1Use of Guiding Catheter Back-up for Complex Cases (Transfemoral Approach)

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a)　Reasons for Poor Back-up Support, Other Pitfalls

One advantage of transfemoral intervention (TFI) is that there are no real limitations in terms of the use of new devices, or kissing balloon technique for bifurcation lesions, procedures requiring a large-diameter guiding catheter. Add to that that handling is easier than with transradial intervention (TRI) and that back-up force is simpler to obtain. Conditions required for sufficient back-up by a guide cath can be summarized as 1) the guide cath's tip and the coronary artery ostium need to be as coaxial as possible, 2) the shape of the guide cath is such that the catheter is firmly pressed against the coronary ostium on the opposite side of the aorta wall, 3) the guide cath's shaft itself is stable, 4) the guide cath can be advanced deep into the coronary vasculature. If you come up against anatomical factors and even device characteristics which do not satisfy these conditions, there is always a possibility that guiding cath back-up will not be possible: this will have a considerable influence on your procedural success rate. Cases such as abnormal anatomy or abnormal coronary artery ostium origin, aortic expansion, complex lesions (proximal tortuosity, chronic total occlusion lesion [CTOs], heavy calcification etc), can quickly become very complex cases when guide cath back-up is insufficient.

To overcome these complications and get your guidewire and a device past the lesion, thought must be given to wire maneuverability and selection, as well as to selection of an appropriate guide catheter to obtain the back-up force you need. For back-up in TFI, there are occasions when deep engagement of a 6 Fr guide catheter will be enough, but in many cases powerful back-up support will only be secured with a strong guide cath above 8Fr. Since condition 3) above sometimes requires the sacrificing of 4) with use of a thick-sized guide catheter, guide caths are mainly selected with an eye on 1) and 2) (Figure 1).

The following is an explanation of how to obtain back-up force in the context of anatomical variation, lesions characteristics and coronary artery type.

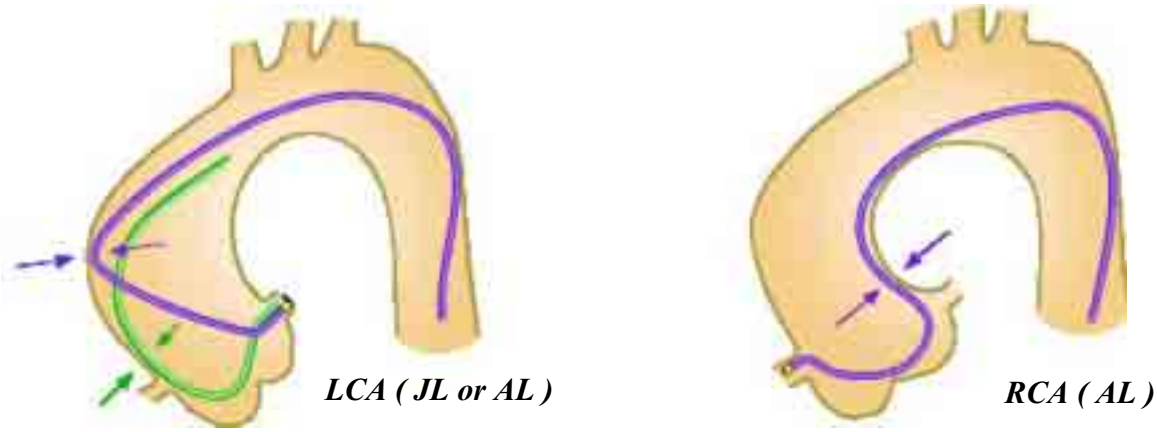

Figure1
Basic guide catheter technique for obtaining back-up force
The direction of the coronary artery ostium and guide catheter tip should be coaxial alignment. The curved tip of the guiding catheter should touch the aortic wall on the opposite side to the sinus of Valsalva.
... Objects in red in the original.　Illustration 1 by Dr. Suzuki
... Objects in blue in the original

b) Iliac Artery or Aortic Artery Tortuosity

Use a large (if possible 10Fr) long sheath provided you can do so without causing ischemia in the lower limbs and accompanying arteriosclerosis obliterans (ASO). Depending on case specifics, if the operability of your guide cath improves by using a firm strong wire 0.038 or 0.063 inches in width, then it may be relatively easy to position the tip of the cath exactly where you want it. However, if this is not possible, the best thing is quickly to switch to an approach from the femoral on the opposite side or one of the approaches in the upper limbs without wasting too much time.

