



Parallel session summary

Limit the number and length of stent

Bon-Kwon Koo, MD, PhD

Seoul National University Hospital, Seoul, Republic of Korea



13:00 – 14:15 **PARALLEL SESSION 1**

AUDITORIUM - LIMIT THE NUMBER AND LENGTH OF STENTS

Chair: M. de Vita, G. Stankovic, D. Vassilev

Panel: G. Kassab, G. Werner, H. R. Sanati, H. Jian-Hua, J. Odenstedt

10' Identification of coronary artery side branch supplying myocardial mass that may benefit from revascularization

Bon Kwon Koo

5' Discussion

10' Clinical potential of myocardial mass at risk calculated by a novel software utilizing cardiac computed tomography-**PRE-RECORDED**

Satoru Sumitsuji

5' Comment and discussion

Ghassan Kassab

10' Angio-based SB territory assessment vs. ischemic territory by MPI vs. FMM assessed by coronary CTA

Bon Kwon Koo

10' How IVUS imaging can reduce the number and length of stent

Akiko Maehara

5' Discussion

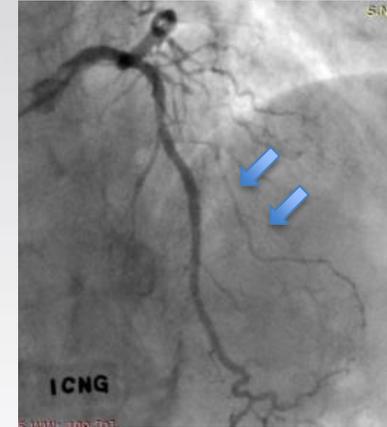
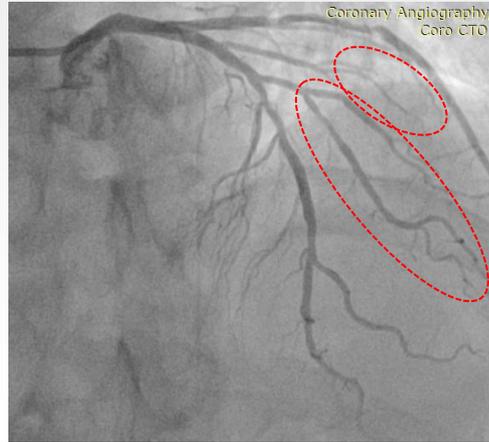
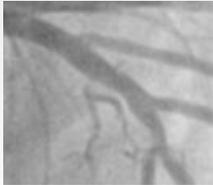


Identification of clinically relevant side branch

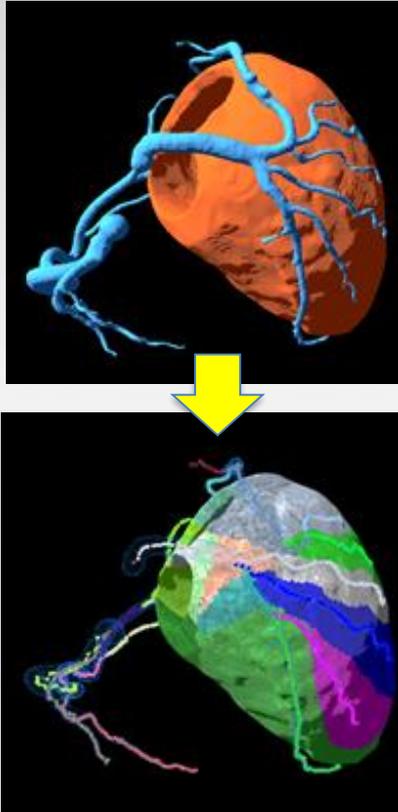
- Angiographic assessment
 - Reference vessel size
 - Visual estimation of myocardial territory
 - SNUH score
- Coronary CT angiography derived myocardial territory
- Myocardial perfusion imaging derived myocardial territory
- Cardiac MRI
- CT perfusion imaging,

Identification of clinically relevant side branch

- Limitations of angiographic assessment
 - Reference vessel size
 - Inter- and intra-individual variability
 - Not measurable in diffuse disease or total occlusion
 - Not accurate



