How to recognize a clinically relevant SB?

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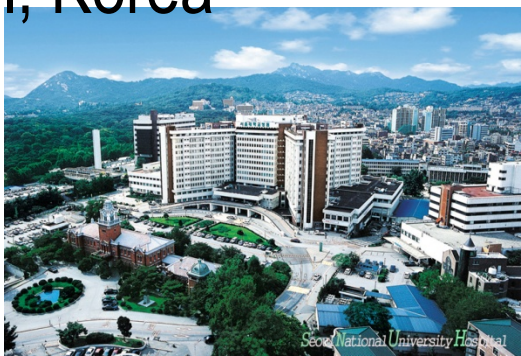
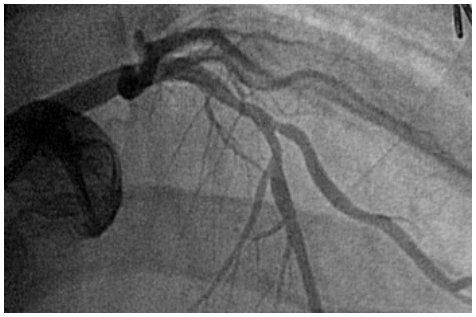
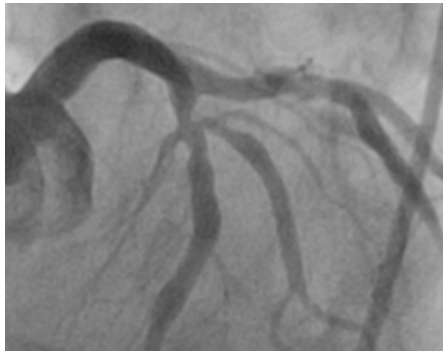
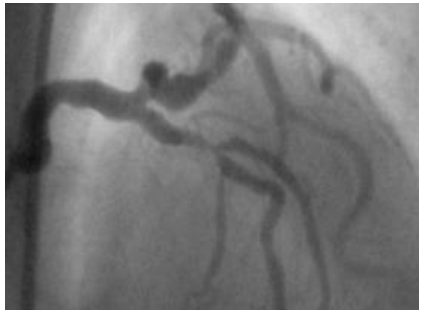
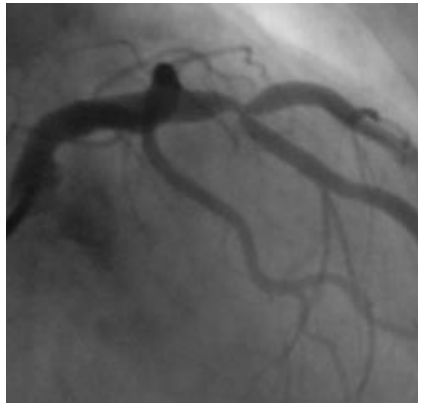
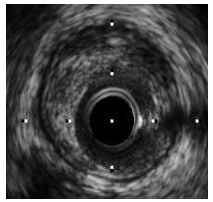


Side branch assessment: How?

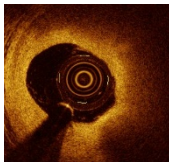



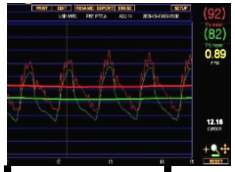
- Angiography
- Intravascular Ultrasound



