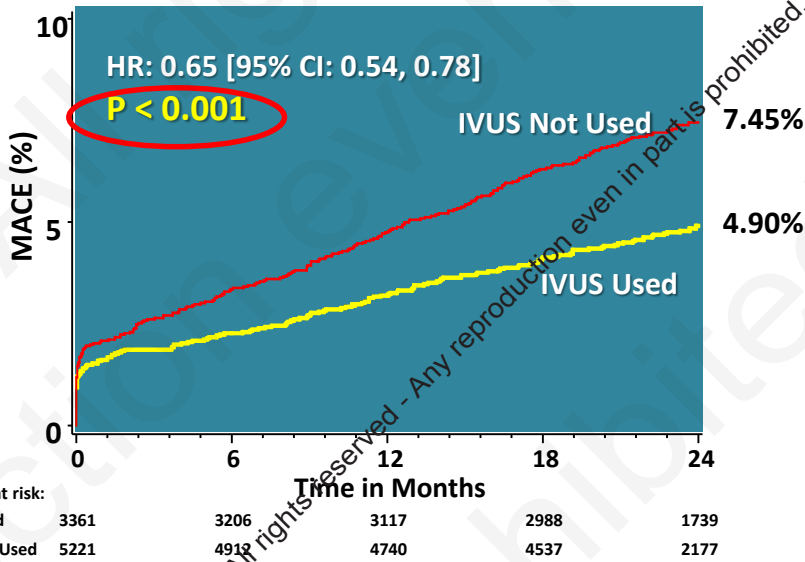# IVUS: When And How I Use It
Case Presentation

Linda Lison and Teguh Santoso

Medistra Hospital
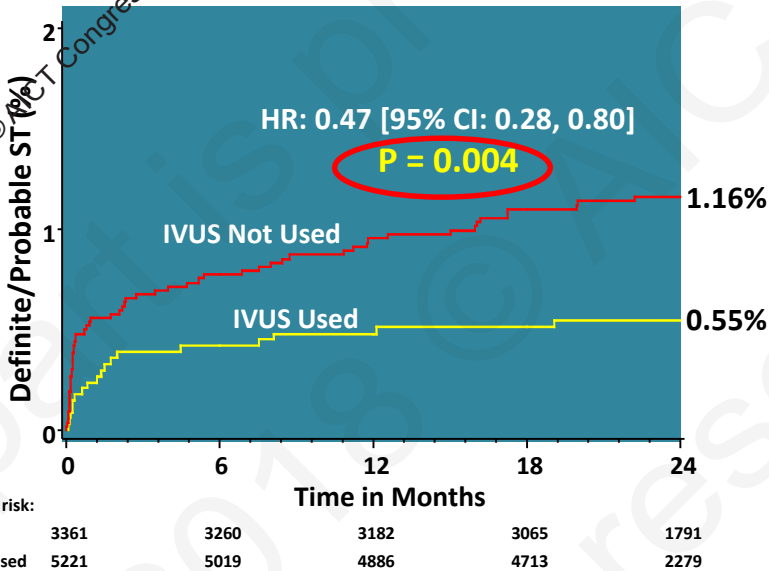
Jakarta

MACE (Definite/Probable ST, Cardiac Death, MI)

HR: 0.65 [95% CI: 0.54, 0.78]
P < 0.001

IVUS Not Used — 7.45%
IVUS Used — 4.90%

Number at risk:

IVUS Used	3361	3206	3117	2988	1739
IVUS Not Used	5221	4912	4740	4537	2177

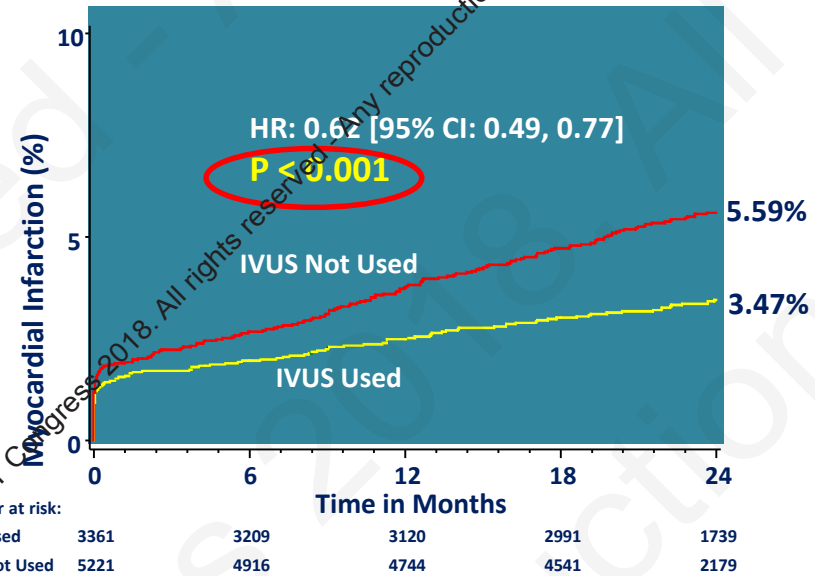# ADAPT-DES:

