FFR in Bifurcation Lesions
: We Should be More Physiologic than FFR!

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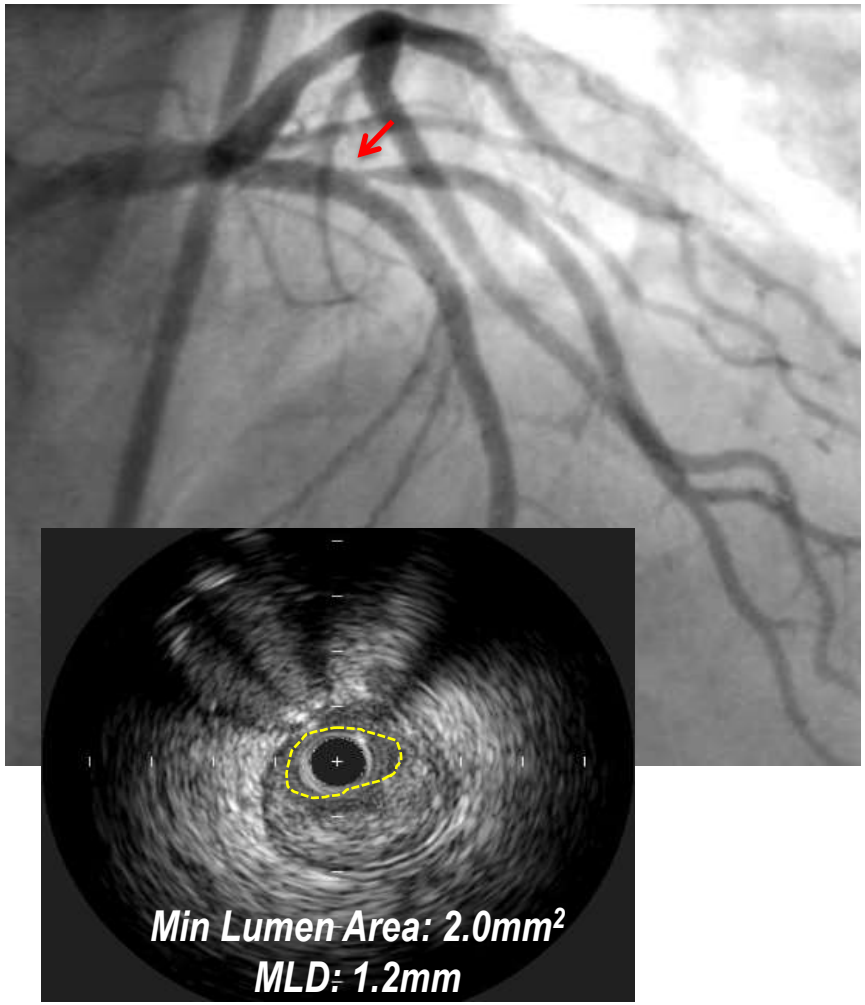
Significant lesion?



- **Anatomically!**
- Physiologically
- Clinically
- Prognostically

Why "physiologic evaluation" in bifurcation lesion?

Pitfalls of anatomical evaluation

- **Angiography**
  - Single directional assessment
  - Variability in stenosis assessment
  - No validated criteria for intervention
  - Not physiologic
- **IVUS/OCT**
  - Difficult to perform in tight stenosis
  - No validated criteria for intervention
  - Not physiologic

Uniqueness of side branch lesions

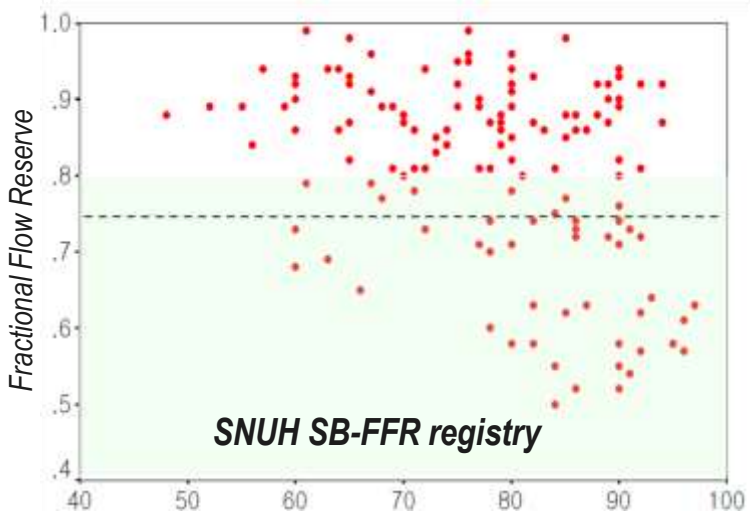
- Various size, various amount of myocardium
- Side branch stenosis is **unique and complex**
  - Underlying plaque → **Eccentric**
  - Remodeling → **Negative remodeling**
  - Complex mechanisms of side branch jailing

    Carina shift, plaque shift, stent struts, thrombus.....

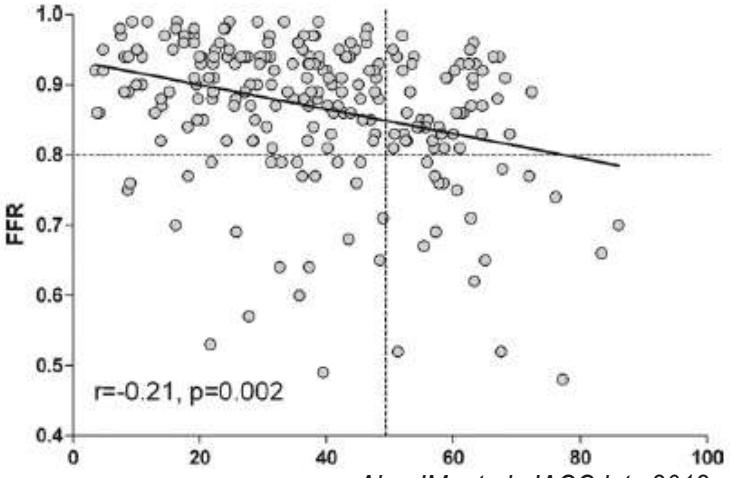
Koo BK & de Bruyne B, Eurointervention 2010

Anatomical severity ≠ Functional significance

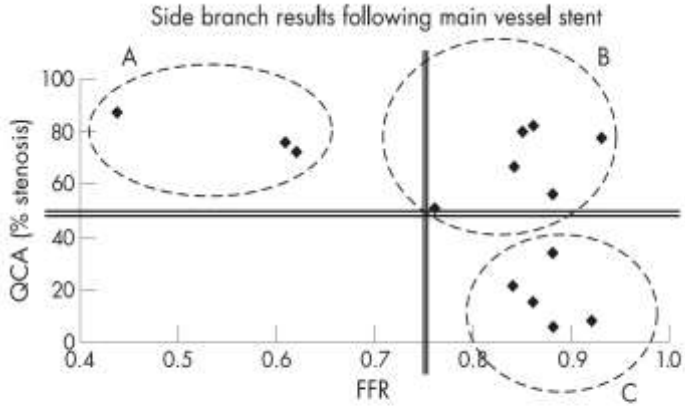
% diameter stenosis vs. FFR in Jailed side branches



