Update on treatment of LM disease

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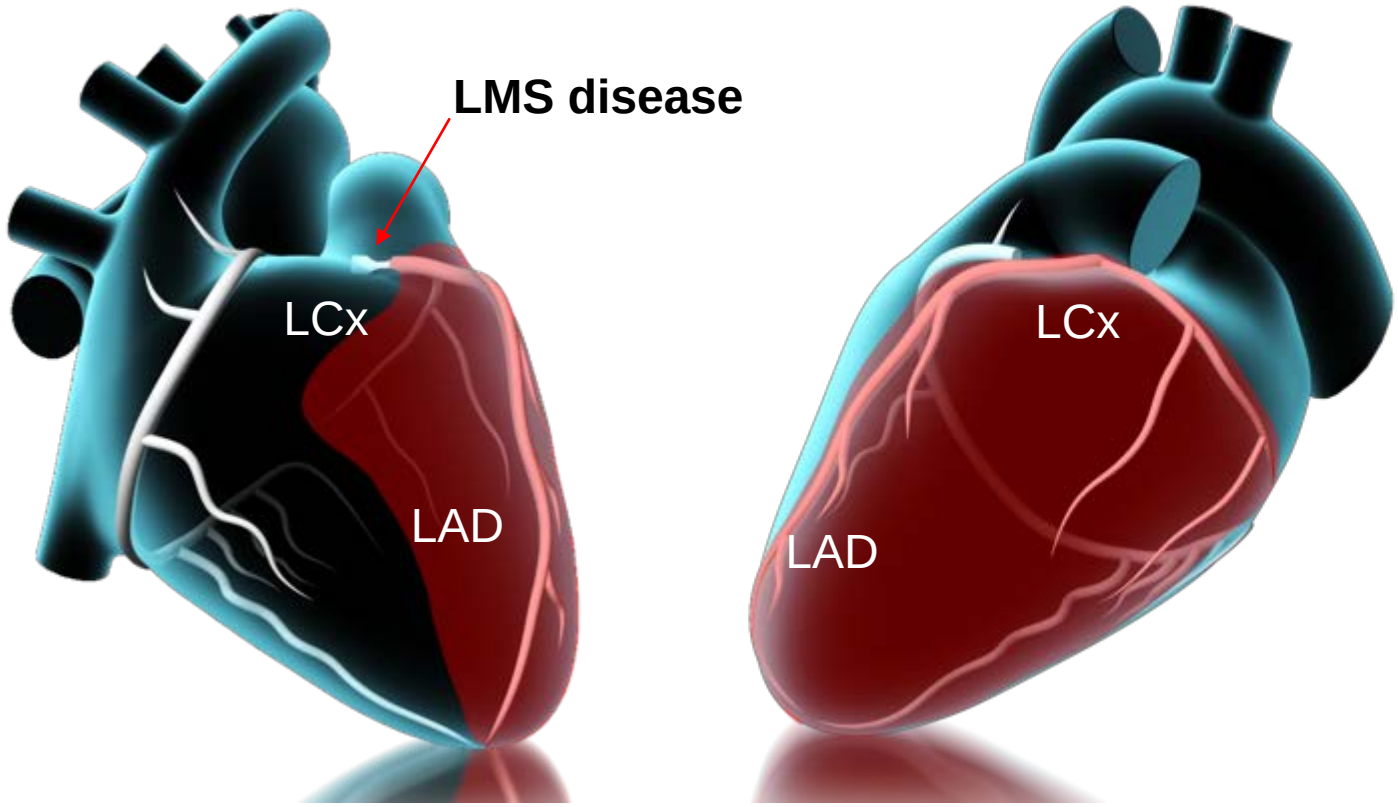
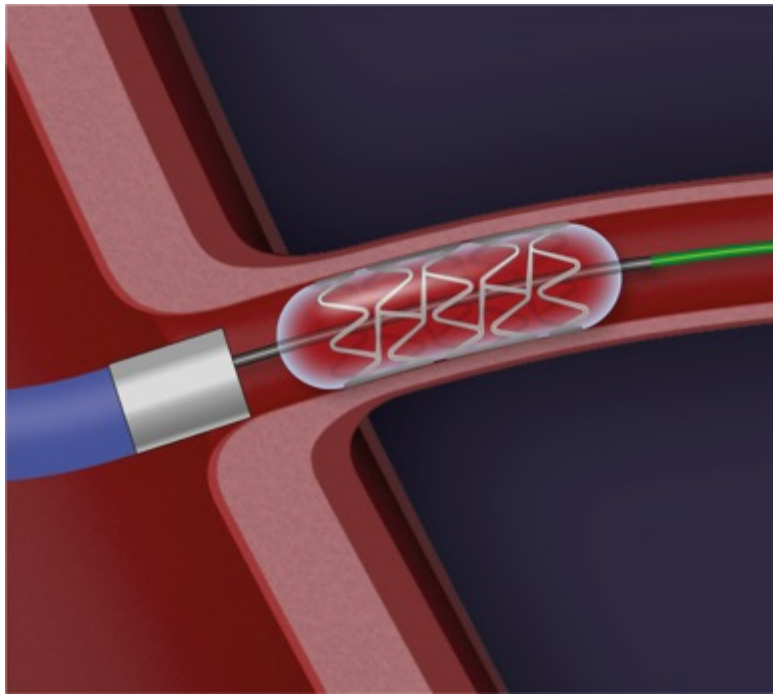
Left Main