Two year f-up data from (3361 pts treated with IVUS-guidance vs 5221 pts treated with angiographic guidance)
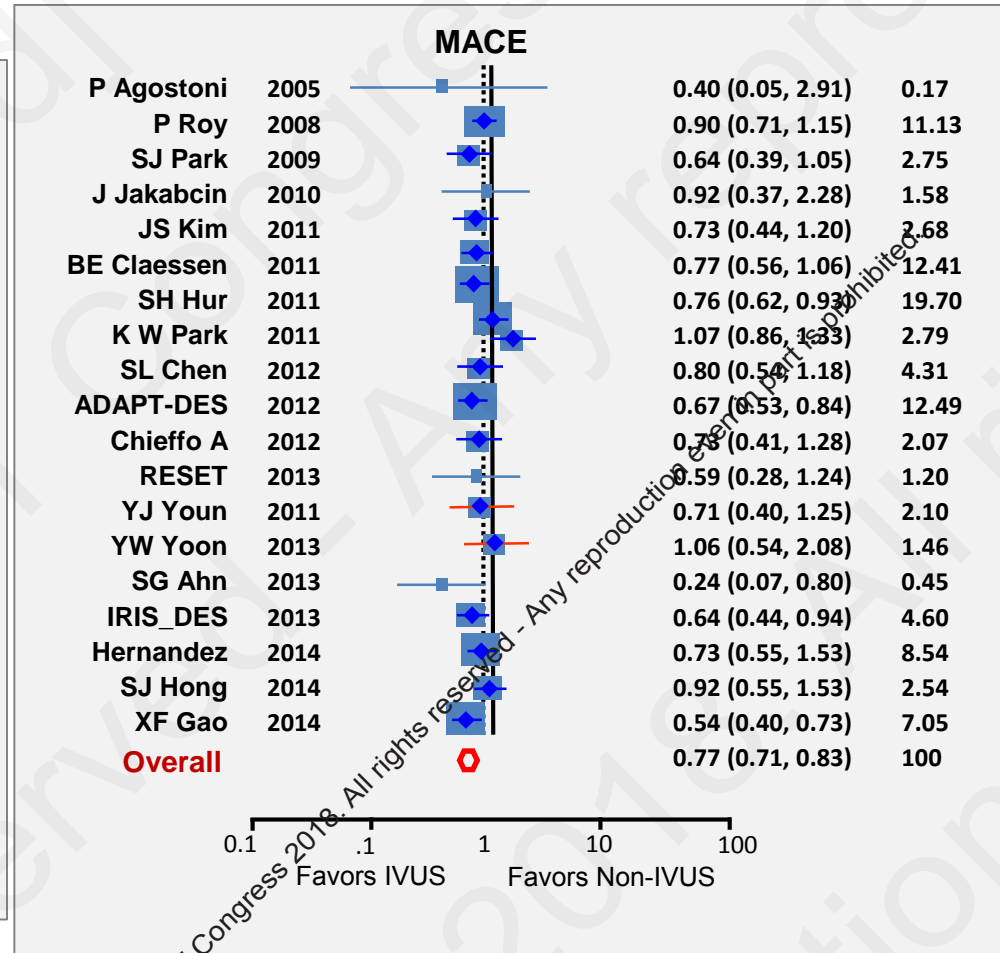
Definite/Probable ST

HR: 0.47 [95% CI: 0.28, 0.80]
P = 0.004

IVUS Not Used — 1.16%
IVUS Used — 0.55%

Number at risk:

IVUS Used	3361	3260	3182	3065	1791
IVUS Not Used	5221	5019	4886	4713	2279

Myocardial Infarction

HR: 0.62 [95% CI: 0.49, 0.77]
P < 0.001

IVUS Not Used — 5.59%
IVUS Used — 3.47%

Number at risk:

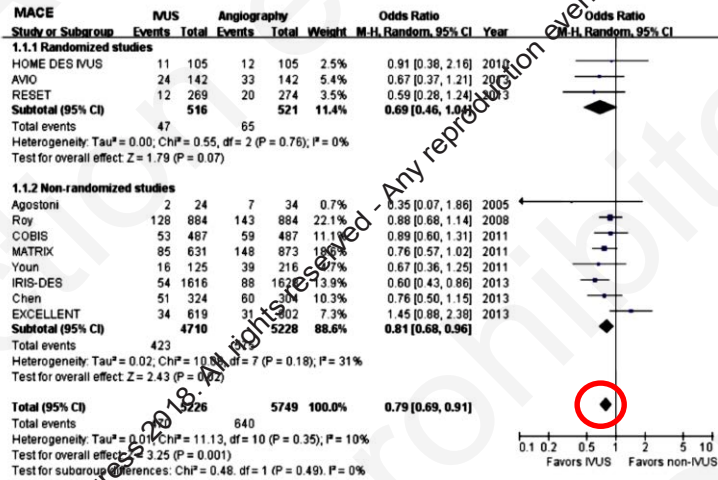|					
IVUS Used	3361	3209	3120	2991	1739
IVUS Not Used	5221	4916	4744	4541	2179