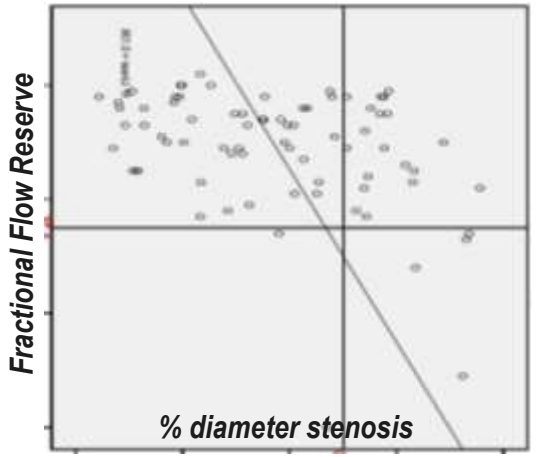
Park SH & Koo BK, J Ger Cardiol 2012



Ahn JM, et al. JACC intv 2012



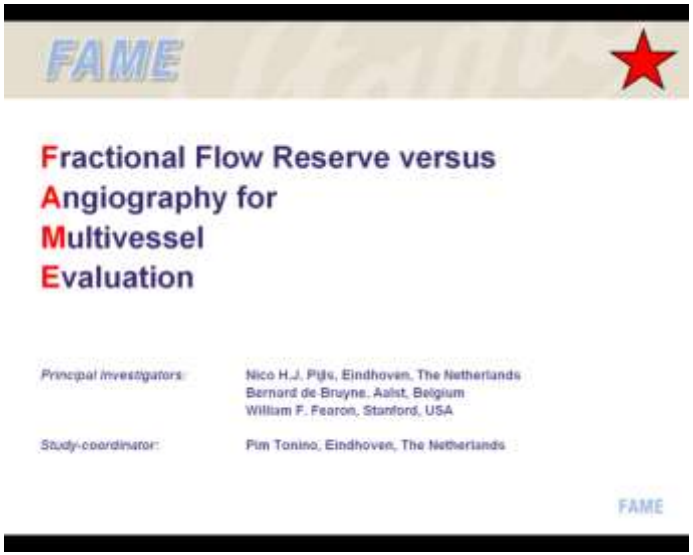
Bellenger, et al. Heart 2007

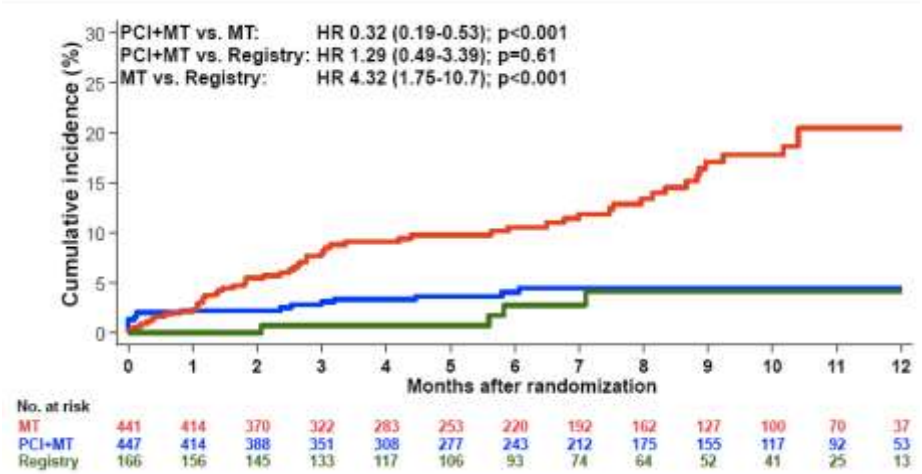


Kumsars I, et al. Eurointervention 2011

Anatomical severity ≠ Functional significance

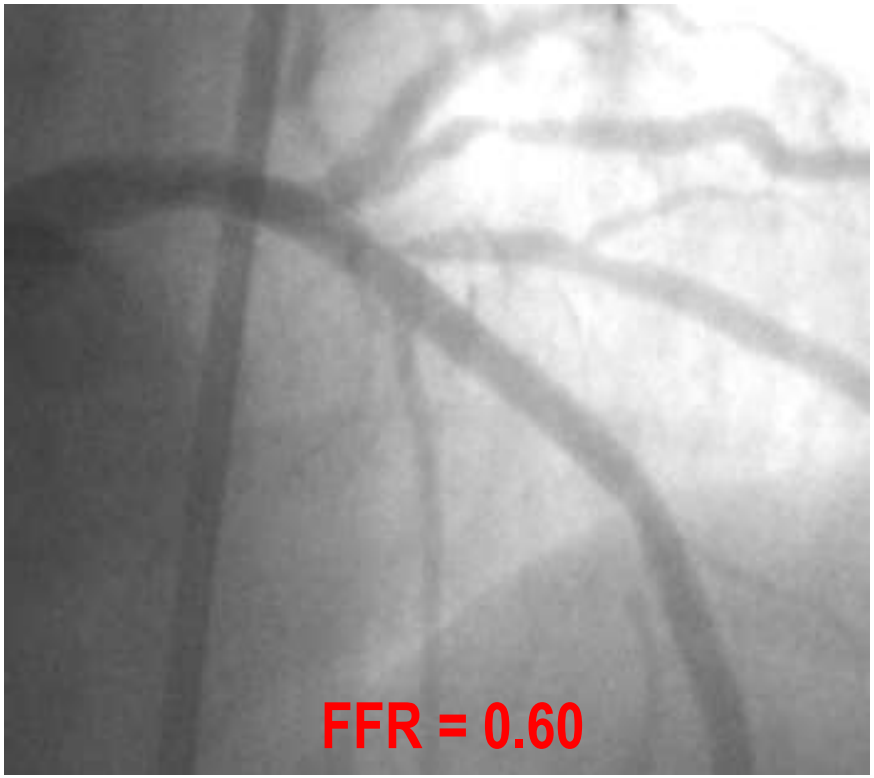
Can FFR (or iFR)-guided SB intervention strategy improve patients' outcome like FAME I & II?





Probably, NOT in general bifurcation lesions……

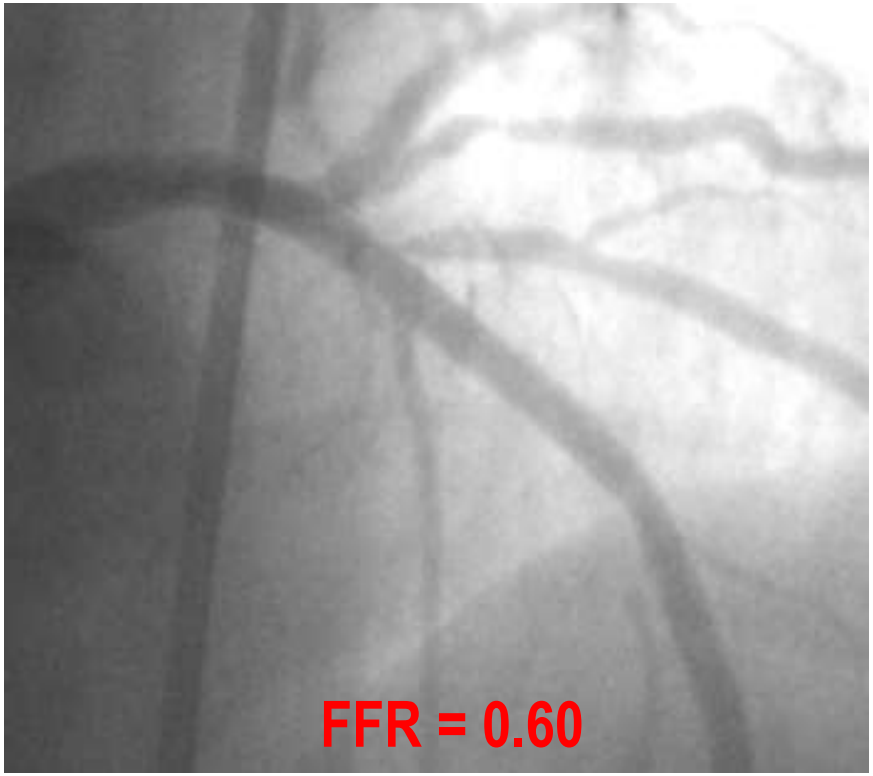
Significant stenosis?



