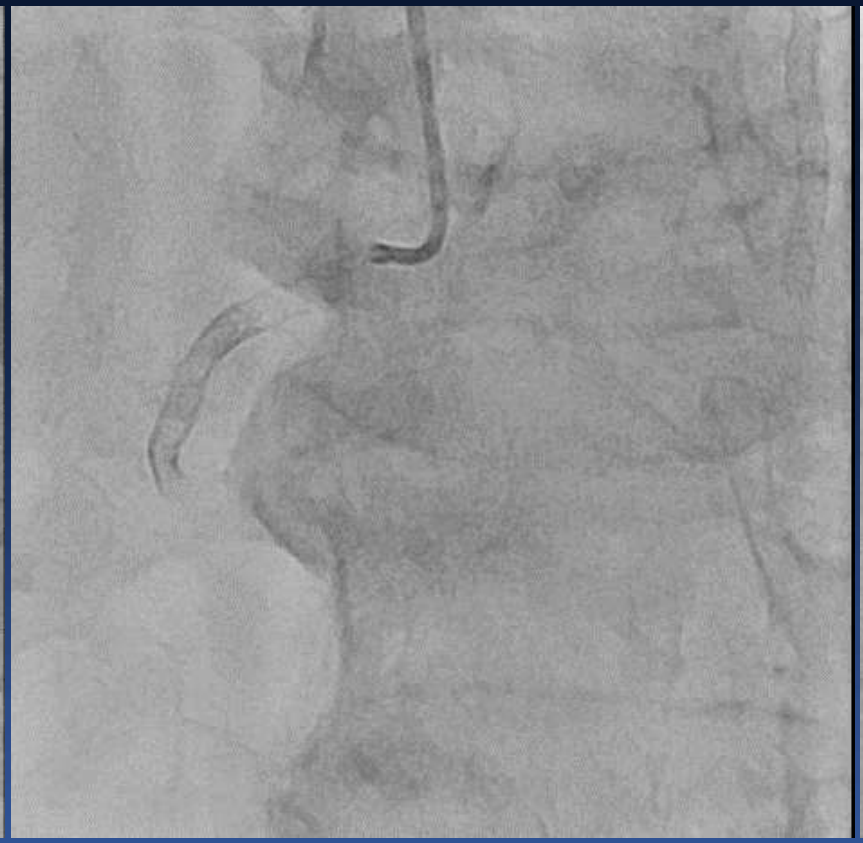
A 74-year-old female with diabetes was admitted for effort chest pain and referred for abnormal results of coronary CT. Her CT at an external hospital demonstrated a severe stenosis at the RCA and diffuse moderate stenosis at the LCX

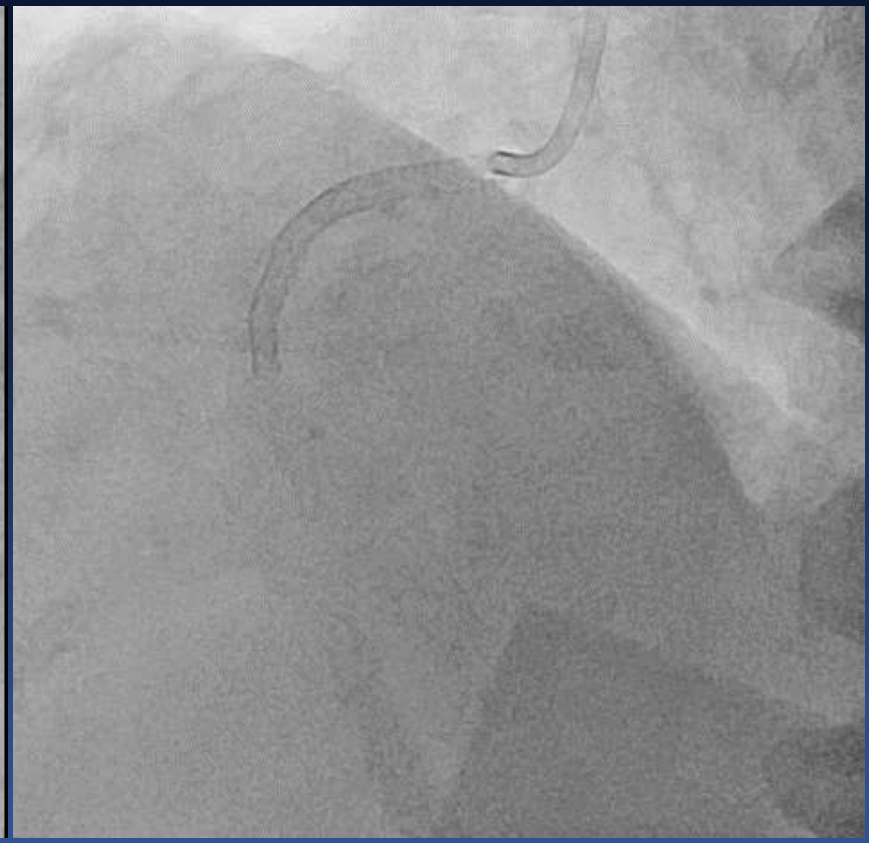
Past Medical History

- **Diabetes** : Y
- **Hypertension** : Y
- **Hyperlipidemia** : N
- **Smoking** : N
- **Family History** : Y
- **Age : 74**
- **Sex : Female**
- **Other: none**