Maehara et al. J Am Coll Cardiol 2013;62:B21-B22

Meta-Analysis of 20 DES Studies
(n=29,068)

Compared with angiographic guidance, **IVUS-guided DES implantation** was associated with **reduced rates** of:
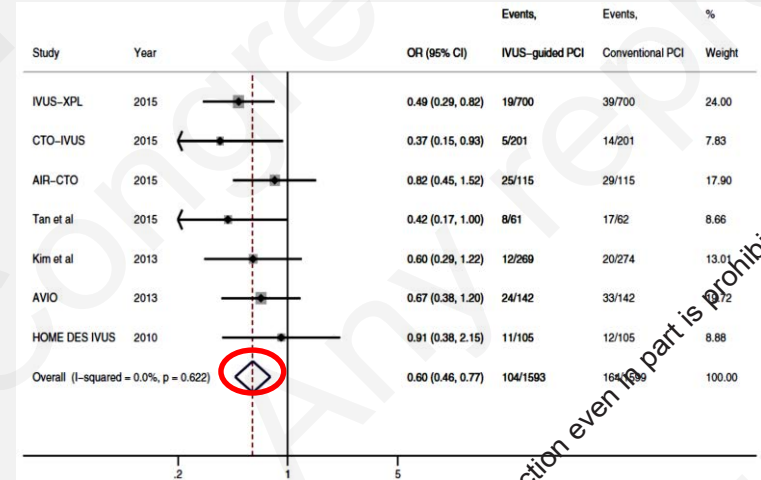
- **Death**
  HR 0.62 (0.54-0.71), p<0.001

- **MACE**
  HR 0.77 (0.71-0.83), p<0.001

- **Stent thrombosis**
  HR 0.59 (0.47-0.73), p<0.001

MACE			
P Agostoni	2005	0.40 (0.05, 2.91)	0.17
P Roy	2008	0.90 (0.71, 1.15)	11.13
SJ Park	2009	0.64 (0.39, 1.05)	2.75
J Jakabcin	2010	0.92 (0.37, 2.28)	1.58
JS Kim	2011	0.73 (0.44, 1.20)	2.68
BE Claessen	2011	0.77 (0.56, 1.06)	12.41
SH Hur	2011	0.76 (0.62, 0.93)	19.70
K W Park	2011	1.07 (0.86, 1.33)	2.79
SL Chen	2012	0.80 (0.54, 1.18)	4.31
ADAPT-DES	2012	0.67 (0.53, 0.84)	12.49
Chieffo A	2012	0.73 (0.41, 1.28)	2.07
RESET	2013	0.59 (0.28, 1.24)	1.20
YJ Youn	2011	0.71 (0.40, 1.25)	2.10
YW Yoon	2013	1.06 (0.54, 2.08)	1.46
SG Ahn	2013	0.24 (0.07, 0.80)	0.45
IRIS_DES	2013	0.64 (0.44, 0.94)	4.60
Hernandez	2014	0.73 (0.55, 1.53)	8.54
SJ Hong	2014	0.92 (0.55, 1.53)	2.54
XF Gao	2014	0.54 (0.40, 0.73)	7.05
Overall		0.77 (0.71, 0.83)	100

0.1 .1 1 10 100
Favors IVUS   Favors Non-IVUS

Zhang Y et al. BMC Cardiovasc Dis 2015;15:153

More Meta-Analyses In Real World Cases: All Favoring IVUS Guided PCI
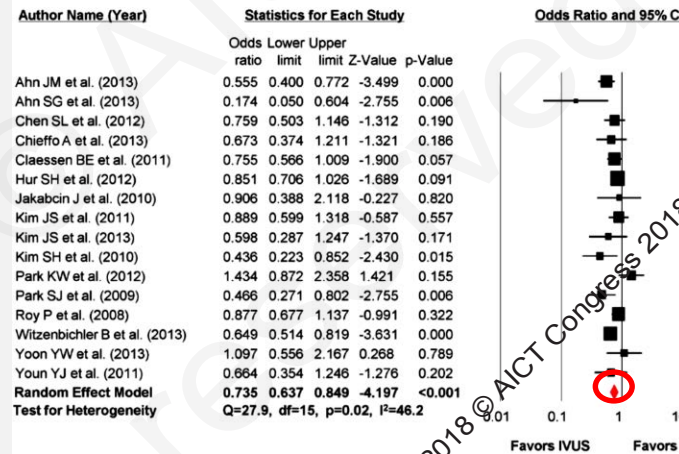

JACC Cardiovasc Interv 2014; 7: 233-43.

Circ Cardiovasc Interv. 2016 Apr;9(4):e003700

Am J Cardiol 2014; 113: 1338-47.

So ..