- Anatomically!
- Physiologically (by FFR)!
- Clinically?
- Prognostically?

We need to be more "physiologic" than physiologic indices.

Clinically significant?

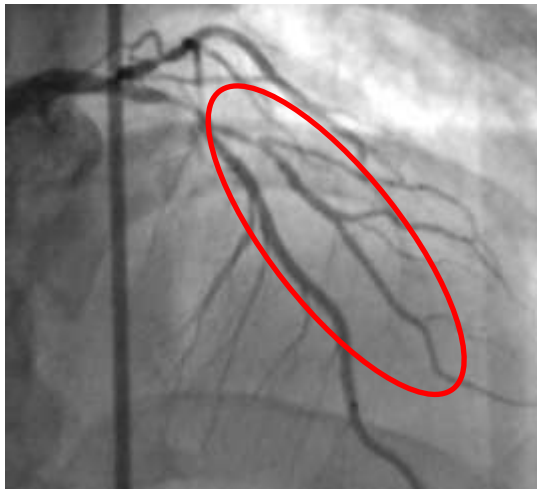


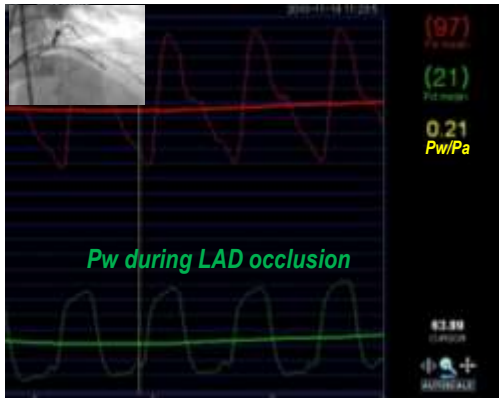
Determinants

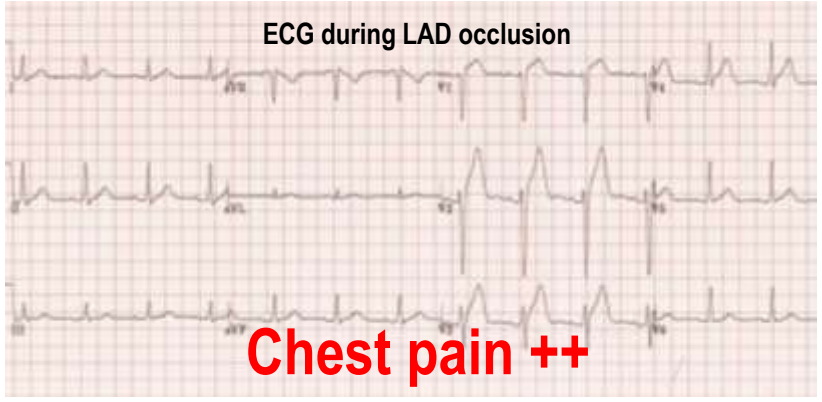
- Presence of ischemia
- Amount of ischemia
- Symptom
- Arrhythmic potential

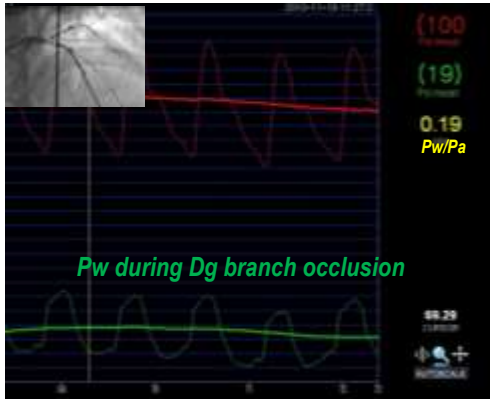
Clinical relevance
What will happen if this branch is occluded?

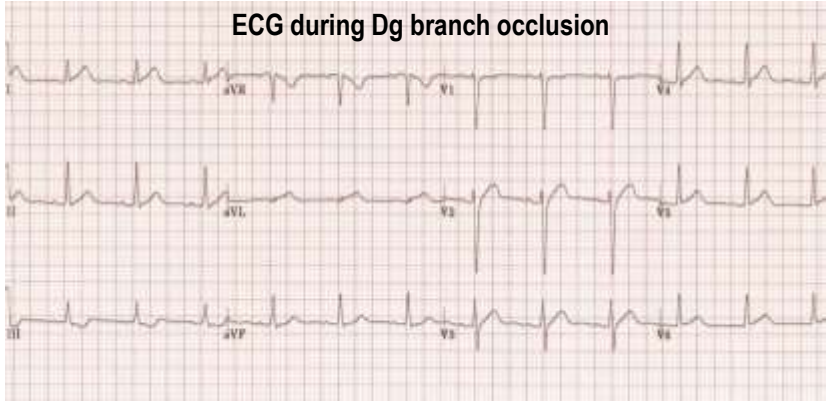
One-minute balloon occlusion test











Clinical significance: Main vs. Side branch

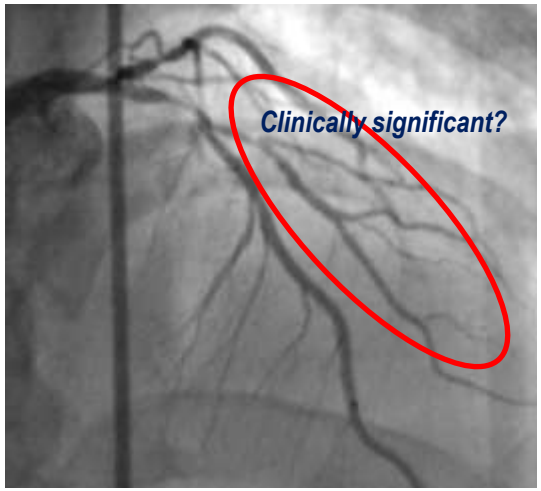
- Responses to 1-minute balloon occlusion -

	LAD	Diagonal	P value
Chest pain (VAS score)	5	2	<0.0001
ST elevation ≥ 1mm	92.3%	35.4%	0.001
QTc interval, msec	454.0±45.4	440.4±35.7	0.07
QTc dispersion, msec	83.8±39.2	70.7±28.5	<0.0001

Side branch has much less clinical relevance in terms of symptom, ischemia and arrhythmic potentials

