



**16<sup>th</sup> Angioplasty Summit TCT AP 2011**  
**KCTA Symposium April 29<sup>th</sup>, 2011**



# **Role of Periprocedural IVUS in Stent Optimization**

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# IVUS Work after Stenting

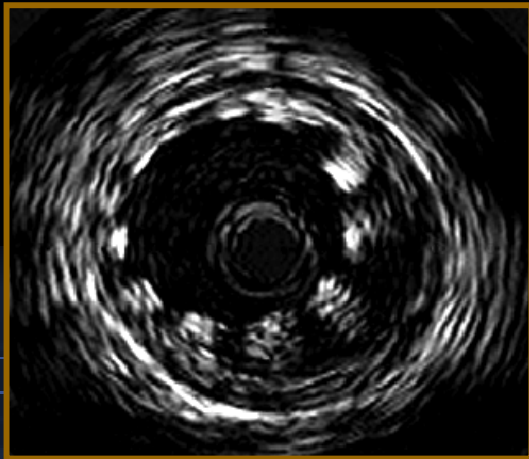
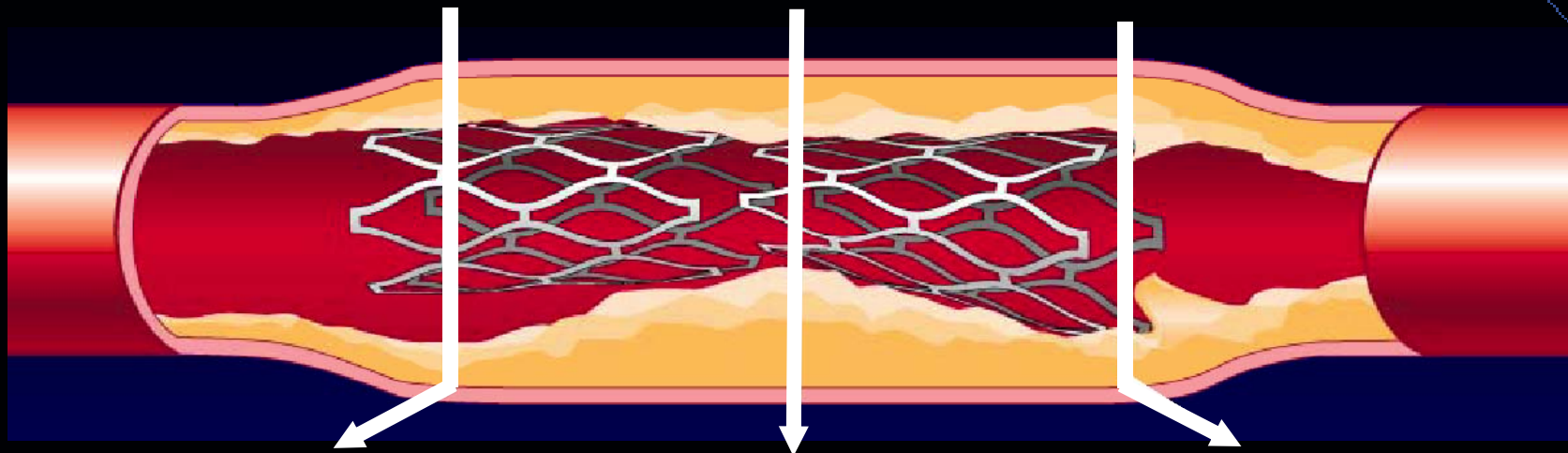
Stent optimization?

Post-stenting complications?

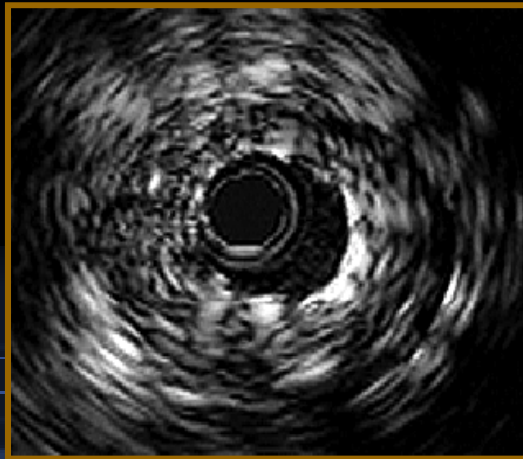
# Post-intervention Applications: Post-stent Implantation

- Verify stent expansion
- Verify stent apposition
- Measure cross-sectional area (CSA):  
strong predictor of long-term restenosis
- Dissections
- Intramural/extramural hematomas
- Thrombus formation

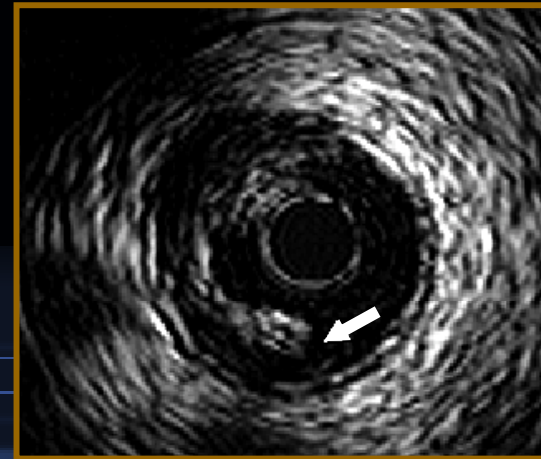
# Problems after Stenting



***Incomplete  
Apposition***



***Stent  
Underexpansion***



***Edge  
Dissection***

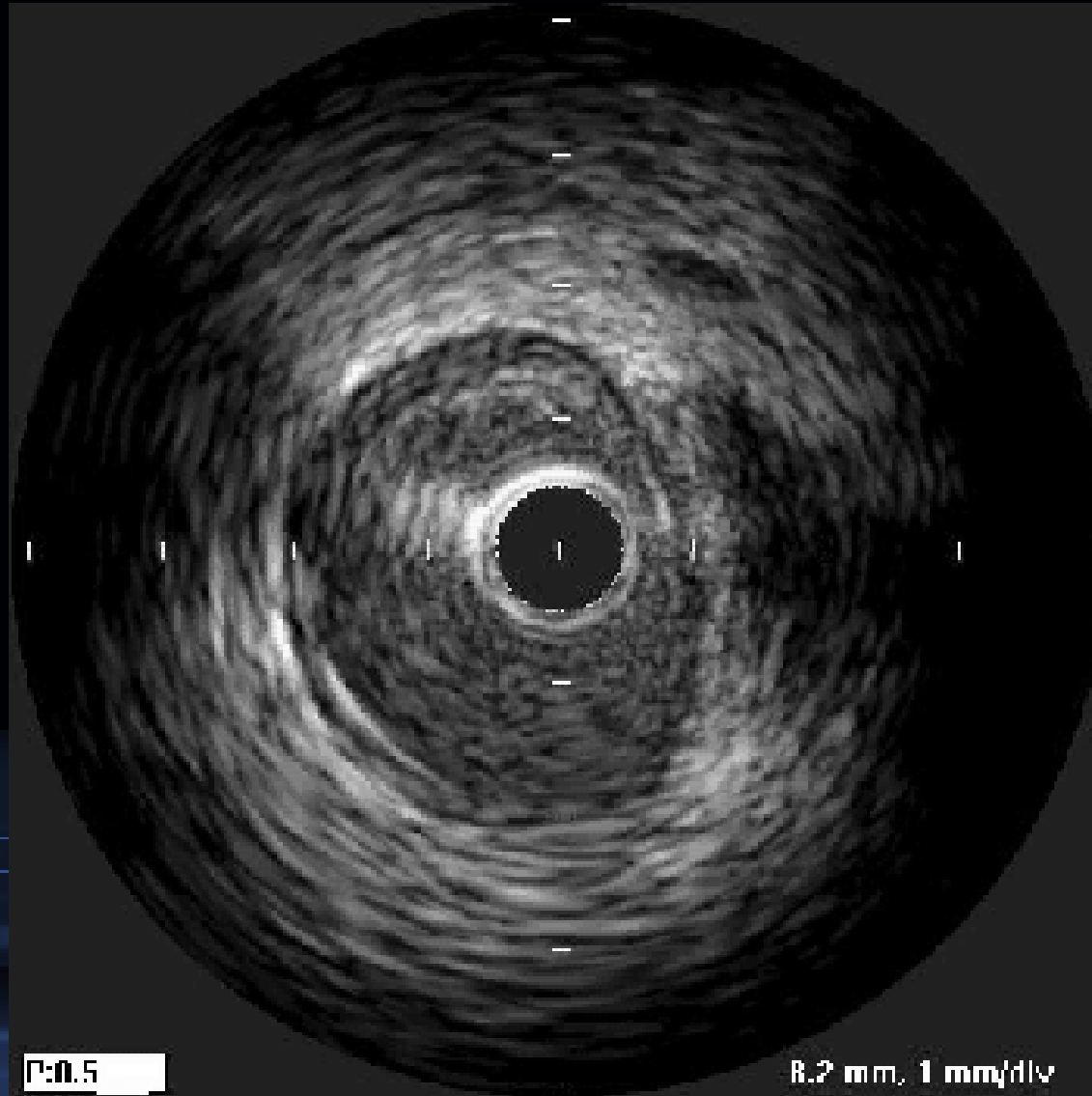
# Optimal Stent Deployment Criteria\*

- Apposition - good apposition of stent struts to the vessel wall such that the stent struts are not surrounded by lumen
- Expansion - bare metal stent is fully expanded if
  - At least  $7.5 \text{ mm}^2$  (since a stent CSA is  $> 7.5 \text{ mm}^2$  has a low restenosis rate); however, not possible in small vessels
  - Stent CSA  $> 90\%$  of ref lumen CSA
- No edge dissections - only treat major dissections and intramural hematomas, not minor edge dissections

*\* Although not all experts agree of optimal stent criteria, above is a reasonable approach using data from multiple studies*

# Stent Expansion

# Stent Underexpansion and malapposition



r:0.5

R.2 mm, 1 mm/div

# Final Stent CSA

(Stent Underexpansion)?

**Target lesion revascularization** ↑

**Stent thrombosis** ↑



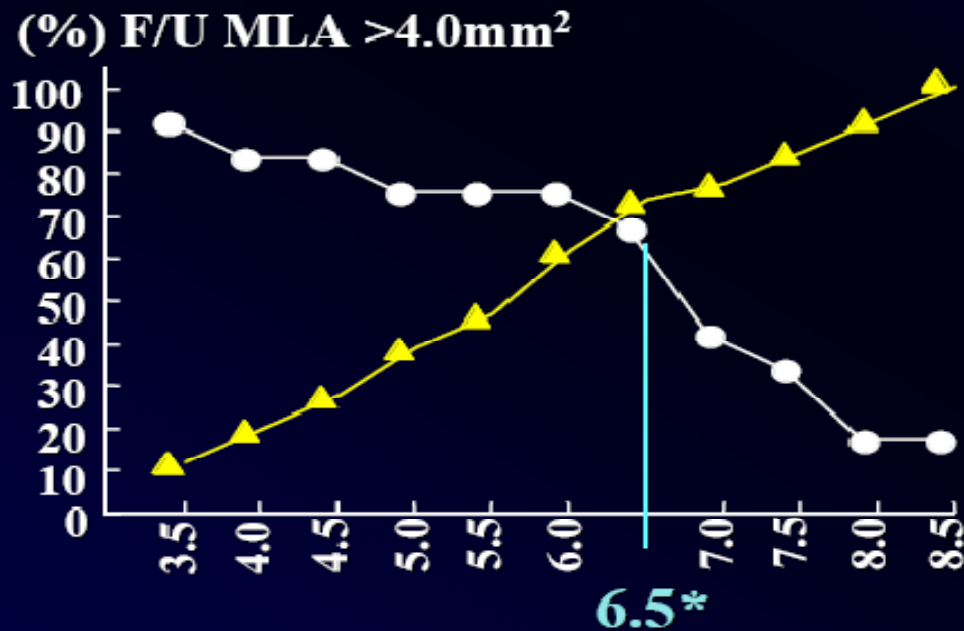
# Final Stent CSA (Stent Underexpansion)?

**Target lesion revascularization ↑**

# Cypher Restenosis

## “Optimal” MSA (from SIRIUS)

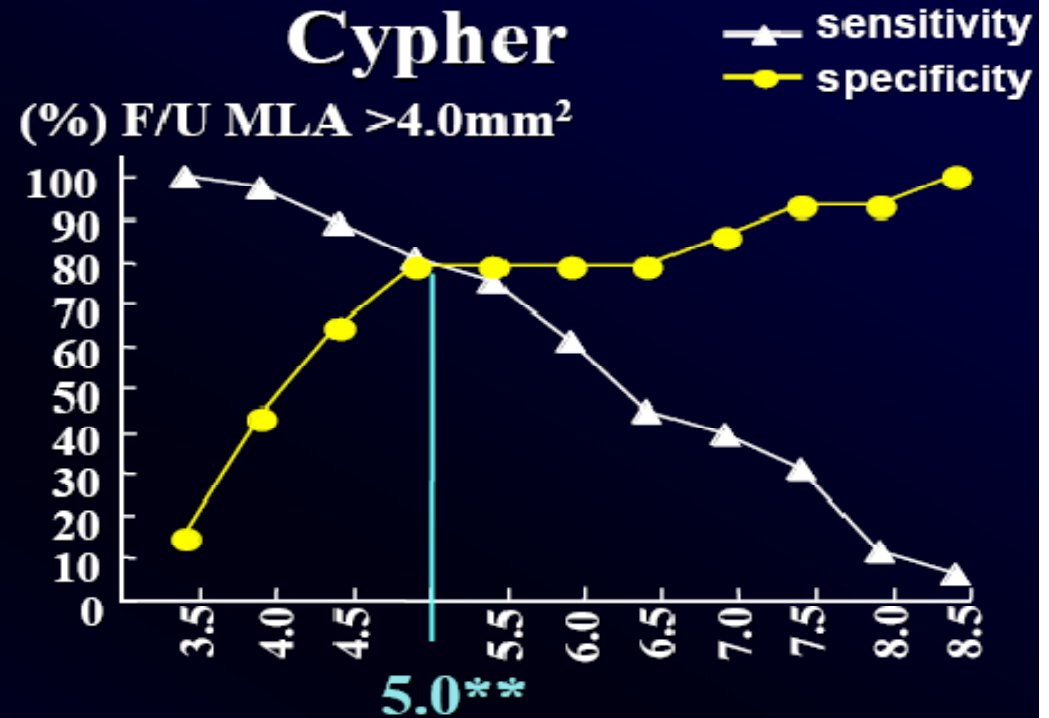
### Bare Metal Stents



Minimum stent area (mm<sup>2</sup>)