In Simple And Also In Real World Complex Cases:
IVUS Guided PCI Is Better Than Angio Guided PCI

But ..
based on IVUS findings,

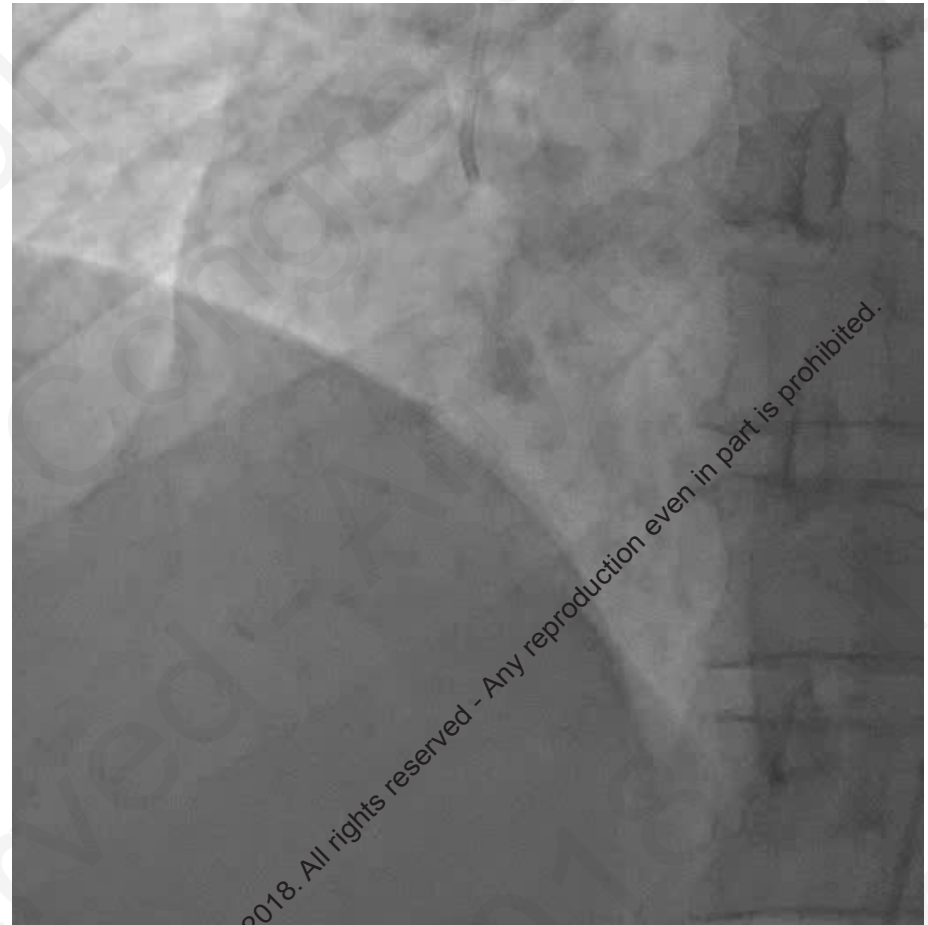can we *defer PCI*

even though there are *ischemic symptoms*
(i.e. acute coronary syndrome)
& angiography shows *critical stenosis* ?

Case 1

- MS, female, 45 yrs old
- Chest pain while doing exercise
- Risk factors: none
- PE: 135/85, otherwise, unrevealing
- Lab: normal CK, CK-MB and troponin
- ECG: ST depressions in II, III, avF
- Chest film: normal

- **Diagnosis:**
Acute coronary syndrome (unstable angina)

Cath: LM/LAD/LCX: normal
RCA: tubular stenosis in pRCA

Case 1: IVUS :
Spontaneous Coronary Artery Dissection (SCAD)

SCAD Type 3
PCI was deferred

Case 2

- SA, female, 42 yrs old
- Sudden onset of chest pain after psychological stress
- Risk factors: none
- PE: 110/80, otherwise, unrevealing
- Lab: elevated CK, CK-MB and troponin
- ECG: down-sloping ST depressions in V2-6
- Chest film: normal

- **Diagnosis: NSTEMI**

Case 2. Angiogram

Cath: LM / LCX / RCA: normal;

LAD: diffuse stenosis in mLAD terminating in total occlusion distally. Non-responsive to IC nitrates.

Case 2: IVUS (from mLAD)
Spontaneous Coronary Artery Dissection (SCAD)