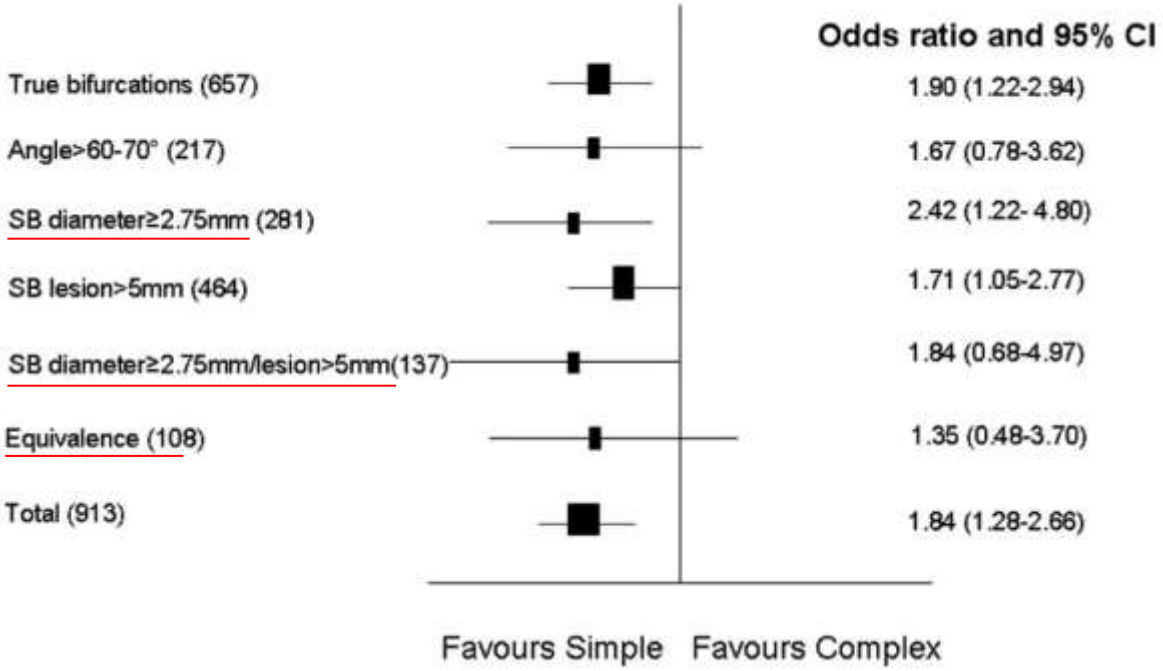
Koo BK, et al., JACC Intv, 2012

How can we find the clinically significant side branch?



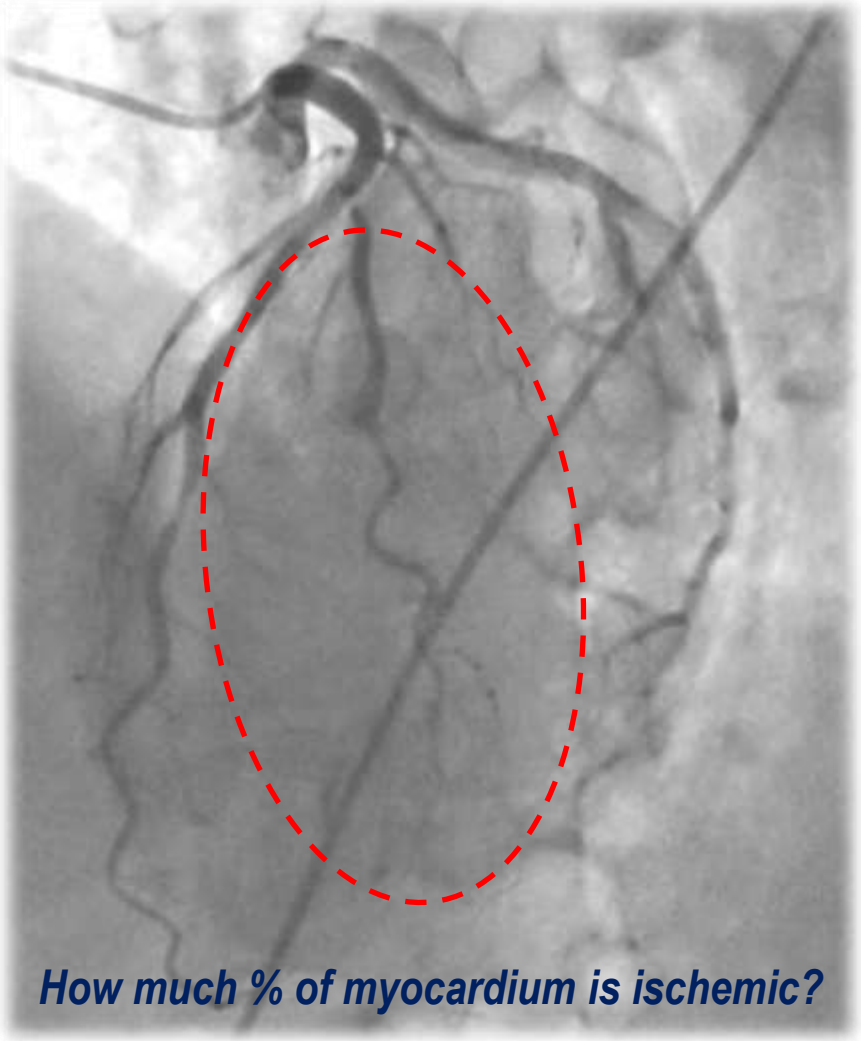
BBC+NORDIC study

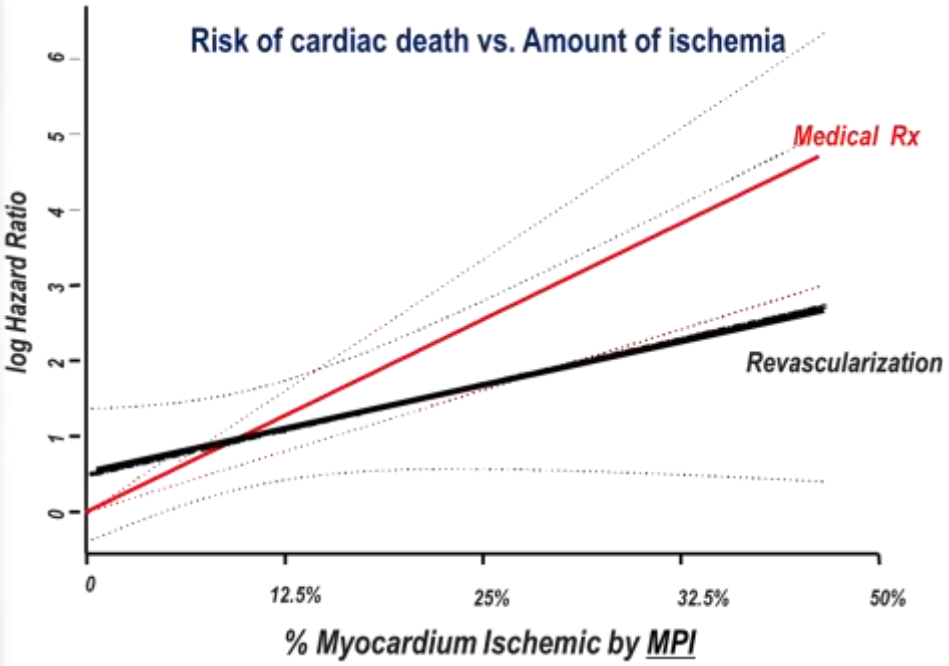
: provisional better, at any discrimination parameter



How can we find the clinically significant side branch?