c) Dilatation of Aortic Root and Abnormal Origin of Coronary Artery (RCA, LCA)

(Figure 2)

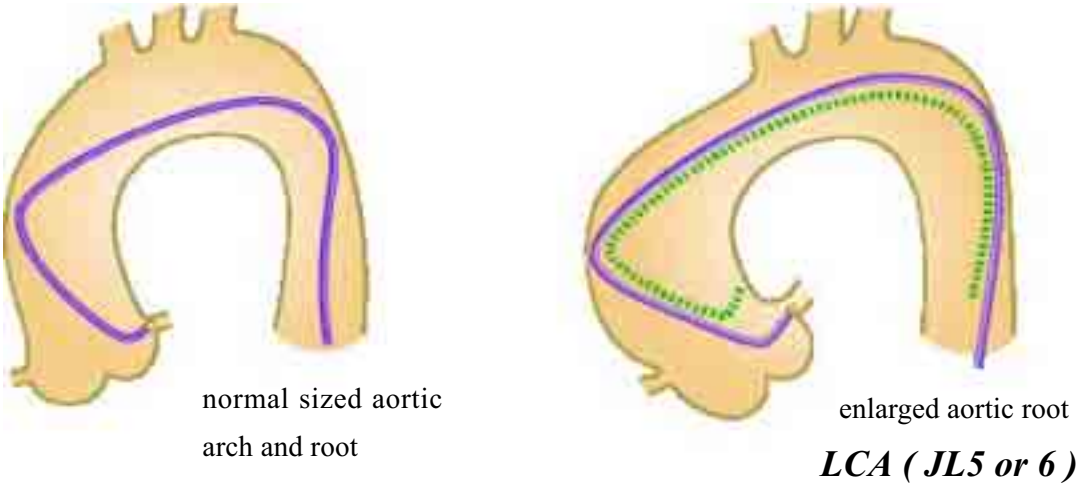

Figure2

Guide cath selection for enlarged aortic root.

The aorta root is larger in patients with aortic valve disease or chronic hypertension. The usual Judkins left type (JL) 4 (LCA) is inappropriate for the LCA ostium because it is too short. The catheter arm ends up running across the aortic root horizontally, and the cath tip simply faces the ceiling of the LMT. As guide cath advances to the aortic root, it also tends to fold in on itself in many cases, which is of no use. Dealing with individual anatomy will always be required, naturally, but in this kind of case, large sizes such as the JL5 or 6 or above, the AL1, 2, the Voda left (VL) 4 are generally indicated. For the RCA, use a JR5, AL1, 2, AR2 or similar. Even though catheter selection is made on the basis of ostial considerations, you will find that there are cases where supporting the device from a position the opposite side of the aorta is impossible.

For abnormally originating left and right coronary arteries, the Amplatz is very often the best option. Equally, there are also cases where changing the 3D shape of a catheter using a dryer or a lighter may be necessary. Abnormal RCAs originating from the left sinus of Valsalva are the most common abnormality in Japanese patients; we often encounter cases like this that require intervention. The RCA usually turns forwards at an acute angle from the ostium, and runs between the pulmonary artery and the aorta. Maintaining co-axiality of your guide cath and the vessel is almost impossible, but I recommend first changing the shapes of your AL1, 2 or JL tips so that they face forward, such tip will engage the artery when used. When pushing and advancing your balloon cath, it can sometimes help to move the guide cath a little away from the ostium when feeding it forward. An abnormal origin in the LCA is rare, and strategies tailored to individual anatomy most likely required.

d) Guiding Catheter- Selection & Handling according to Coronary Origin Anatomy

<u>The Right Coronary Artery (RCA)</u>

A) Guide cath- selection from anatomical variation (ostial origin, ostial orientation) at the RCA ostial take-off (Figure 3).