SCAD Type 2
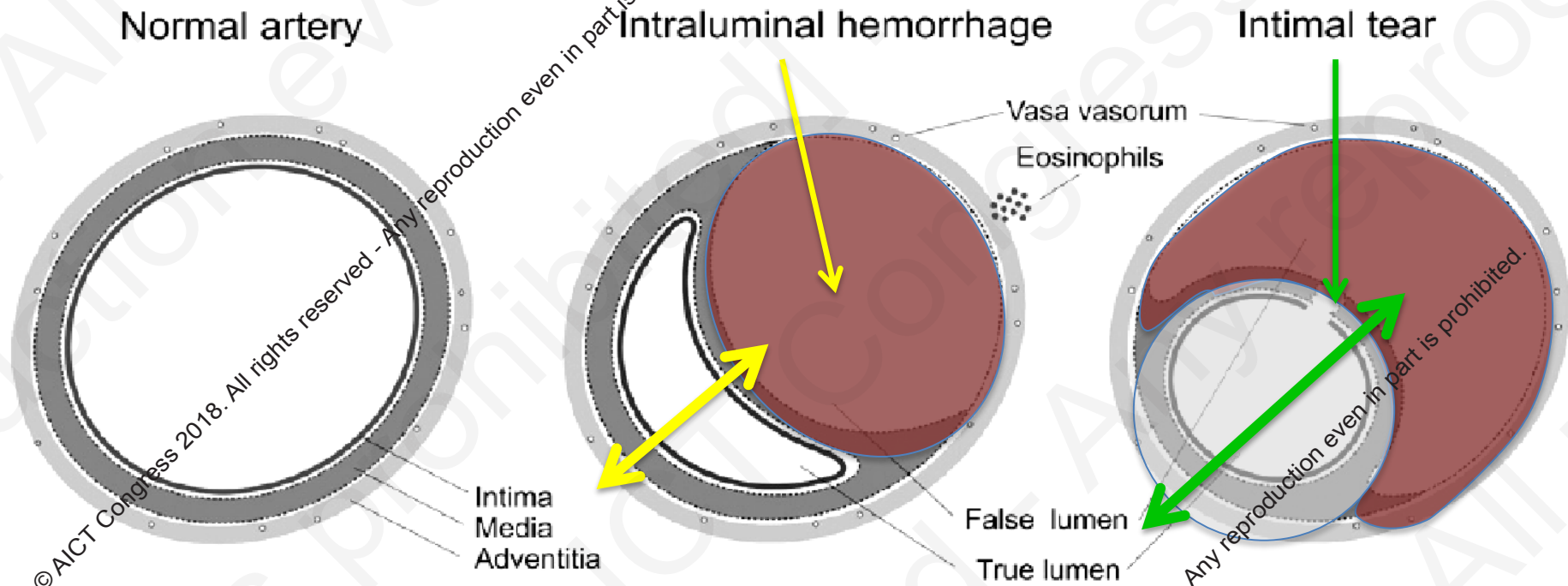**PCI was deferred**

Spontaneous Coronary Artery Dissection (SCAD)

Definition:

- **Non-traumatic and non-iatrogenic** separation of the coronary arterial wall by **intramural hemorrhage** creating a false lumen, with or without an intimal tear

- Separation can occur between the **intima and media**, or between the **media and adventitia**

- Resulting **intramural hematoma compresses the arterial lumen**, compromising antegrade blood flow, and can cause **myocardial ischemia or infarction**
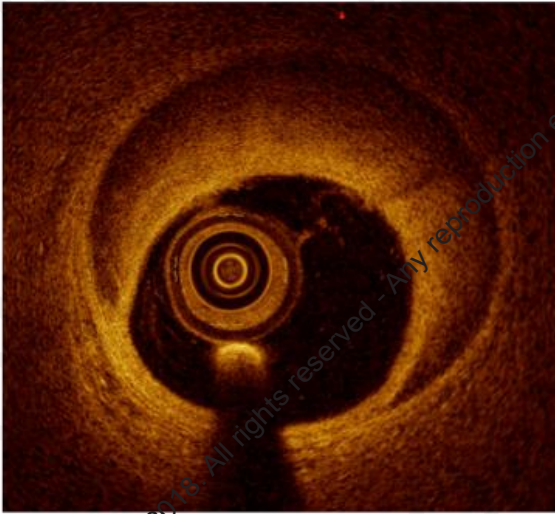
Al-Daraji. Histopathology 2005.

Mechanisms of SCAD

Normal artery · Intraluminal hemorrhage · Intimal tear

Vasa vasorum
Eosinophils
Intima
Media
Adventitia
False lumen
True lumen

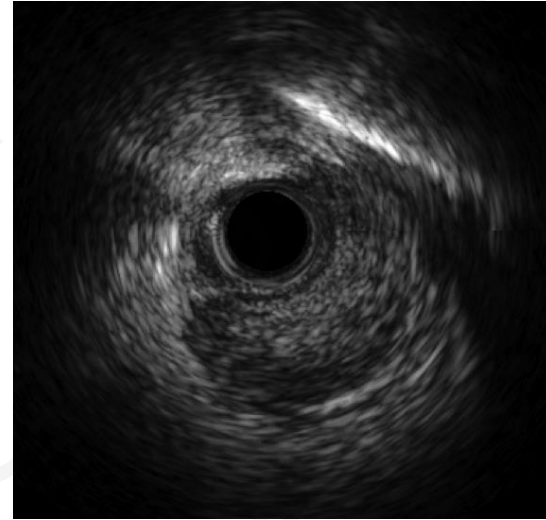- **Intimal tear initiating dissection**

- Spontaneous bleed from **vasa vasorum** (e.g. increase density from atherosclerosis, eosinophilic degranulation)

