Left Main Coronary Interventions

18

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Introduction

Interventions of the left main coronary artery (protected and unprotected) require special and careful consideration of other lesions assessment, lesion preparation, and proper device selection and placement.

Left Main Stenosis

Location

- Majority of left main lesions are distal bifurcation with 20% involving the isolated ostium and 10% involving isolated mid-body (Fig. 18.1).

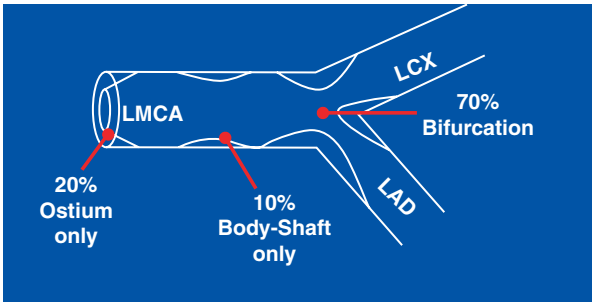

Fig. 18.1 Percentage of distribution of the location of involvement in left main stenosis

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Diagnosis of Left Main (LM) Disease

- Angiographic diagnosis of LM disease may not be accurate especially in intermediate lesions, especially in short LM lesions, and in diffuse disease process. Diffuse LM disease may conceal stenosis and cause the vessel to appear disease free.
- The identification of diffuse LM disease should be suspected when the reference diameter of the LM is similar to the reference diameter of the left anterior (Murray's law) descending coronary artery (LAD) [1].
- Additional imaging or physiological assessment is recommended if warranted.
- Role of intravascular ultrasound (IVUS):
  - The cut-off for intervention of LM is minimal luminal area (MLA) <6 mm^2 [2]. This has been shown to correlate with a fractional flow reserve (FFR)) <0.8 (Fig. 18.2).
- Role of FFR:
  - FFR values (>0.80) in left main lesions are associated with excellent long-term outcomes [3].
  - Presence of downstream disease may affect the FFR value of LM disease.
  - Myocardial bed supplied by the LM artery may be larger if it supplies collaterals to an occluded RCA.
  - It is postulated that the presence of a significant lesion in either the LAD or the LCX makes the myocardial bed smaller for the LM leading to a falsely higher FFR. The left main FFR alone cannot be accurately measured when there are significant downstream serial lesions. If the LAD and LCX are hemodynamically insignificant, the left main FFR will be accurate.

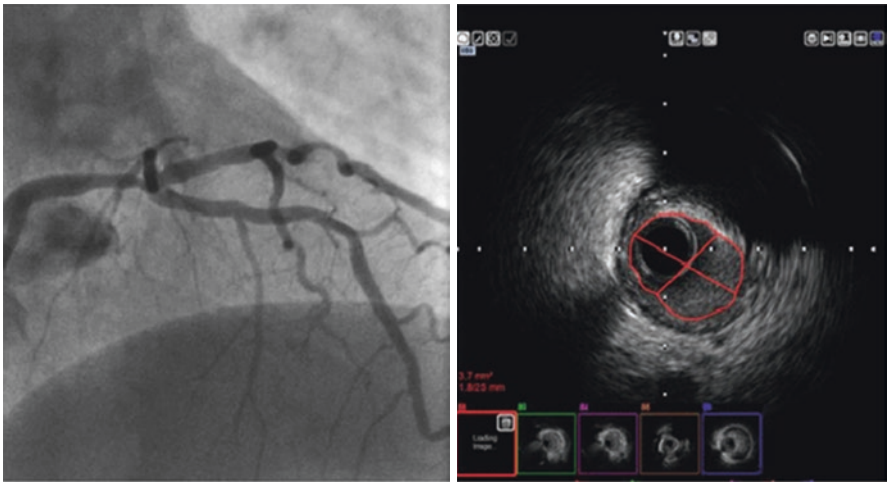

Fig. 18.2 Moderate LM disease by angiography and IVUS showed MLA of 3.7 mm^2

Supporting Evidence for Percutaneous Intervention for Left Main Stenosis

The EXCEL, NOBLE, SYNTAX, and PRECOMBAT trials had a direct comparison of PCI vs CABG for left main intervention.