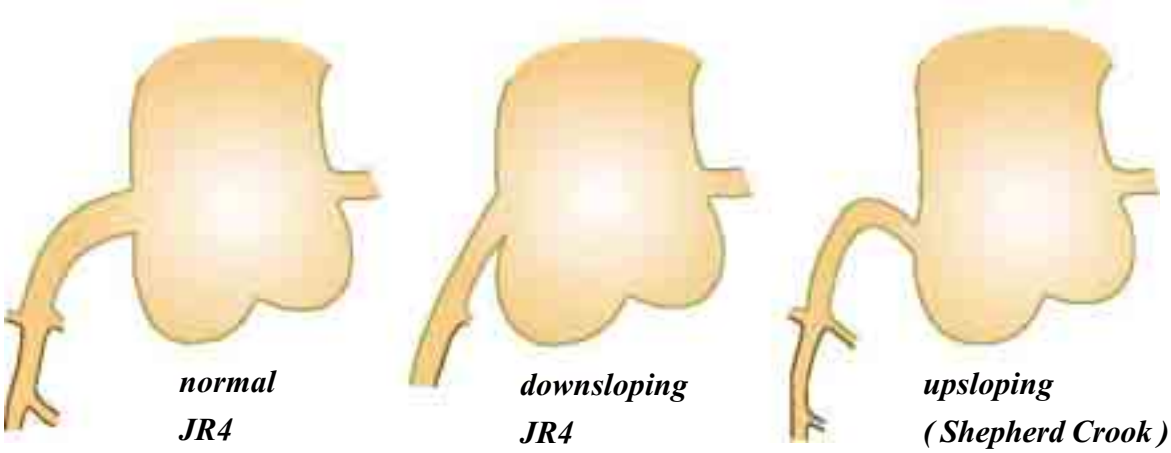

Figure3
Anatomical variation in ostial RCA take-off and guide catheter selection

1) *Normal:* The AL1, AR2, Multipurpose, JR, Hockey-stick (HS) and others can be adequate here, but the AL and HS are better for their extra back-up force. The AL type can be difficult to advance very deeply.
2) *Downsloping orientation*: The Multipurpose and JR are commonly used. The former can engage deeply and provide back-up from just pushing, while the JR does the same function if you turn clockwise and push in.
3) *Upsloping orientation (Shepherd's Crook)*: This type is the so-called raised right-shoulder, and it is hardest one to obtain back-up force for with a guide cath. Back-up can often not be obtained using a JR, and the Amplatz is frequently useful here, even though procedurally, a lot of care is required with the Amplatz type. The AL1 is the conventional choice for Japanese patients, but the AL2 may also be used in the event of a large aorta. Safe handling requires a certain amount of skill and the device should not suddenly be plunged deep into the vasculature from the ostium, as sometimes seems to happen. When you require deep engagement for inserting your device, there is less risk of injury if you first advance the device a little before feeding the guide cath along to its deeper position. If you are dealing with a proximal ostial lesion, take great care that the guide cath tip does not cause any trauma to lesion directly at the time of engagement. With a lesion near the RCA ostium, avoid inserting anything more than the tip of the catheter, and do not attempt deep engagement, until the wire has crossed the lesion. Then you may engage the catheter to a deeper position.
4) *Anterior origin:* The Multipurpose is applied to some cases.
5) *Superior origin:* Use an AL2 or Multipurpose.

B) Obtaining sufficient back-up from JR caths (Figure 4)