PRE

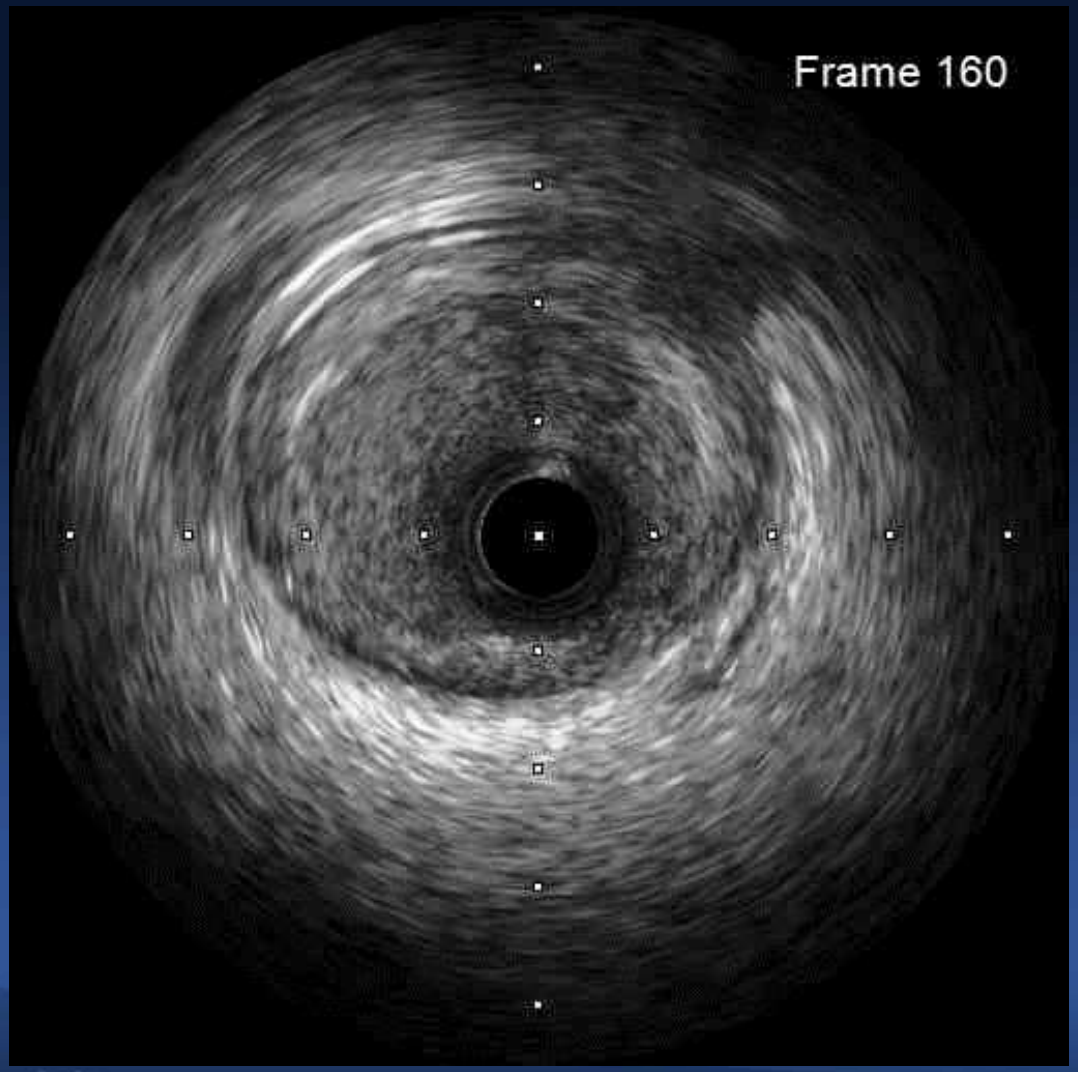


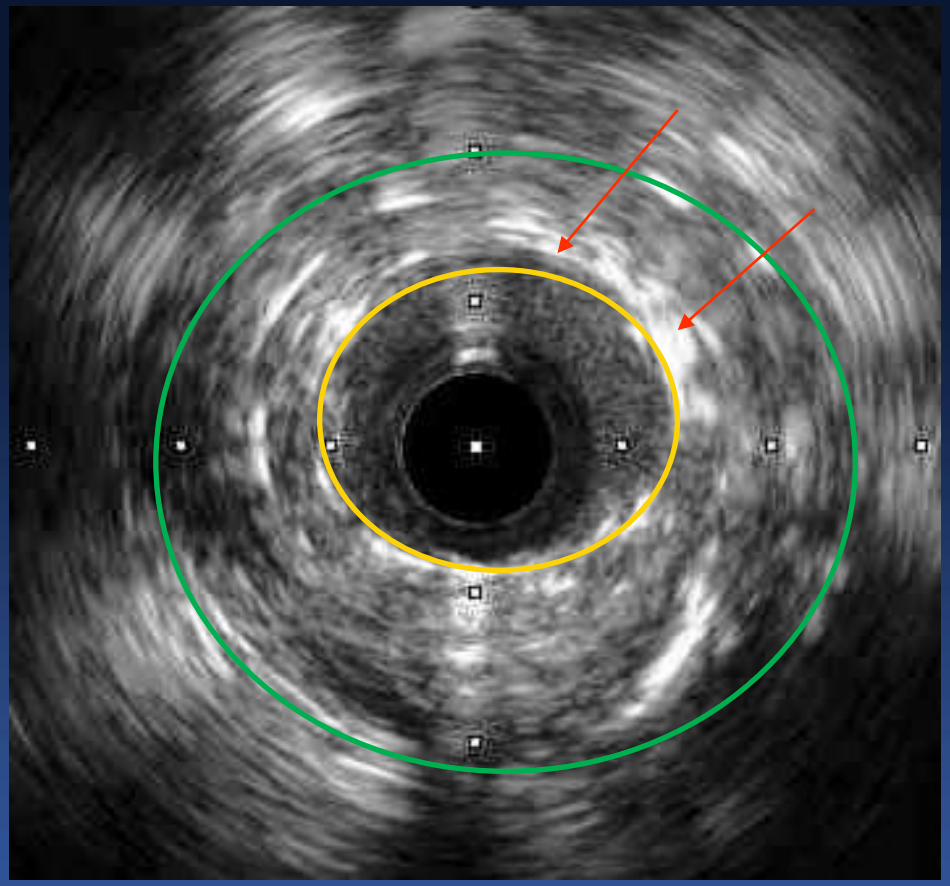