EXCEL Trial [4]

- 1905 patients
- Primary endpoint: a composite of death from any cause, stroke, or MI.
- At three years, the primary endpoint occurred at a similar rate in both groups (15.4 versus 14.7 percent p = 0.018 for noninferiority, p = 0.98 for superiority).
- At 5 years: no difference in the primary outcome in both groups (22.0 versus 19.2 percent, odds ratio 1.19, 95% CI 0.95–1.50, p = 0.13).
- Death from any cause, a secondary outcome, occurred more frequently in the PCI group (13.0 versus 9.9 percent).
- The rate of ischemia-driven revascularization was higher with PCI (16.9 versus 10.0 percent).
- Thrombosis (stent/ graft) was higher in CABG vs PCI (6.5% vs.1.6%).

NOBLE Trial [5]

- 1201 patients.
- Primary endpoint: composite of all-cause mortality, non-procedural MI, any repeat coronary revascularization, and stroke.
- At 5-year, Kaplan–Meier estimates of the primary endpoint were 28 and 19 percent, respectively (HR 1.58, 95% CI 1.24–2.01)]. There was no difference in all-cause mortality (9 percent in both groups).
- Revascularization occurred significantly more often after PCI as did non-procedural MI (17 versus 10 and 9 versus 3 percent, respectively).

PRECOMBAT Trial [6]

- 600 patients.
- Primary endpoint: death from any cause, MI, stroke, or ischemia-driven target vessel revascularization.
- Follow-up at 1 year showed noninferiority of PCI over CABG. The event rates were 8.7 and 6.7 percent for PCI and CABG (absolute risk difference 2, 95% CI-1.6 to 5.6, respectively) mainly driven by the higher rate of ischemia-driven target lesion revascularization in the PCI group (6.1 versus 3.4 percent).
- At five years, the event rates for the primary outcome were not statistically significant with 17.5 and 14.3 percent in the PCI and CABG groups.

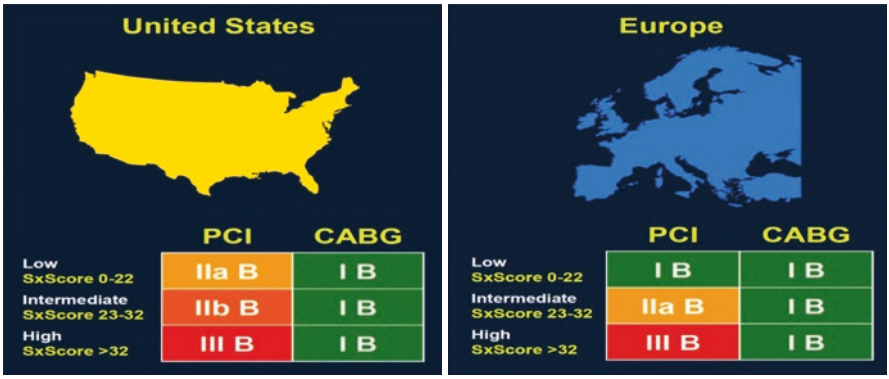

Fig. 18.3 Current Guidelines for CABG vs PCI for Left main and multivessel disease. Adapted from Windecker et al. and Fign et al. [7, 8]

Ischemia-driven target lesion revascularization remained the principal reason for the higher rate in the PCI group.

PCI may thus be considered an acceptable revascularization modality for selected patients with left main CAD, a decision which should be made after heart team discussion, taking into account each patient's individual risk factors and preferences.

Current Guidelines [Fig. 18.3]

Protected Versus Unprotected LM Intervention

- PCI is the preferred approach in protected LM because of the increased risk associated with repeat CABG. Recent and emerging data have shown that PCI is safe in unprotected LM.