- Optical Coherence Tomography

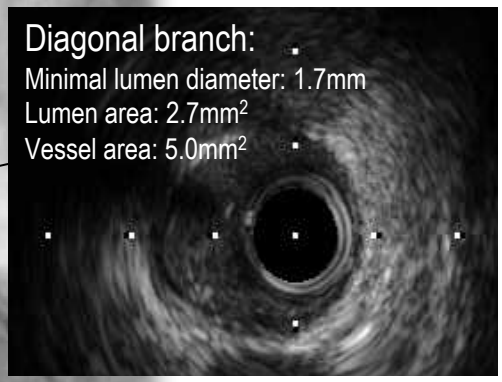


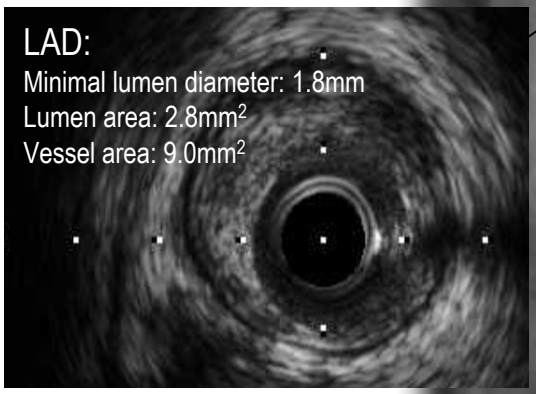
- Fractional Flow Reserve

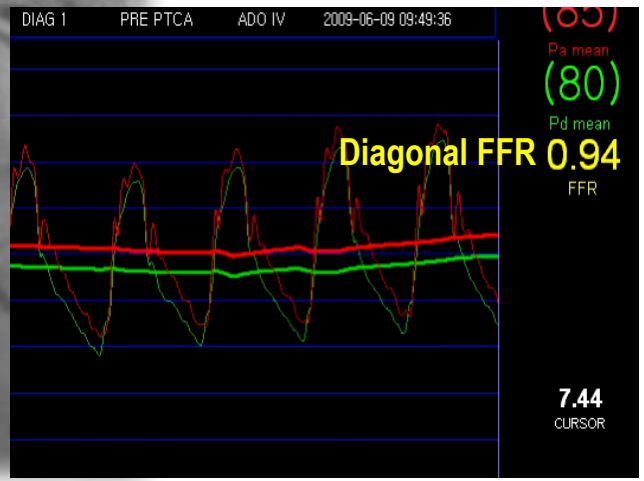


- Coronary CT angiography

Limitation of anatomical assessment

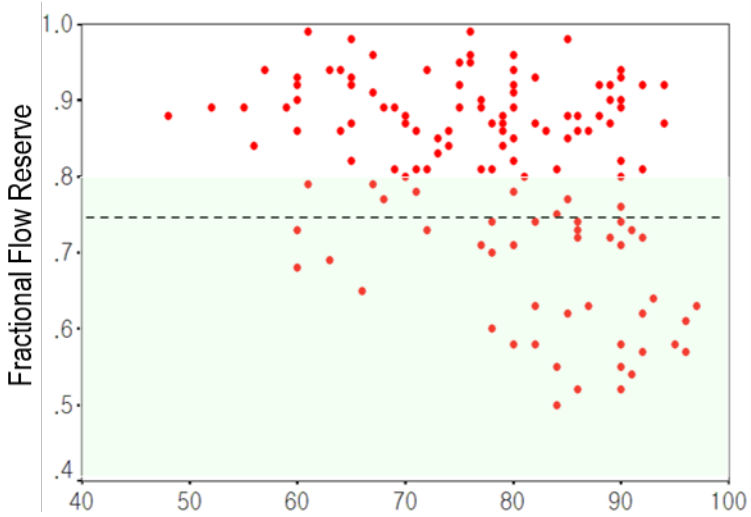




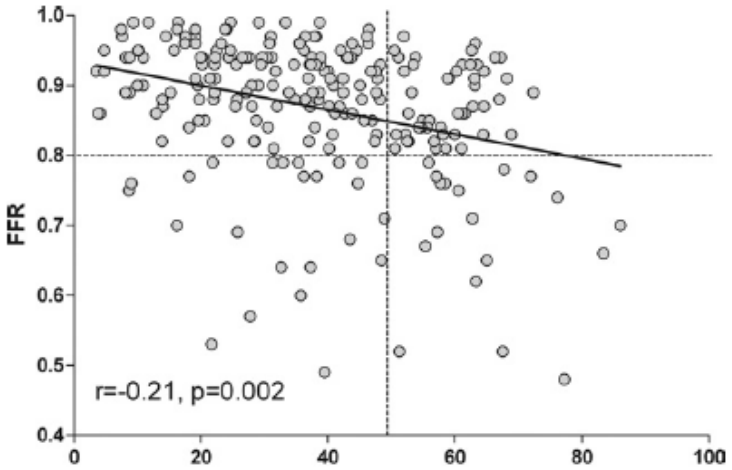


FFR vs. % diameter stenosis in Jailed side branches

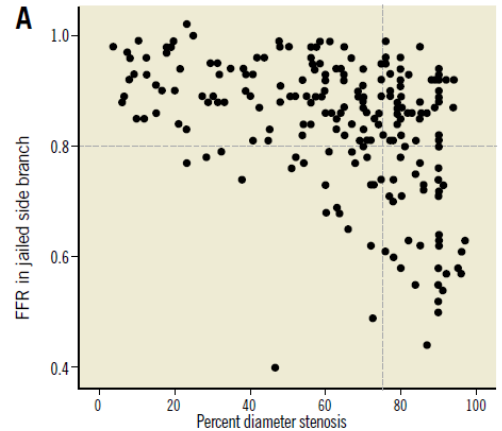
Anatomical severity ≠ Functional significance



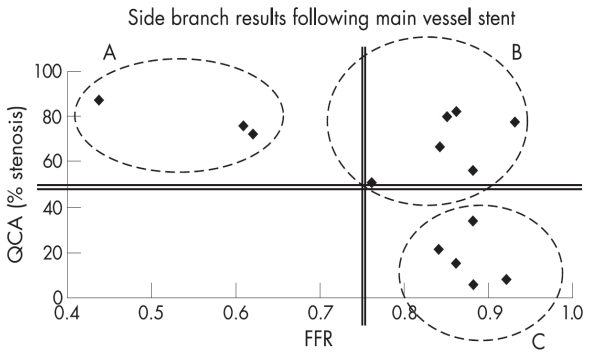
Koo BK, et al. J Am Coll Cardiol 2005;46:633
Park SH & Koo BK J Geriatr Cardiol 2012;9:278



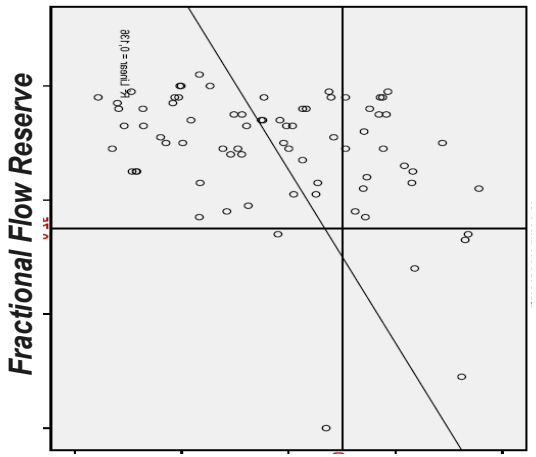
Ahn JM, et al. J Am Coll Cardiol intv 2012;5:155



Lee JM, et al. Eurointervention 2015;11:V59



Bellenger, et al. Heart 2007;93:249



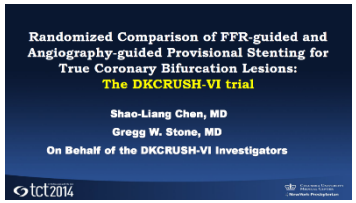
Kumsars I, et al. Eurointervention 2011;7:1155

Angio-guided vs. FFR-guided approach

- Previous studies focused on angiographic findings failed to define the side branch characteristics which favor side branch stenting.
- FFR-guided side branch intervention strategy has not yet proved its superiority over angiography-guided intervention.

	FFR-guided group	Angio-guided group	P
	N=108	N=108	
Side branch PCI	30%	45%	0.02
TVR	5 (4.6%)	4 (3.7%)	0.7
MI	0	0	1
Cardiac death	0	0	1