Calculation of myocardial mass at risk from CCTA



Fractional Myocardial Mass (FMM)

- Myocardial mass supplied a by specific vessel
- Calculated from vessel length in CT

- 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

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

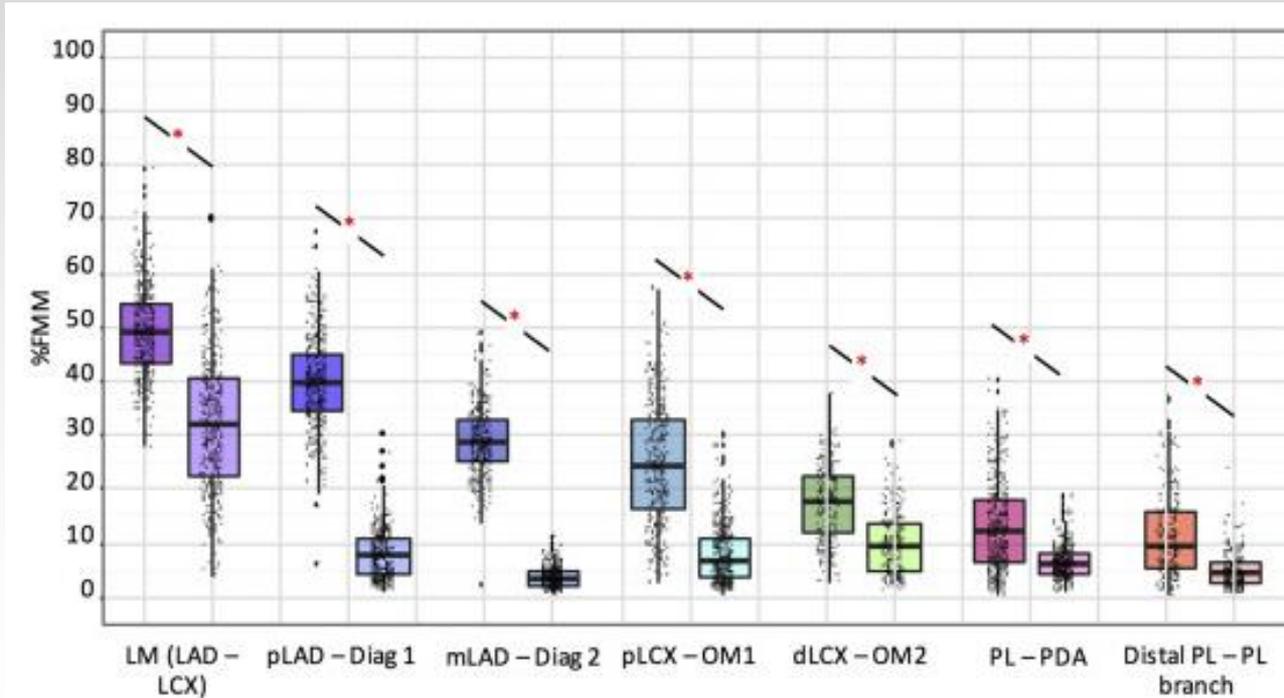
$$M_0 = M_1 + M_2 + M_3 + \dots$$

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

$$\%FMM = FMM \div LV \text{ mass} \times 100$$

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

%FMM in major coronary artery and its branches



HY Kim, et al. JACC Cardiovasc Interv 2017



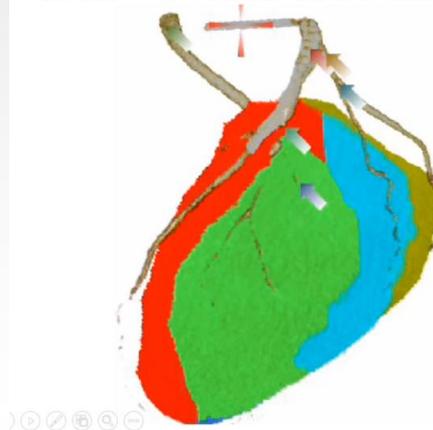
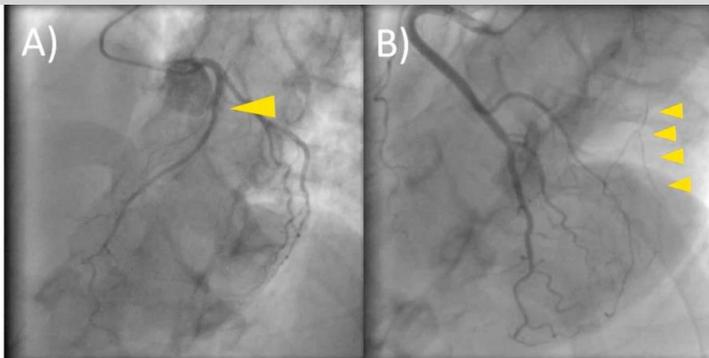
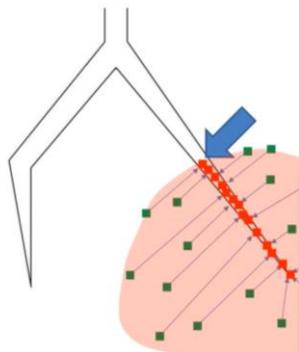
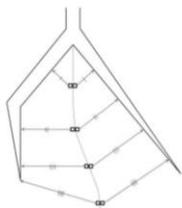
Estimation of myocardial at risk by Modified Voronoi method

Clinical Potential of Myocardial Mass At Risk Calculated by a Novel Software utilizing Cardiac CT

Satoru Sumitsuji MD, FACC.
Cardiology for International Education and Research
Osaka University Graduate School of Medicine



Modified Voronoi Method



MMAR(%)

	MMAR(%)
Whole LV	100.0
LAD	22.6
LCX	9.8
RCA	22.4
Dx	20.7
OM	11.9
PDA	12.5



Estimation of myocardial at risk by Modified Voronoi method

Validation Study with Cadaver heart

Cardiovasc Interv and Ther