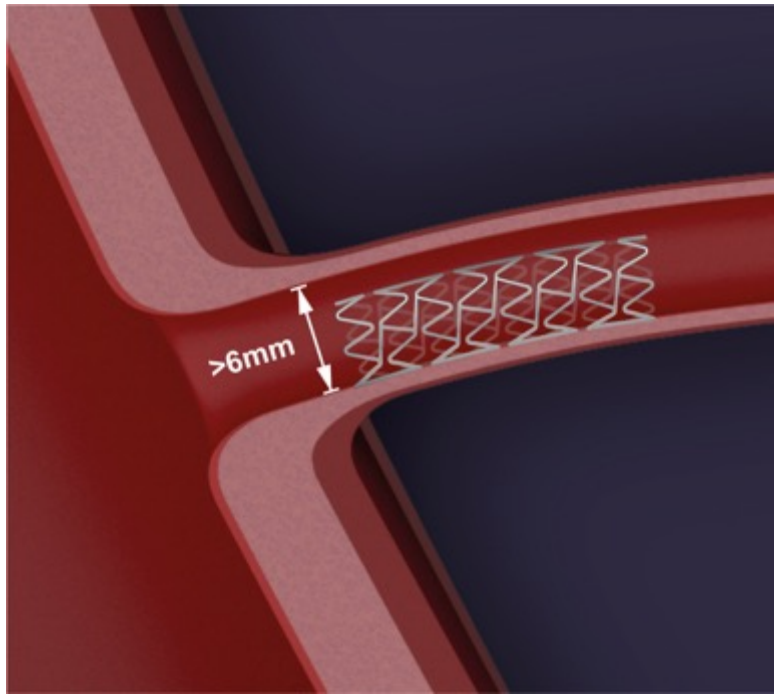
Subtends 75% to 100% of myocardium, depending on dominance
severe LM disease reduces flow to a large portion of myocardium