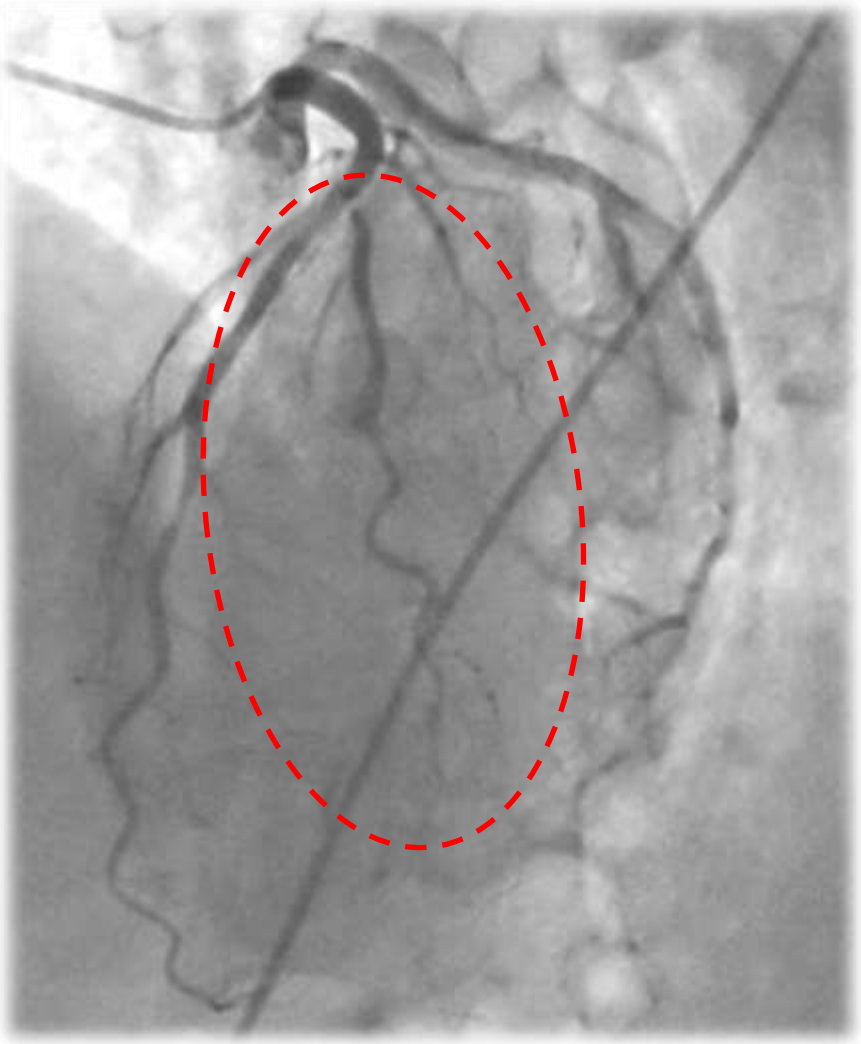
Focus more on "myocardial mass at risk" than angiographic parameters

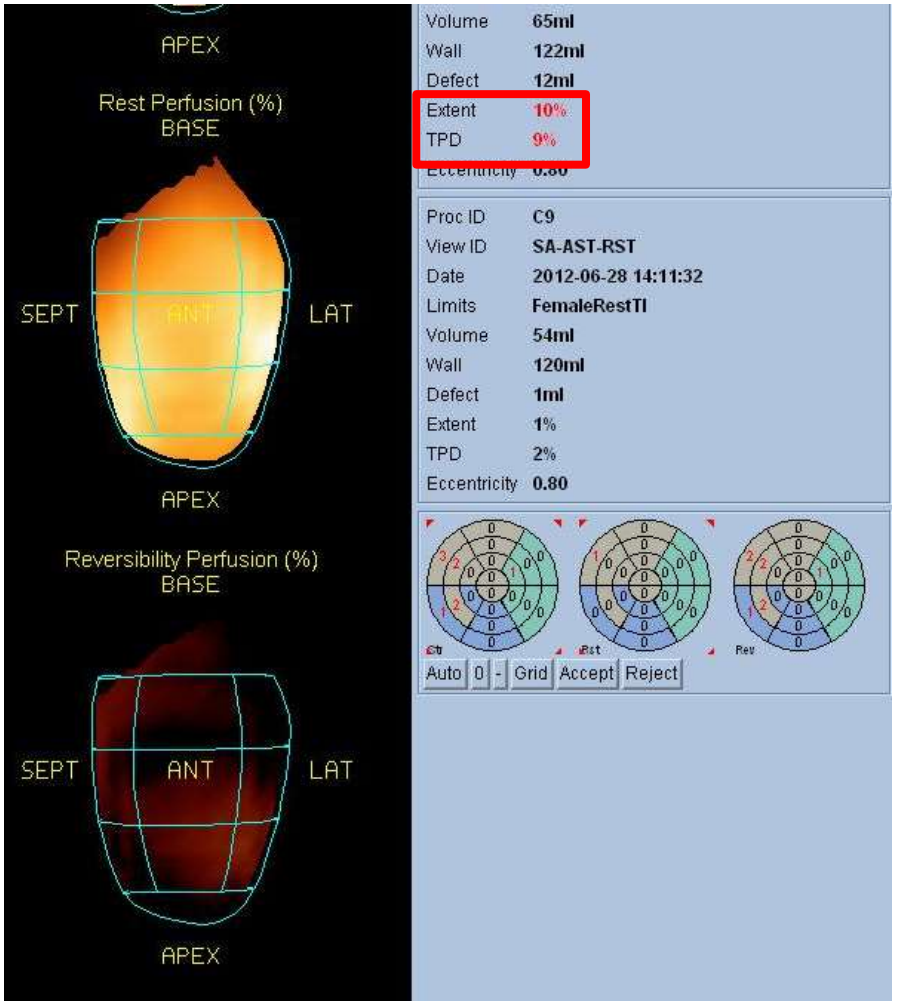




Hachamovitch, Circulation 2003

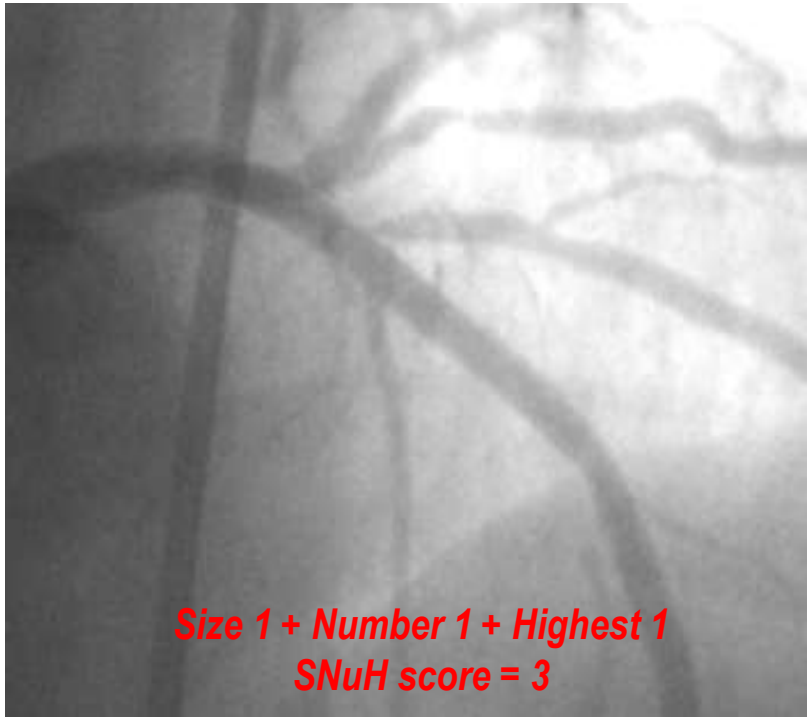
How much % of myocardium is ischemic?