DOI 10.1007/s12928-015-0370-0



ORIGINAL ARTICLE

Reproducibility and clinical potential of myocardial mass at risk calculated by a novel software utilizing cardiac computed tomography information

Satoru Sumitsuji¹ · Seiko Ide¹ · Patrick T. Siegrist¹ · Youssef Salah¹ ·



Journal of Cardiovascular Computed Tomography

journal homepage: www.JournalofCardiovascularCT.com



Research paper

Cardiac computed tomography-derived myocardial mass at risk using the Voronoi-based segmentation algorithm: A histological validation study



Seiko Ide, MD^a, Satoru Sumitsuji, MD^{a,*}, Osamu Yamaguchi, MD, PhD^b, Yasushi Sakata, MD, PhD^b

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Validation Study with Animal Heart

Myocardial mass at risk (MMAR) is an important predictor of adverse cardiac events in patients with acute coronary syndrome. This study aims to validate the accuracy of MMAR calculated from

Coronary Territory by CT

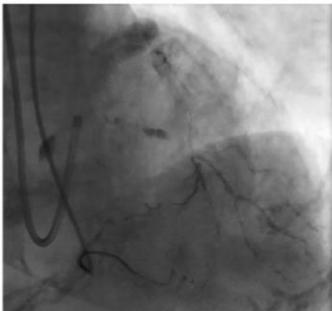
	Cadaver heart Kalbfleisch (129 cases)	MMAR Sumitsuji / Ide (42 cases)
	RV mass = 22.5% of whole heart mass ¹ 16.4 % of whole heart mass = RCA territory in LCA dominant heart ²	
LAD	41.7%	40.8%
LCX	21.0%	21.8%
RCA	37.3%	36.9%

1: Lorenz CH et al. J Cardiovasc Magn Reson. 1999;1:7–21.
2: Kalbfleisch H et al. Am Heart J. 1977;94(2):183–8.