Need for Hemodynamic Support

- Hemodynamic support devices are rarely required if LV EF > 50%. We recommend the use of IABP for EF 35–50% and Impella for EF < 30%. In rare cases of complex distal left main with occluded RCA (or non-dominant), we recommend the use of an IABP or Impella to avoid hemodynamic deterioration even when the LV function is normal (Fig. 18.4).

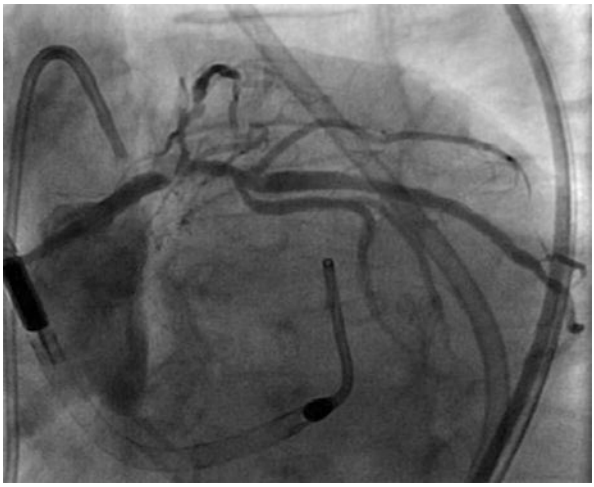

Fig. 18.4 Patient with significant LM disease and LVEF 15%; PCI of LM was performed with Impella support

Planning for Intervention: Simple Versus Complex Lesion (DEFINITION Study)

Simple vs. Complex Lesions

- A simple LMB lesion has SB diameter stenosis <70% and lesion length < 10 mm. This is seen in 75% of cases and can be treated with a single-stent provisional approach.
- A complex LMB lesion has SB diameter stenosis >70% and lesion length > 10 mm. A simple lesion can change to a complex lesion with the presence of 2 of the following 6 minor criteria:
  - 1) Moderate to severe calcification.
  - 2) Multiple lesions.
  - 3) LAD-LCx bifurcation angle >70.
  - 4) Main vessel reference vessel diameter < 2.5 mm.
  - 5) Thrombus-containing lesion.
  - 6) Main vessel lesion length > 25 mm.
- Complex lesions generally require a 2-stent strategy.

Femoral Versus Radial Approach

- Both approaches are suitable, but the femoral approach is preferred if there is a need for a larger size guide (>6Fr), rotational/orbital atherectomy, or hemodynamic support.

Optimal Angiographic Views

- AP caudal, AP cranial, LAO cranial, and LAO caudal for visualization of bifurcation.

Approach

Ostial LM

- Sheath size: 6F or 7F,
- Guide selection: FL or VL (with side holes). Avoid aggressive guides and deep engagement and ventricularization.
- Wires: Runthrough, Fielder. Buddy wire may be needed to provide additional support.
- Lesion preparation/debulking: Predilation with compliant or semi-compliant balloons. May need Flextome/AngioSculpt for adequate vessel preparation. Rotational or orbital atherectomy may be required for heavily calcified lesions (if rotational atherectomy of LM is planned, place a temporary pacing wire). If using rotational atherectomy, disengage the guide slightly and start rota from inside the guide so that the ostium is also adequately prepared.
- Stent selection: DES is preferred.
- Stenting strategies.
  - Disengage the guide slightly but keep it close enough to enable adequate visualization of the vessel.
    While holding wires taut, pull back the guide slowly to disengage it from the ostium but while maintaining wire and guide control.
    Place stent to cover the lesion with a slight overhang into the aorta.
    Deploy stent with inflation of stent balloon to high pressures at the ostium.
    Postdilate stent and "flare" ostium with high-pressure inflation of the noncompliant balloon with a portion of the balloon protruding into the aorta.
    Flash ostial balloon may be used for flaring of the ostium of the stent.
  - Modified Szabo technique.
    Wire lesion.
    Place a second, steerable wire in the aorta to stabilize the guide.
    Place stent over the initial wire and position with 1–2 mm ostial overhang into the aorta.
- Postdilate with final "flaring" of ostium with a noncompliant balloon with high pressure using 0.5 mm higher balloon size than the stent size.