Koo BK, et al. Eur Heart J 2008



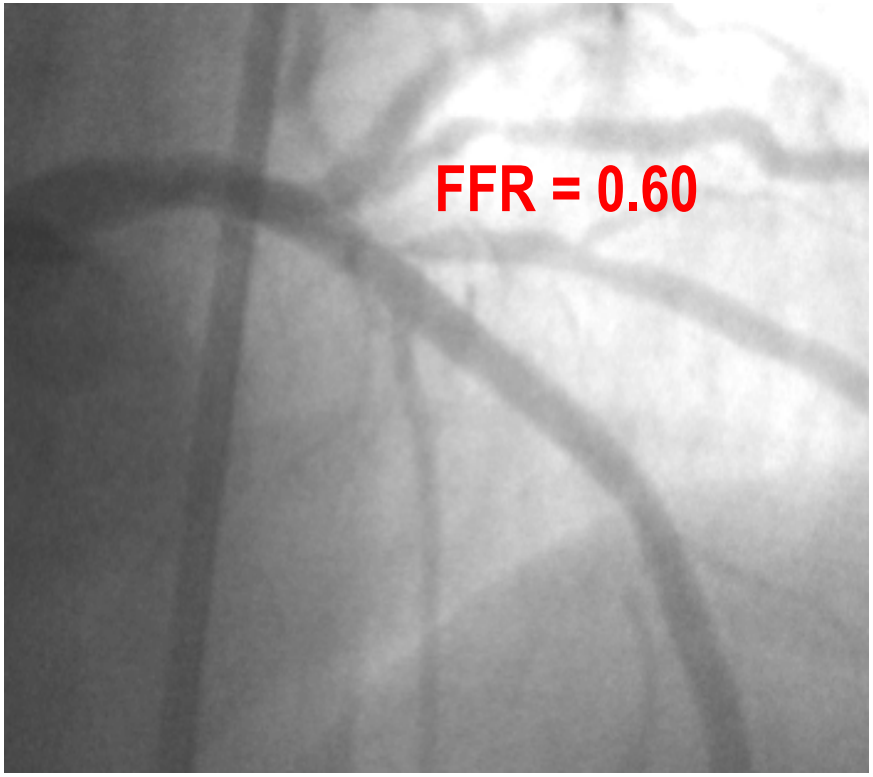
Results (3): One-year clinical outcomes

	Angio group (n=160)	FFR group (n=160)	p
Cardiac death, n(%)	1 (0.6)	2 (1.3)	0.56
MI, n(%)	22 (13.8)	19 (11.9)	0.74
TLR, n(%)	8 (5.0)	5 (3.1)	0.57
CABG, n(%)	0	0	-----
TVR, n(%)	11 (6.9)	9 (5.6)	0.82
MACE, n(%)	29 (18.1)	29 (18.1)	1.00
ST-def/prob, n(%)	2 (1.3)	1 (0.6)	0.56

tct2014

Chen SL, et al. JACC Cardiovasc Interv 2015

Significant stenosis?



- Anatomically
- Functionally
- Clinically
- Prognostically

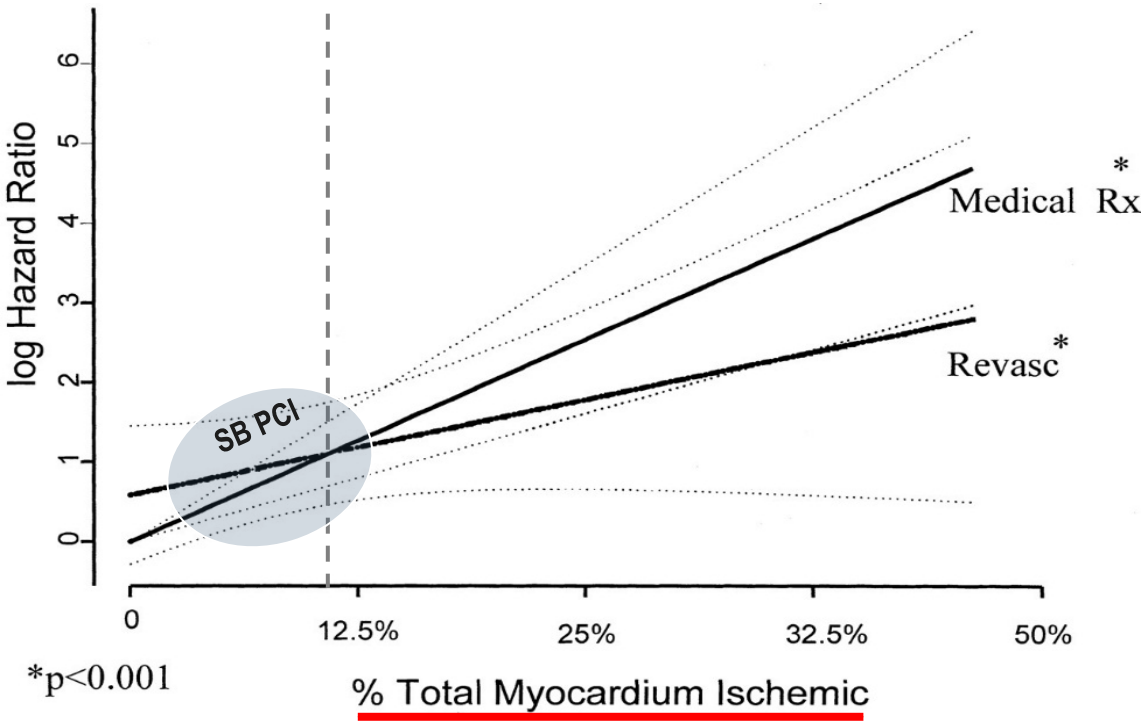
Stenosis+ → Clinically relevant ischemia+ → Revascularization → Better Prognosis

Prerequisites of clinical benefit with PCI

- Presence of ischemia
- **Presence of moderate to severe ischemia**
- Selection of appropriate PCI strategy
- Adequate PCI procedure

Which side branch deserves stent implantation?

- In terms of ischemia at risk, revascularization is better than medical treatment when moderate to severe ischemia exists. Therefore, it is important to define the side branches that can cause ≥10% ischemia.

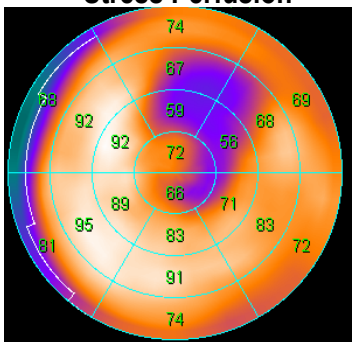


Hachamovitch, Circulation 2003

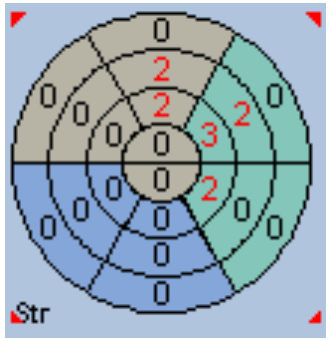
Moderate to severe ischemia?