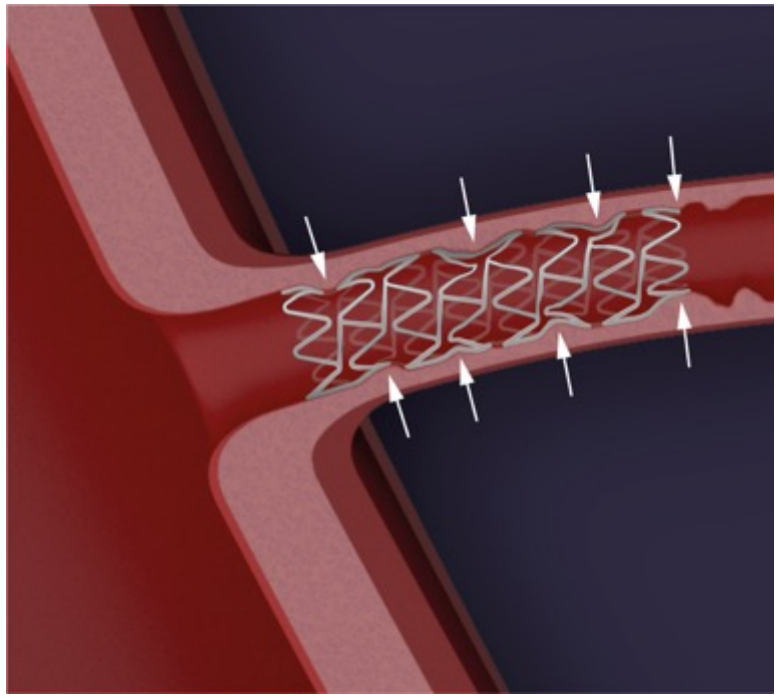
Left Main: Challenges with Stenting



Ischaemia with instrumentation



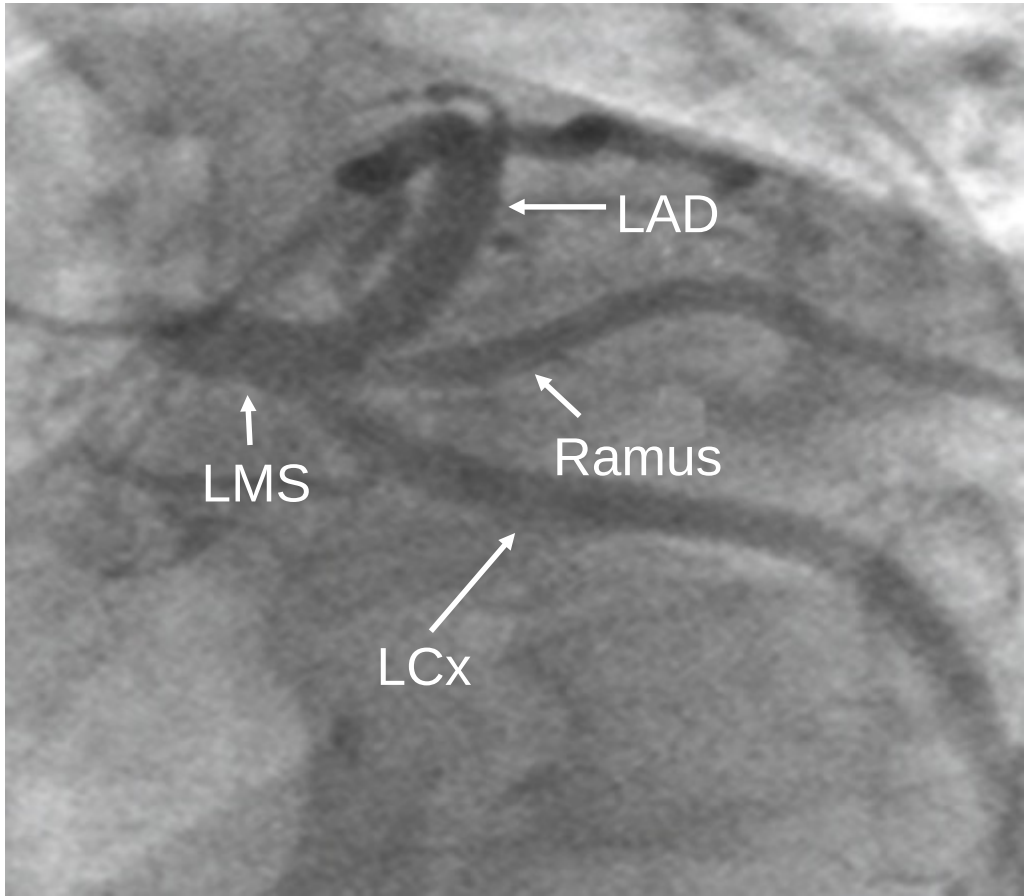
Large diameter- may be >6mm diameter (larger than available stent/balloon limits)



Relatively greater elastic tissue content- elastic recoil after balloon or PCI

LM bifurcation

- Involved in >80% of LM lesions
- Size mismatch- average LM diameter 5.6mm
- Wide bifurcation angle
- Often calcified
- Side branches are important!