Mid-LM

- Sheath size: 6F.
- Guide selection: VL vs EBU vs FL.

- Wires: Runthrough, Fielder.
- Lesion Preparation/Debulking: Predilation with compliant or semi-compliant balloons. May need Flextome/AngioSculpt for moderately calcified vessels and rotational atherectomy may be required for moderate to severely calcified lesions (temporary pacing wire may be needed if rotational atherectomy is planned).
- Stent selection: DES is preferred.
- Stenting strategies: true-mid LM lesions have landing zones proximally and distally, and hence a focal stent placement after adequate preparation of the lesion is feasible. Postdilate to high pressures using a noncompliant balloon.

Distal LM

- Sheath size: 7F or 8F.
- Guide Selection: VL vs EBU.
- Wires: Runthrough, Fielder. Wire both the LAD and LCx and wire the more significant or tighter lesion first. If rotational atherectomy is considered, wire only the vessel that is heavily calcified either directly with a RotaWire/Viperwire or exchange with a Fielder wire/ Finecross microcatheter.
- Lesion preparation/debulking: Predilation with compliant or semi-compliant balloons. May need Flextome/AngioSculpt for moderately calcified vessels. Rotational or orbital atherectomy may be required for moderate to severely calcified lesions (Fig. 18.5). Temporary pacing wire may be needed if rotational atherectomy is planned.
- Stent selection: DES is preferred.
- Stenting strategies: follow approach to treatment of LM bifurcation lesions as detailed in Fig. 18.6.