3.0/15, 3.0/22

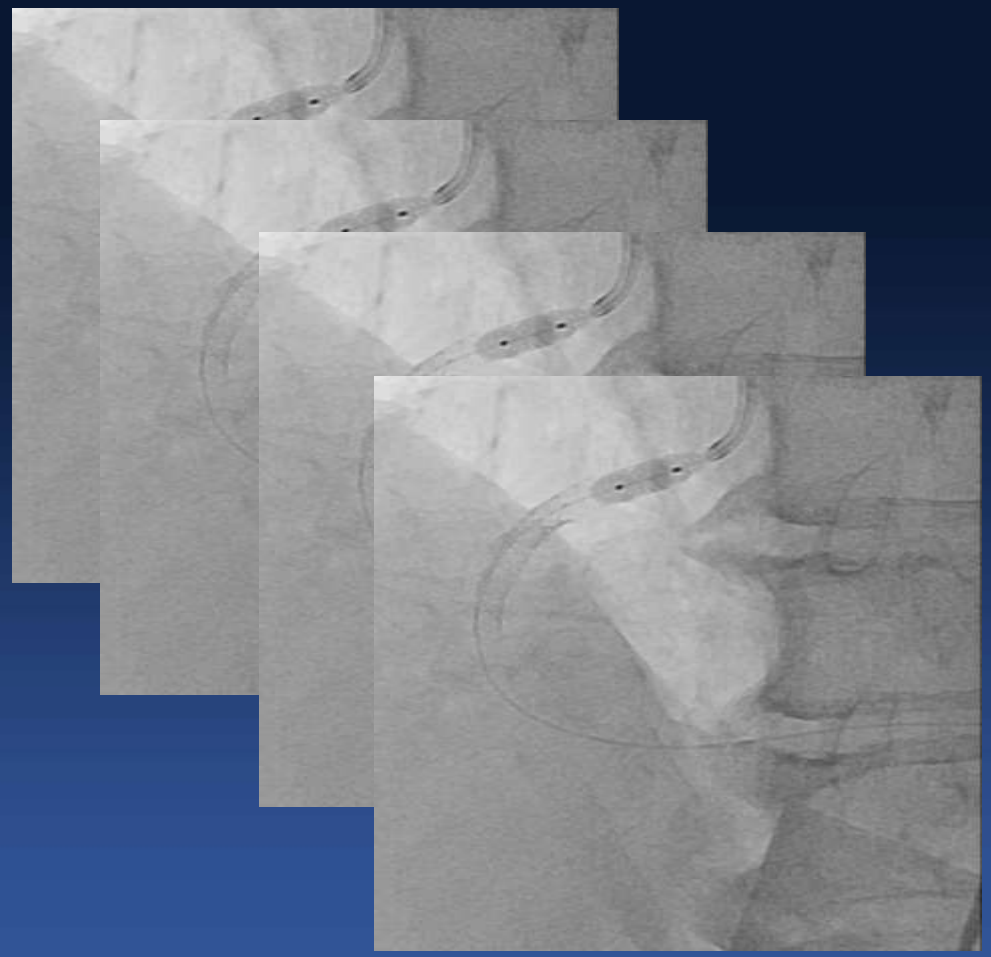
Pre IVUS