- Continued arterial pressurization leads to **longitudinal and circumferential propagation and coronary occlusion** due to intimal flaps
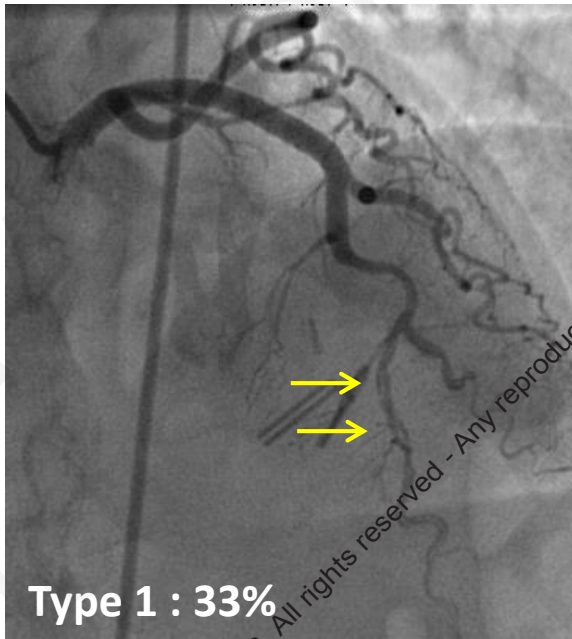
Maehara A, et al. Am J Cardiol 2002;89:466-8.
Saw J. Can J Cardiol Sep 2013;29:1027-33

Intracoronary Imaging For SCAD

OCT:

- Better resolution (10-20 microns)
- Clearly delineate true/false lumen, intramural hematoma, intimal tear, intraluminal thrombi
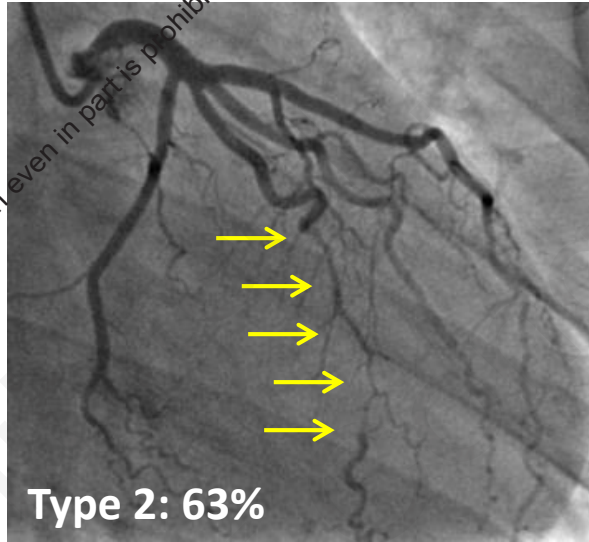- Poorer penetration (may not see full extension of hematoma in some areas)

IVUS:

- Lower resolution (150-200 microns)
- Can delineate true/false lumen, intramural hematoma, intraluminal thrombi
- May not visualize intimal tear
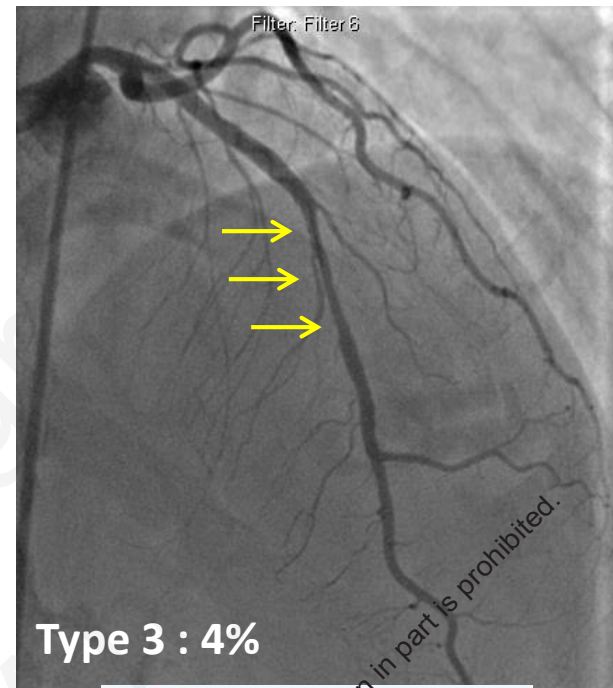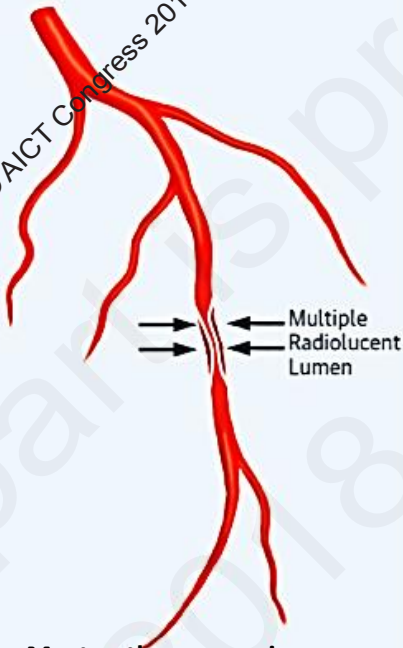- Better penetration (can visualize full vessel extent of hematoma)
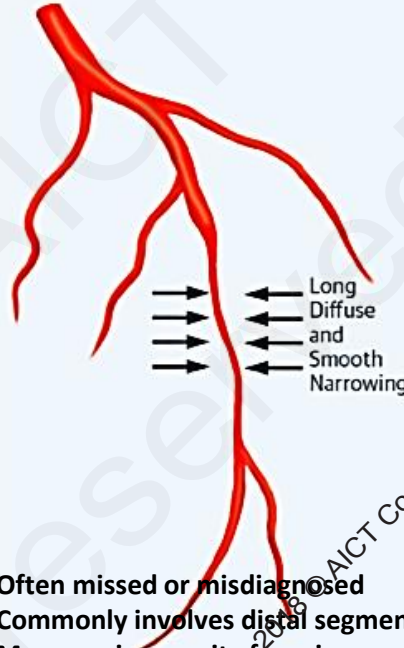
Types Of SCAD
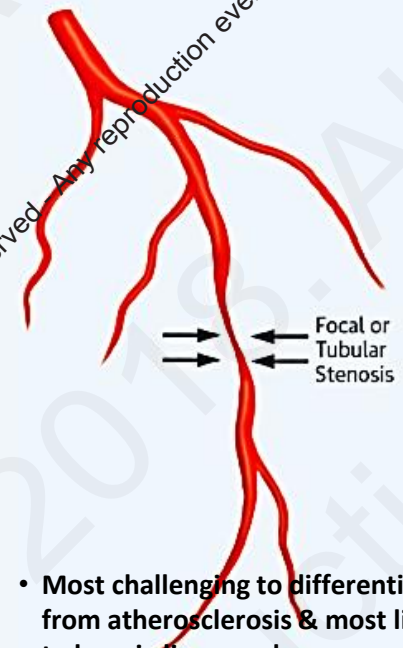