\*predictive value=56%

### Cypher



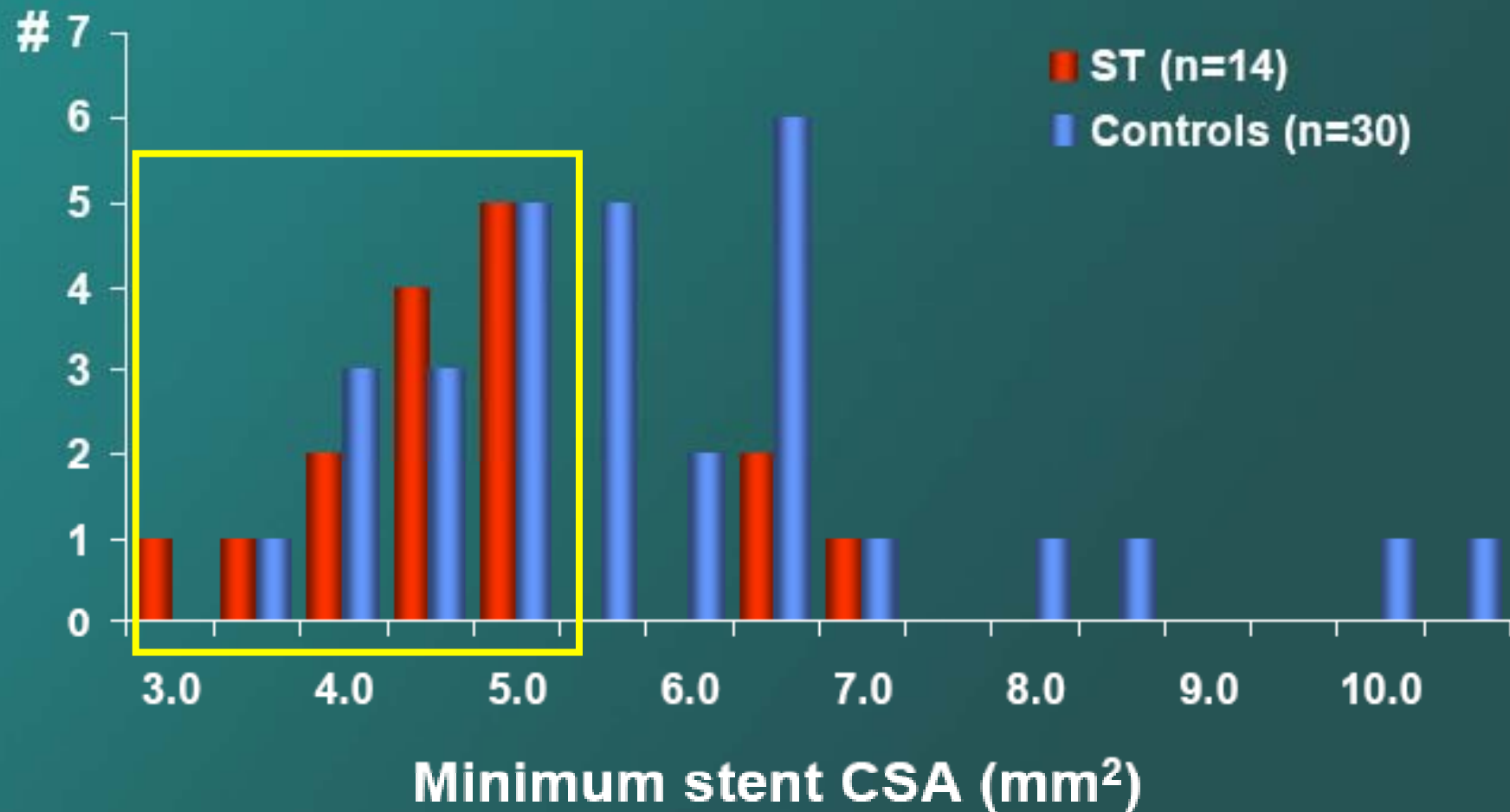
Minimum stent area (mm<sup>2</sup>)

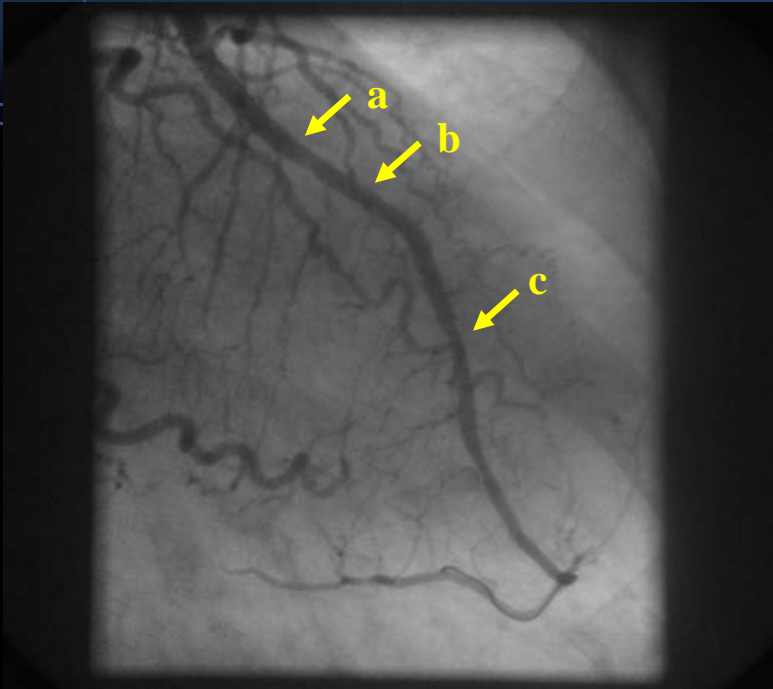
\*\*predictive value=90%

# Final Stent Area (Stent Underexpansion)?

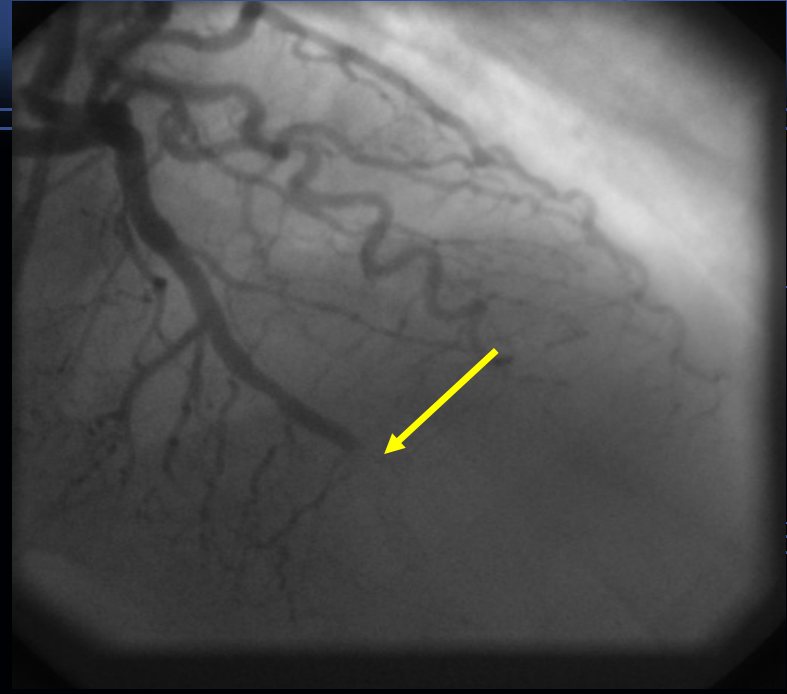
**Stent thrombosis ↑**

# Predictors of Acute/Subacute/Late DES Thrombosis @ WHC(*SES*)

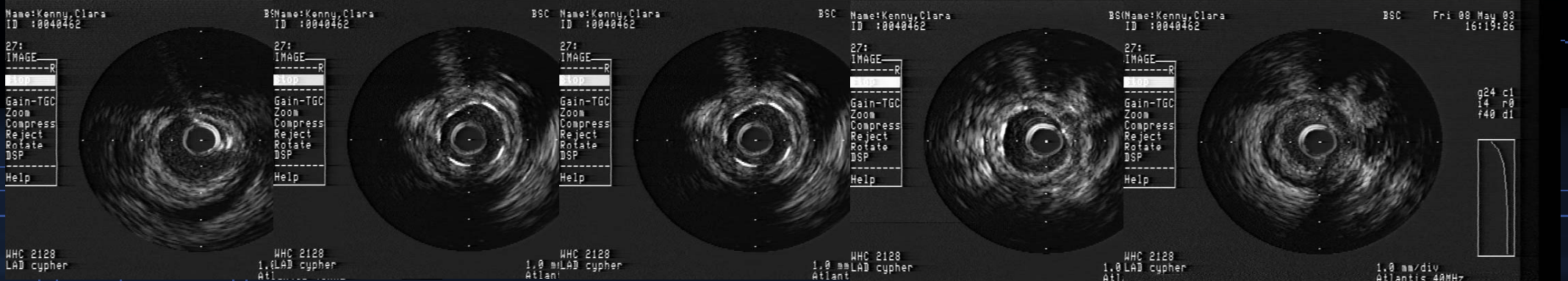




Pre



125 days later

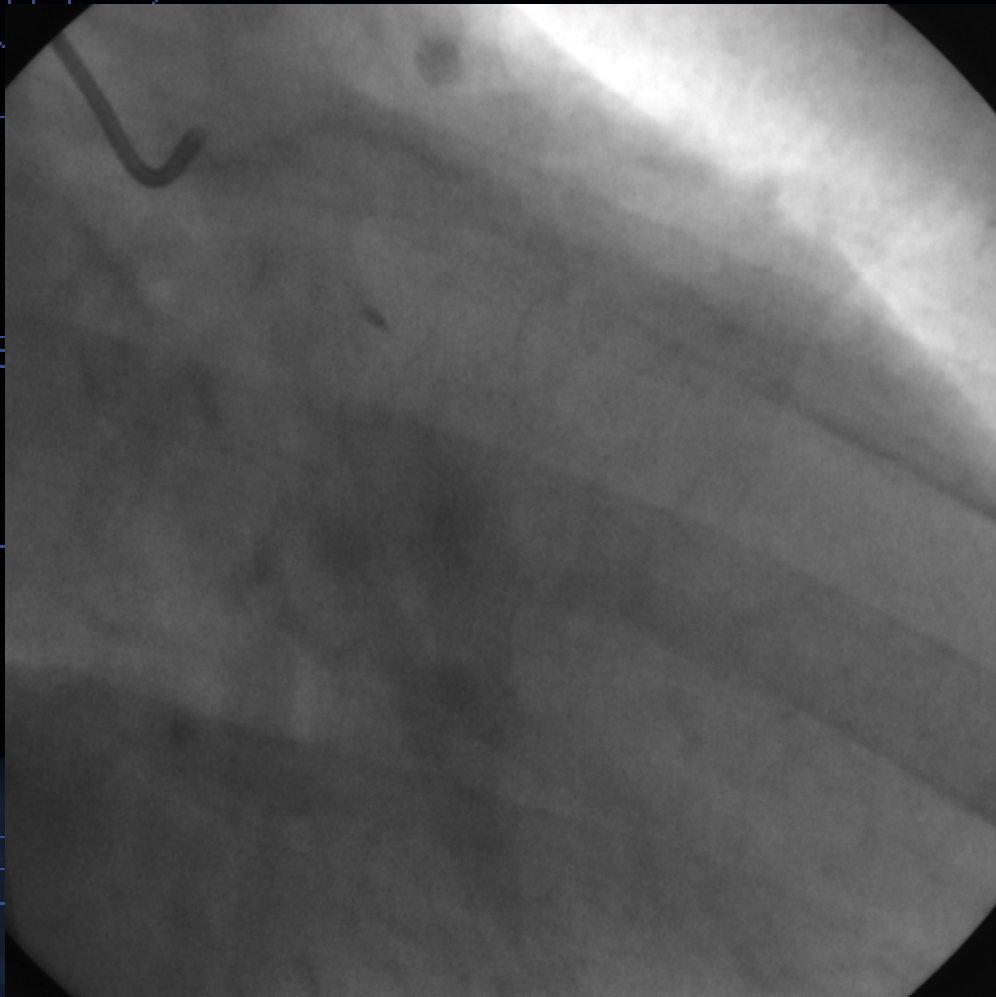


a) EEM area=13.0 mm<sup>2</sup>  
 Plaque burden=0.705  
 LA=3.8 mm<sup>2</sup>  
 P&M area =9.2 mm<sup>2</sup>

b) EEM area=12.9 mm<sup>2</sup>  
 MSA=3.5 mm<sup>2</sup>  
 P&M area=9.6 mm<sup>2</sup>

c) EEM area=8.4 mm<sup>2</sup>  
 Plaque burden=0.682  
 LA=2.7 mm<sup>2</sup>  
 P&M area=5.7 mm<sup>2</sup>