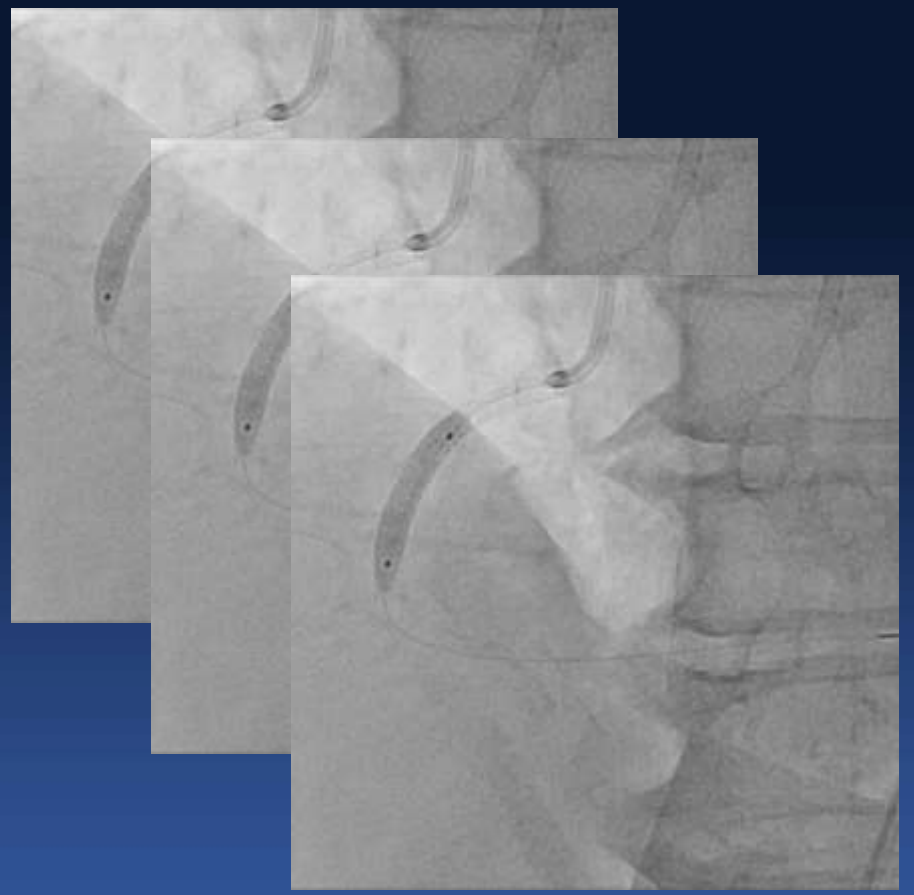


VESSEL SIZE= 4.08
STENT SIZE= 2.16

Several Times!!