Calculation of % ischemia from MPI

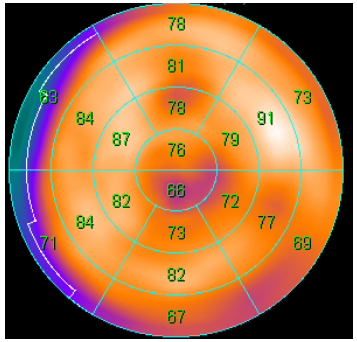
Stress Perfusion



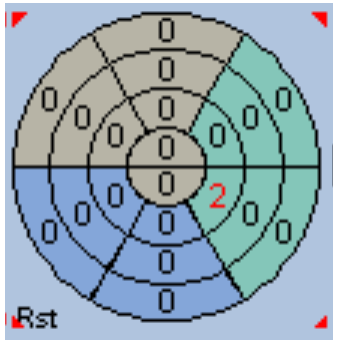
Summed Stress Score 11



Rest Perfusion



Summed Rest Score 2



Reversibility Perfusion

Summed Difference Score (SDS) 9

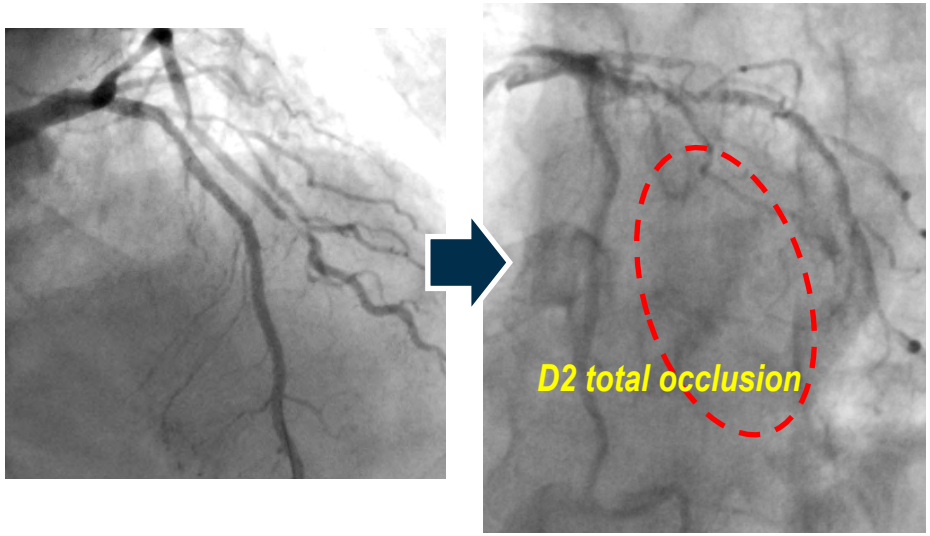
Summed score

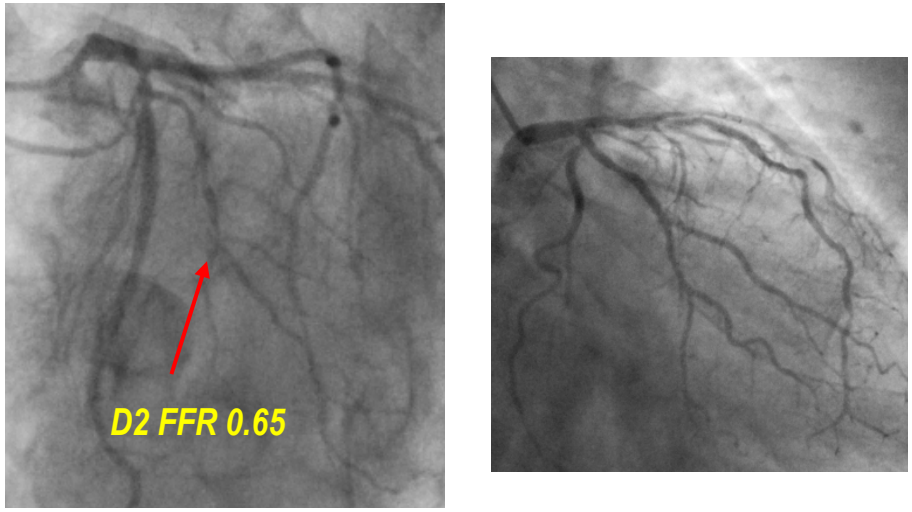
- 5-grade scoring system (0-4) in 20 segments of myocardium
- Represents both ischemic extent and severity

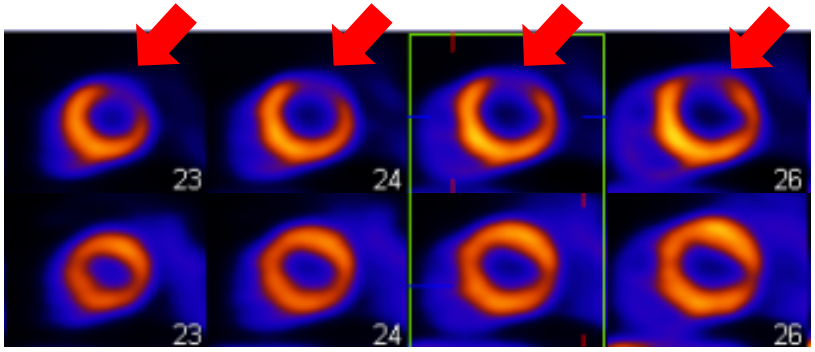
Summed difference score (SDS) = summed stress score (11) – summed rest score (2) = 9

% Ischemia = SDS 9÷ 80 × 100 = 11%

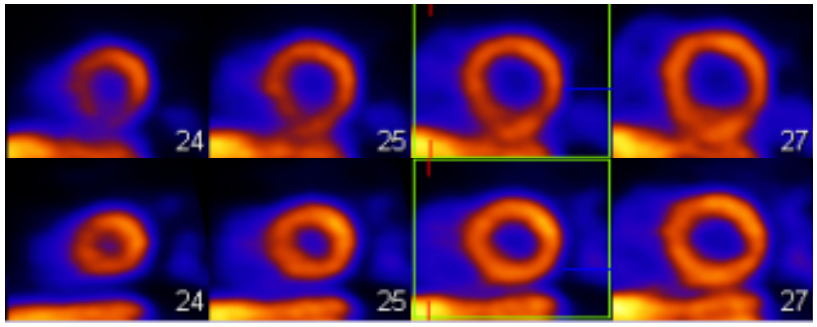
% myocardial ischemia?