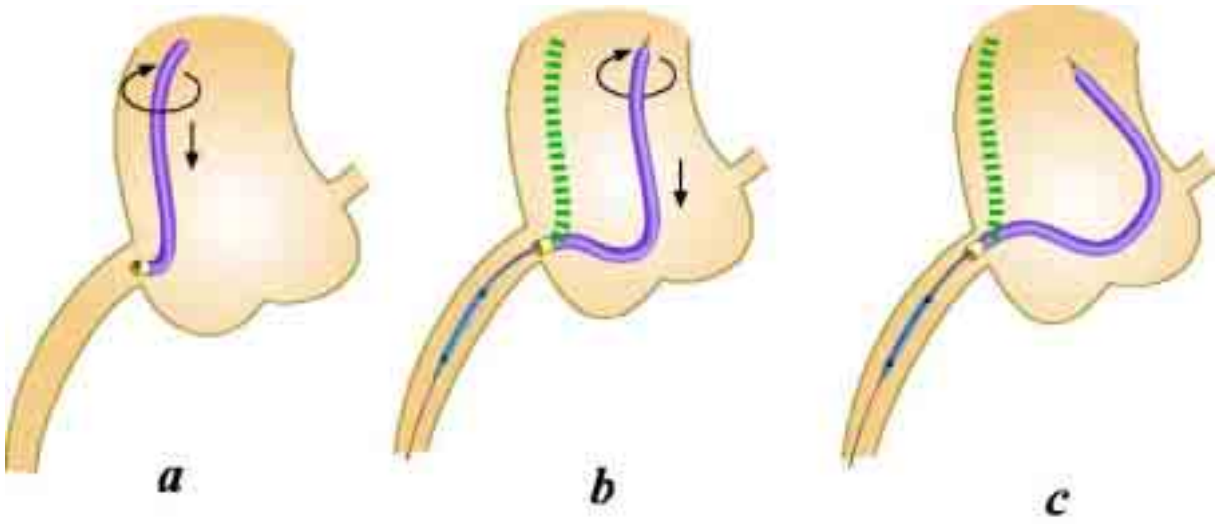

Figure4
Use of JR in RCA to obtain required back-up
Advance the balloon catheter tip from "a" to "b" to enter RCA. Torque and push forward quickly, which alters the tip shape to resemble the AL type. Back-up can now be obtained by pushing the catheter to the opposite side of the aorta

By pushing in quickly using strong clockwise torque in a normal RCA ostium (a), it is possible to change your tip shape to that similar to the AL type (b). We advise doing perform this when the tip of a balloon catheter is also positioned in the coronary artery.

C) With lesions located on or immediately behind bends in the proximal RCA, the back-up you need to get the wire across will not be obtained from a Judkins type. Change to an Amplatz.

The Left Coronary Artery (LCA)

The VL is often used to treat LCA lesions; placing the catheter deep in the LAD or by positioning it shallow in the LCX, it is usually feasible to get vessel and catheter co-axial. Doing so enhances handling for, say, a CTO and deep engagement is also a possibility. Guide cath selection and handling for specific anatomical features follows;

The Left Anterior Descending Artery (LAD)

A) Selection of guide cath from left major trunk (LMT) length
   If the LMT is standard length or longer, the JL, JL-short tip, VL, AL and others can be used. Remember though that the VL and AL give stronger back-up power. The catheter tips soft, deep engagement should not be too much of a problem. If the LMT is short or non-existent, you may need to select a guide cath to insert into the circumflex (LCx), which complicates LAD guide cath selection, but pressing the guide cath tip against the aortic ostium can give you the right tip for the LAD. If you need to deep engagement, choose a VL, as the AL will not do the job.

B) Choosing the best Amplatz: When the left sinus of Valsalva or the take-off angle of the sinus of Valsalva sinus are large, and if there is superior origin,) use a AL 1, 5, 2 or 3 – (up to AL2 most common type for Japanese patients)

C) Anterior variation of ostial LCA due to aortic extension

Obtaining back-up is difficult when the LMT is coming from behind and especially if the LMT is facing upward. The AL cath will often be your best option here.

D) With a CTO in the ostial LAD, you must maintain good co-axiality between your cath tip and the direction of the LAD take-off, in order to preserve back-up. Use a short tipped JL, VL or AL because a normal JL will tend to make the ostium face the ceiling of the LMT (Figure 5).