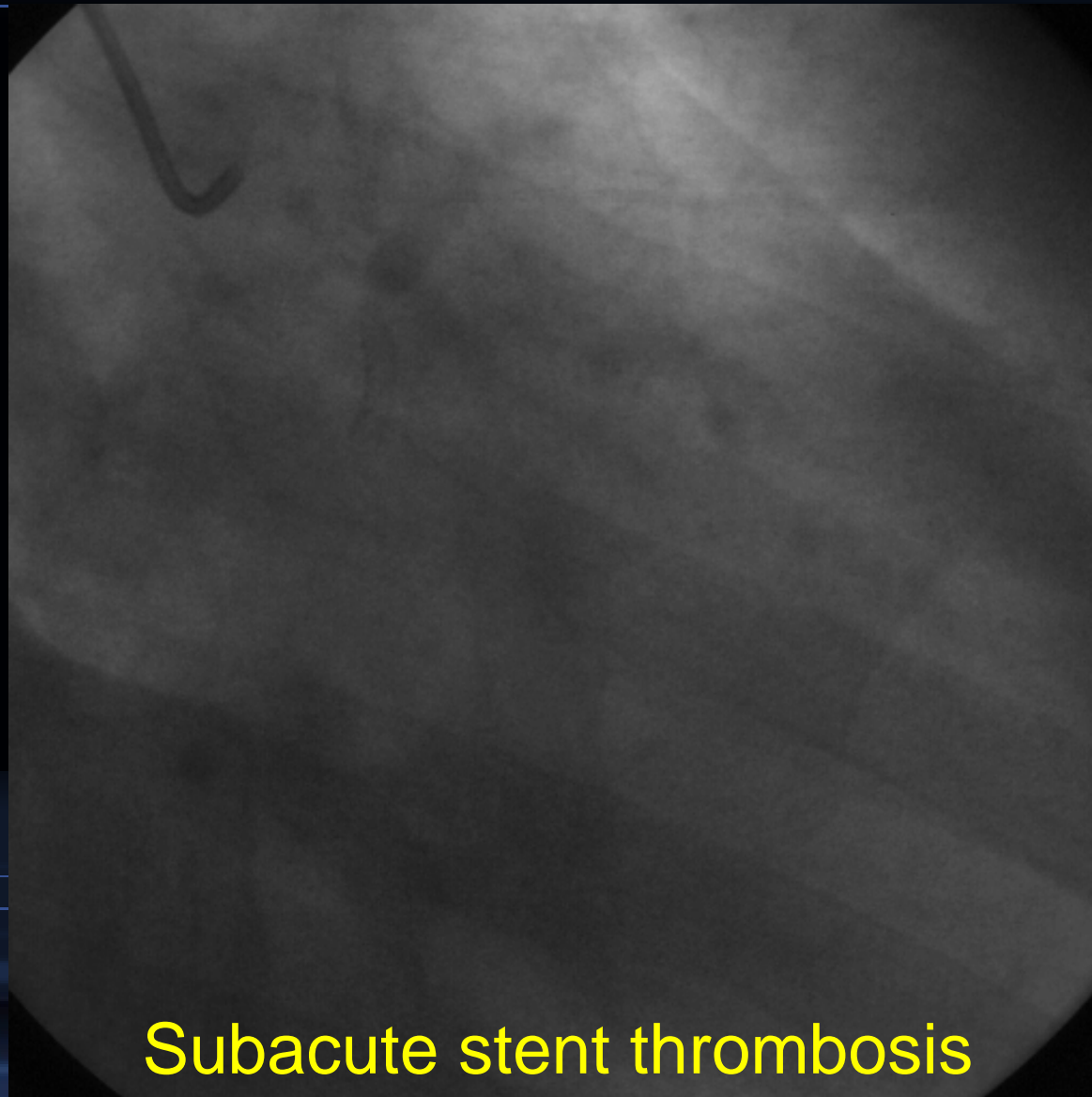
# 51/M STEMI



3.0\*19mm stent at 8 atm



# STEMI

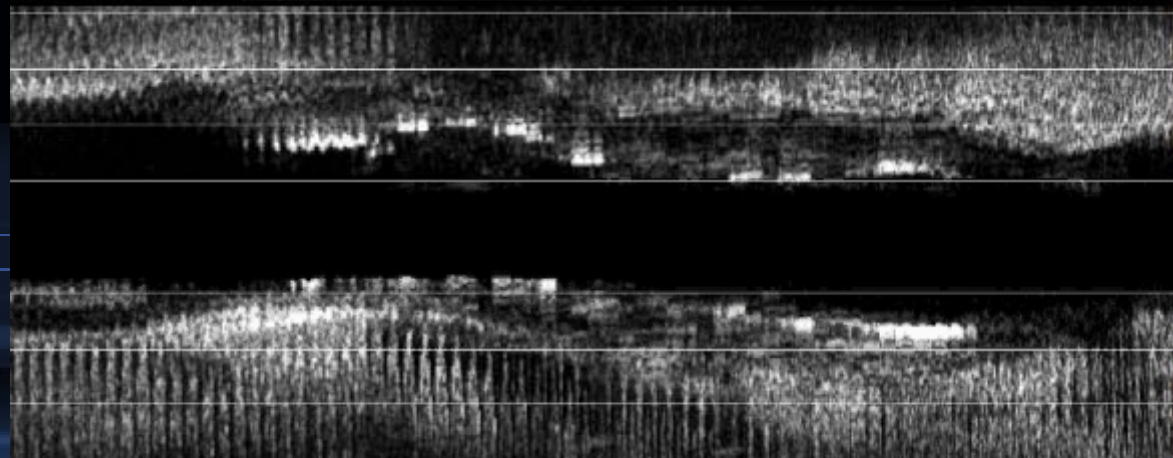
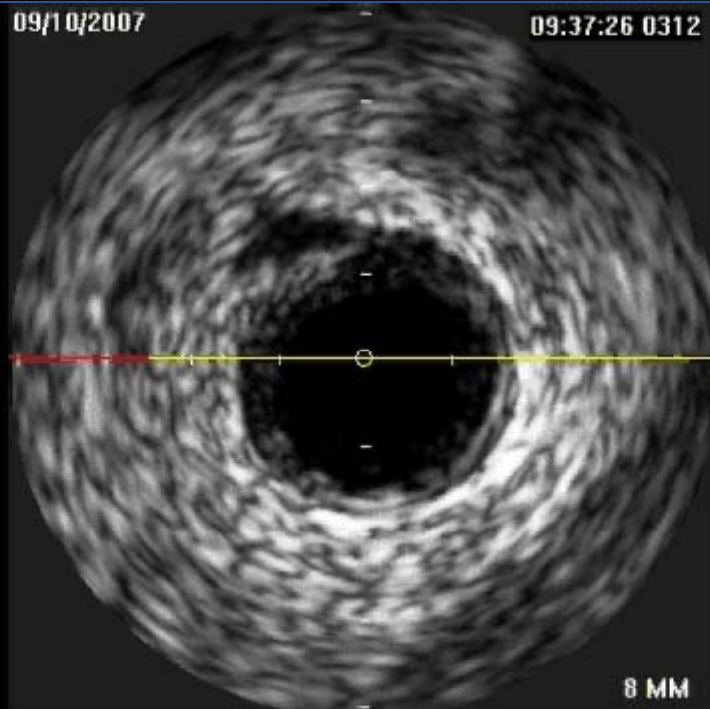


Subacute stent thrombosis

# IVUS

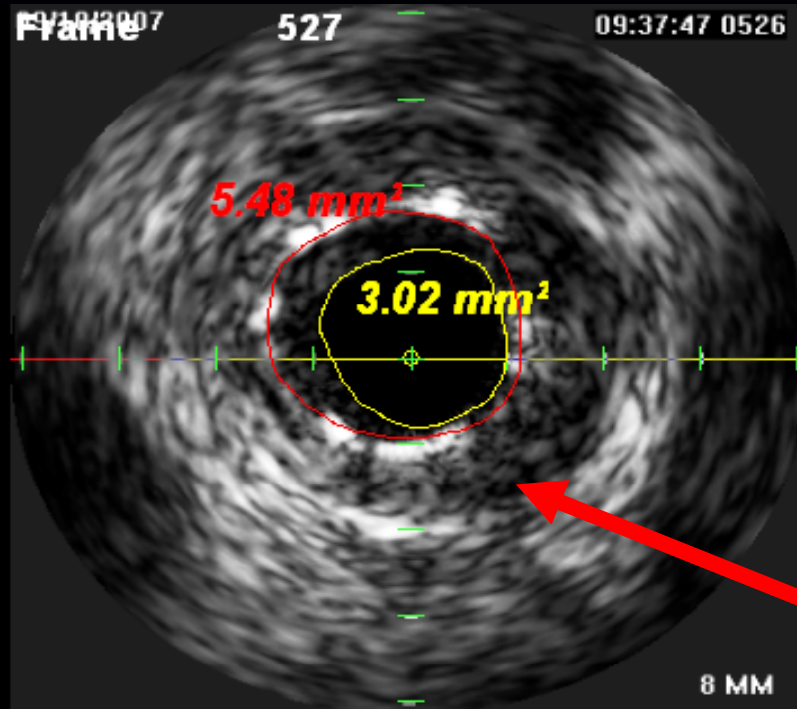
09/10/2007

09:37:26 0312





# Minimum Stent Area Site



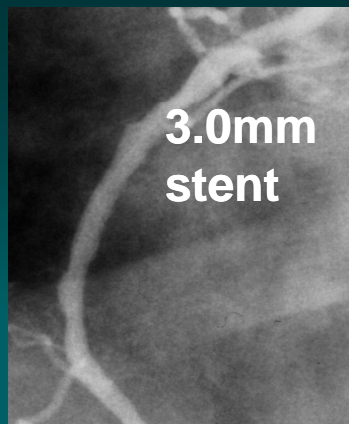
... Patient Gender: M  
[-] Study  
... Study Name: IVUS  
... Study ID: 20070910-95213  
... Study Date & Time: 2007-09-10 9:52:1  
... Referring Physician:  
[-] Series  
... Series Number:0  
... Series Date & Time: N/A  
... Series:  
... Modality: US  
... Performing Physician: LCx-STENT  
... Institute: C.N.U.H-JMH  
... Equipment: JOMED  
... Acquisition Date & Time: N/A  
... Manufacturers Model Name: IN-VISION  
... Pullback rate: 0.50 mm/s  
... Acquisition rate: 10.0 frames/s  
... Loaded frames 327 through 986 steppir  
... Key Frames  
... 527

**Stent underexpansion (70%)**

minimum stent CSA less than 80% of the mean reference lumen CSA

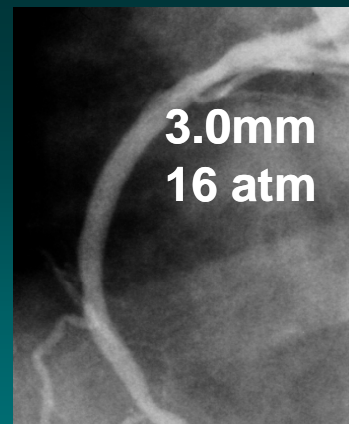
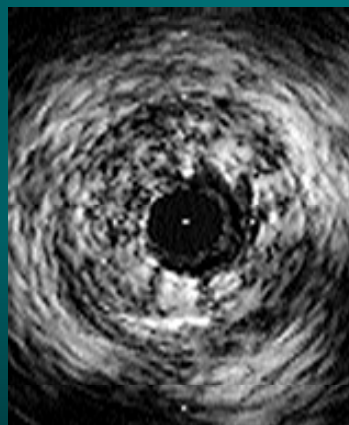
# Impact of Higher Pressure Adjunct PTCA on Stent Dimensions

- Use higher pressures for underexpanded stents (stent CSA significantly smaller than the reference lumen) unless the stent or balloon was initially undersized

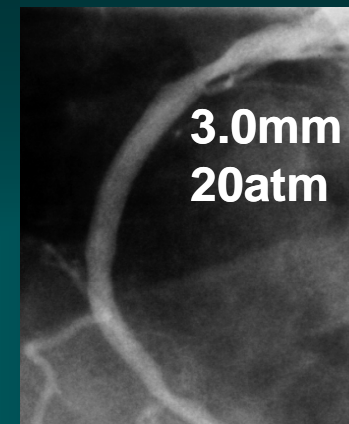
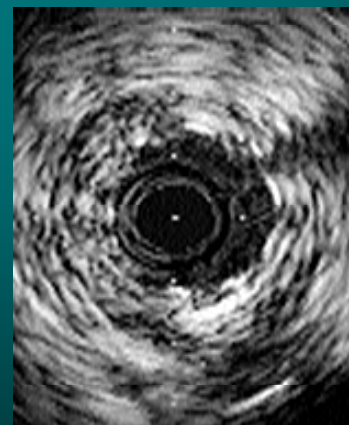


DS = 27%  
MLD = 1.93mm

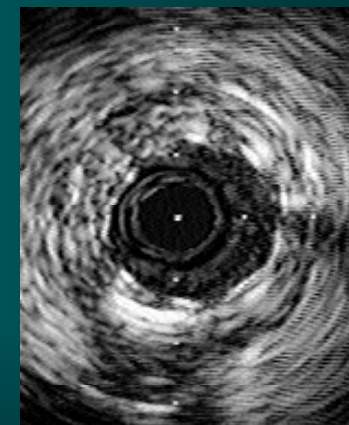
Post Stent



Post PTCA#1

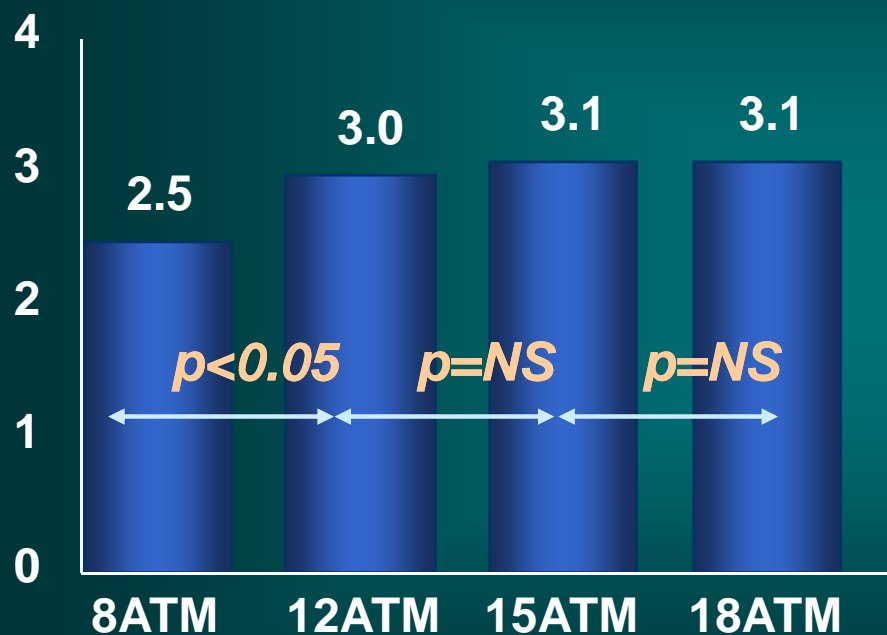


Post PTCA#2

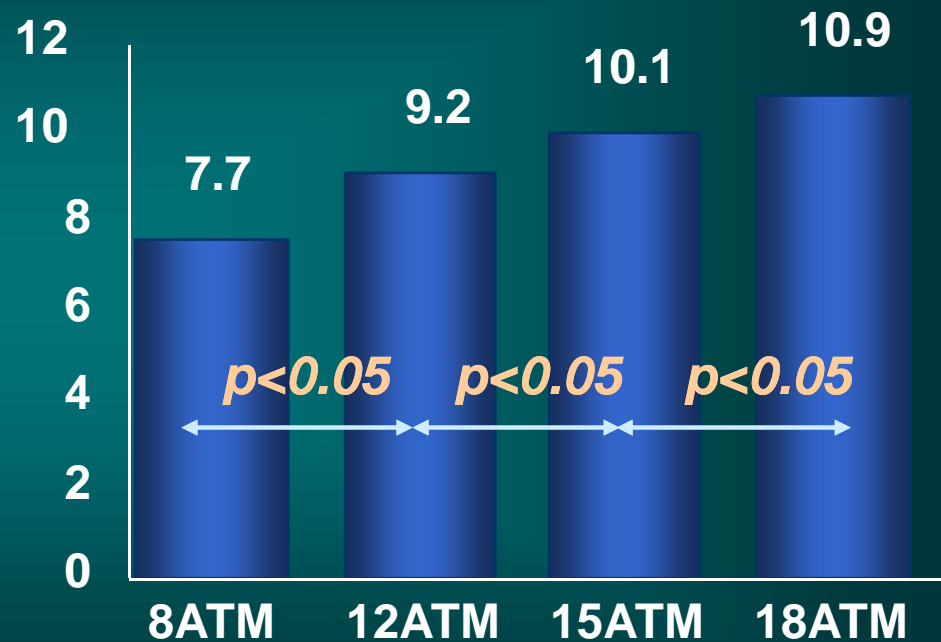


# Impact of Progressively Higher Pressure Adjunct PTCA on Stent Dimensions

QCA MLD (mm)