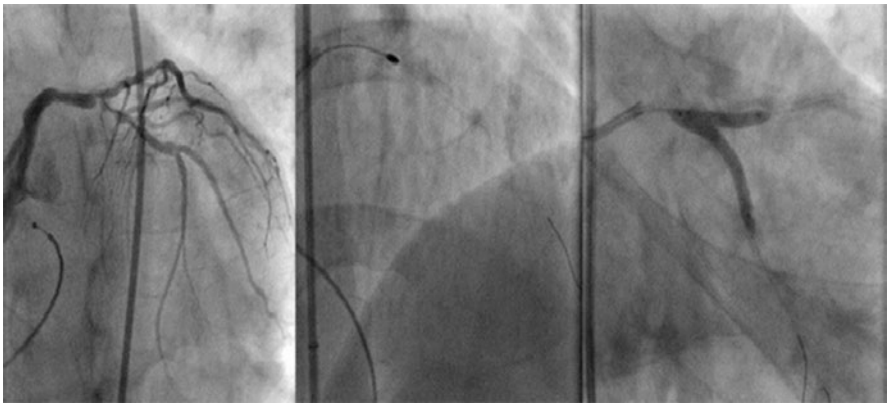

Fig. 18.5 Distal LM disease being debulked by rotational atherectomy

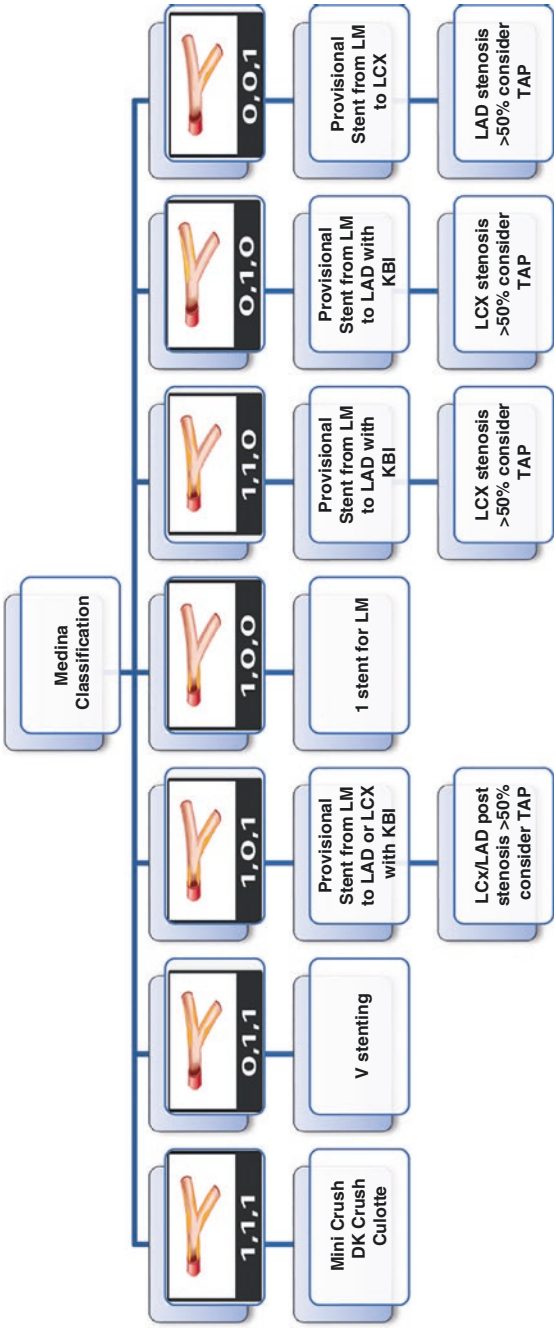

Fig. 18.6 Strategies for left main intervention based on the Medina classification, modified from Bifurcaid app with permission

Provisional Stenting

- If no significant disease in side branch(Medina 1,1,0 or 0,0,1 or 0,1,0).
- Wire the MBV with Runthrough and the SBV with Fielder.
- Adequate lesion preparation and debulking should be performed.
- Confirm the position of the stent in MBV and deploy.
- Withdraw SBV wire and rewire SBV through MBV stent strut.
- Final kissing balloon inflation (KBI).

Two-Stent Strategy

- Bifurcation angle can also help guide the intervention strategy. For wider bifurcation angles >70 or when the LCx is smaller than the LAD (but larger than 2 mm), DK crush is the ideal 2-stent technique. If the bifurcation angle is <70 and the LCx diameter is within 0.5 mm of the LAD diameter, either the Culotte or the DK crush technique can be performed.
- SKS or V stenting has advantages of relative ease of the procedure and good angiographic results obtained with little hemodynamic disruption also, the need to rewire the side branch is eliminated. If the bifurcation lesion is Medina [0,1,1], then the best strategy would be V stenting strategy. For SKS, PMV must be large enough and at least 2/3 the size of (DMV + SBV).
- Below is a brief description of different two-stent strategies. For a detailed description of two-stent strategies, *see Bifurcation Interventions Chapter 16.*

SKS/V Stent

- Rarely used except in emergent cases.
- SKS: >2 mm overlap in LM, V stent: ≤2 mm overlap in LM.
- Wire the MBV with the Runthrough wire and wire SBV with the Fielder wire.
- Lesion preparation and debulking should be performed as necessary.
- Both stents positioned with proximal overlap with both markers exactly aligned.
- Simultaneous stent deployment in MBV and SBV (equal pressures) with careful deployment to avoid risk of proximal vessel dissection.
- Final kissing balloon inflation (KBI) (Fig. 18.7).

Mini Crush

- Wire the MBV with the Runthrough wire and wire SBV with the Fielder wire.
- Lesion preparation as needed.
- Place SBV stent with ≤2 mm protrusion into the MBV.
- Deploy SBV stent, and then remove wire and stent balloon.
- Deploy MBV stent (completely cover and crush protruding SBV stent).