Sumitsuji, Ide, et al. CVIT online

Clinical Application during CTO intervention

Case: LADCTO with Bifurcation



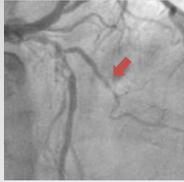
LAD CTO : 33.3% of LV myocardium



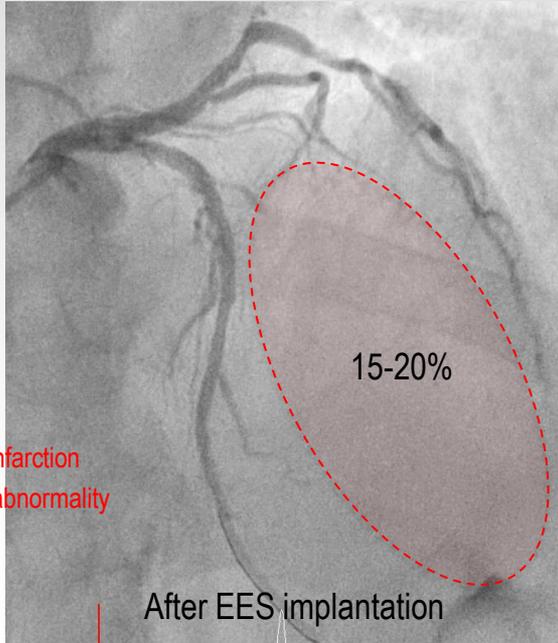
Case: LADCTO with Bifurcation



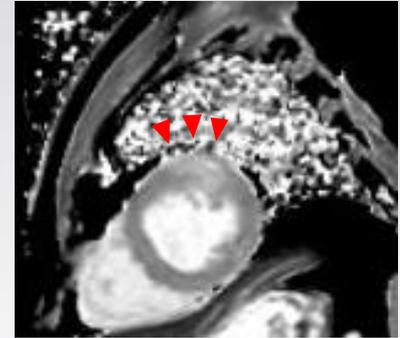
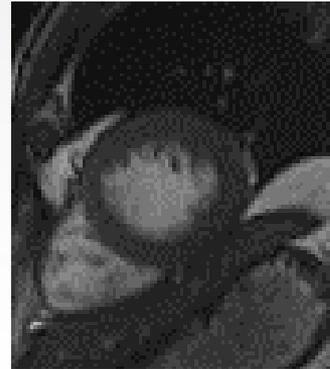
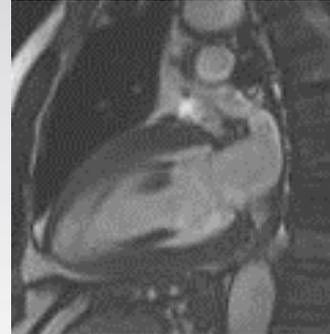
Anatomical territory = Ischemic burden?



M/69 Stable angina



- Angina
- Myocardial ischemia/infarction
- Regional wall motion abnormality
- LV dysfunction
- Cardiac death