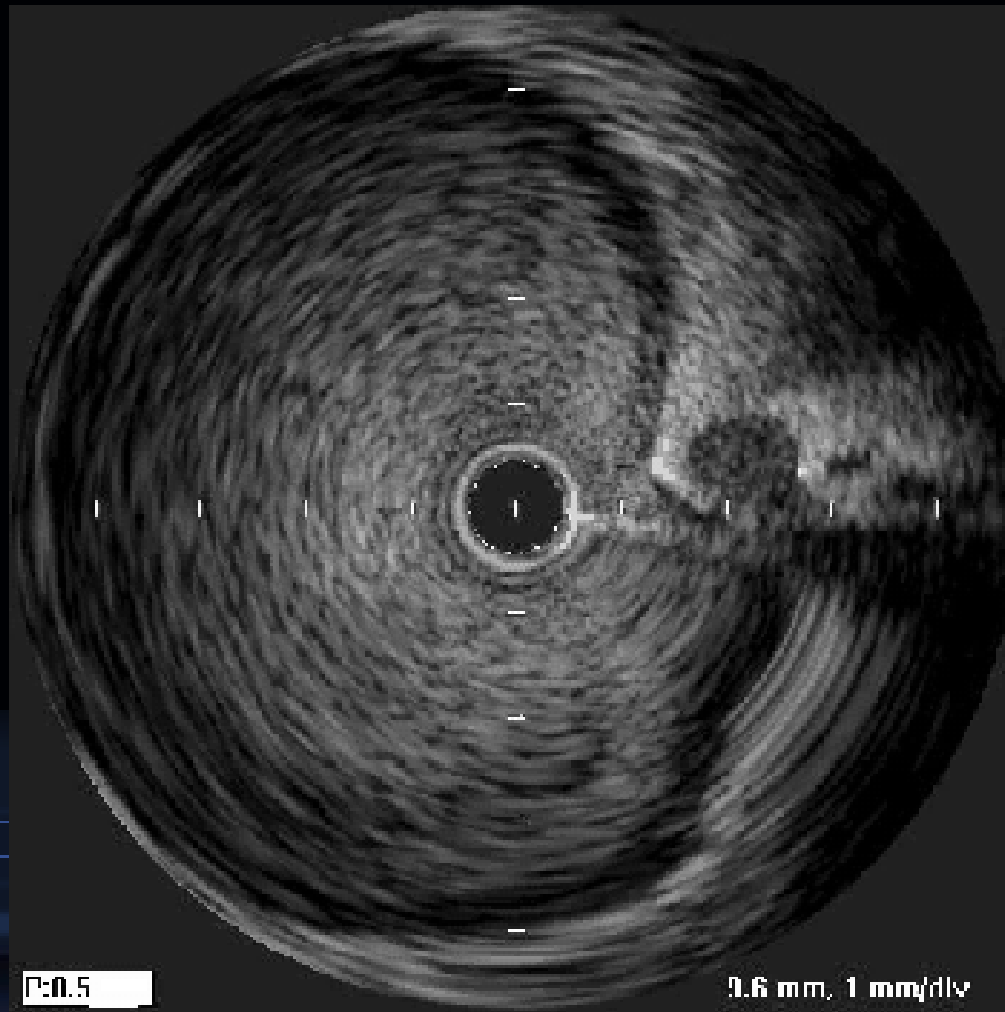
IVUS Stent CSA (mm<sup>2</sup>)\*



\*ANOVA  $P < 0.0001$

# Stent Apposition

# Stent malapposition



# Post-stenting Complications

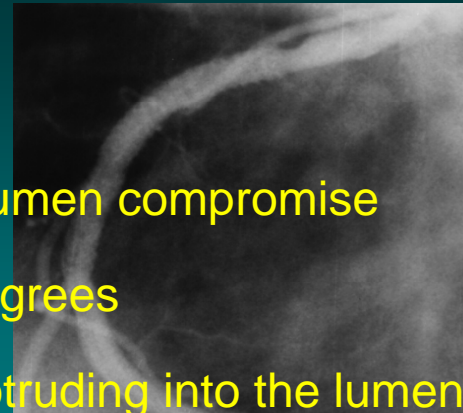
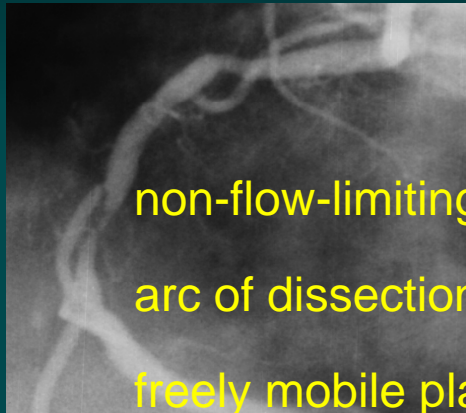
- **Dissection**
- **Intramural/Extramural hematomas**
- **Stent thrombosis/No-reflow**
- **Stent dislodgement**
- **Perforation**



# Dissection



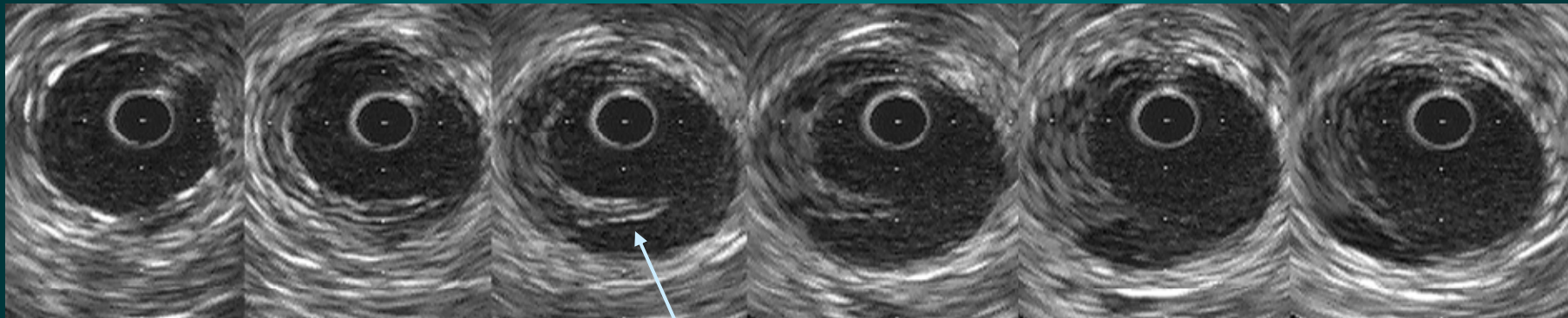
# Minor Stent Edge Dissection



non-flow-limiting or no lumen compromise

arc of dissection <90 degrees

freely mobile plaque protruding into the lumen,  
but not directed toward the center of the lumen

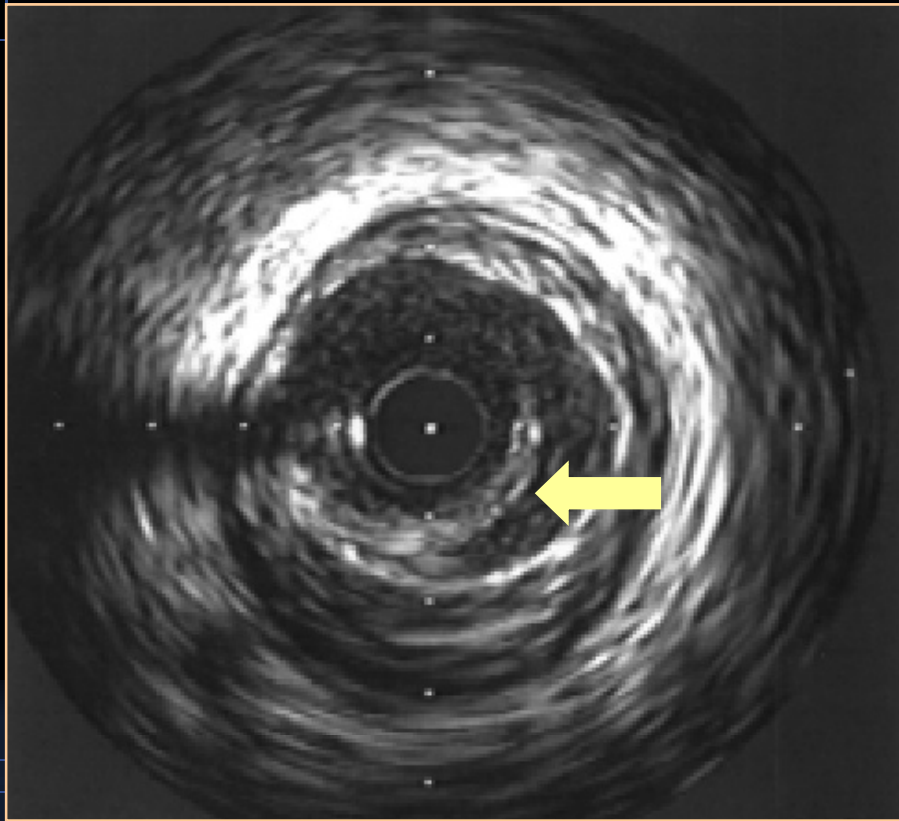


0 → 1.5mm → 7.5mm

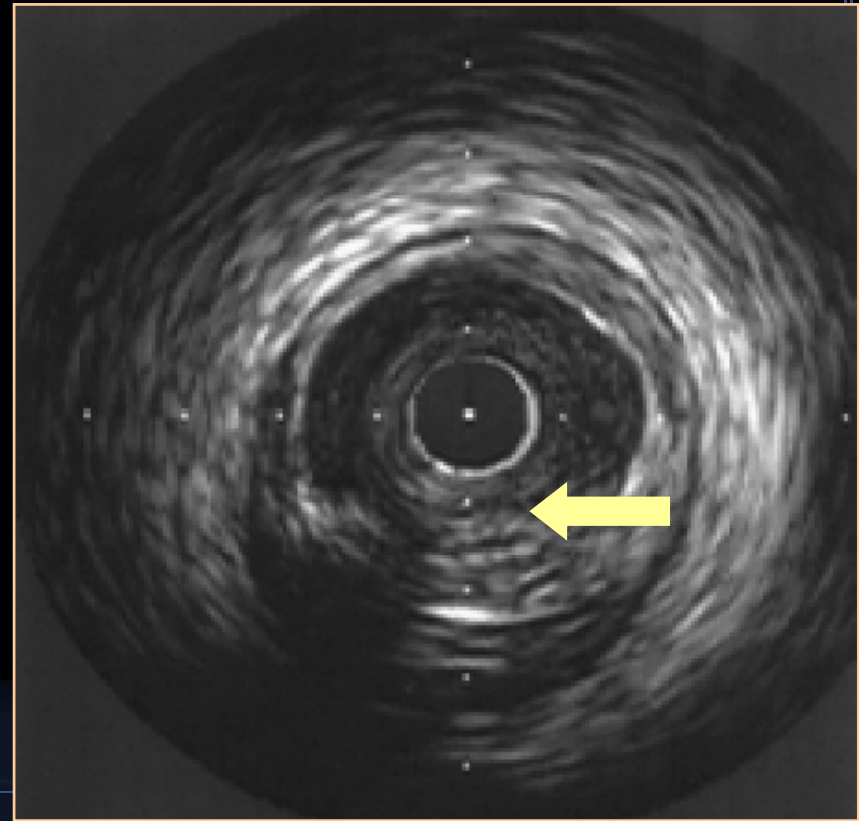
**Dissection**



# Fate of Minor Edge Dissection

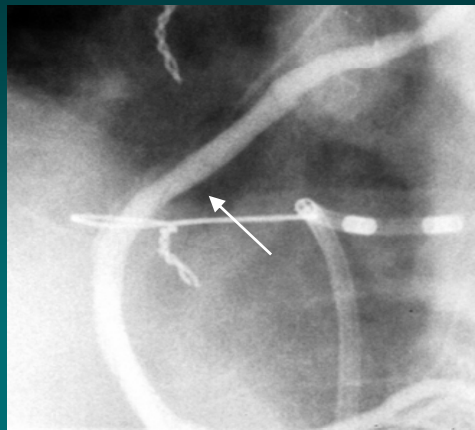
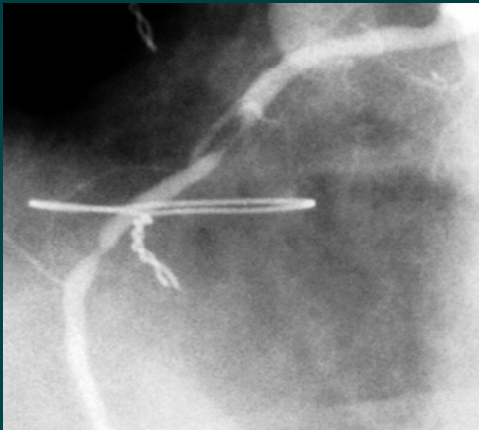