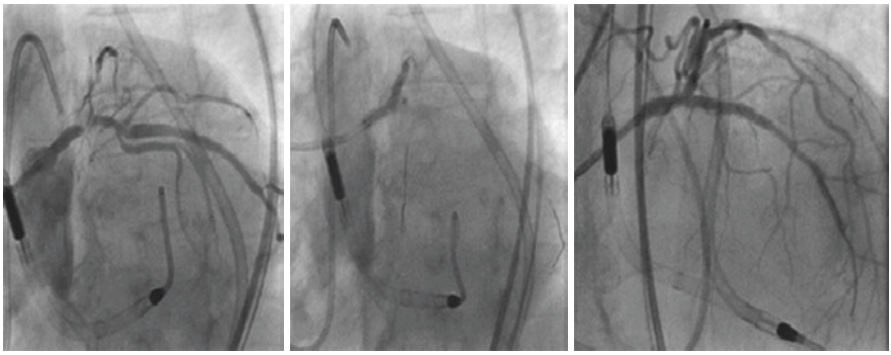

Fig. 18.7 SKS stenting of LM disease with Impella support

- Rewire SBV stent through struts of MBV stent and advance a noncompliant balloon (if difficulty is encountered, use a compliant balloon first) to dilate the ostium adequately.
- Final KBI.

Double Kissing CRUSH (DK-CRUSH)

- Wire the MBV with the Runthrough wire and wire SBV with the Fielder wire.
- Adequately prepare and stent the SBV first.
- Balloon the MBV with a noncompliant balloon (First Crush).
- Perform first KBI.
- Take the SBV wire out.
- Stent the MBV (Second Crush).
- Rewire the SB through MV stent struts.
- Perform second KBI.

Culotte Stenting

- Optimal when significant diffuse side branch and main vessel disease.
- Wire the MBV with the Runthrough wire and wire SBV with the Fielder wire.
- Lesion preparation and debulking should be performed as necessary.
- Place and deploy SBV stent with the proximal end extending into the PMV for 3–5 mm.
- Remove the jailed wire and rewire the DMV through the SBV stent struts.
- Advance balloon over the wire and dilate to open the stent cell in preparation for stenting the MBV.
- Remove the SBV wire.
- Advance the MBV stent and position it to overlap the proximal portion of the SBV stent.

- Deploy the stent and rewire the SBV.
- Final KBI.

T-Stenting and Small Protrusion (TAP)

- Used when prior patent MV stent or as a bailout after provisional stenting.
- Wire the MBV with the Runthrough wire and wire SBV with the Fielder wire.
- Lesion preparation as needed.
- Place MBV stent.
- Remove the jailed wire from SBV.
- Rewire the SBV through the MV stent struts.
- Place SBV stent with 1–2 mm protrusion into the MBV.
- Advance balloon in the MBV.
- Deploy the stent in SBV.
- Pull the stent balloon system back, align it with the MV balloon, and inflate both the balloons simultaneously (Fig. 18.8).

Trifurcation of Distal LM

- If the distal LM trifurcates into LAD, LCX, and ramus, the treatment of trifurcation lesion could be treated as bifurcation lesion with LM and two larger branches of the three, and leave the smaller of the three branches alone.

Imaging after Stent Placement

- IVUS or OCT can be used to assess adequate stent expansion, complete stent strut apposition, and rule out any dissections. At 3 years, in patients receiving DES for LM lesions, a mortality benefit was seen with IVUS guidance compared with angiographic guidance (4.7% vs.16.0%). Randomized trials, however, have failed to show a clinical benefit of IVUS use.

Antiplatelet Selection

- DAPT is recommended at least for 1 year.

Surveillance Angiography

- There is no evidence for routine use of surveillance angiography, and hence, we recommend repeat angiography only if clinically indicated.