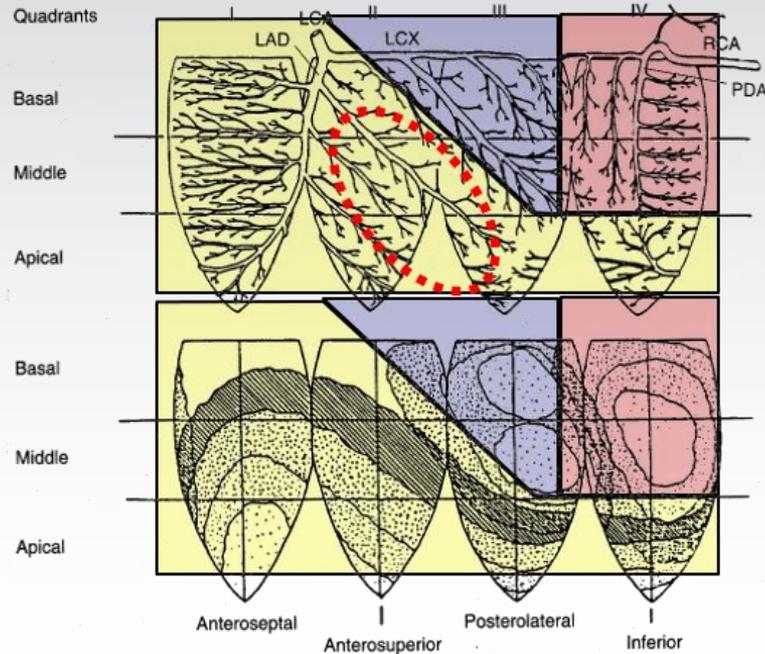


Stroke Volume:	74.55 ml
Ejection Fraction:	52.18%
Total Myocardial Mass	143.10 g
Total Enhanced Mass	10.51 g
Enhanced/Total mass	7.30%

Heterogenous delayed enhancement in basal to mid ant wall **subendocardial layer**.
Combined infarcted and non-infarcted myocardium

Simple angiographic approach

- Determinants of diagonal branch territory -

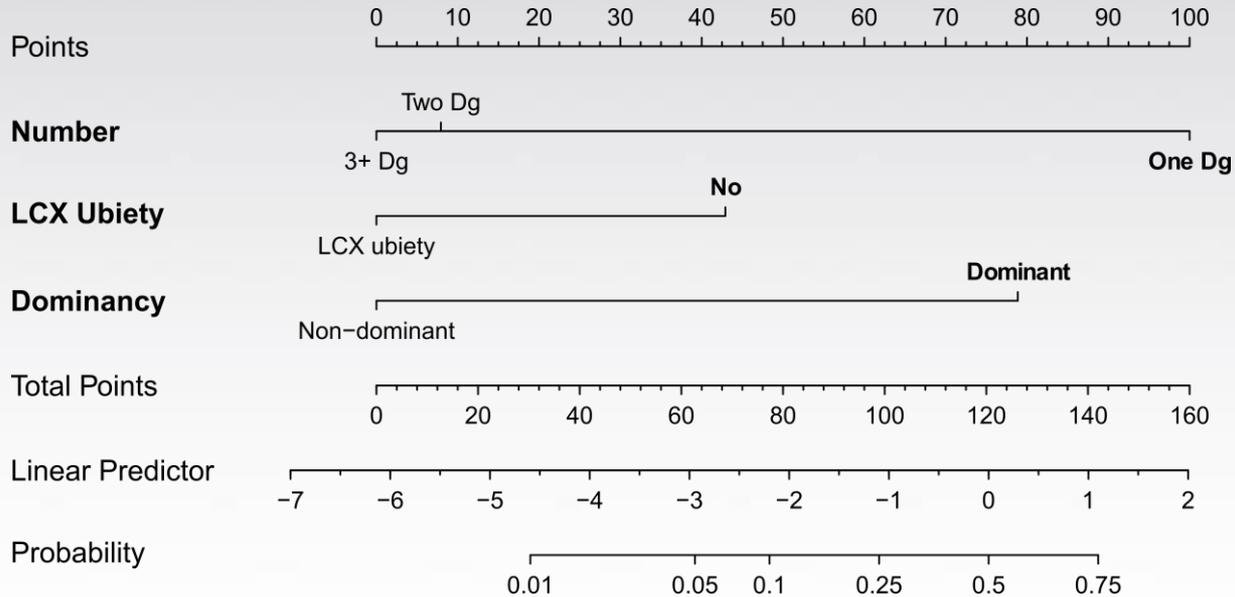


- Diagonal branch vessel size
- Diagonal branch length
- **Total diagonal territory**
- **Number of diagonal branch**
- **Dominancy**
 - Absolute – LAD vs. LCX
 - Relative