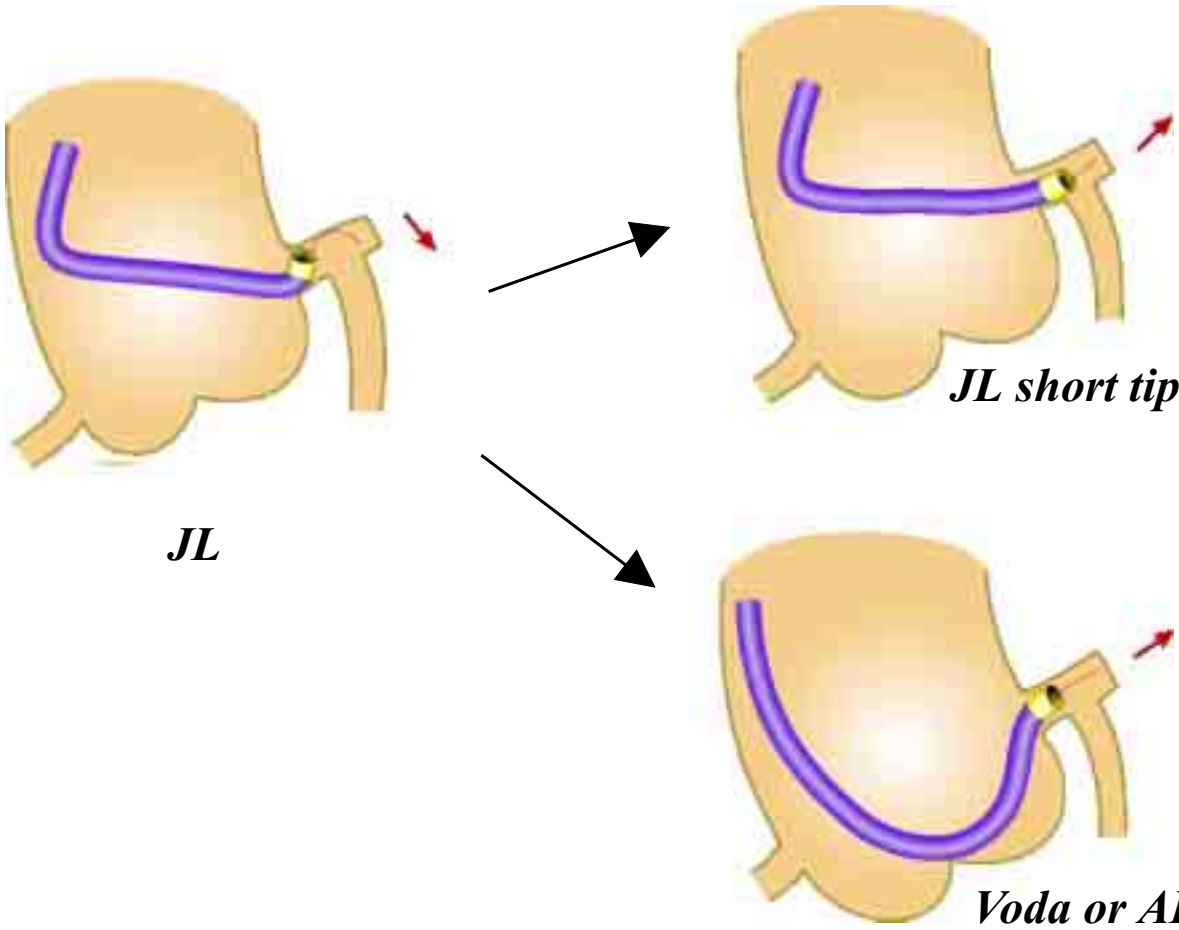

Figure5　Guide catheter selection for CTO in ostial LAD

(1) With a usual JL type, the guidewire orients towards the artery ceiling

Left Circumflex Artery (LCX)

C) Selection of guide cath from left major trunk (LMT) length

For an LMT of standard length or longer, any guide cath can be used, but the JL-short tip and VL the easiest. If a co-axiality with the LCX is not obtained with a JL, short tip caths shorter than the LAD will often work well in the LCX. Turning the guidewire anti-clockwise and advancing it once a balloon is at the coronary artery ostium, will allow you to re-shape tip to that of an AL type (Figure 6). If your LMT is shorter non-existent, any shape of guide caths should pass easily along to the LCX, and you will get the best back-up from a VL. Pushing the guiding cath and balloon cath forward slightly can dislodge any wedging.

B) Distal to a sharp curve after bifurcation with the LCA, a Judkins will not give you the back-up you need to get a wire across. Change to an Amplatz or similar.

e) Ostial lesion, Ostial bends

For complex lesions such as CTOs or ostial lesions, to improve guidewire handling and back-up, choose a guide catheter with a tip that will not get bent between the guide cath and the lesion. Attempts to get strong back-up from a guide catheter can sometime cause dissection at the tip of the guide catheter. If that happens, having your wire and balloon in place at least means you can treat effectively, but great care should be taken to make sure you have not inflicted any trauma on the vessel before withdrawal.

f) Special Techniques

A) Parallel Wire Technique (Figure 7)

You may find that sufficient guide cath back-up can still not be obtained even after a wire has crossed the occlusion. If you have a large nearby side-branch proximal to the lesion, you may be able to reduce vessel tortuosity proximal to the occlusion and fix guide cath position by inserting a second, support wire into this side-branch.