Type 1 : 33%

Type 2: 63%

Type 3 : 4%

Multiple Radiolucent Lumen

Long Diffuse and Smooth Narrowing

Focal or Tubular Stenosis

- **Most pathognomonic**
- **Constant dye staining arterial wall**

- **Often missed or misdiagnosed**
- **Commonly involves distal segment**
- **May vary in severity from inconspicious mild stenosis to complete occlusion**

- **Most challenging to differentiate from atherosclerosis & most likely to be misdiagnosed**
- **IVUS / OCT helpful**

Management of SCAD Patients

- Early diagnosis
  (coronary angiogram +/- IVUS or OCT)

- Revascularization versus conservative therapy

- Medical therapy: long-term ASA, beta-blocker

- Vascular screen (fibro-muscular dysplasia, +/- genetics)
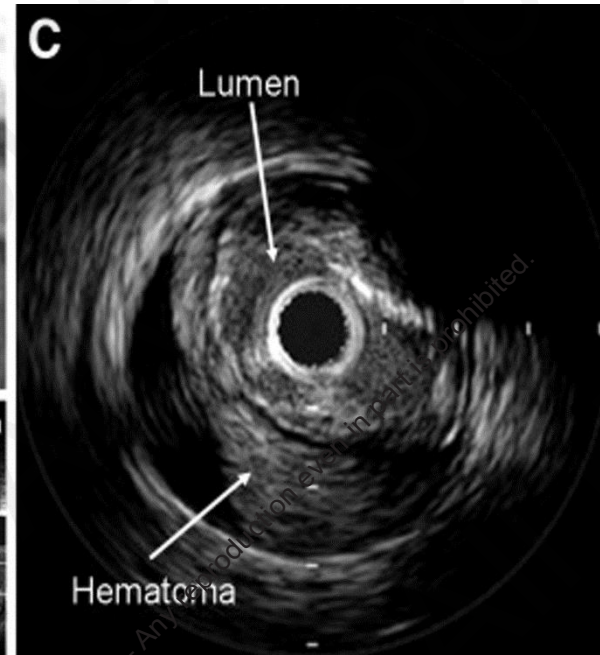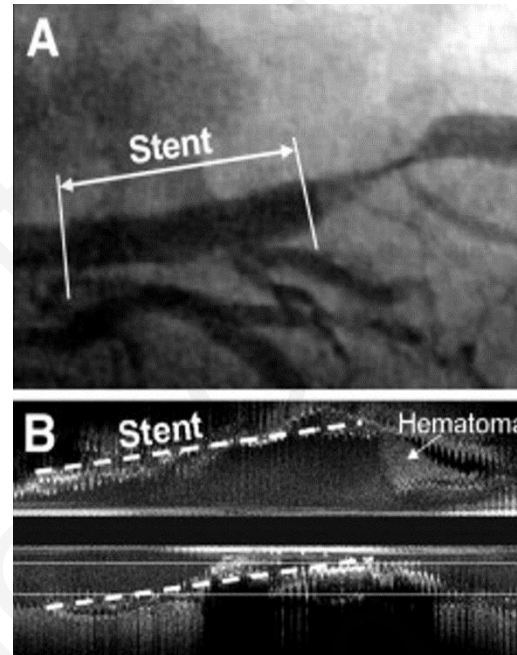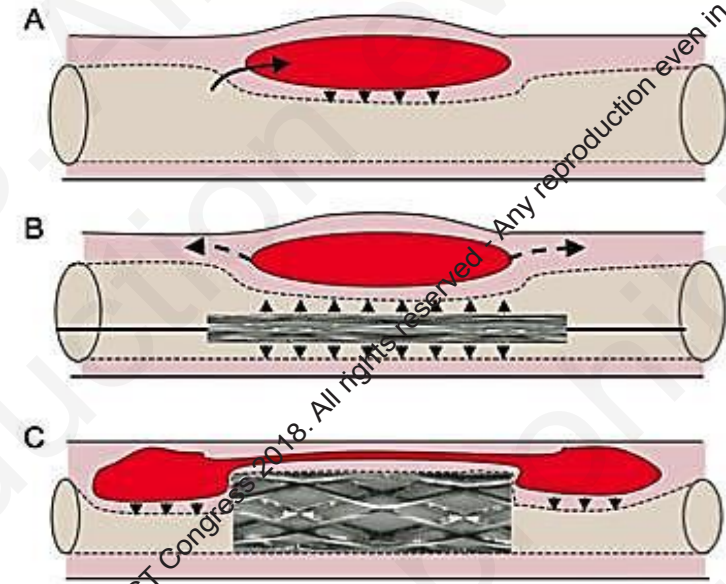
- Long-term cardiovascular follow-up