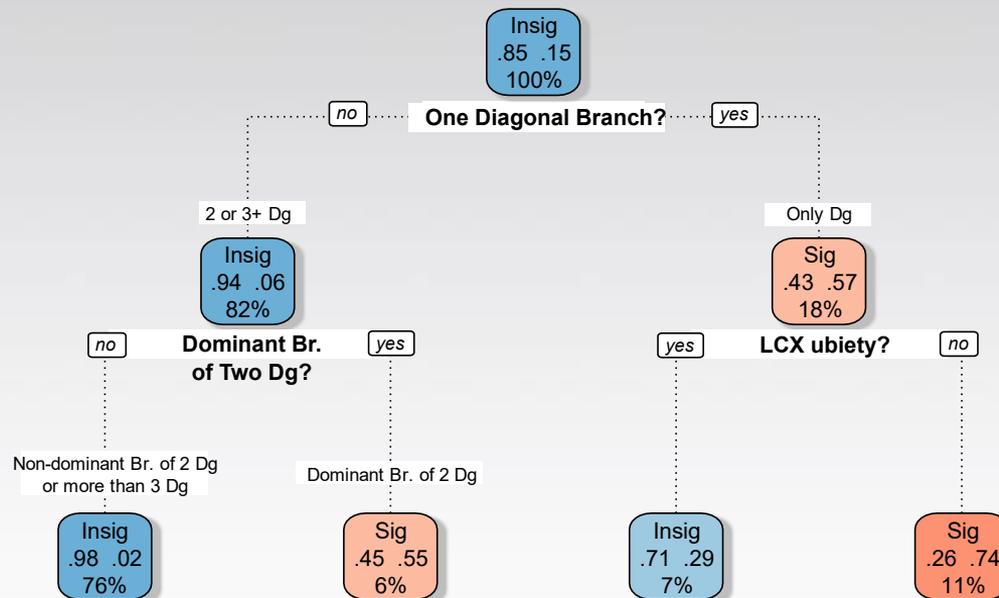
Nomogram to Predict Likelihood of Diagonal Branch %FMM $\geq 10\%$



Unpublished and preliminary data
Data from FMM registry, Kim HY et al. JACC interv 2016



Decision Tree to Predict Likelihood of %FMM $\geq 10\%$



Decision Tree	Sp	Sn	NPV	PPV	AUC [95% C.I.]	Accuracy
Number + Ubiety + Dominancy	0.916	0.765	0.956	0.619	0.84 [0.73-0.95]	0.89 [0.82-0.94]

Unpublished and preliminary data
Data from FMM registry, Kim HY et al. JACC interv 2016

How IVUS imaging can reduce the number and length of stent?

Akiko Maehara

Columbia University, Cardiovascular
Research Foundation, New York

ADAPT-DES - Current Cohort -

Assessment of Dual AntiPlatelet Therapy with Drug-Eluting Stents

Lesion and Procedural Characteristics

	IVUS n = 3361	No IVUS n = 5221	P Value
# of lesions treated	1.48±0.75	1.52±0.81	0.024
Bifurcation lesion	14.2%	16.2%	0.012
In-stent restenosis lesion	11.6%	9.6%	0.003
Bypass graft lesion	2.9%	6.3%	<0.0001
# of DES implanted	1.71±0.96	1.69±1.03	0.31
Total stent length (mm)	33.6±21.9	31.8±22.6	0.0002
Max device diameter (mm)	3.44±0.56	3.14±0.50	<0.0001
Max balloon pressure (atm)	16.9±3.7	16.7±3.5	0.070

Procedural Data (II)

	IVUS (n=962)	Angiography (n=1016)	P
Per lesion, n (%)			
Stent number	1.81±0.80	1.76±0.77	0.16
Mean stent length, mm	49.99±25.10	47.38±22.42	0.02
Mean stent diameter, mm	3.14±0.51	2.97±0.48	<0.001
Max balloon diameter, mm	3.73±0.56	3.51±0.53	<0.001
Max post-dilation pressure, atm	19.7±3.7	19.0±3.7	<0.001

IVUS guidance did not decrease the actual stent length compared to PCI without IVUS by appropriate coverage, and reduced future events.

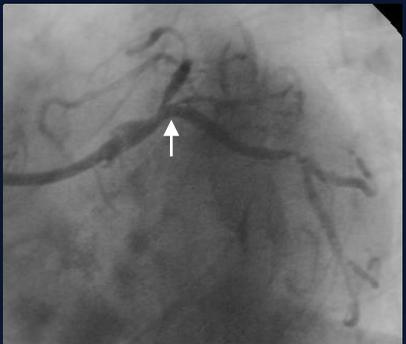
Special 2 comments for Bifurcation...