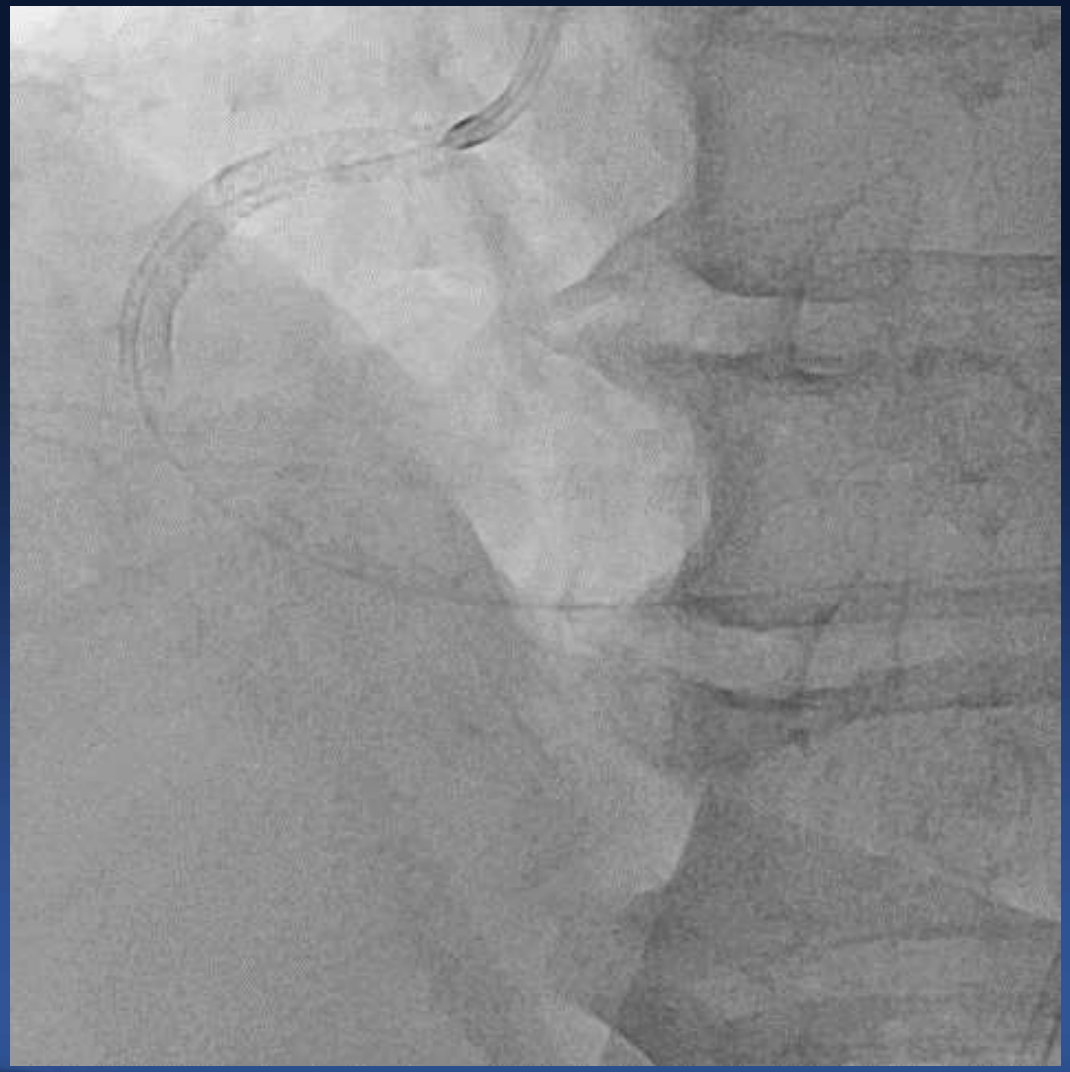


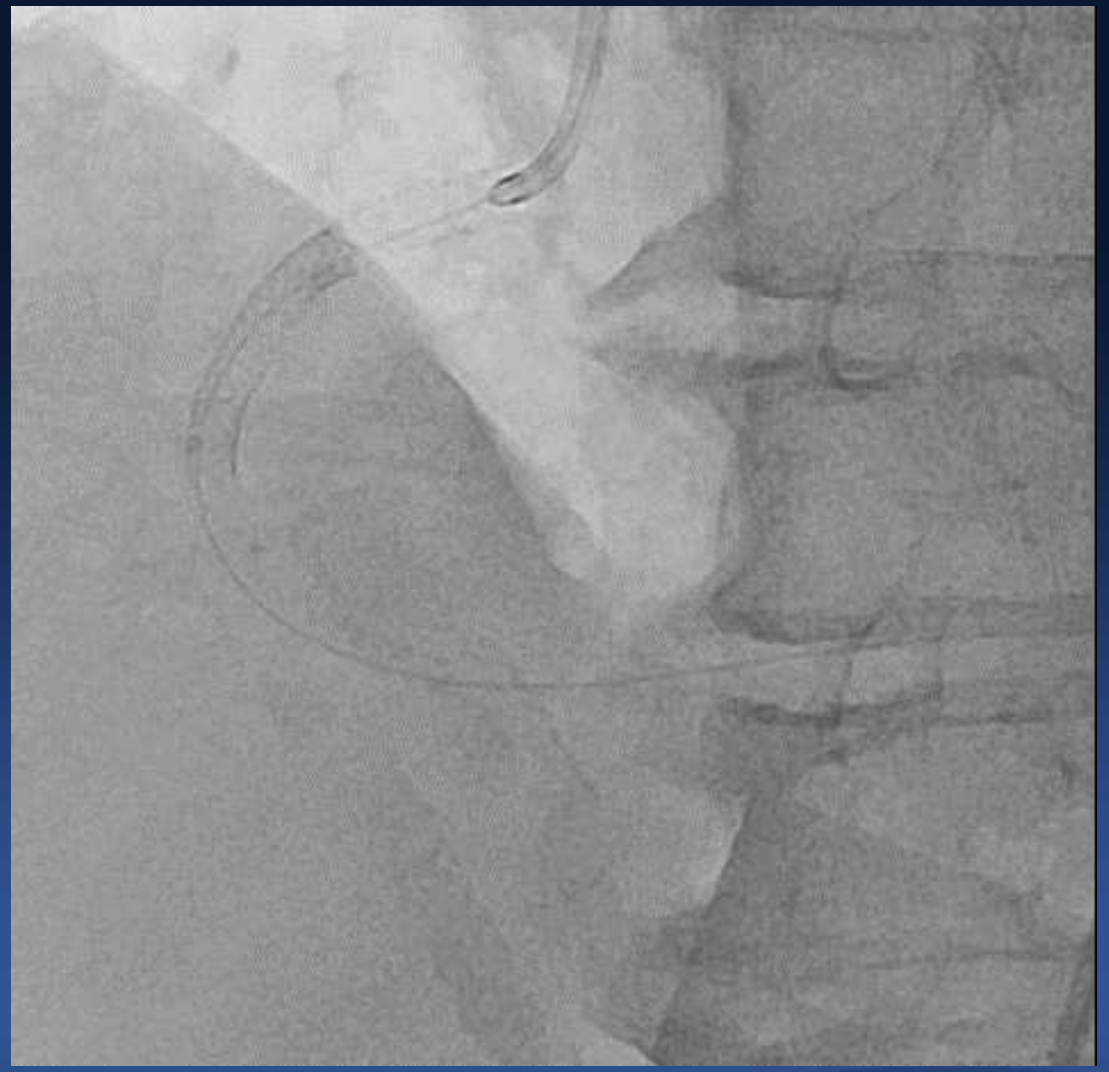
3.25/20



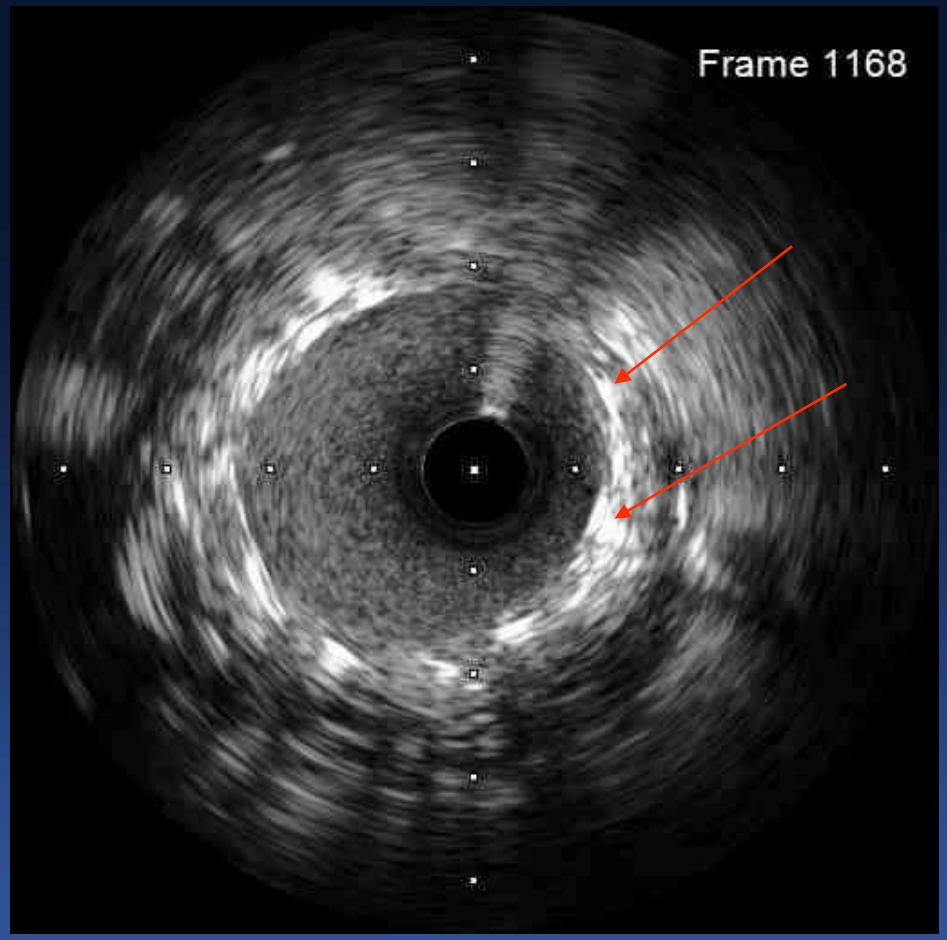
4.0/10

Post Balloon



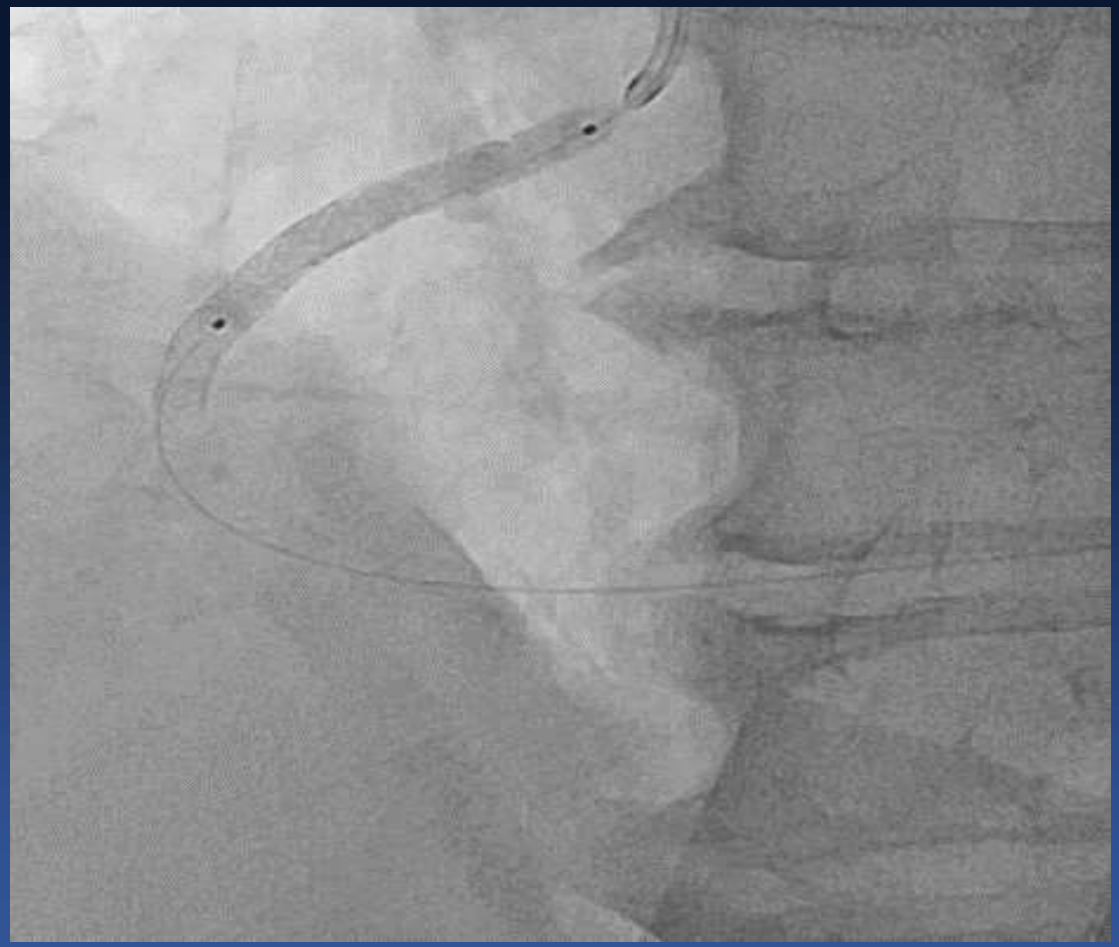