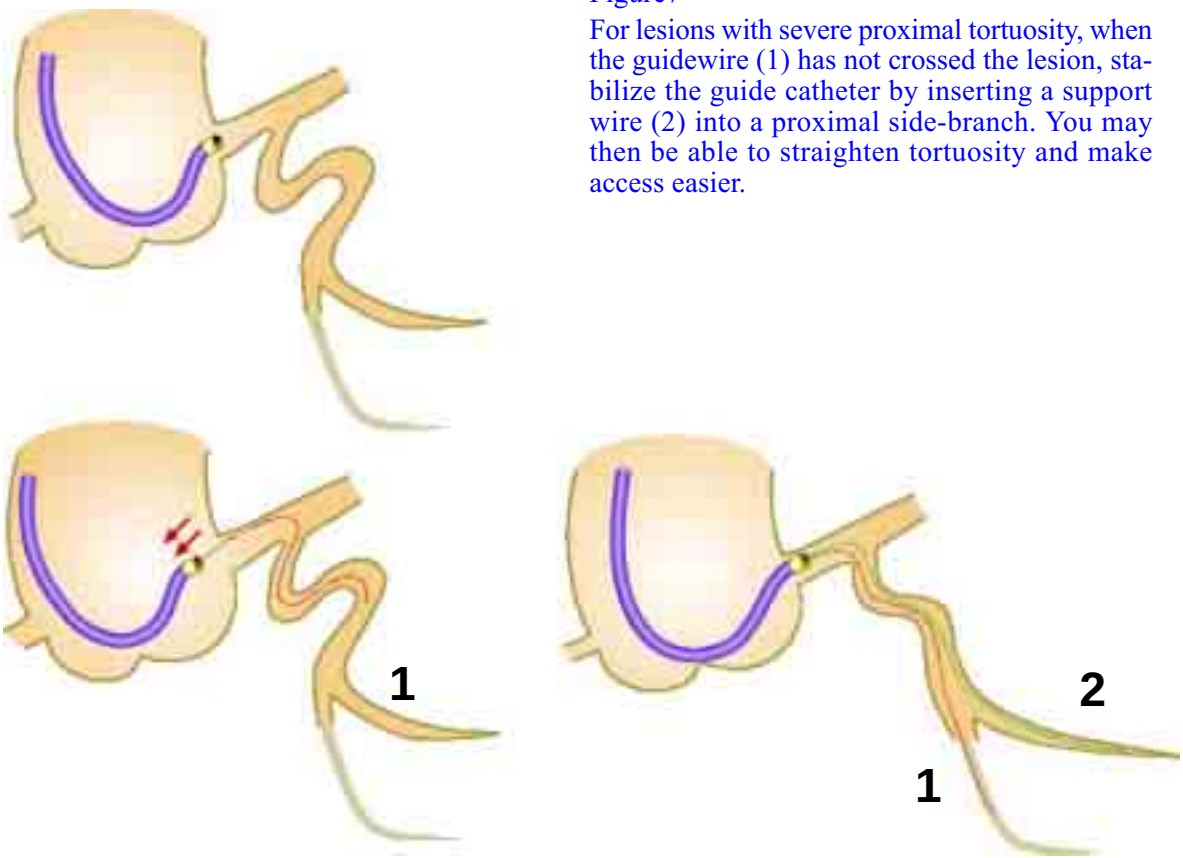

Figure7
For lesions with severe proximal tortuosity, when the guidewire (1) has not crossed the lesion, stabilize the guide catheter by inserting a support wire (2) into a proximal side-branch. You may then be able to straighten tortuosity and make access easier.

B) Double Guide-Catheter Technique (Figure 8)

If, in ostial RCA or LCA lesions (i.e. in the short LMT proximal to the ostia of the LAD and LCA), you can not get sufficient back-up even with an 8Fr guide cath, and forcing it will cause kinking, inserting a 6Fr into the 8Fr device should give you the stronger back-up force you need. For the 6Fr cath, use a JR or Multipurpose. Some operators cut off the end of a 7Fr guide, with a slanting cross-cut and insert that in an 8Fr sheath. Other institutions insert a 6Fr guide catheter, but at ours, we specially order in the 120cm 6Fr Goodman Road-Master™ cath for use with a Y-connector.