Negative remodeling at the ostium of the sidebranch

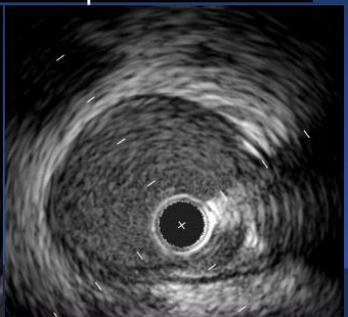
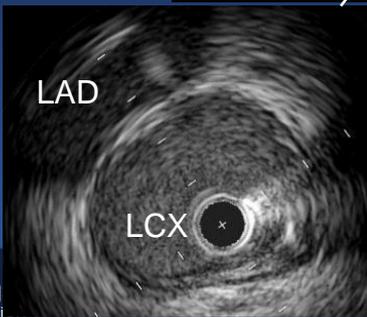
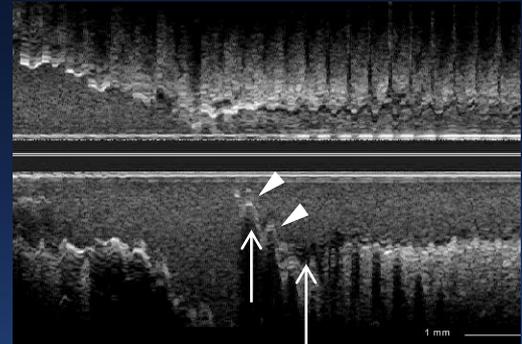
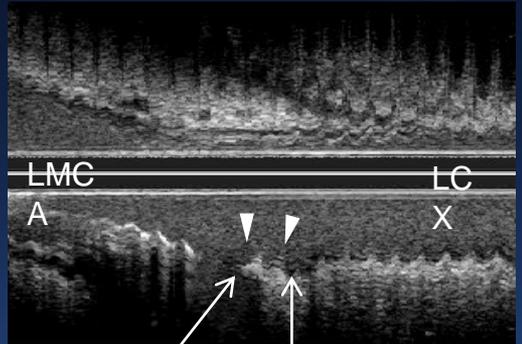
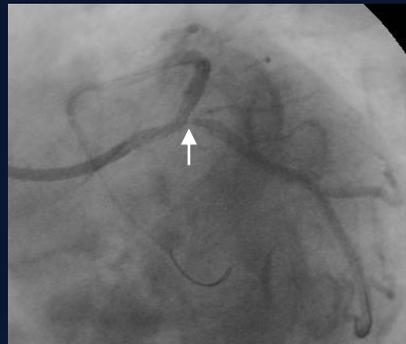
- Present in 70%-90%
 - Fujii et al. Am J Cardiol 2003;92:59-61
 - Kang et al. Am J Cardiol 2011;107;1787-93
 - Costa et al. Int J Cardiovasc Imaging. 2013;29:1657-66.
 - Kang et al. Catheter Cardiovasc Interv 2012;81:1150-5
- Although negative remodeling contributes to a smaller MLA of SB ostium, it rarely affects SB FFR without a significant plaque burden
 - Kang et al. Am J Cardiol 2011;107;1787-93

Carina Shift

Pre -PCI



Final





Take Home Message

- Identification of clinically relevant side branch should be the 1st step for bifurcation lesion evaluation.
- Clinical application of CCTA-based novel technologies (FMM, MMAR, CAMS ...) can be helpful in defining clinically relevant side branches before the invasive procedures.
- For all branches, ischemic territory is smaller than supplying territory.
- Lessons learned from invasive imaging can provide important insights in defining clinically significant stenoses and enable adequate PCI.
- Most side branches do not supply <10% of myocardium and cannot cause >10% ischemia. Therefore, don't do too much (physiologic assessment, imaging, PCI.....) for side branches.