Distal edge dissection



6-month follow-up IVUS

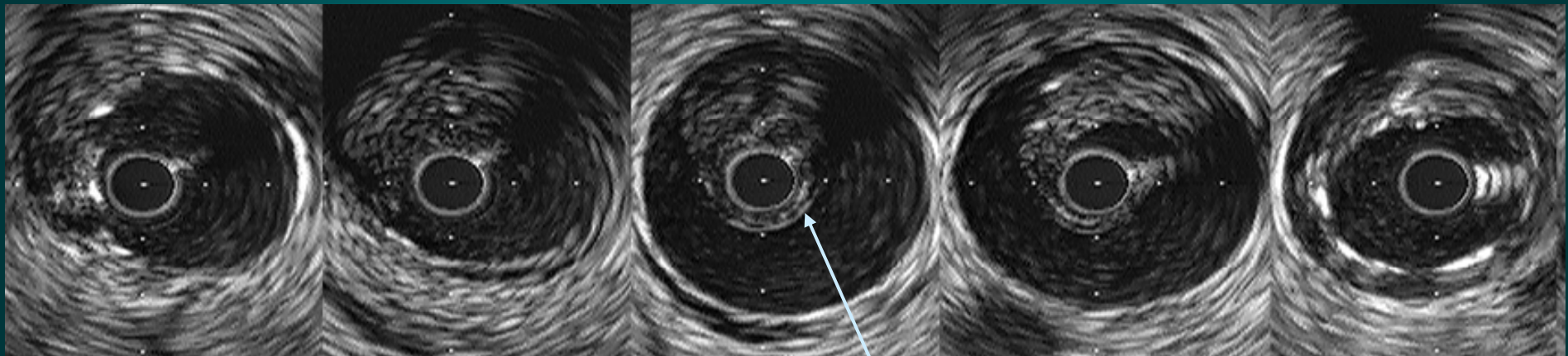
# Major Stent Edge Dissection



a mobile flap

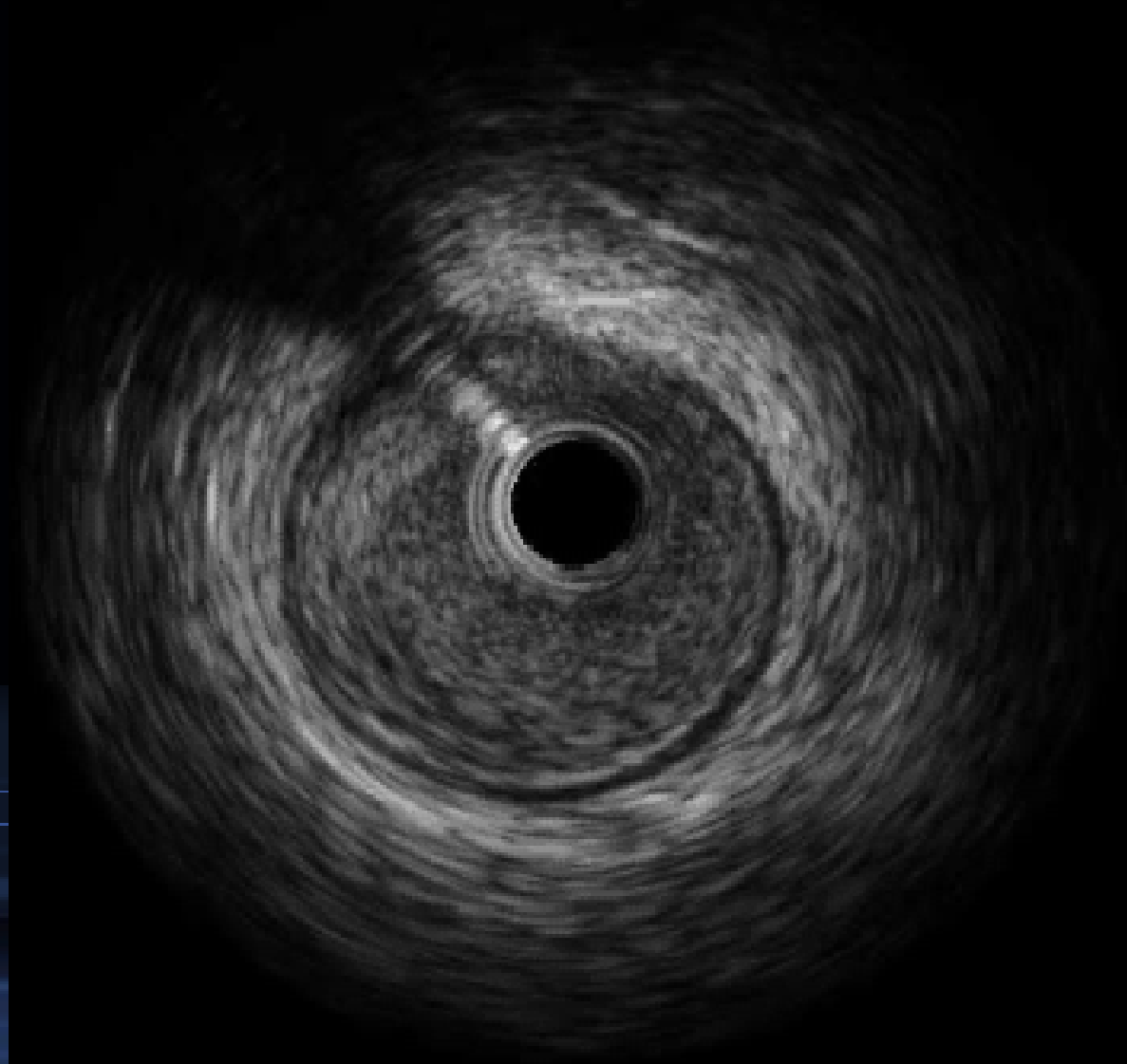
arc of dissection  $> 90$  degrees

flow-limiting or lumen compromise

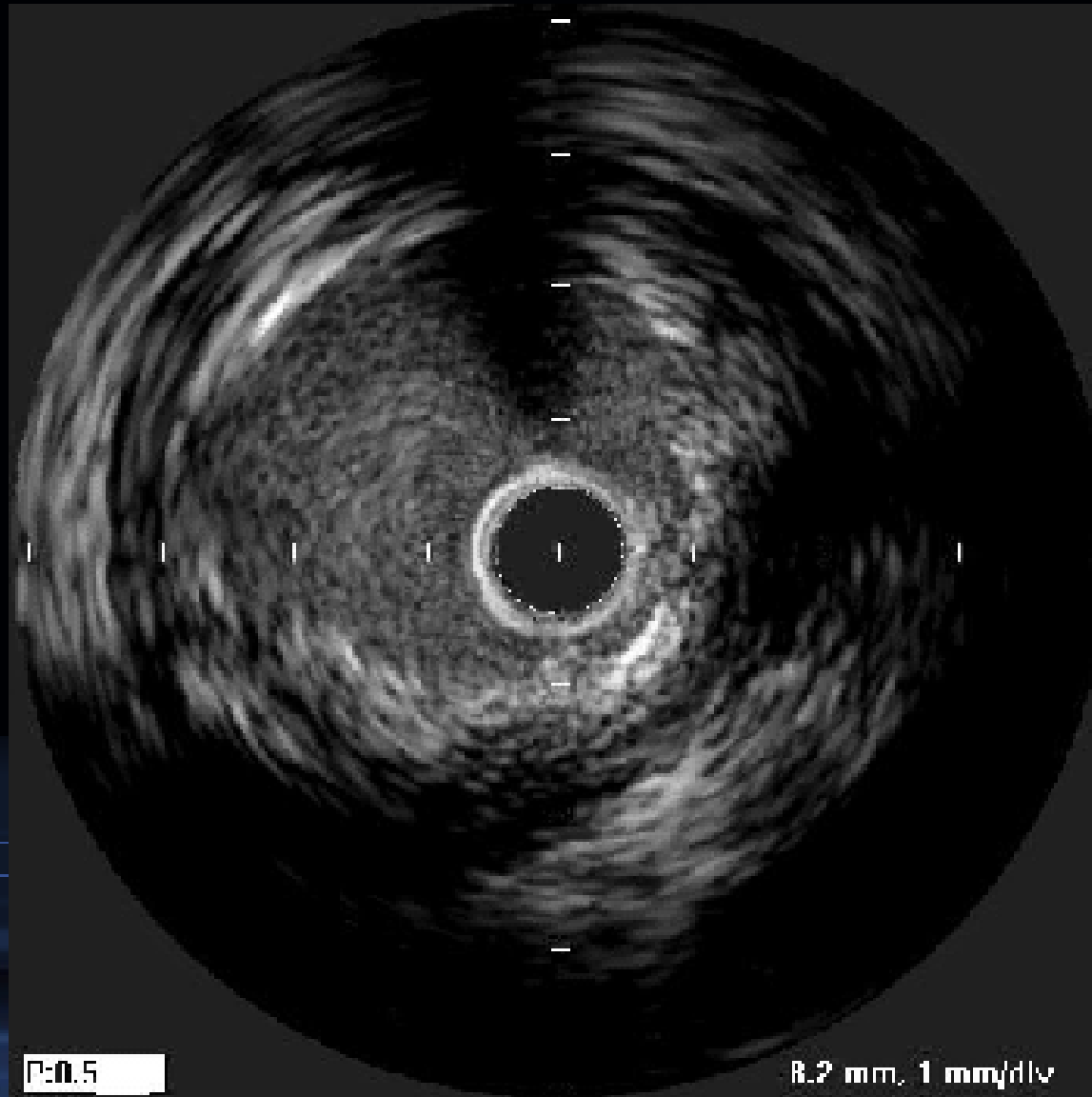


**Dissection**

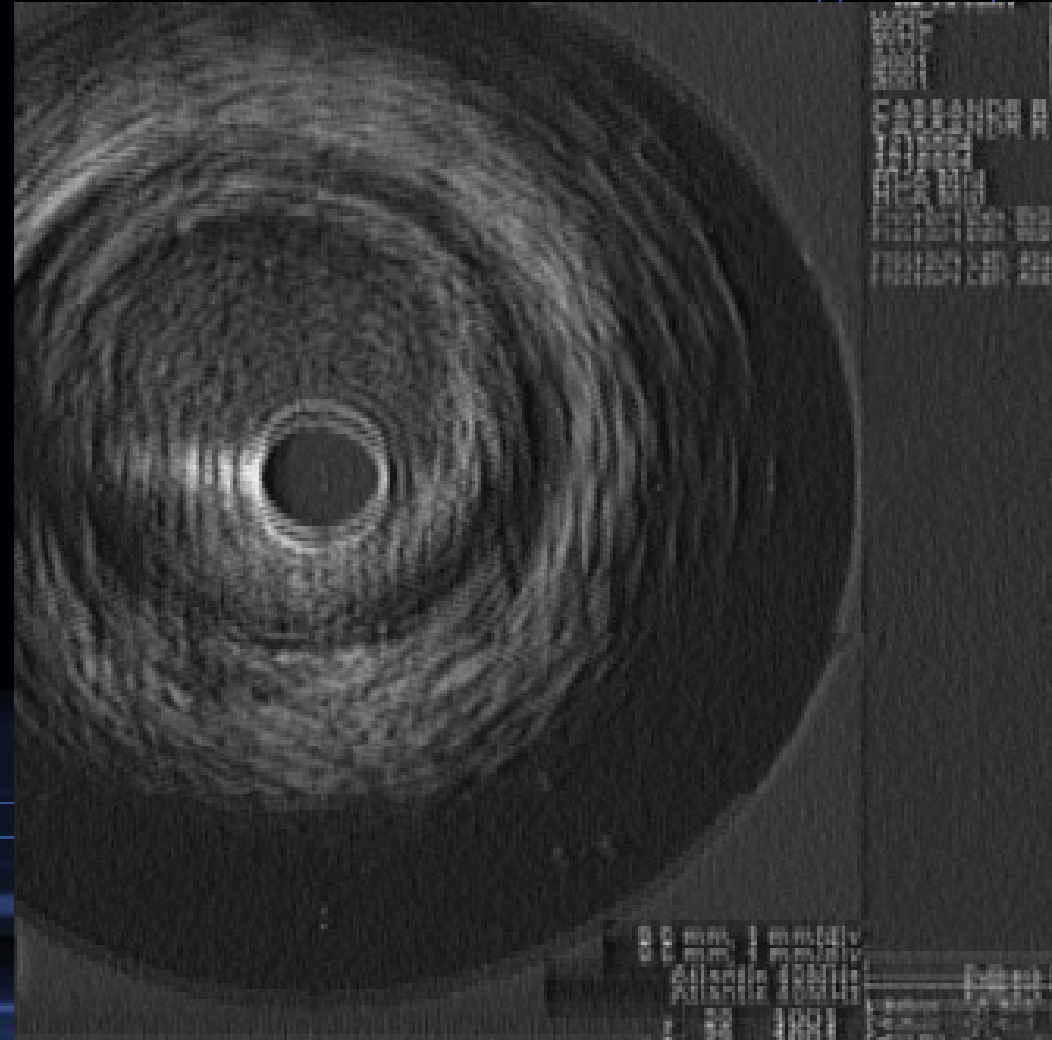
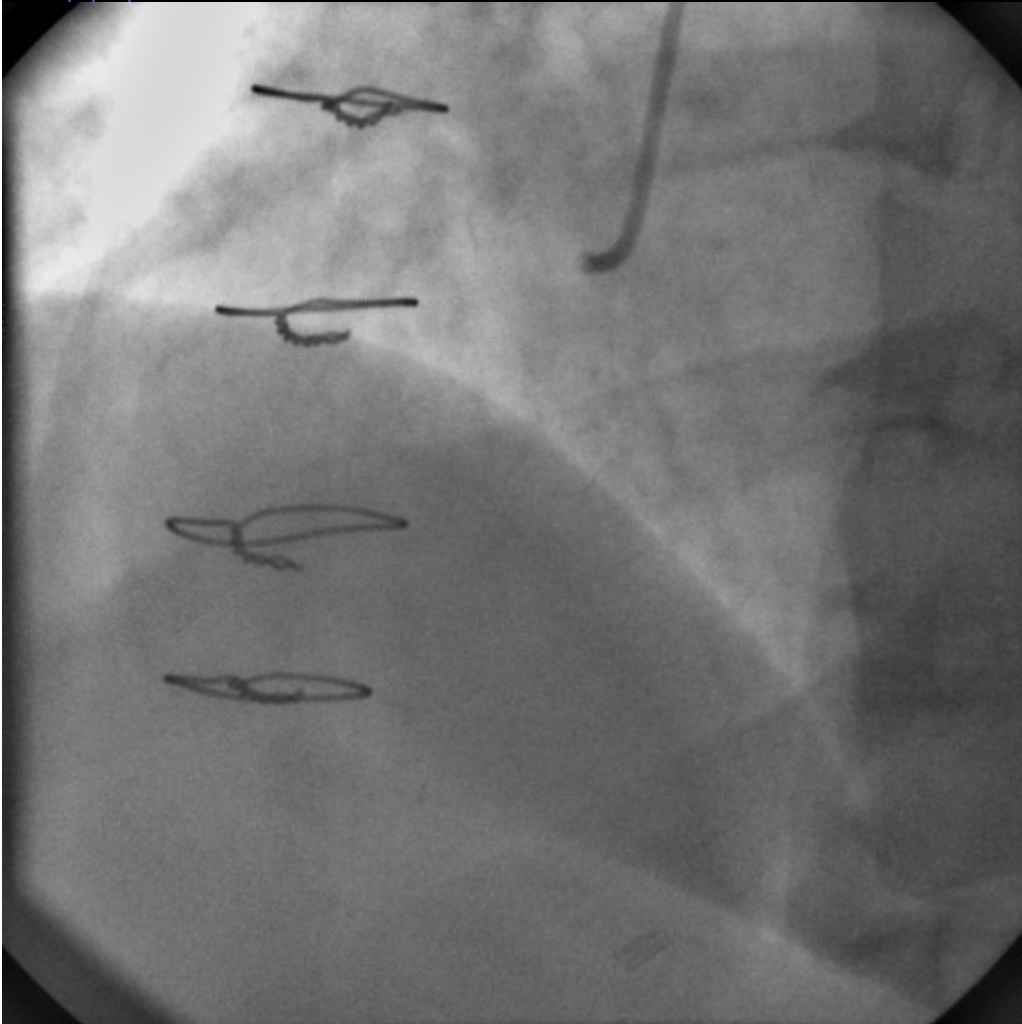
# Dissection after PTCA