Scoring system for diagonal branches
- SNuH score -

Variables	Description	Score
Size (**S**)	Vessel diameter ≥ 2.25~2.5mm	1
Number (**Nu**)	Number of diagonal branches ≤ 2	1
Highest (**H**)	No branch below the target branch	1



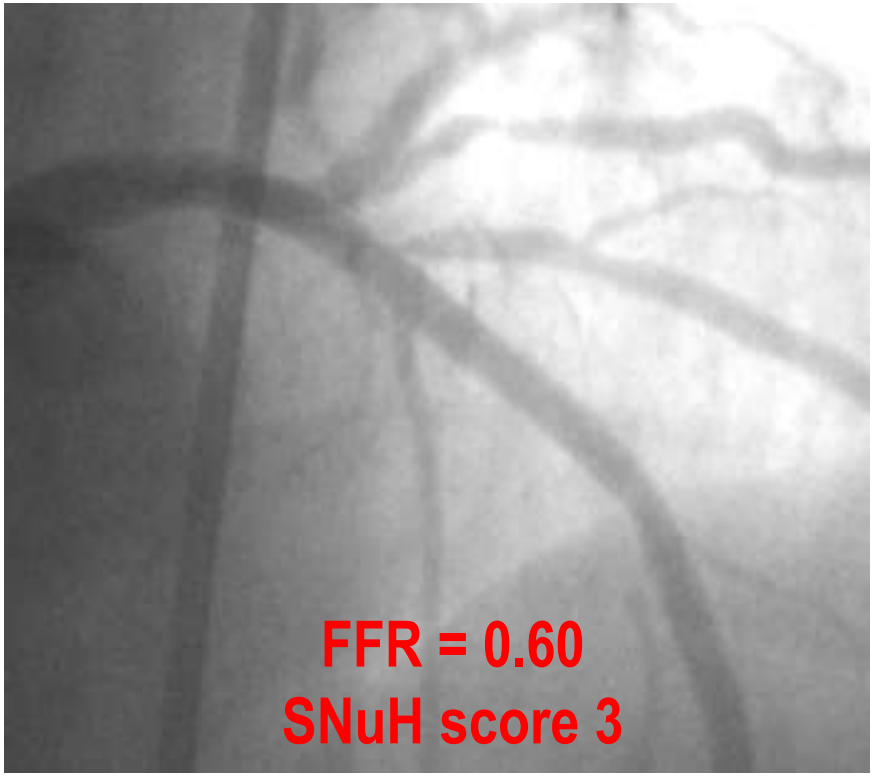
Koo BK, et al., JACC Intv, 2012

Which diagonal branch is causing ST elevation with 1min balloon occlusion?

	ST elevation+	ST elevation-	P value
Patient characteristics	N=24	N=41	
Age, years	63.1±6.1	62.3±8.6	0.51
Diabetes Mellitus	9 (39%)	12 (29%)	0.42
LV ejection fraction, %	63.1±6.1	62.3±8.6	0.68
Angiographic characteristics			
% diameter stenosis	68.1±17.3	64.9±14.0	0.42
Lesion length, mm	15.3±10.7	11.4±8.3	0.10
Reference diameter, mm	2.4±0.3	2.3±0.4	0.12
SNuH score*	3 (2-3)	2 (1-3)	0.005

Koo BK, et al., JACC Intv, 2012

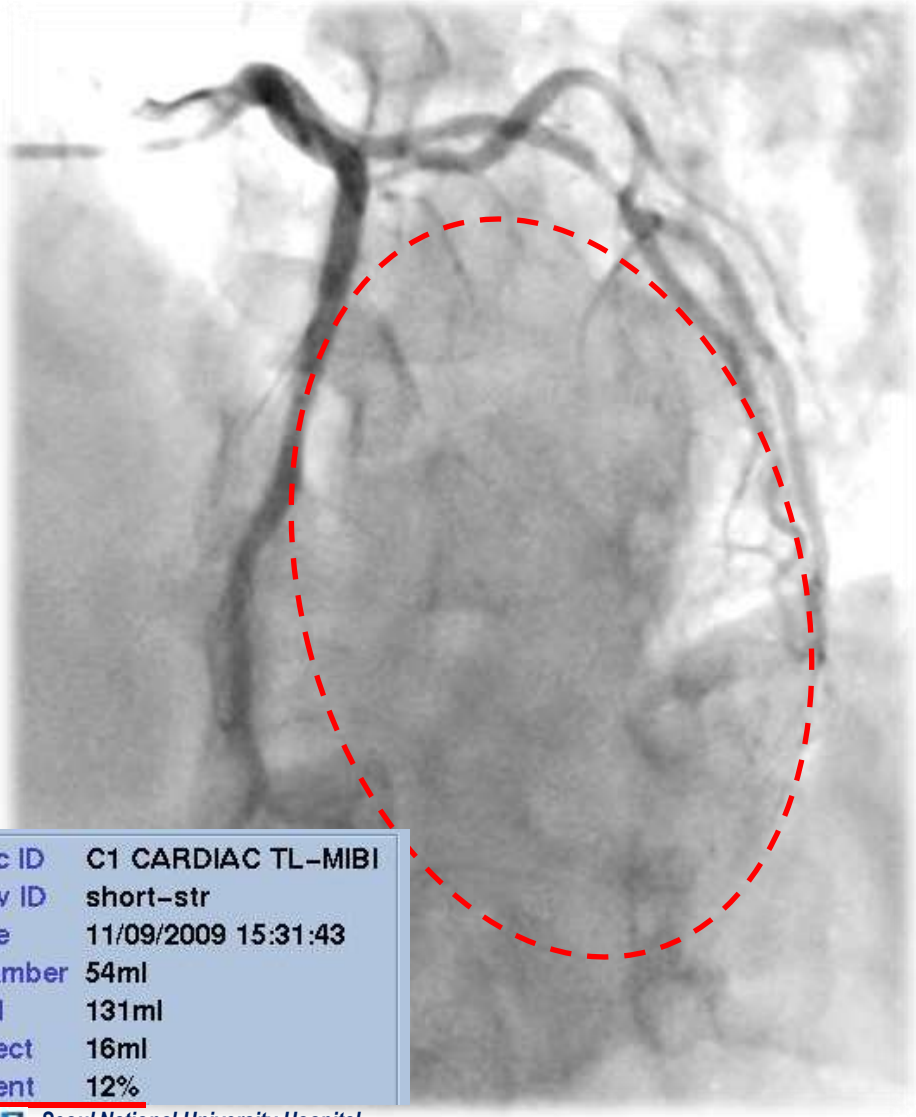
Significant stenosis?

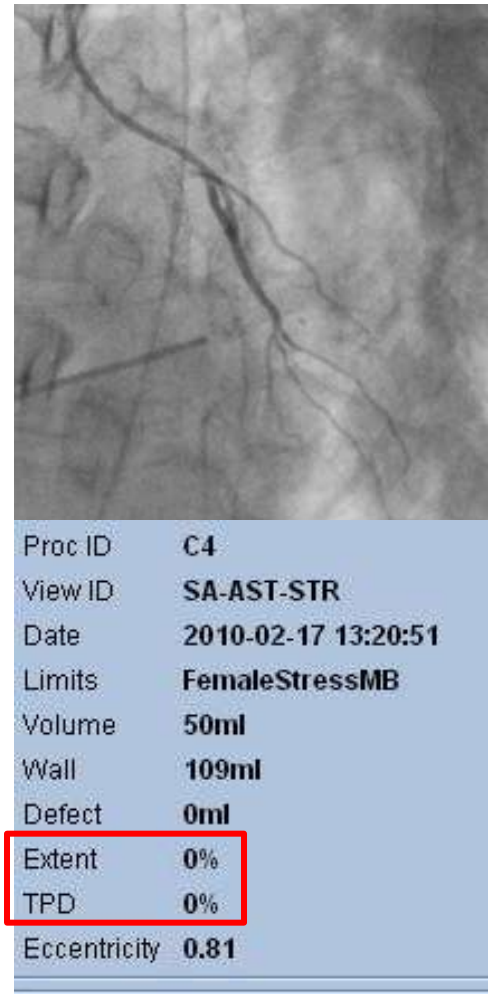


- **Anatomically!**
- **Physiologically!**
- **Clinically!**
- **Prognostically?**