LM PCI- the evidence

LM PCI vs CABG

SYNTAX trial

Synergy Between PCI with Taxus and Cardiac Surgery

LM substudy

- 357 patients PCI vs 348 patients CABG

- Compared with CABG, LM PCI with SYNTAX score<33 had similar rates of MACE/stroke/death at 5 years

- LM PCI had greater TLR (23% at 5 years)

LM PCI vs CABG

	EXCEL	NOBLE
No. pts	1905	1201
No. sites	126	36
Regions	Europe/N. America/S. America/Asia	Europe
Patient population	LM stenosis>70% or 50-70% if significant on functional test SYNTAX <32	Visually assessed LM stenosis>50% or FFR<0.8 Average SYNTAX 22
Stent	Everolimus-eluting (Xience)	Biolimus-eluting (Biomatrix)
Follow up	3 years	5 years
Primary outcome	Composite all cause mortality/stroke/MI	Composite all cause mortality/non-procedural MI/repeat coronary revasc/stroke
Conclusions	PCI non-inferior to CABG	CABG superior to PCI at 5 years MACCE rates similar to 1 year then diverge

Guidelines

ESC/EACTS

	CABG		PCI	
	Class[a]	Level[b]	Class[a]	Level[b]
Left main CAD				
Left main disease with low SYNTAX score (0 - 22).[69,121,122,124,145–148]	I	A	I	A
Left main disease with intermediate SYNTAX score (23 - 32).[69,121,122,124,145–148]	I	A	IIa	A
Left main disease with high SYNTAX score (≥33).[c] [69,121,122,124,146–148]	I	A	III	B

ACC/AHA

UPLM*

CABG

PCI

I	B
IIa—For SIHD when *both* of the following are present: • Anatomic conditions associated with a low risk of PCI procedural complications and a high likelihood of good long-term outcome (eg, a low SYNTAX score of ≤22, ostial or trunk left main CAD) • Clinical characteristics that predict a significantly increased risk of adverse surgical outcomes (eg, STS-predicted risk of operative mortality ≥5%)	B
IIa—For UA/NSTEMI if not a CABG candidate	B
IIa—For STEMI when distal coronary flow is TIMI flow grade <3 and PCI can be performed more rapidly and safely than CABG	C
IIb—For SIHD when *both* of the following are present: • Anatomic conditions associated with a low to intermediate risk of PCI procedural complications and an intermediate to high likelihood of good long-term outcome (eg, low-intermediate SYNTAX score of <33, bifurcation left main CAD) • Clinical characteristics that predict an increased risk of adverse surgical outcomes (eg, moderate-severe COPD, disability from prior stroke, or prior cardiac surgery; STS-predicted risk of operative mortality >2%)	B
III: Harm—For SIHD in patients (versus performing CABG) with unfavorable anatomy for PCI and who are good candidates for CABG	B

Assessment of LM disease

Assessing LM disease

- Important to get it right!
- High mortality with untreated significant LM disease
- Bypass of non-significant LM lesion:
  - Early graft occlusion
  - Acceleration of native disease
- PCI complications eg stent thrombosis

Assessing LM disease

- >50% diameter stenosis considered cutoff
- But angiography not always accurate in assessing significance
- 30% mismatch between angiographic assessment and FFR
  - 13/213 patients with stenosis>50% but FFR>0.8
  - 49/213 patients with stenosis<50% but FFR<0.8

→ **Tendency to *underestimate* visually**

Hamilos et al, Circ, 2009

Assessing LM disease

- Non-invasive functional testing can be non-contributive
  - Eg reduced uptake in all territories ‘balanced ischaemia’