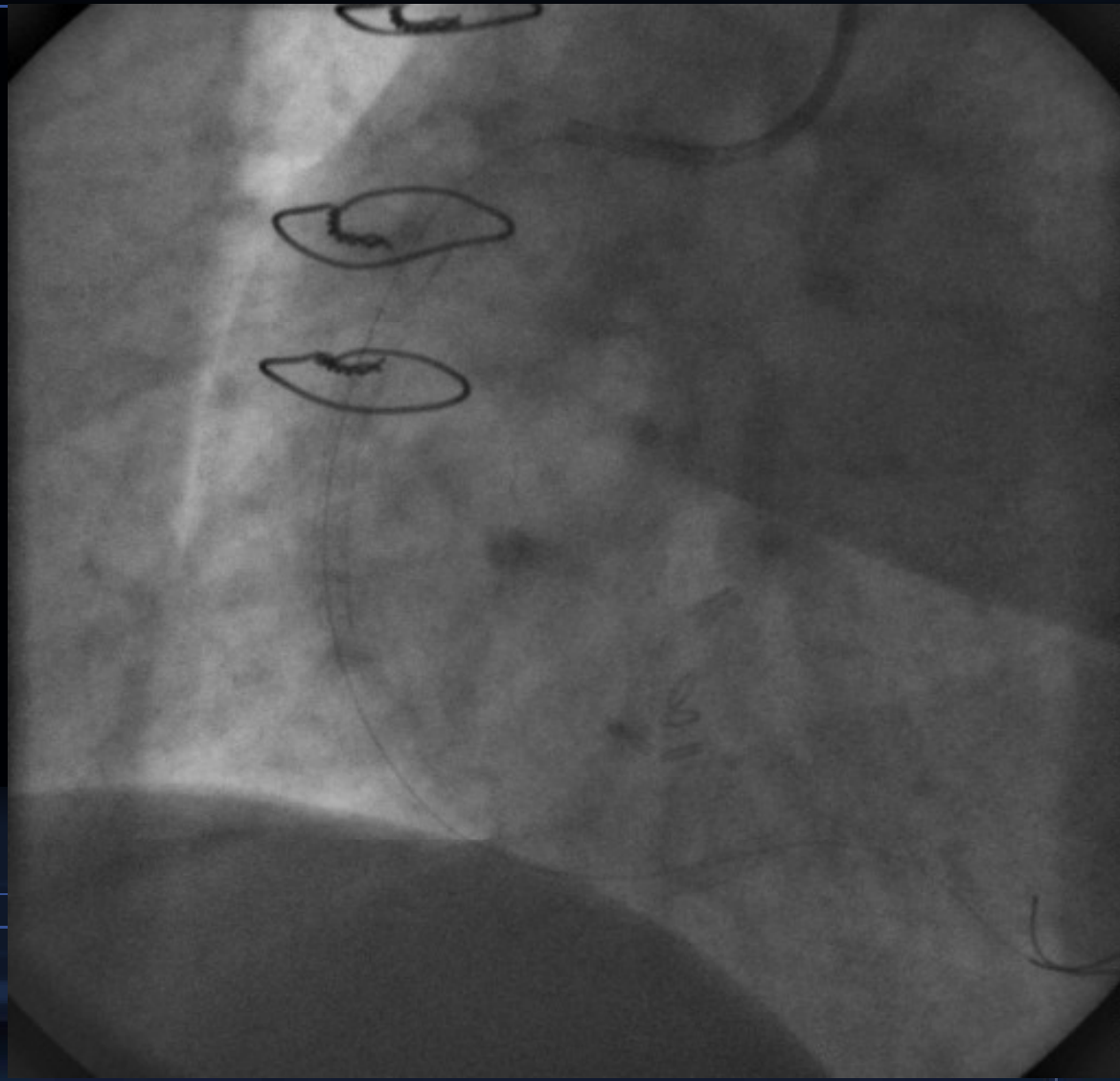
# Dissection after Stenting



**58Y/F Unstable angina, PostCABG (1998), HT, DM, HL, CHF**  
**Normal CK-MB, Tnl**



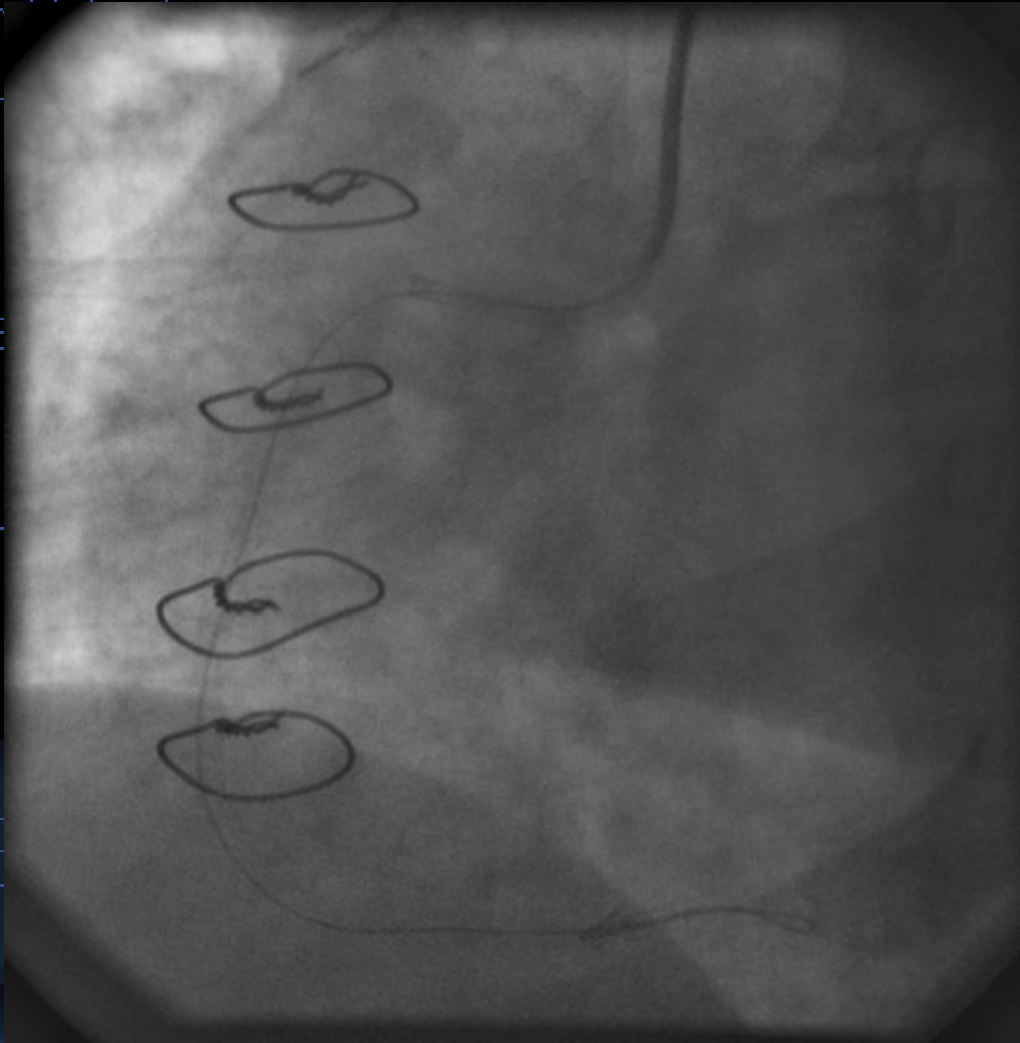
# 3.5\*33mm Cypher stent for mRCA at 14 atm





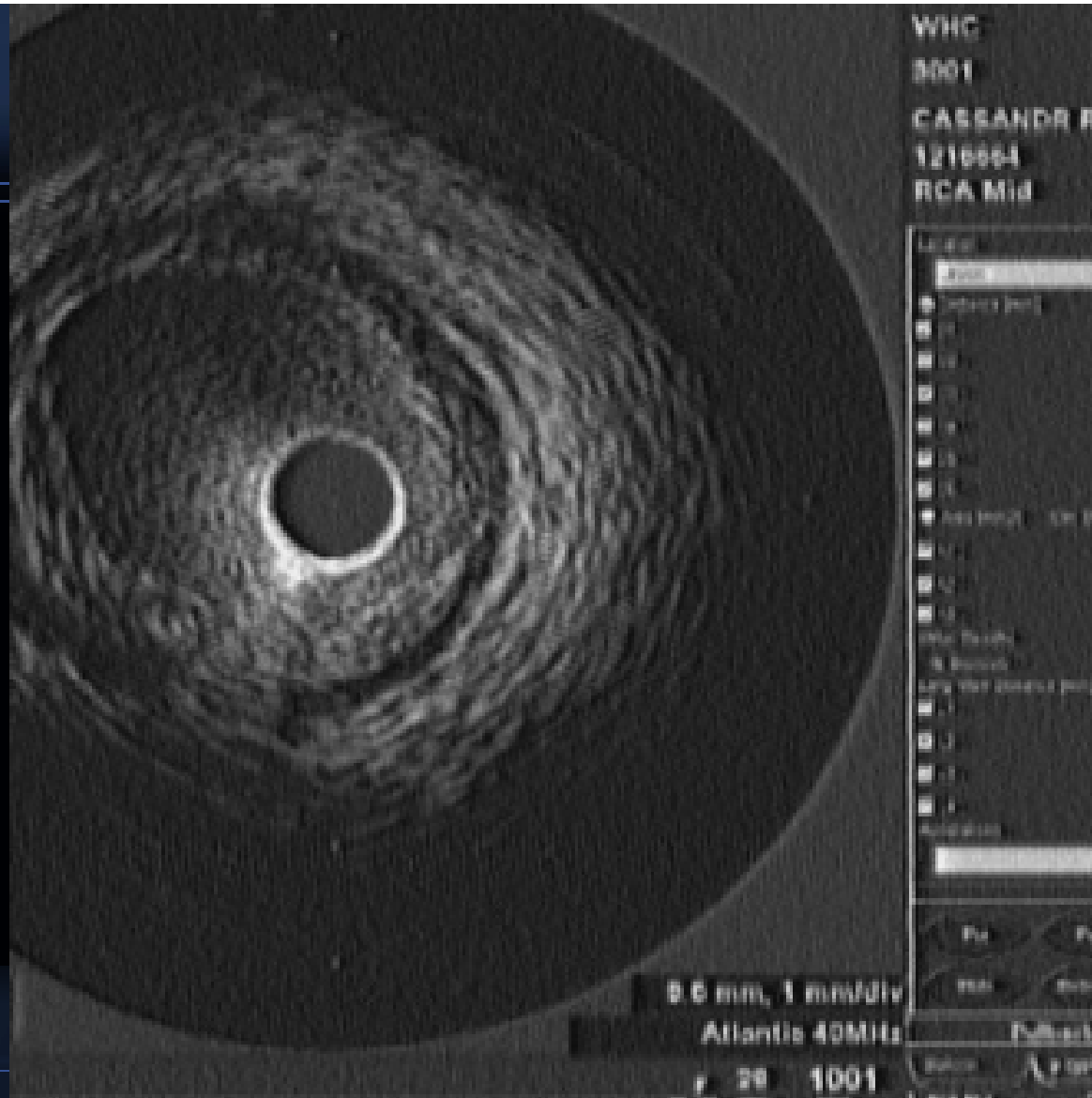
4 hours after stenting, Severe chest pain with ST elevation in II,III,aVF

CK-MB 25.9 ng/ml, Tnl 10.6 ng/ml



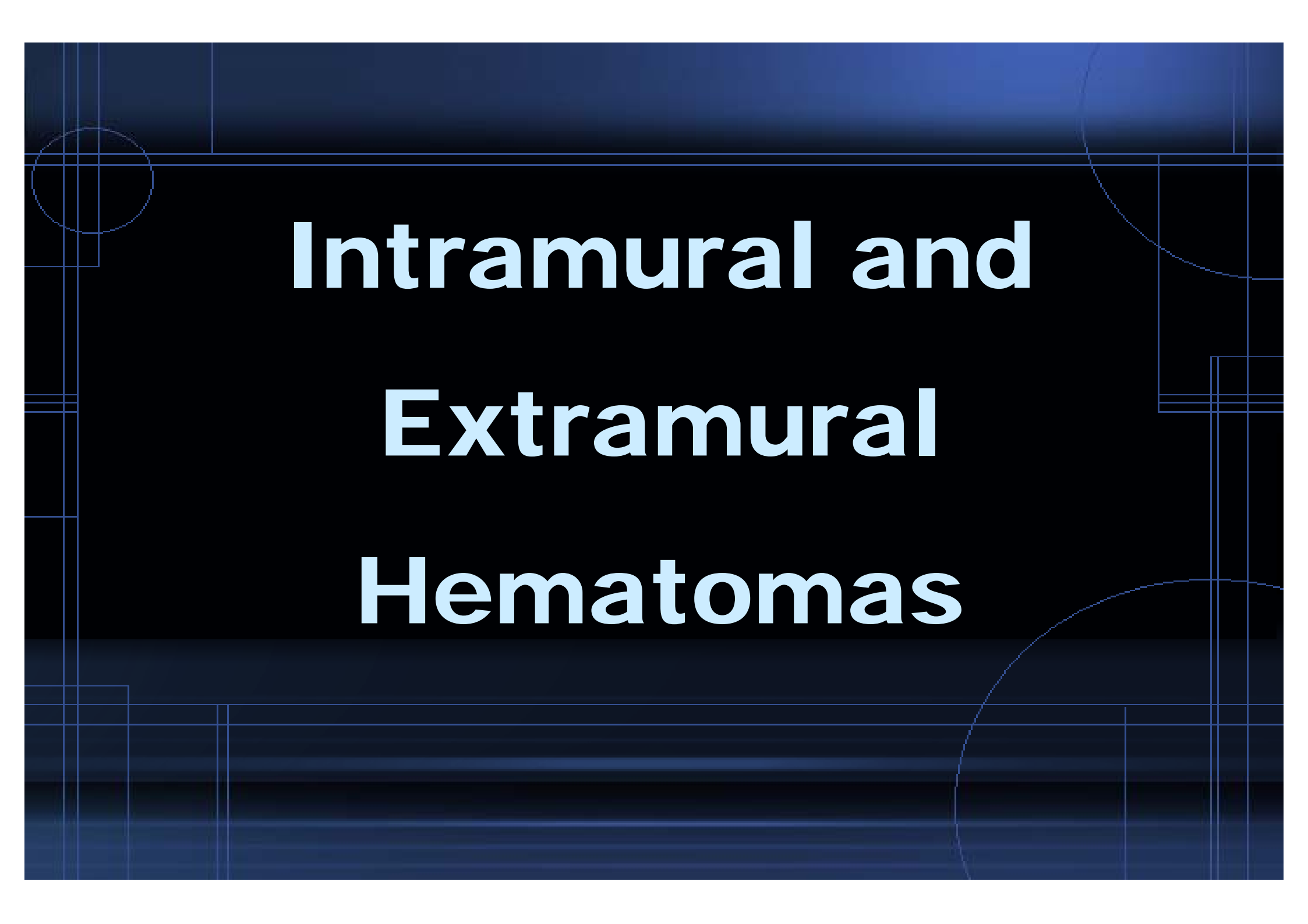
Acute stent thrombosis

**Just after  
PCI**



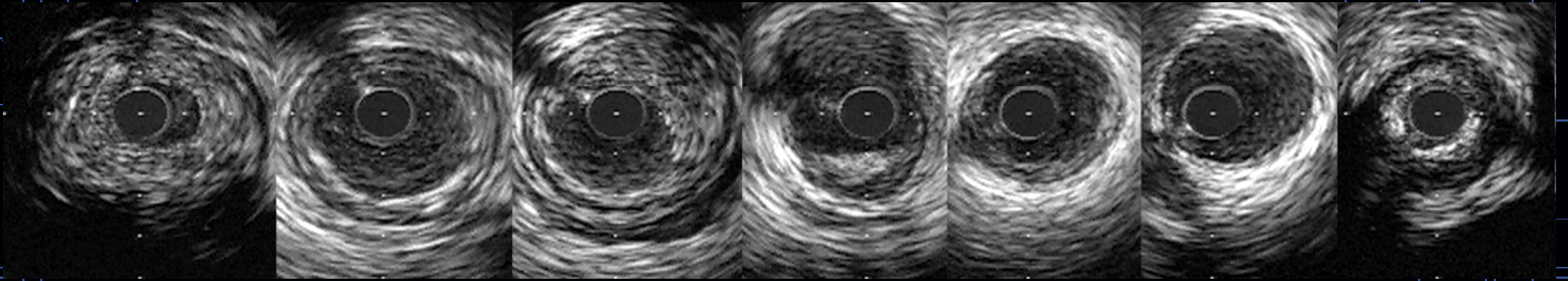
**Distal stent edge dissection,  
Thrombus, reference segment plaque burden**