Determinants of prognosis

: Ischemic burden, collateral recruitability and **treatment strategy**

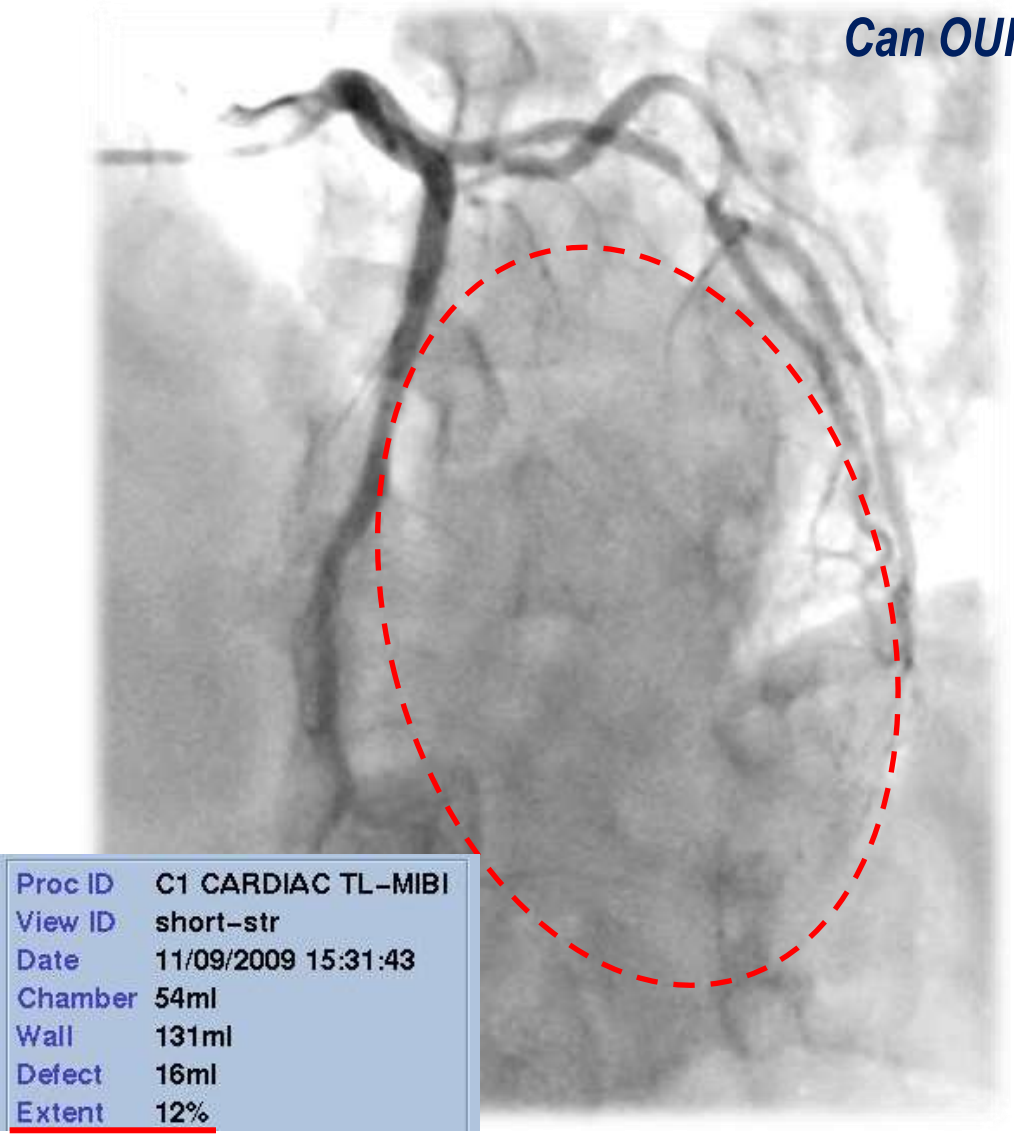




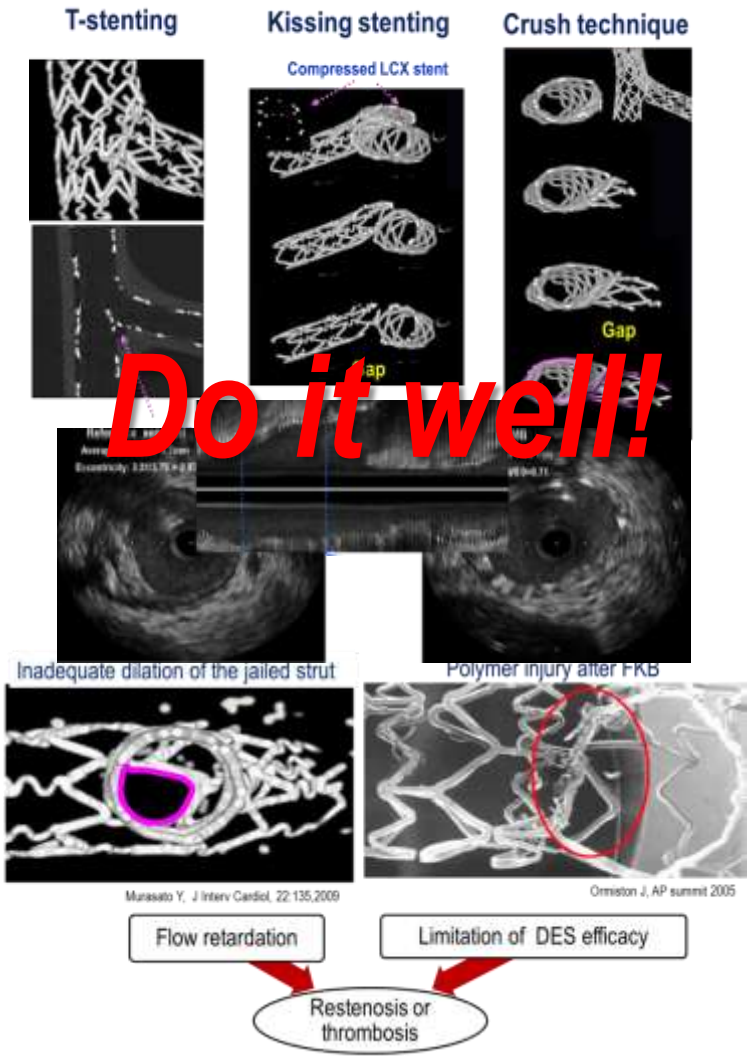
Determinants of prognosis

: Ischemic burden, collateral recruitability and **treatment strategy**

Can OUR revascularization improve the prognosis?