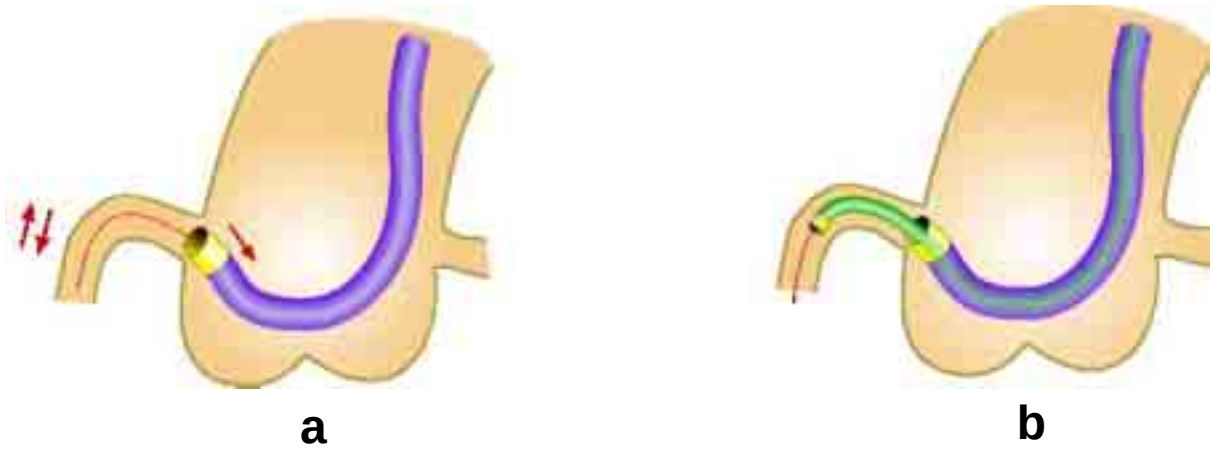

Figure8
CTO lesion in proximal RCA or LCA ostium
Obtaining the back-up force required to get your guidewire across may be impossible. In this situation, place a 6F guide cath inside 8F guide cath, to make a “double-catheter”. The back-up force needed to cross the wire should now be obtainable.

C) Deep Engagement Using Anchor Balloon Technique

This method is the standard procedure for 6Fr cath TRI, but deep insertion of an 8Fr guide cath may be possible for distal lesions in large RCAs. Dilate a balloon proximal to the lesion, and insert a guide cath along the balloon cath while holding the balloon still. Even though the 8Fr cath has a soft tip, it can still pose a risk to the coronary artery , so all due care and attention is required. This procedure may also be applied for the extraction of thrombus by suction, if required.

D) Multifunctional Catheter as a Guide for Guidewire Crossing

Guidewire-selection is sometimes complicated by severe LCX origin anatomical abnormality. If this is the case, pass a wire through which goes through the inner lumen of a multipurpose cath and into the LAD. Then place the side-hole proximal to the side-branch ostium. Passing a second wire through the side-hole into the trunk of the circumflex is now possible. With very tortuous or snaking vessels, torque control of the wire is hindered if your tip has a sharp curve. Using a multifunctional catheter is sometimes the best way to straighten the first vessel bend and increase guidewire support.

E) Double Guidewire Technique For Locating True Lumen in Dissected Ostial RCA (Figure 9)

Irrespective of how experienced the operator is, careless mistakes can lead to ostial RCA dissection when engaging the guide cath there. This is often caused by the guide cath tip facing the base of the aorta. Once this happens, the false dissection lumen makes it very hard to get the guidewire into the true RCA lumen. To get round this, we leave the first wire where it is, fixing the guiding catheter, and pass the into the true lumen by lifting the guiding cath tip up a little away from the ostium, we are usually able to get it into the true lumen.