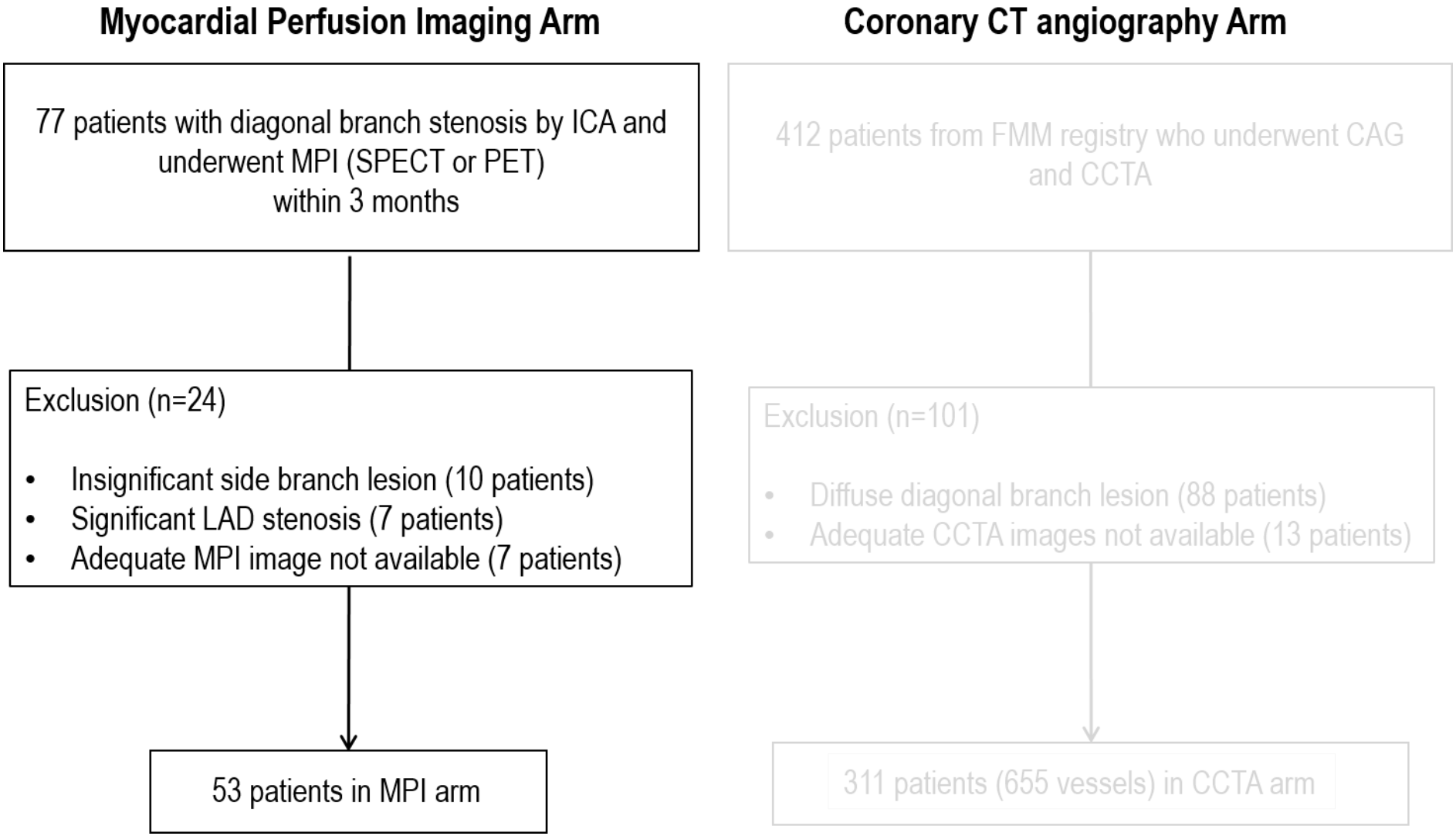


SSS	SRS	SDS	%Ischemia
12	0	12	15.0%



SSS	SRS	SDS	%Ischemia
4	0	4	5.0%

Assessment of clinical relevance of a side branch with MPI and CCTA



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SNuH score

Variables	Description	Score
Size (**S**)	Vessel diameter ≥ 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

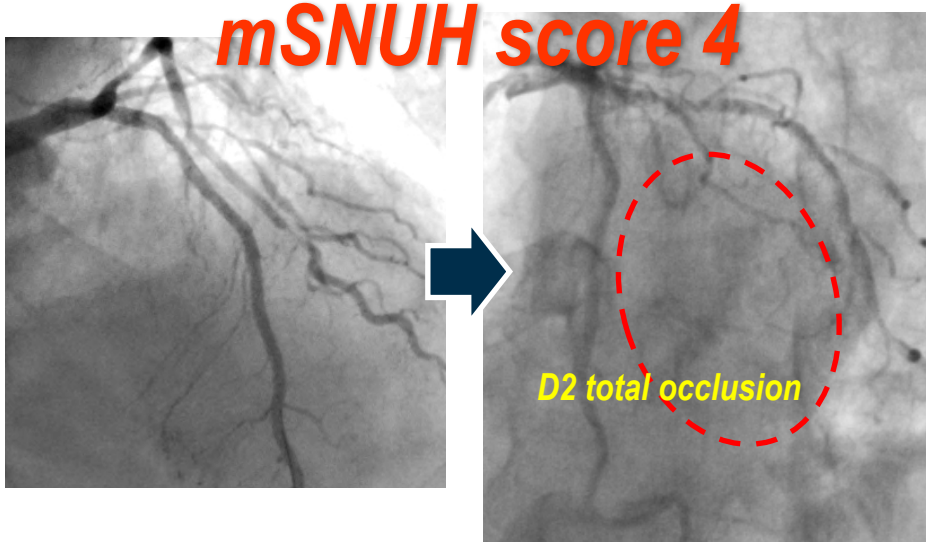
Modified SNUH (mSNUH) score

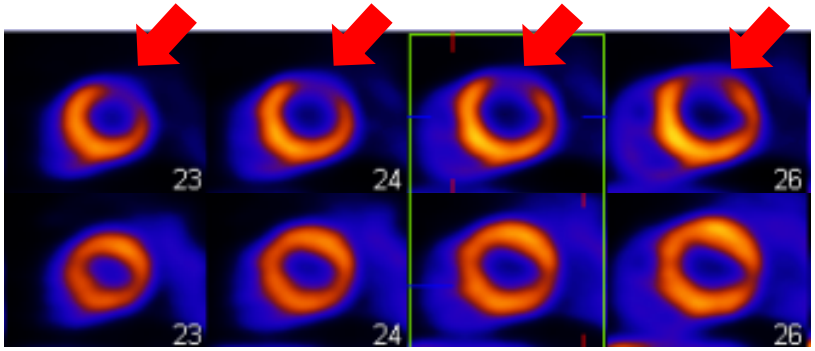
Variables	Description	Score
Size	Vessel diameter ≥ 2.5mm	1
Number	Number of diagonal branches = 1	2
	Number of diagonal branches = 2	1
	Number of diagonal branches ≥ 3	0
Ubiety	Left dominant or Apical area reaching OM branch	-1*
Highest	No branch below the target branch in proximal to mid LAD	1

*If total score is 0, then -1 is not added (The lowest total score is 0.)

% myocardial ischemia?