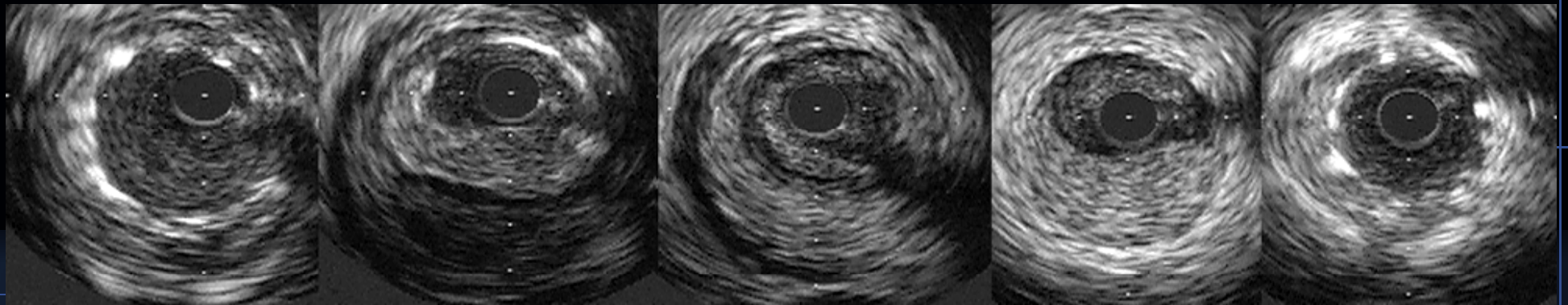


# Intramural and Extramural Hematomas

# Intramural and Extramural Hematomas

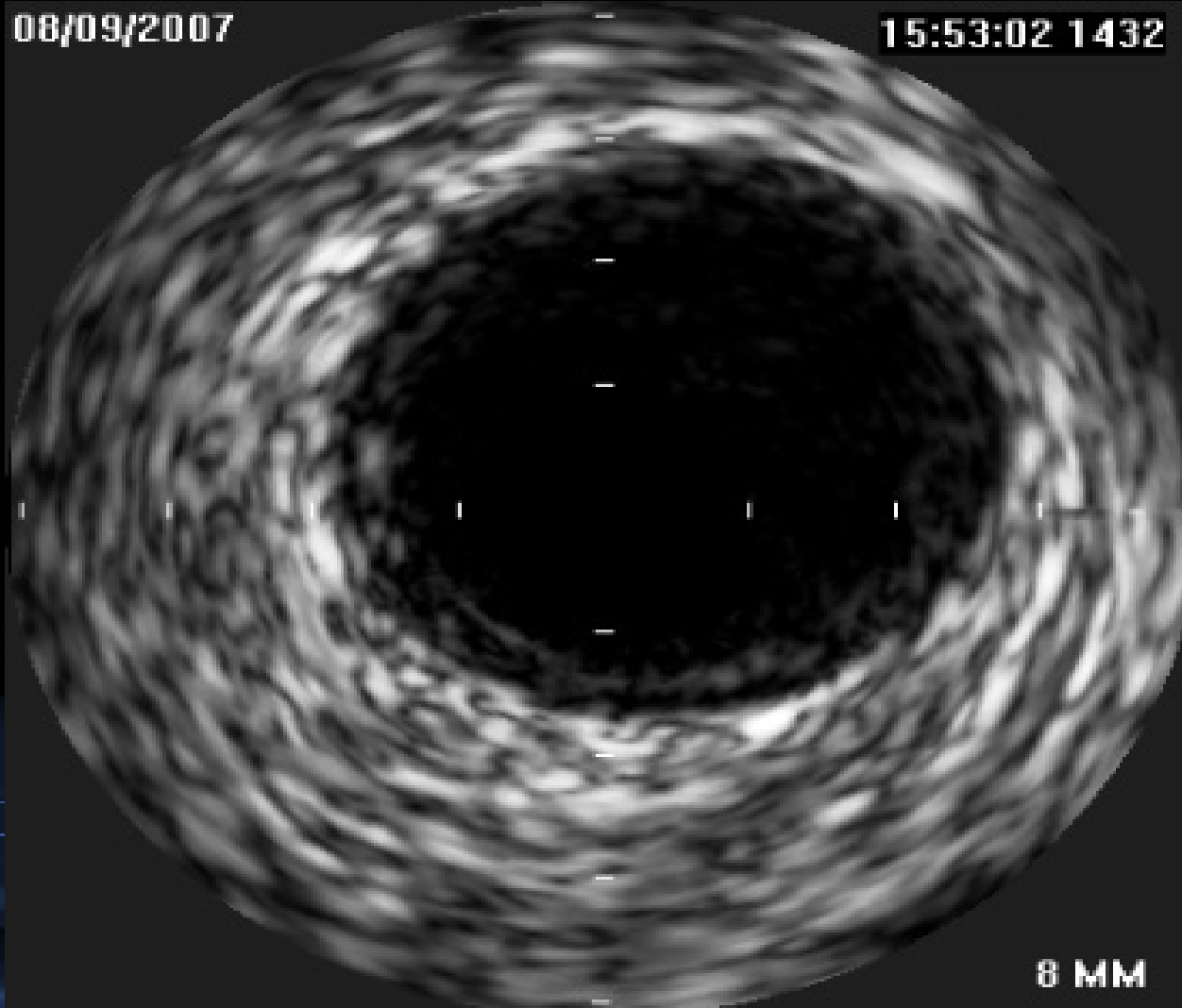


0 → 1.25mm → 7.5mm

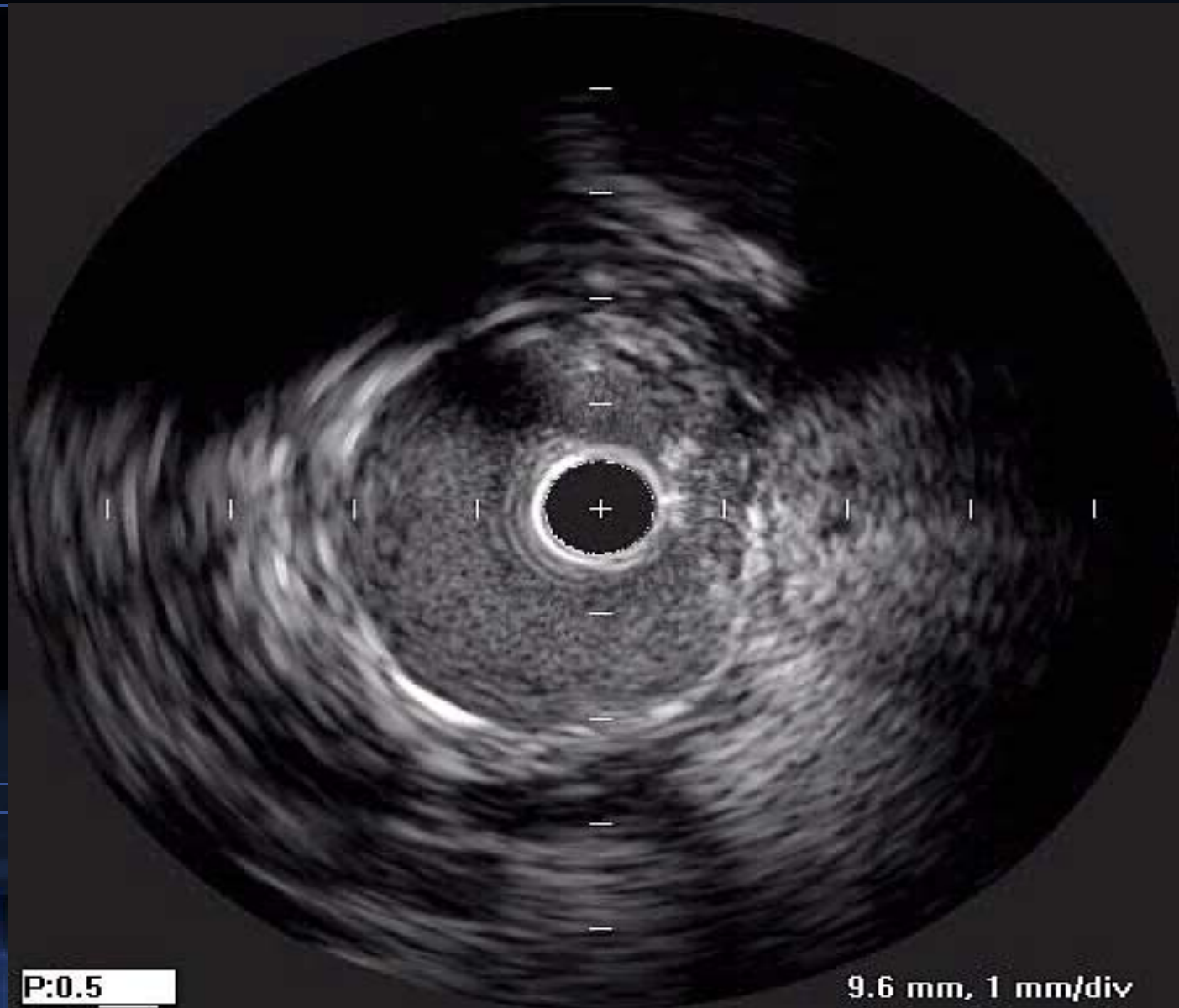


0 → 2mm → 8mm

# Intramural Hematoma

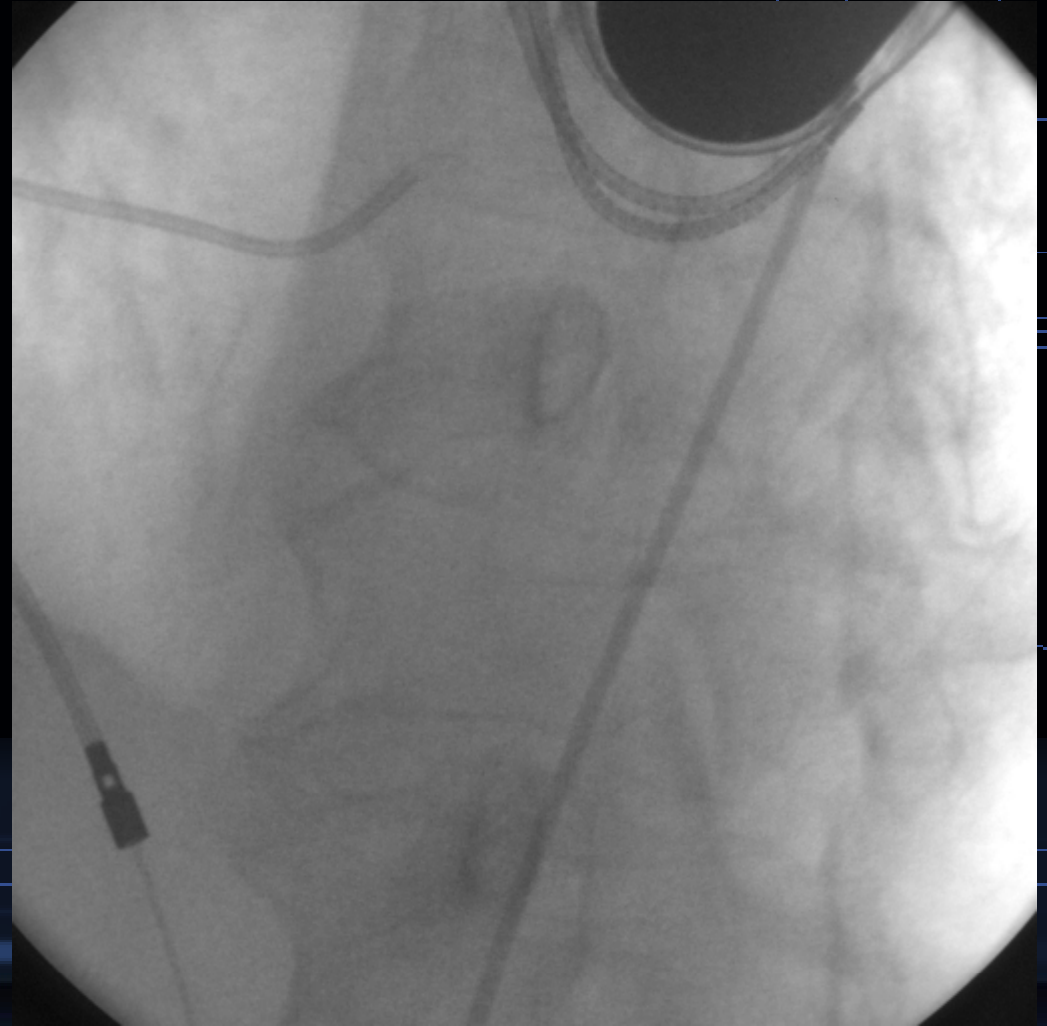
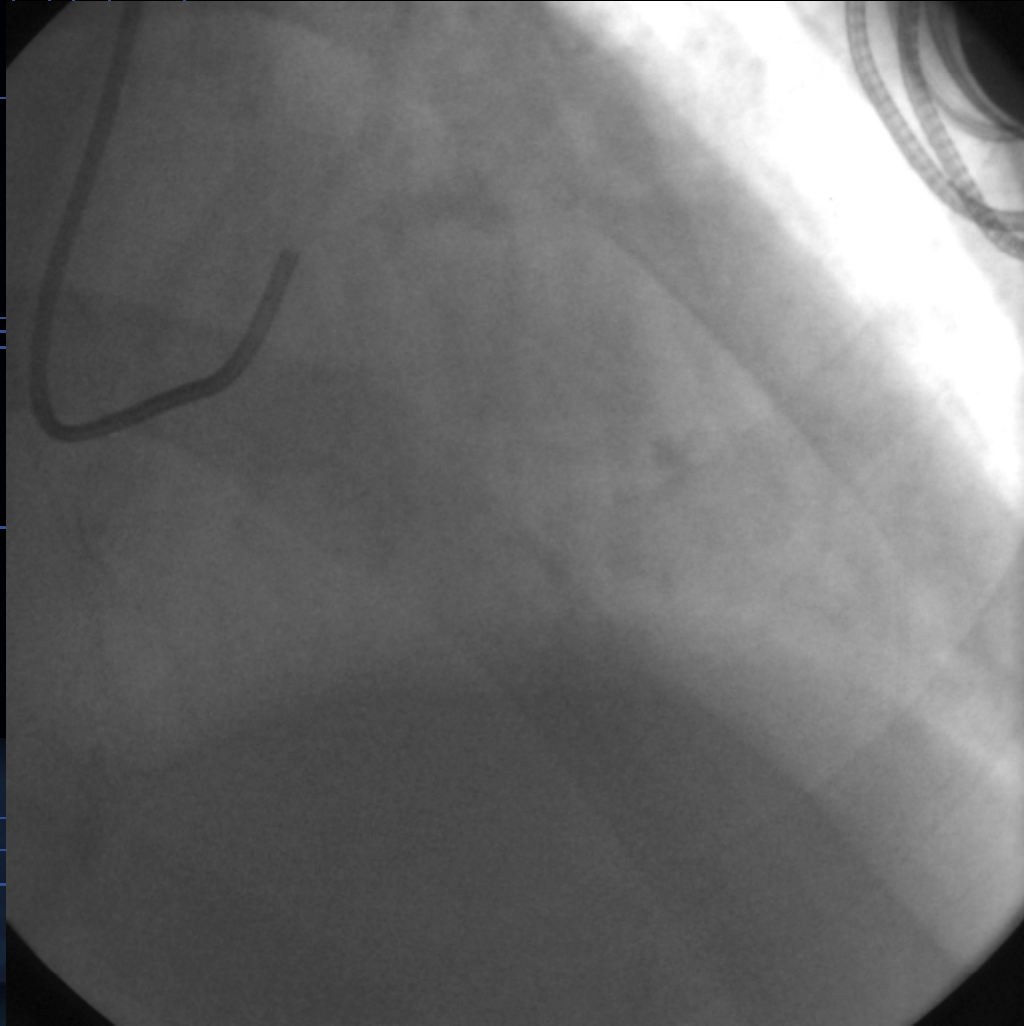