- FFR is useful
  - FFR>0.75 or 0.8 is strong predictor of favourable outcome with medical treatment

Intermediate LMCA stenosis (DS* 30-70%)

Ostial or Shaft Stenosis

- **Whether to Treat or Not: FFR guidance**
  - FFR measurement is crucial
- **How to Treat: IVUS guidance**
  - Pre-intervention IVUS evaluation
    Evaluate minimal lumen diameter, reference vessel diameter, lesion length, plaque burden and distribution.
  - Pre-intervention IVUS optimization
    MSA‡ >8.2mm^2 is important

Bifurcation Stenosis

- **Whether to Treat or Not: FFR guidance**
  - FFR measurement is important
    Consider a bifurcation stenosis as a single unit of disease (see Figure 2.)
  - IVUS can assist the functional evaluation of bifurcation stenosis
    MLA†>4.8mm^2 (sensitivity 89%, specificity 83%) and plaque burden>72% (sensitivity 73%, specificity 79%) to predict FFR≤0.80 (see Figure 3.)
- **How to Treat: IVUS guidance**
  - Pre-intervention IVUS evaluation
    Evaluate anatomic features favoring single stent cross over stenting (see Table 4.)
  - Post-intervention IVUS optimization
    Evaluate MSA in every segment of LMCA (see Figure 5.)

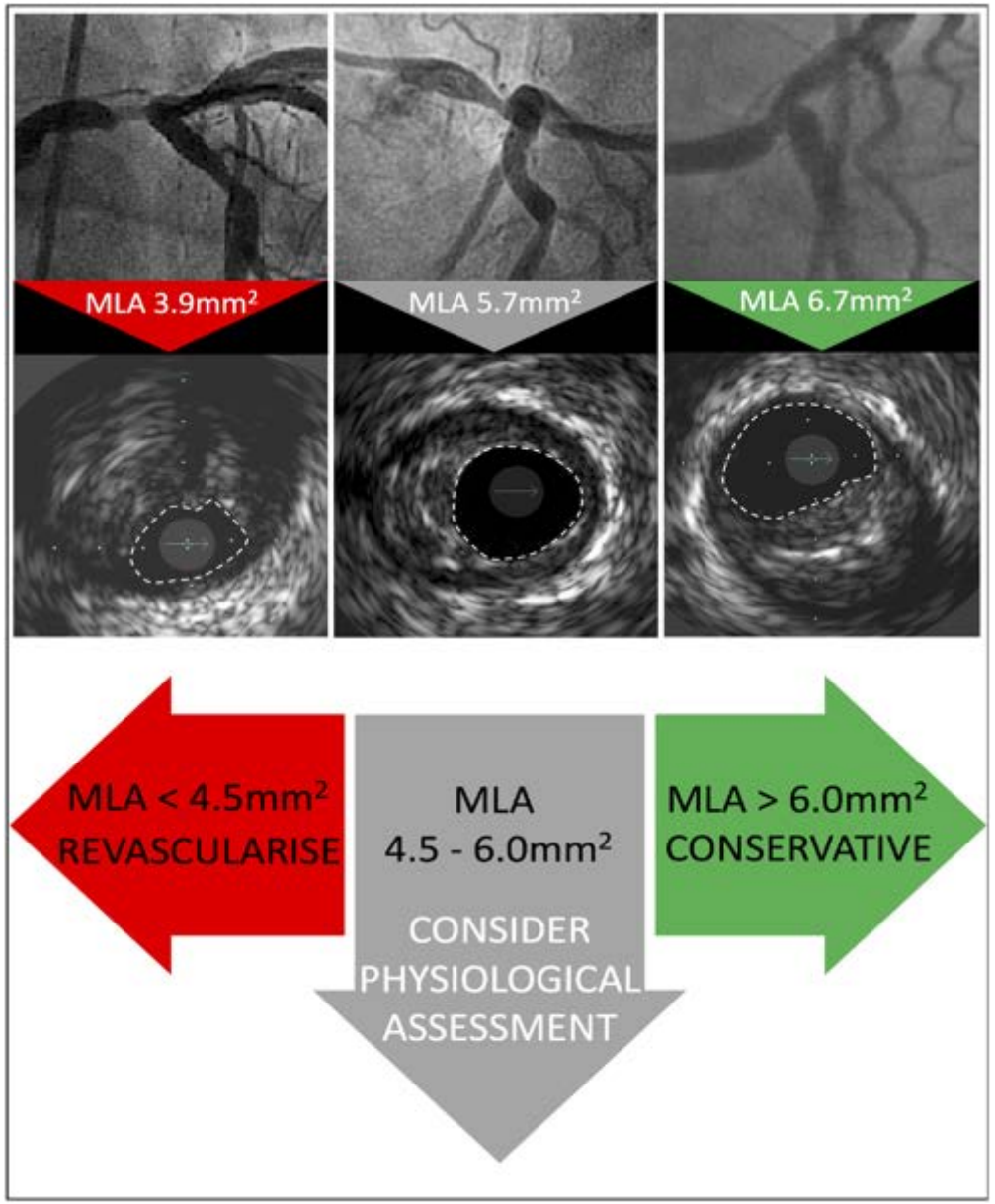
* Visual estimated diameter stenosis; † Minimal lumen area; ‡Minimal stent area