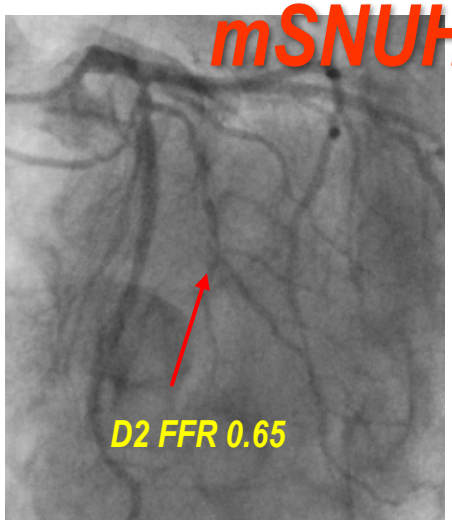
mSNUH score 4

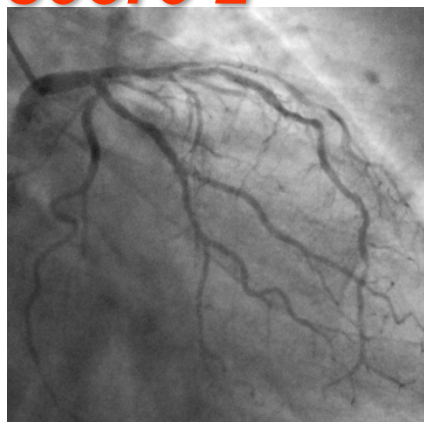


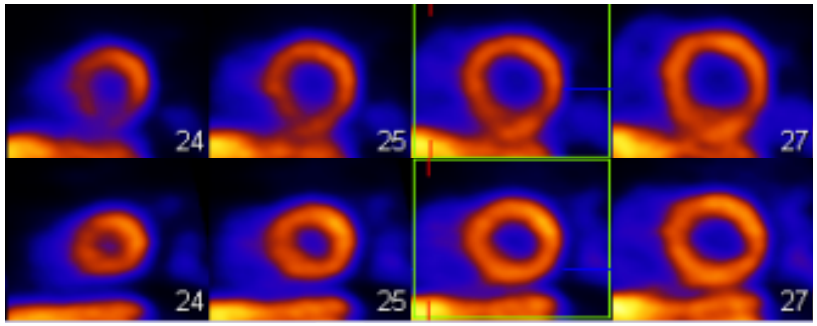


SSS	SRS	SDS	%Ischemia
12	0	12	15.0%

mSNUH score 2







SSS	SRS	SDS	%Ischemia
4	0	4	5.0%

Angiographic and flow characteristics for ≥10% ischemia

	Ischemia ≥10% (n=13)	Ischemia <10% (n=40)	*P*
Size ≥ 2.5mm	13 (100%)	25 (67.5%)	0.023
Number of diagonals			0.032
2	5 (38.5%)	27 (67.5%)	
1	8 (61.5%)	9 (22.5%)	
Apical area reaching OM branch (**U**biety)	3 (23.1%)	21 (52.5%)	0.064
Highest in prox-mid LAD*	11 (84.6%)	20 (50.0%)	0.028
Flow data from PET			
Stress myocardial blood flow	1.44±0.34	1.74±0.32	0.033
Coronary flow reserve	1.55±0.45	1.91±0.49	0.068
Relative flow reserve	0.59±0.07	0.68±0.09	0.015

*No branch below the target branch in proximal and mid LAD segments

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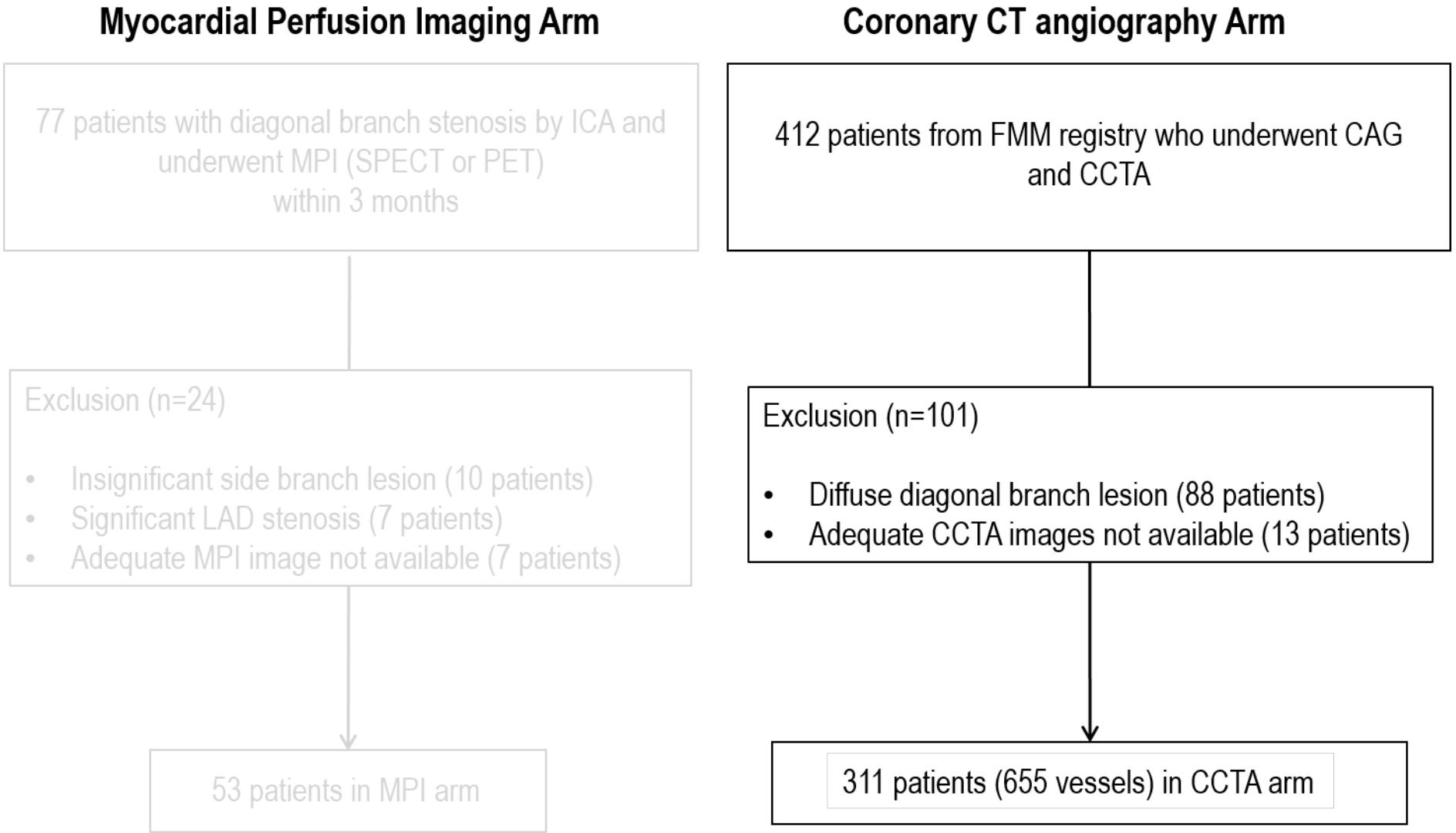
Assessment of clinical relevance of a side branch with MPI and CCTA