Revascularization vs. Conservative Tx?

- ***Conservative therapy preferred for stable or "stabilized" unstable patients***
  - SCAD often heals spontaneously

- **PCI** only indicated when:
  - Ongoing ischemia, chest pain, ST elevation, hemodynamic instability
  - SCAD involves major vessels and not too diffuse
  - If PCI is performed: use scoring balloon for predilatation, stent from healthy segment distal to intramural hematoma, then proximal to IMH (if necessary 2 stents) & IVUS guided.

- **Emergent CABG** indicated when:
  - Extensive dissection >1 vessel with ongoing ischemia
  - Retrograde dissection into left main

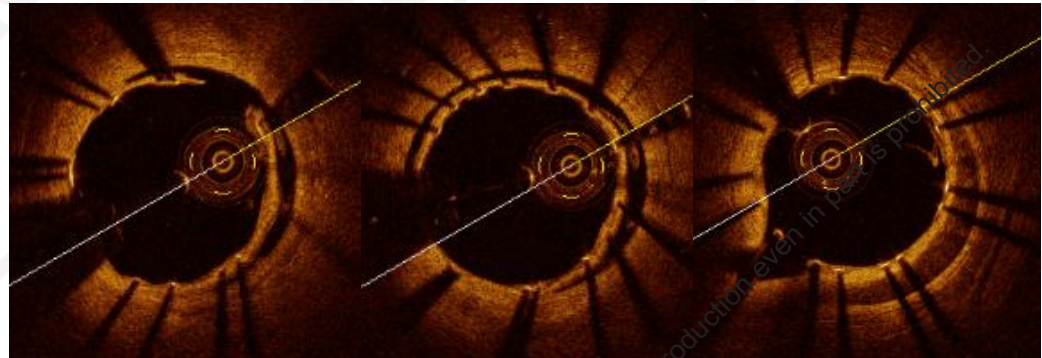Saw J. Can J Cardiol Sep 2013;29(9):1027-33

PCI Challenges with SCAD

- *Difficulty advancing coronary wire* into distal true lumen

- *Propagating intramural hematoma antegrade and retrograde* with angioplasty, extending dissection and further compromising true lumen arterial flow

- *Dissection tends to extend into distal arteries*, which are *too small* for stents

- Often extensive dissected segments requiring *long stents*, *increasing stent restenosis*

- Risk of *stent malapposition after intramural hematoma resorb and heal*, with risk of late stent thrombosis

- *Most dissected coronary arteries heal spontaneously* without revascularization

Propagation of Intramural Hematoma (IMH)

- Balloon dilatation or stenting may propagate intramural hematoma proximally or distally
- If PCI is performed: use scoring balloon for pre-dilatation to break the IMH, stent from healthy segment distal to intramural hematoma, then proximal to IMH (if necessary 2 stents) & IVUS guided.

Tremmel, J. A. *J Am Coll Cardiol Intv* 2011;4:129-130

Stent Malapposition After Resorption Of Intramural Hematoma

- ***Stent mal-apposition is common after intramural hematoma resorb and heal***, with risk of **late stent thrombosis**

Conclusions

- **It is well known that the use of *IVUS during PCI will reduce MACE, death and stent thrombosis***

- The cases of ***spontaneous coronary artery dissection (SCAD)*** presented here illustrate a ***unique utility of IVUS***

- SCAD is a clinical condition where **PCI may have to be deferred** despite the presence of clinical and/or angiographic indication

- SCAD is under-diagnosed and more frequent than previously reported

- **Conservative therapy is the generally recommended treatment** in stable or "stabilized" unstable patients and is associated with angiographic healing at ≥26 day follow-up

- **PCI is associated with poor long-term success**

Thank You

14th

AICT

ASIAN INTERVENTIONAL CARDIOVASCULAR THERAPEUTICS

THE OFFICIAL CONGRESS OF APSIC

7 - 9th September 2018

Hong Kong
Convention and Exhibition Centre (HKCEC)