Park et al, JAHA, 2012

IVUS

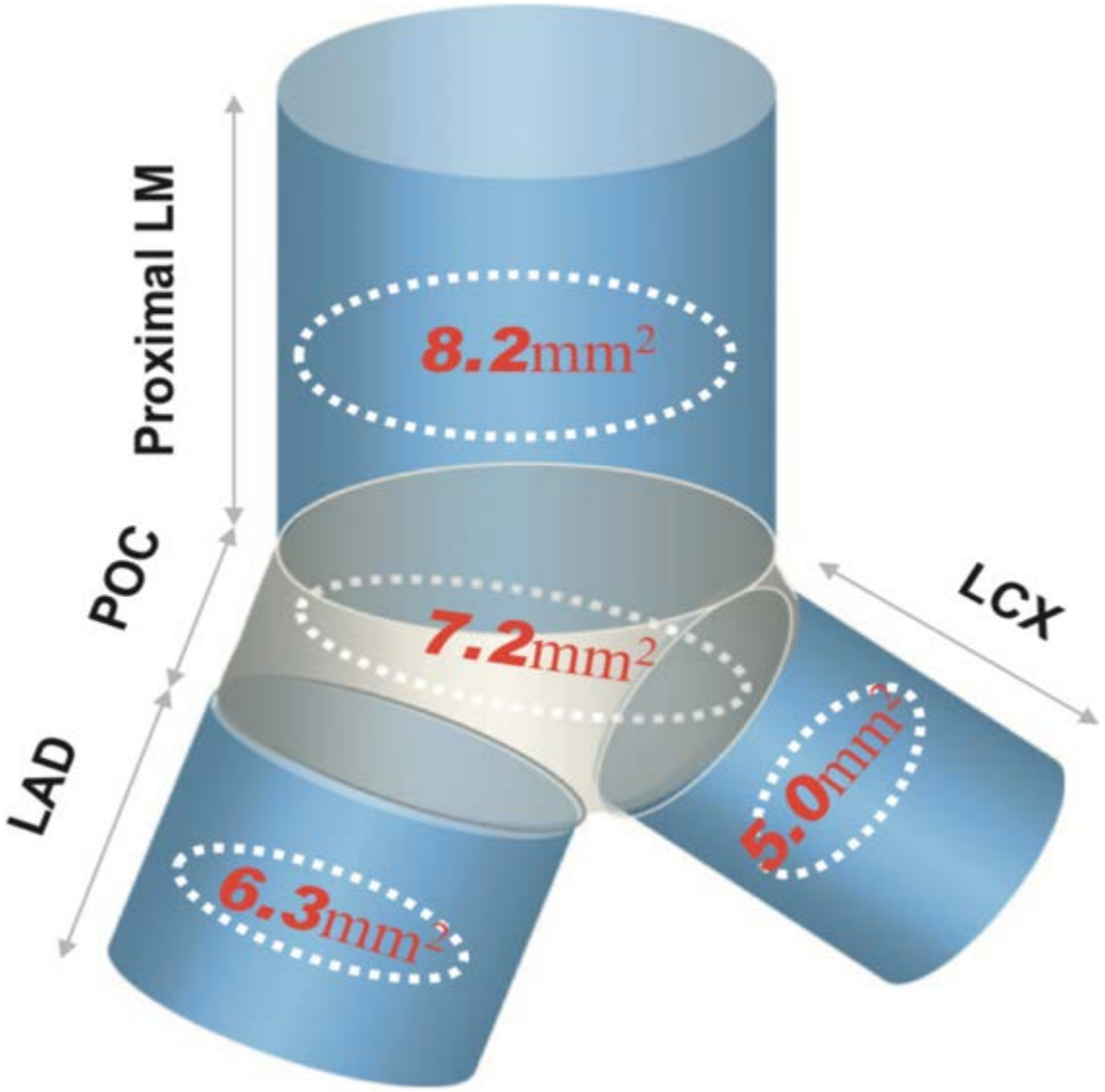
LESION	STENT	OPTIMISATION	OUTCOMES
➓Extent and character of plaque ➓Luminal areas (MLA) ➓Ostia of daughter branches	➓Sizing ➓Optimal proximal and distal landing zones ➓Stent length	➓Expansion ➓Apposition of stents ➓Distal LM and 2-stent strategy ➓Stent deformation	➓ISR ➓Target vessel revascularisation