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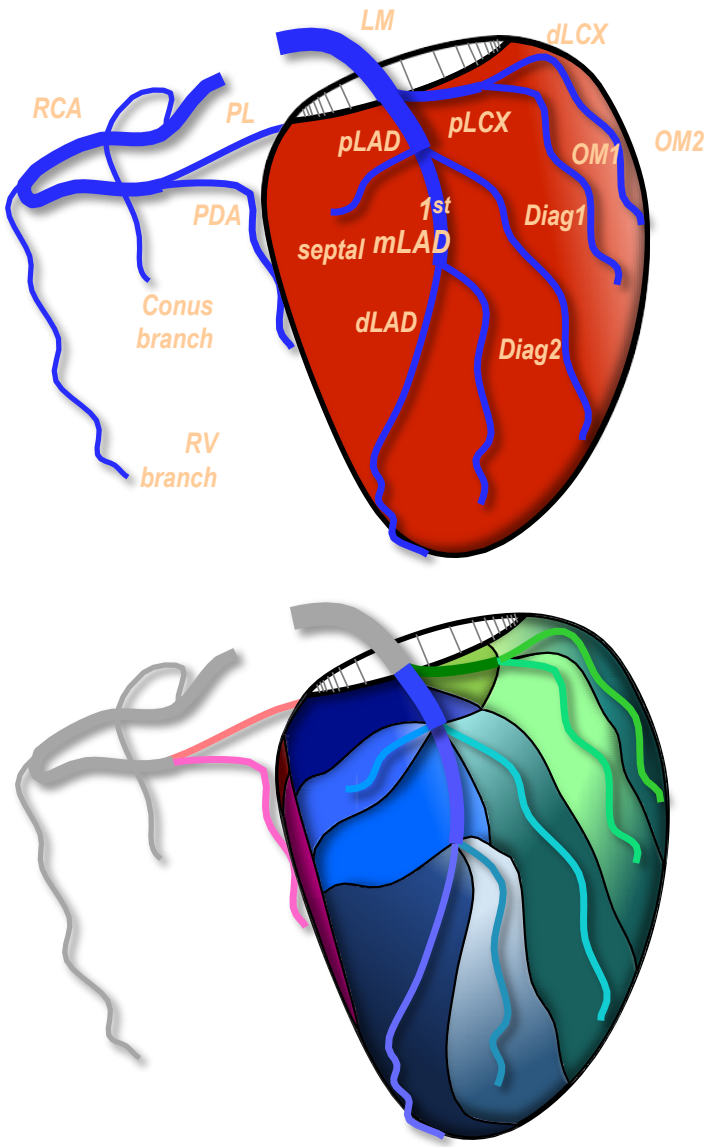
Calculation of myocardial mass at risk from CCTA



Fractional Myocardial Mass (FMM)
: Myocardial mass supplied a by specific vessel calculated from vessel length in CCTA

- Allometric scaling between cumulative vessel length and myocardial mass found in mammalian heart was applied to human heart.

- FMM was computed using stem and crown model based on allometric scaling system.