POST BA



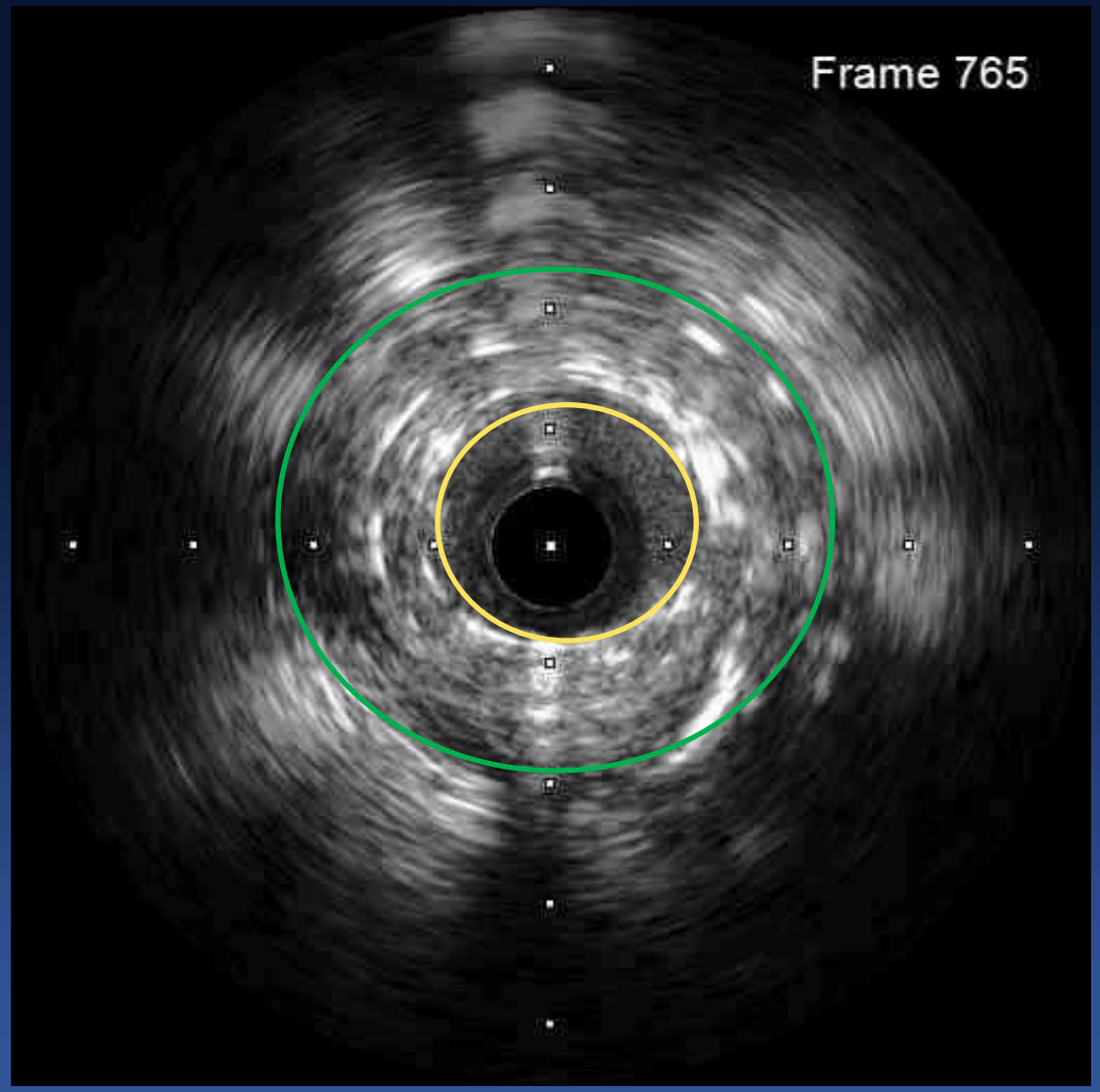
VESSEL SIZE= 4.08
STENT SIZE= 3.70

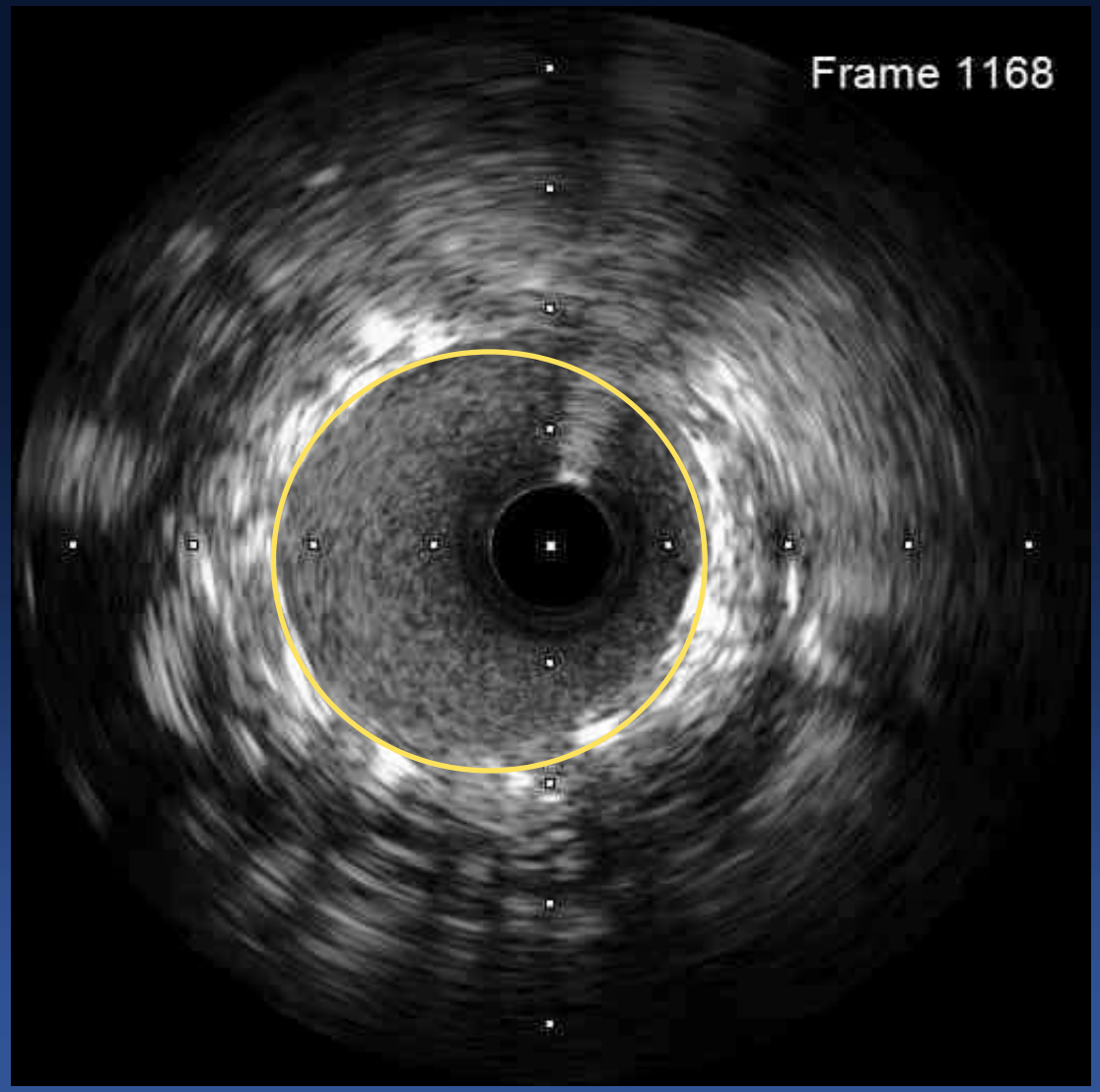
DEB



3.5/30

FINAL





VESSEL SIZE= 4.08
STENT SIZE= 2.16

VESSEL SIZE= 4.08
STENT SIZE= 3.70

Conclusion

- There are many causes of ISR ; under-expansion
- To understanding cause of ISR; must be need image (IVUS, OCT)
- Severe Under expansion ISR is usually caused by not doing any pre-modification or image guided.

- Through the image, we should select a device that fits the vessel size and actively expand it

- Image guided PSP can improve the patient's outcome and prevent ISR.