Role of MLA



EHJ, 2019

IVUS in LM PCI



- Stent area (MSA) on IVUS is a strong predictor of ISR

Kang et al, Circ Cardiovascular Interv 2011

IVUS in LM PCI

MAIN-COMPARE

- Registry; 201 matched pairs (IVUS guided vs angio only)
- 3 year mortality lower with IVUS guidance (4.7% vs 16%)

IVUS in LM PCI

- **EXCEL IVUS substudy**
  - IVUS guidance in 722 of 935 (77%) patients who underwent PCI
  - The final MSA measured on IVUS showed a *strong association* with adverse events in 3 year follow-up
  - Post-PCI MSA with 9.9+/- 2.3mm2

EXCEL IVUS substudy

3-year Outcome Stratified by Minimal Stent Area by IVUS

	Smallest tertile (n=172)	Intermediate tertile (n=169)	Largest tertile (n=163)	p-value Smallest vs Intermediate	p-value Smallest vs Largest
MSA range (mm^2)	4.4 - 8.7	8.8 - 10.9	11.0 - 17.8	-	-
3-year event rates					
Death/MI/stroke	19.4% (32)	16.1% (26)	9.6% (15)	0.45	0.01
Death	13.8% (22)	10.0% (16)	5.2% (8)	0.34	0.01
MI	10.5% (17)	8.2% (13)	3.7% (6)	0.49	0.02
Stroke	1.8% (3)	1.2% (2)	2.1% (3)	0.66	0.98
Definite/probable stent thrombosis	3.1% (5)	1.2% (2)	0.0% (0)	0.26	0.03
Left main revascularization	12.9% (19)	8.3% (13)	8.8% (14)	0.30	0.41

Haemodynamic support

- Consider in high risk LM PCI with LV dysfunction

- PROTECT II trial
  - RCT of Impella 2.5 vs IABP in high risk PCI (including LM)
  - Average LVEF 24%
  - No difference in in-hospital mortality or MACE at 30 days
  - Trend to decreased MACE at 90 days in Impella group

Case study:

Impella-supported LMS Shockwave PCI

Conclusion

- PCI increasingly an alternative to CABG in LM disease
  - Currently strongest indications are in low-complexity disease
- Physiology and imaging-guided assessment for intermediate LM lesions
- Importance of intra-coronary imaging during LM PCI