L : length, M : mass

$L_0 = L_1 + L_2 + L_3 + \ldots$

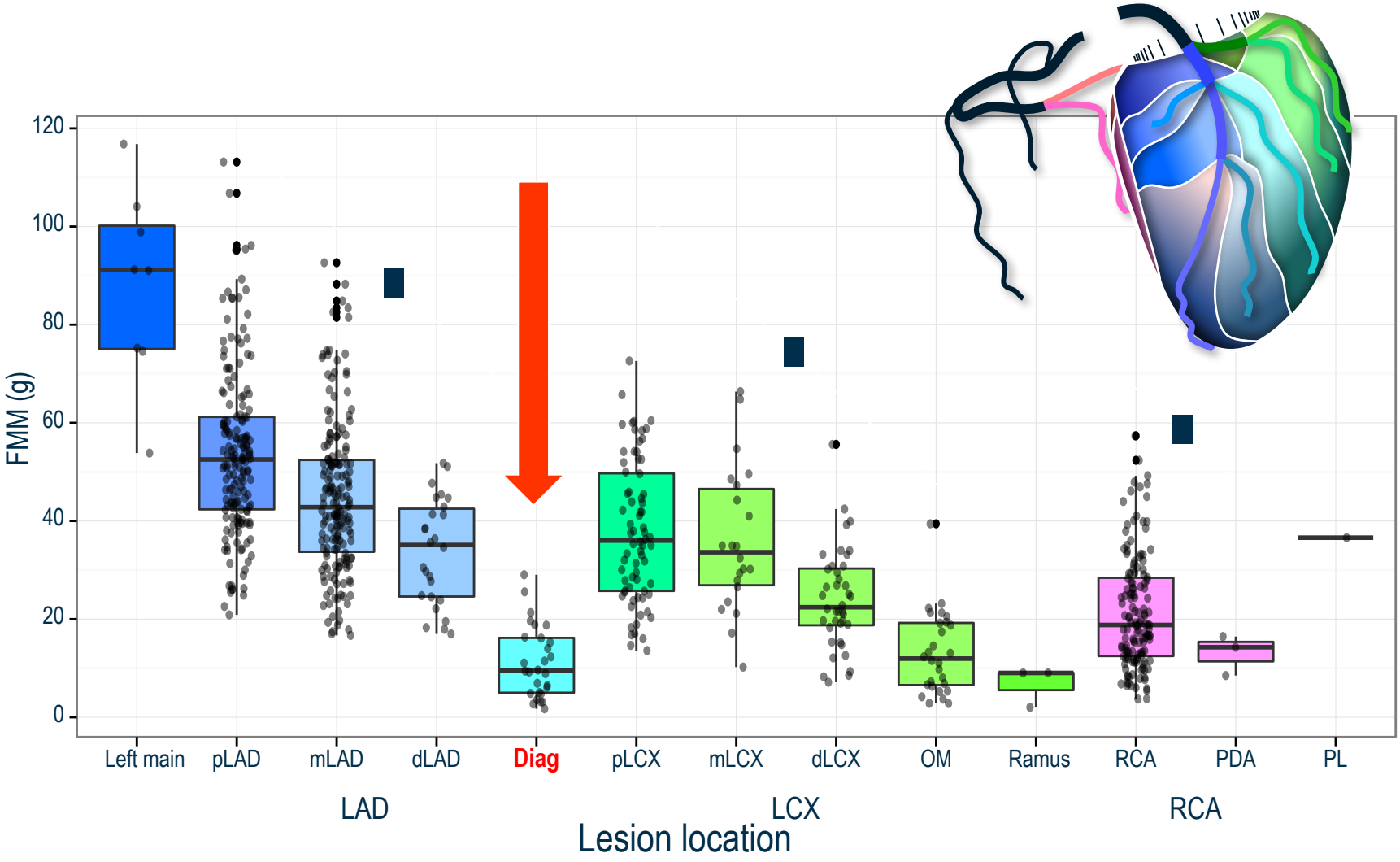
$M_0 = M_1 + M_2 + M_3 + \ldots$

$M_x = k \cdot L_x^{(4/3)}$

% FMM = FMM ÷ LV mass × 100

Courtesy of Jin-Ho Choi, MD, Samsung Medical Center

FMM in major coronary artery and its branches

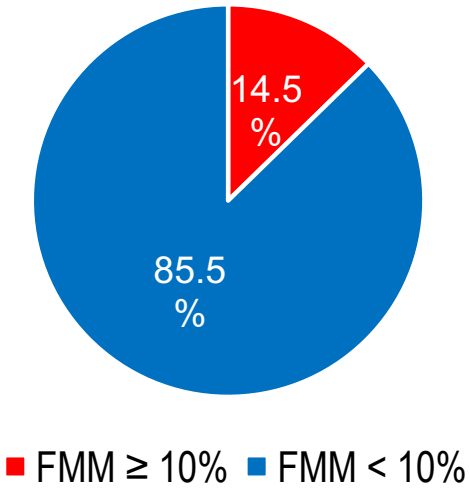


Kim HY, Choi JH, JACC Interv 2016

Courtesy of Jin-Ho Choi, MD, Samsung Medical Center

Myocardial mass at risk from CCTA

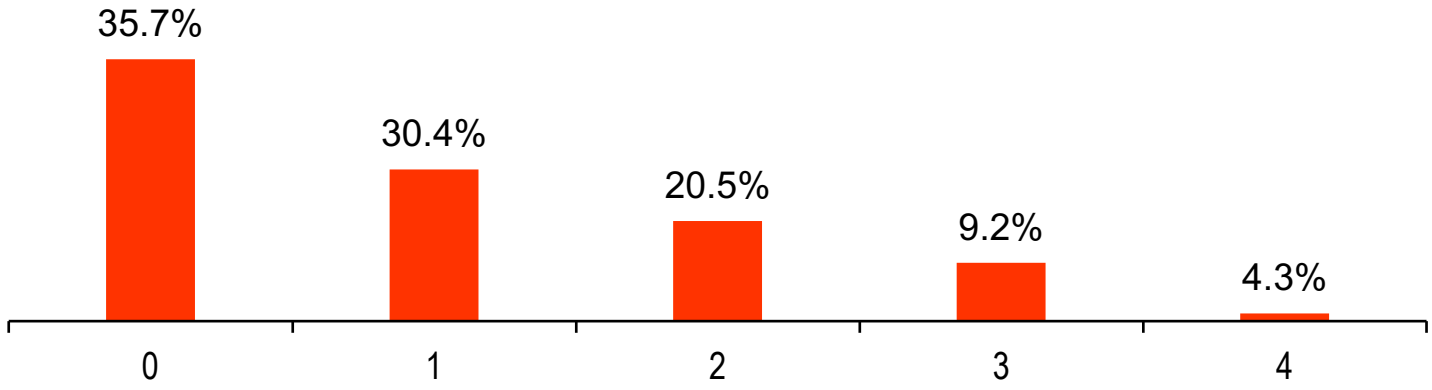
Distribution of %FMM



Angiographic characteristics for ≥10% FMM

	FMM ≥10% (n=83)	FMM <10% (n=572)	P
Size ≥ 2.5mm	58 (69.9%)	127 (22.2%)	<0.001
Number = 2	24 (28.9%)	270 (47.2%)	<0.001
Number = 1	51 (61.4%)	22 (3.8%)	
Apical area reaching OM (Ubiety+)	21 (25.3%)	219 (38.3%)	0.022
Highest in prox-mid LAD (Highest+)	63 (75.9%)	248 (43.4%)	<0.001

Distribution of modified SNUH score



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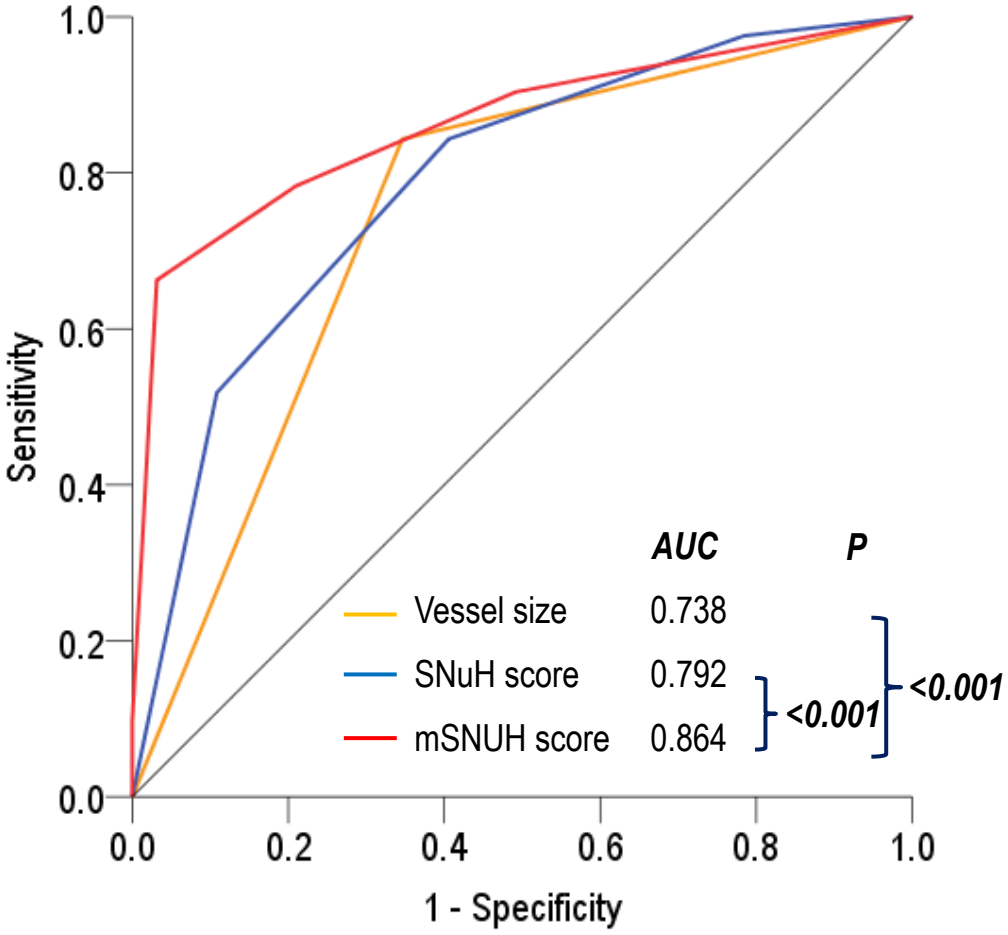
Discrimination/Reclassification ability for ≥10% FMM



Model	cfNRI	P	rIDI	P
Vessel size vs. SNuH score	0.673	<0.001	0.375	0.003
Vessel size vs. **mSNUH score**	**1.099**	**<0.001**	**1.888**	**<0.001**
SNuH score vs. **mSNUH score**	**1.160**	**<0.001**	**1.101**	**<0.001**

cfNRI, Category free net reclassification improvement;
rIDI, Relative integrated discrimination improvement

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How to assess side branches?

- Assess myocardial mass at risk before you do anything (IVUS, FFR, ballooning, stenting…) for side branches.
- Estimate the size, location and influence of other branches.
- Remind that only a few side (diagonal) branches can cause moderate to severe ischemia.