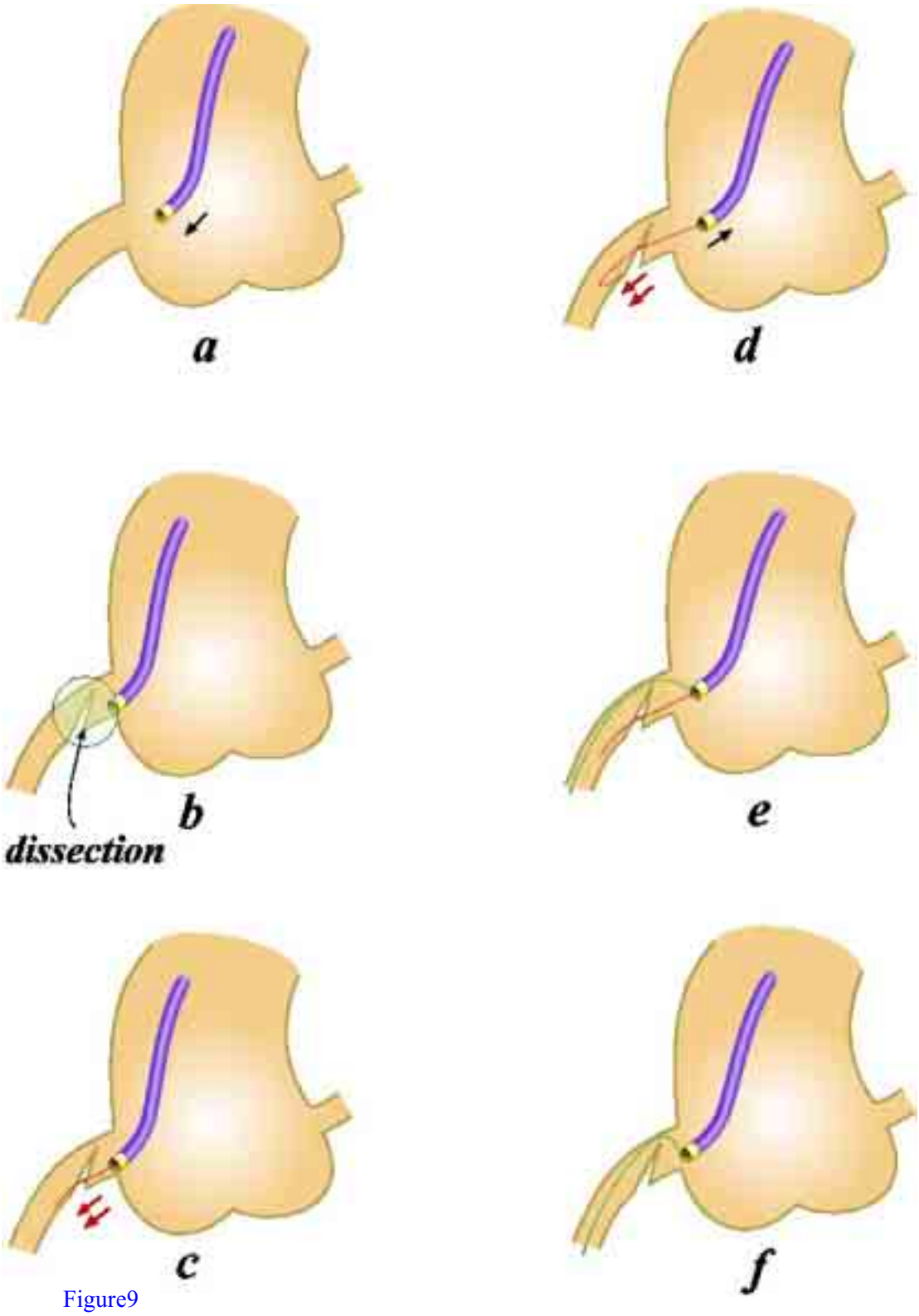

Figure9

Double guidewire technique to select true lumen in right ostial coronary dissection

g) Complications

A) Guiding cath-induced coronary- (dissection and perforation) and aortic- trauma

When choosing a guide cath for coronary ostia, and while using a deeply-engaged guide cath, it is very easy to cause vessel injury when you remove the devices.

B) Hemodynamic destabilization due to aortic regurgitation can easily be cause by the Voda, AL1 and 2 and other guiding caths.

C) Prolonged guiding catheter-wedging or cath tip-induced spasm can cause and prolong ischemia.

D) Cholesterol emboli (shower embolism, blue toe syndrome): Injury to an atherosclerotic aortic wall caused by a guide catheter, may cause renal insufficiency at 2-3 months. Symptoms include Pain, numbness, cyanosis and necrosis in both legs. Especially with the Voda type, attention must be paid when inserting the guidewire and removing the wire.

E) Embolized atheroma: An atheromatous mass entering the guide cath from a severely atherosclerotic aortic wall can find its way into s in the coronary vasculature as emboli, and cause acute coronary occlusion and embolism in all organs of the body

F) Progress and development of new LMT disease caused by intervention in the LCA: One report suggests that this occurs in 0.04% of all interventions due to guide cath-induced intimal injury. It seems clear that in complex cases the guiding cath often interacts negatively with the intima. Great care must be taken when handling your guide catheter in these high-risk cases. Even though relatively uncommon, this kind of complication can prove fatal. Long-term follow up of these complications is also strongly advised.