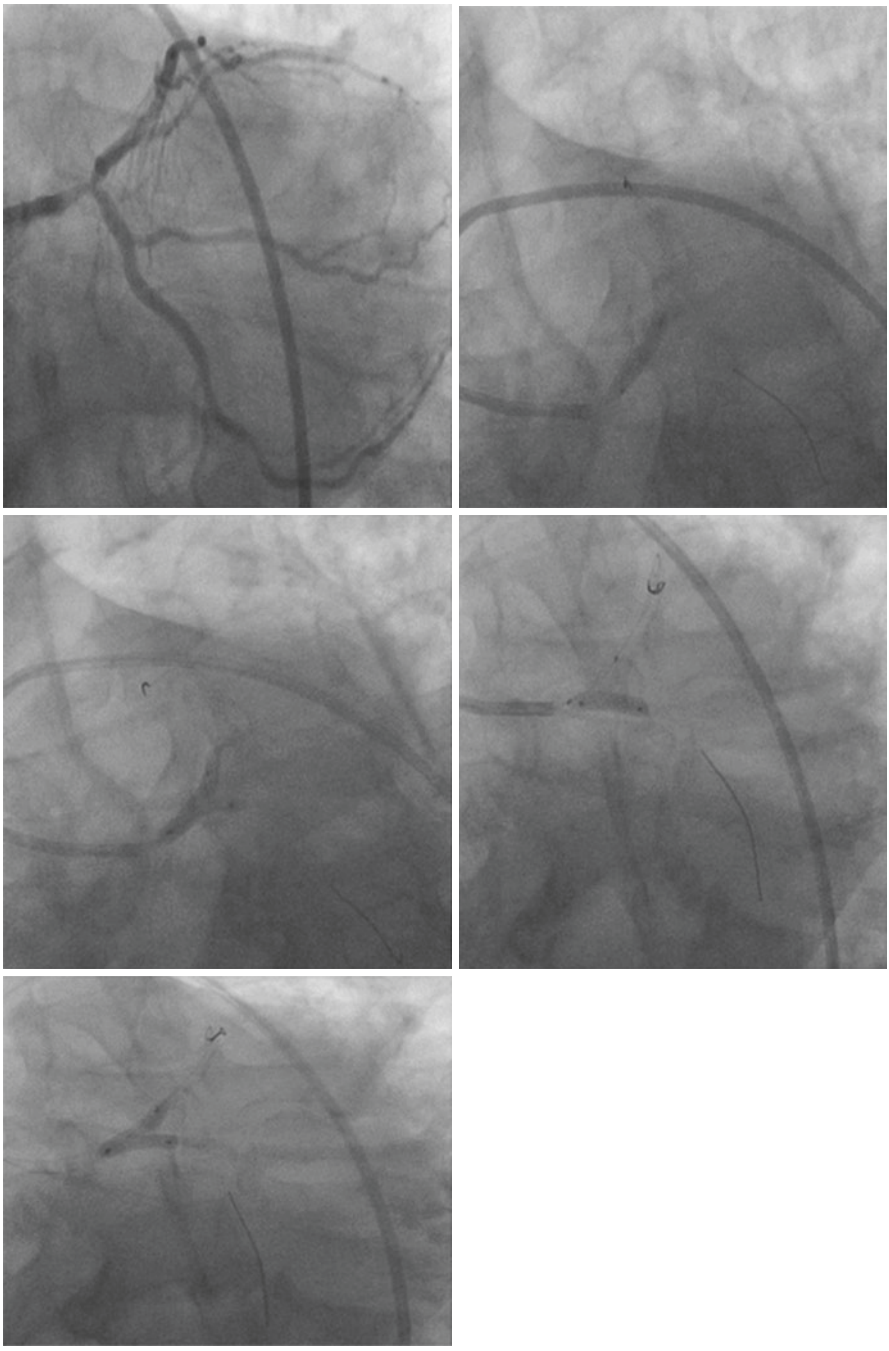

Fig. 18.8 Tap technique for distal LM disease

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