# Extramural Hematoma



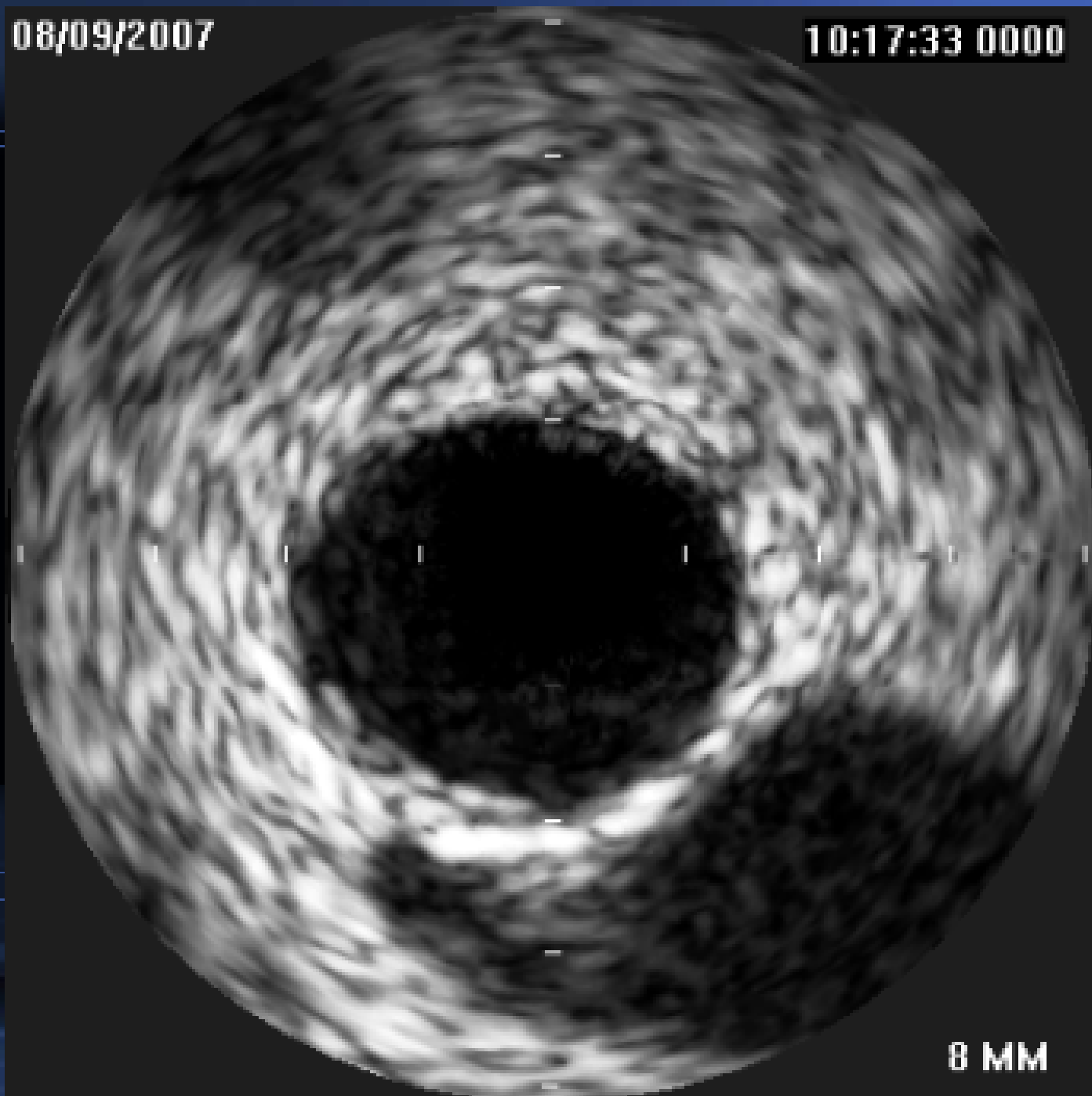
# Thrombus and No-reflow

74/M UAP, HT, DM, ESRD (HD), s/p PPM (VDD)



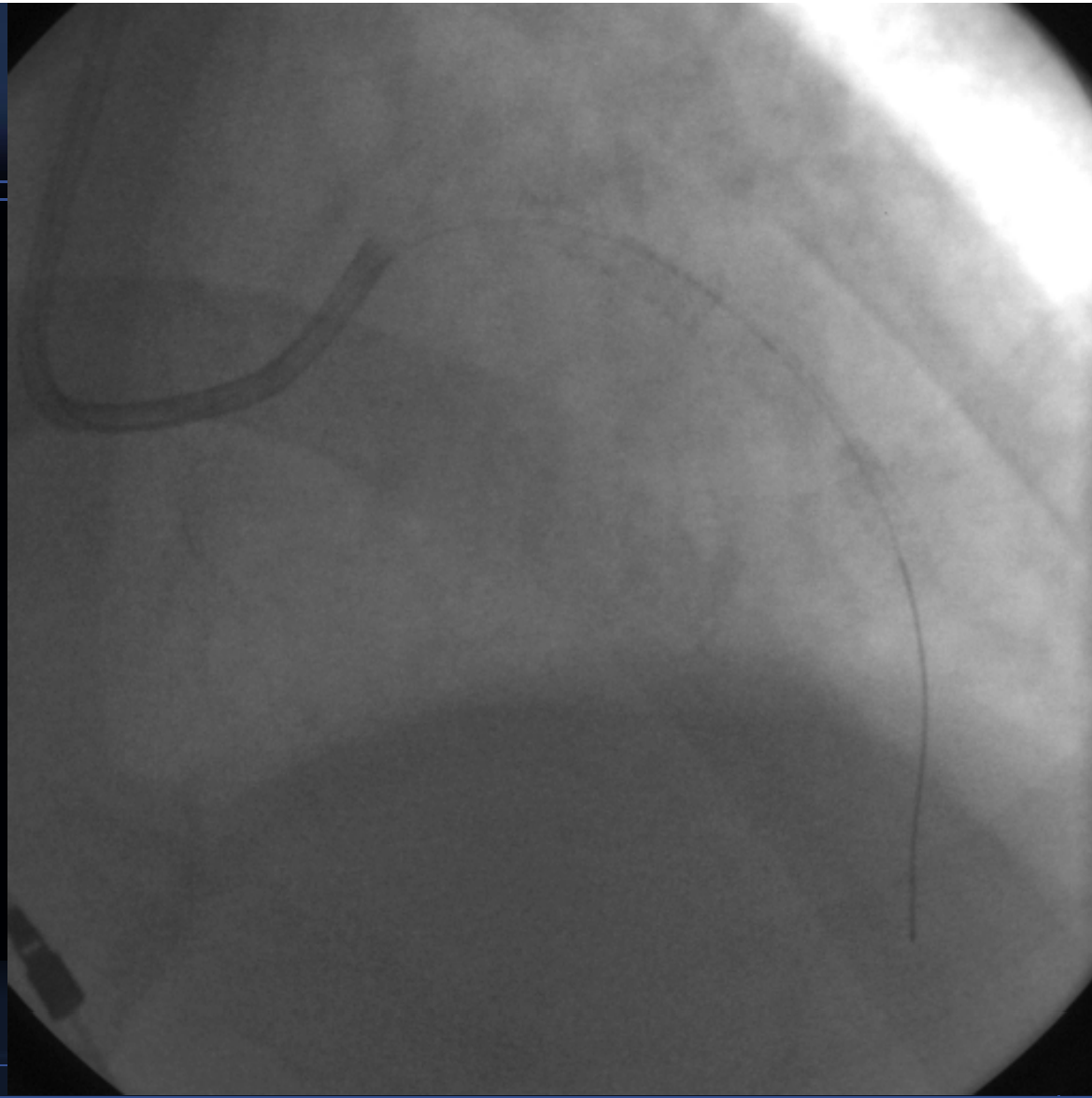
08/09/2007

10:17:33 0000



8 MM



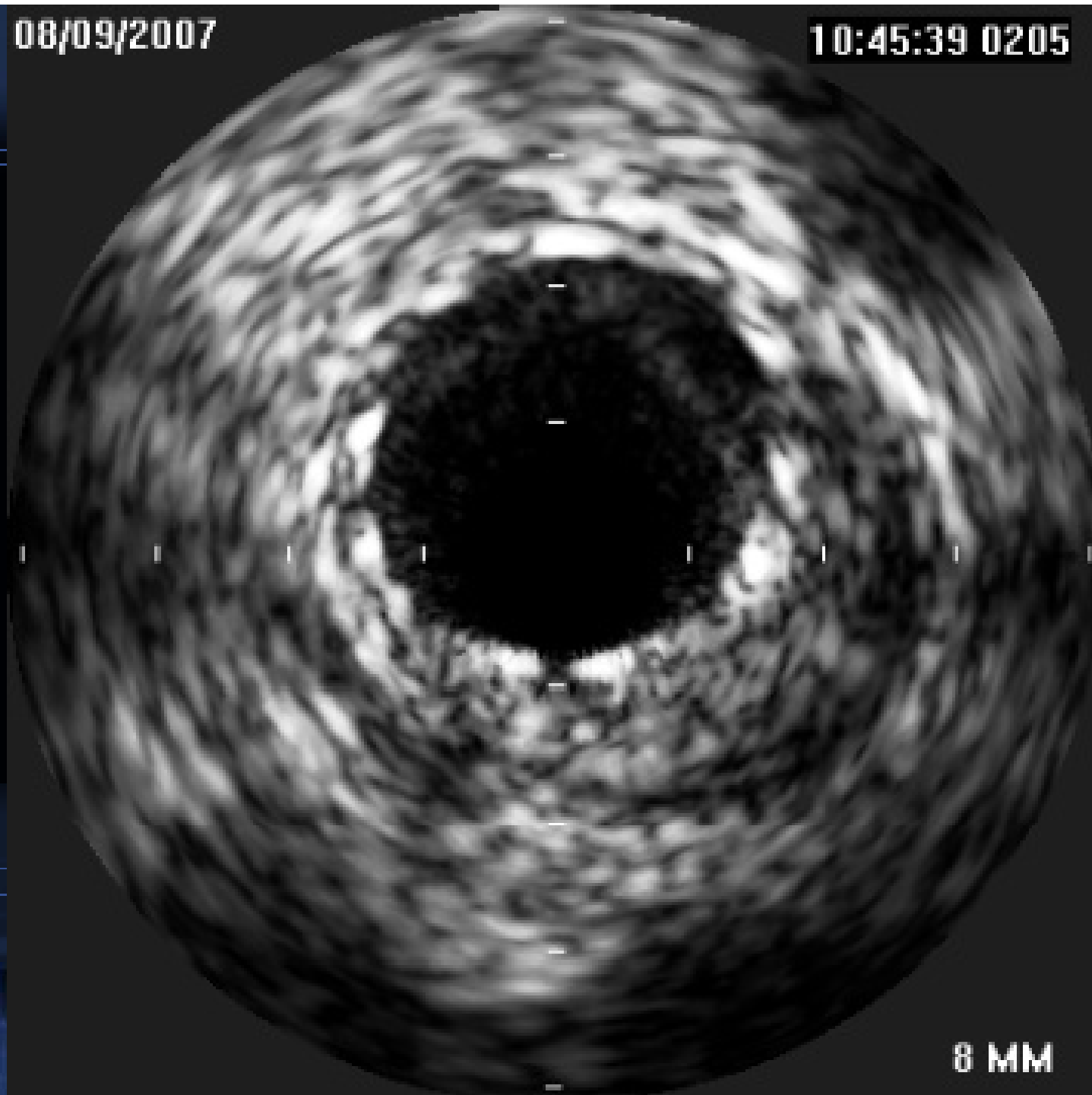


**3.5\*38mm stent for mLAD at 8atm**  
**3.5\*18mm stent for pLAD at 14atm**



08/09/2007

10:45:39 0205

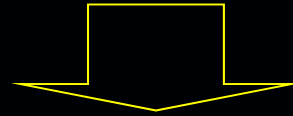


8 MM

# IVUS-Guided Intervention

## **Pre-interventional lesion assessment**

**Severity of coronary stenosis**  
**Lesion characteristics**  
**Anatomical relationship with other vessel**



## **Choice of devices**

**Determine device size and length**  
**Making strategy of intervention**



## **Post-interventional assessment**

**Accuracy of intervention**  
**Procedure-related complications**

# Conclusions

- To achieve stent optimization and to detect post-stenting complications

Use IVUS



**Thank You For Your  
Attention!**