Proc ID	C1 CARDIAC TL-MIBI
View ID	short-str
Date	11/09/2009 15:31:43
Chamber	54ml
Wall	131ml
Defect	16ml
Extent	12%



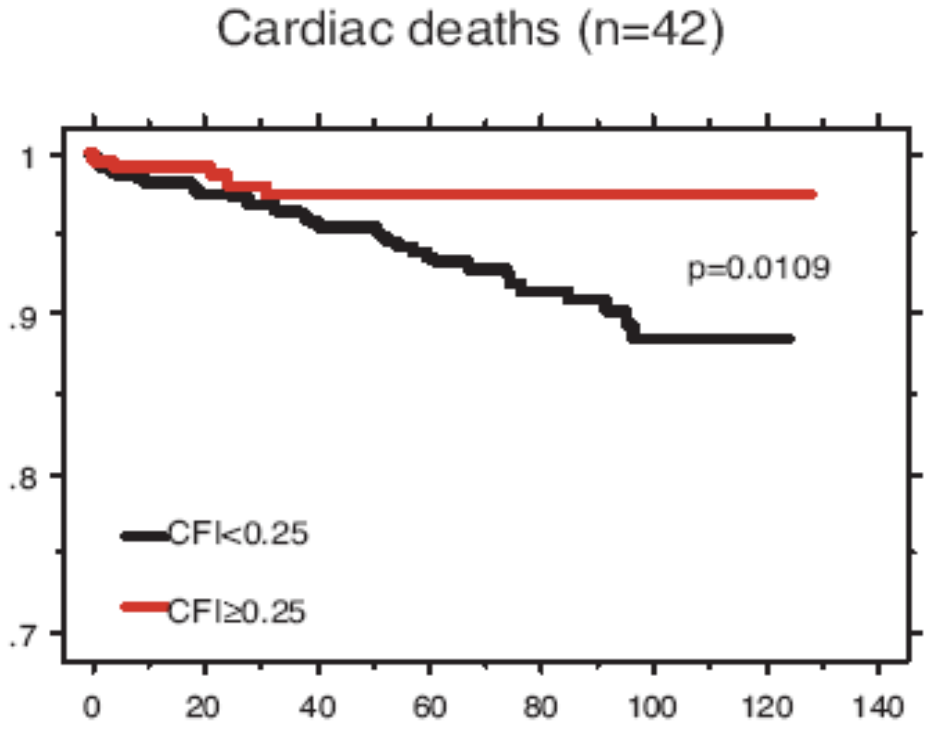
Determinants of prognosis

: Ischemic burden, **collateral recruitability** and treatment strategy

Beneficial Effect of Recruitable Collaterals

A 10-Year Follow-Up Study in Patients With Stable Coronary Artery Disease Undergoing Quantitative Collateral Measurements

Pascal Meier, MD*; Steffen Gloekler, MD*; Rainer Zbinden, MD*; Sarah Beckh, BS; Stefano F. de Marchi, MD; Stephan Zbinden, MD; Kerstin Wustmann, MD; Michael Billinger, MD; Rolf Vog… i, MD; …



Background—The p… this study was to assess the impact … ients with stable coronary artery di…

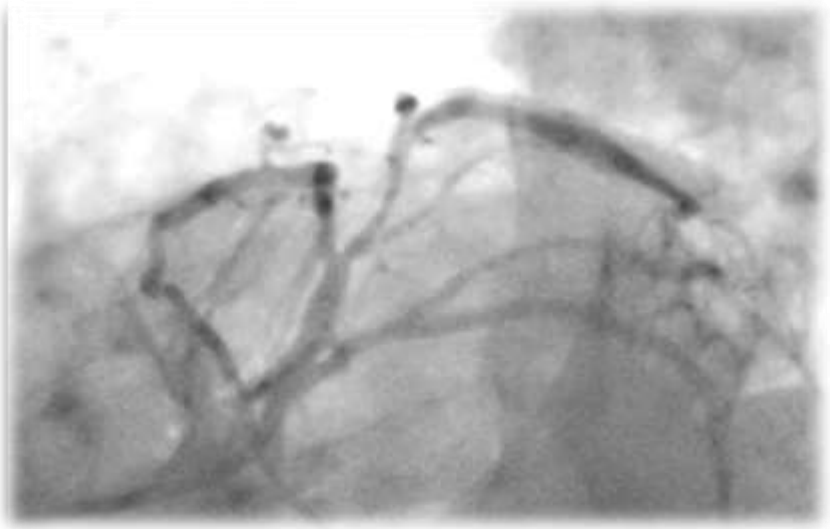
Methods and Resul… t coronary artery disease and 739 p… titative, coronary pressure–derived … ere prospectively included in a col… flow parameters obtained during a…

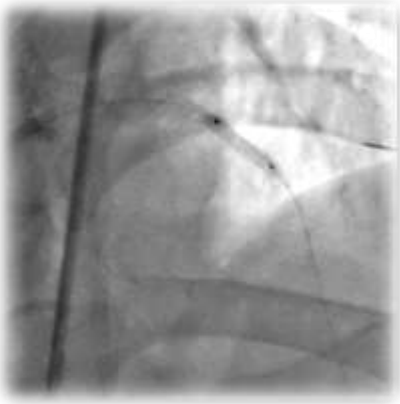
(1)

where P_{occ} is mean c… tients were divided into groups with pe… nformation on the occurrence of all-ca… ve 10-year survival rates in relation to al… and 89% and 97% in the group with high CFI (P=0.0393, P=0.0109). Through the use of Cox proportional hazards analysis, the following variables

Meier, Circulation 2007

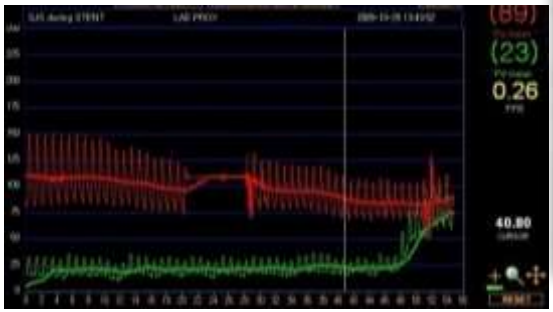
Coronary wedge pressure (Pw) reflects collateral recruitability : LAD vs. Diagonal branch

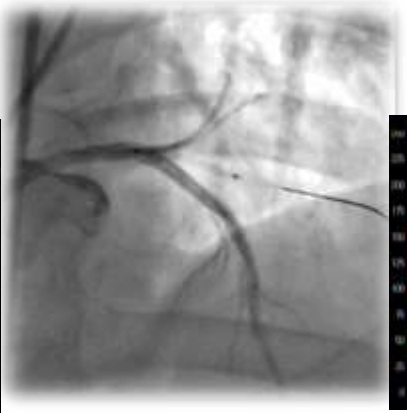




LAD

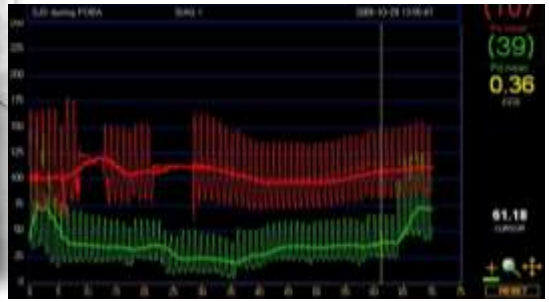
Pw 23mmHg, Pw/Pa 0.26





Diagonal

Pw 39mmHg, Pw/Pa 0.36



Koo BK, et al., JACC Intv, 2012

When you evaluate the bifurcation lesions…

- Don't believe too much in anatomical severity, it may mislead you.
  → **When doubtful, measure FFR.**
  → **However, be aware that "physiologic evaluation" is more important than physiologic index itself.**

- Before intervention or FFR measurement, assess myocardial mass at risk.

- Consider the possibility that the side branch is naturally protected

- If you decide to stent the side branch,
  → **Use IVUS and Do it (very) well.**

The key of "Physiologic Evaluation" of bifurcation lesion is to understand that side branch is different from main branch in terms of anatomy, physiology, clinical relevance and prognosis.