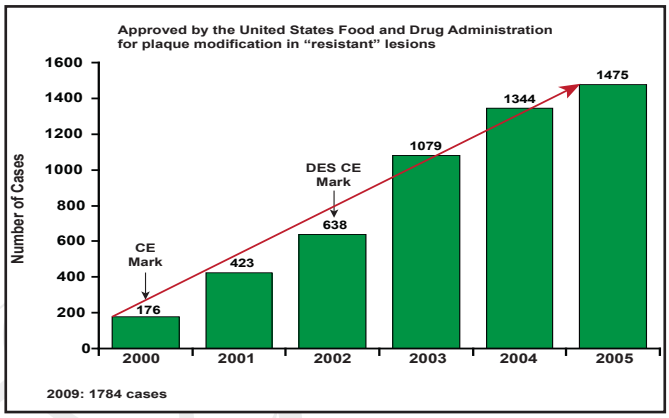
its surface, allowing for controlled cutting of the intima. Like the rotablator, the use of the cutting balloon is increasing in Spain (Figure 2). Like the rotablator, balloon cutting offers no clear advantages regarding rates of restenosis and TVR, but its use does result in less dissection, bail-out stenting, balloon slippage, and plaque shifting. It may be particularly useful for small vessels, bifurcated vessels, ostial lesions, and in-stent restenosis. The major drawback is deliverability.

Figure 2. Cutting Balloon.



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The third device, the scoring balloon, consists of 3 nitinol spiral "scoring" wires with nitinol-enhanced active deflation. It has a low crossing profile (2.7F) and is compatible with a 6F catheter or 5F sheath. It offers the advantages of being a nonslip device (avoids "geographic miss"), fewer dissections, fewer "snowplow effects" (pushing atherothrombotic material into a side branch or downstream), good deliverability, and having better stent expansion/apposition. One study has shown that pretreatment with the scoring balloon enhanced stent expansion and minimized the difference between predicted and achieved stent dimensions [De Ribamer Costa, Jr J et al. *Am J Cardiol* 2007]. In another study that was conducted in Israel (Israeli Registry), PM was performed with the scoring balloon prior to stent implantation in 745 patients. Procedural and clinical success rates were greater than 96%, device slippage occurred in only 1.2% of lesions, and there were no scoring balloon-related perforations.

Although early studies show the PM has little impact on the rate of restenosis, target lesion restenosis, or death rates and may increase procedural myocardial infarction and major cardiac adverse events [Bittl J et al. *J Am Coll Cardiol* 2004], Prof. Diaz believes PM may be important when dealing with selected acute cases. Specifically, it may help to decrease plaque volume and shifting, alter calcification, increase lesion compliance, facilitate stent delivery, and minimize vessel trauma.

Hybrid LIMA to LAD for Survival

Written by Phil Vinall

Hybrid coronary revascularization (HCR) is the planned use of a combination of minimally invasive surgical techniques for left internal mammary artery (LIMA) to left anterior descending (LAD) artery bypass grafting and the use of percutaneous coronary intervention (PCI) for revascularization of other territories that is performed during the same procedure. This hybrid approach for treating multivessel coronary artery disease (CAD) may offer the best of both worlds and is an alternative to coronary artery bypass grafting (CABG) through sternotomy alone or multivessel PCI. Ihab Attia, MD, FSCAI, Ain Shams University, Cairo, Egypt, discussed the pros and cons of this approach, pointing out the need for hybrid operating suites with surgical and fluoroscopic capabilities to support the performance of this procedure.

The LIMA is the optimal conduit for the LAD, in that it provides durable patency and is associated with survival advantages, while stenting the circumflex artery and right coronary artery with drug-eluting stents (DES) is also associated with excellent clinical outcomes. When combined with robotically enhanced minimally invasive surgery, this approach may be better tolerated than traditional CABG that is performed with a sternotomy. In addition, a hybrid strategy has the potential to offer optimal revascularization while providing patients with a truly minimally invasive approach that is potentially accompanied by reduced surgical trauma and reduced morbidity. Robotic LIMA is associated with less postthoracotomy syndrome and quicker recovery than minimally invasive direct coronary artery bypass (CAB).

Hybrid surgery may be best targeted to patients who are at high risk for sternotomy (elderly or frail patients and those with comorbidities), younger patients who may need other surgery in the future, those with complex LAD disease, and patients with left main disease when the circumflex is small and could be stented after a LIMA graft has been placed. Prof. Attia believes that the LAD should not be stented when there is ostial, bifurcation, or diffuse disease or if chronic occlusions are present because of the higher risk that is associated with stenting and better outcomes that are expected with CABG.

Aggressive continuous antiplatelet therapy is necessary after PCI and can be implemented if surgery is performed first. PCI of high-risk lesions may also be safer with a patent LIMA-LAD graft in place. The disadvantage of performing surgery first is that the fallback option of conventional

CABG leads to higher morbidity if suboptimal PCI occurs. Performing PCI first offers several advantages, including: minimized risk of ischemia during minimally invasive direct-CAB; possibility to convert to a conventional CABG if there are suboptimal PCI results; and possibility of hybrid coronary revascularization in the setting of PCI for myocardial infarction in non-LAD targets. The disadvantages of performing PCI first include: having to perform surgery under aggressive platelet inhibition (increased bleeding); stent thrombosis is possible at reversal of heparin; PCI is performed with an unprotected anterior wall; and there is no angiographic LIMA control. Advantages of performing surgery and PCI in one session include only one intervention; no waiting time with the possibility of myocardial ischemia in nonrevascularized territories; full cardioanesthesia backup; and the possibility of switching from PCI to surgery and vice versa any time. In addition, there is the opportunity for immediate angiography of the LIMA-LAD graft, and aggressive PCI of high-risk lesions can be performed with a documented patent LIMA-LAD. Downsides include a risk of bleeding with dual antiplatelet therapy at the time of surgery and a risk of stent thrombosis in the setting of the inflammatory response to surgery [DeRose JJ. *Semin Thorac Cardiovasc Surg* 2009].

As the patient population with multivessel CAD ages and presents with more comorbidities, the exploration of less invasive approaches is warranted. HCR offers the potential advantages of improved survival with the use of a LIMA-to-LAD conduit at surgery and reduced symptoms with use of DES with minimal surgical trauma. The optimal timing and order of revascularization in HCR remains unclear.

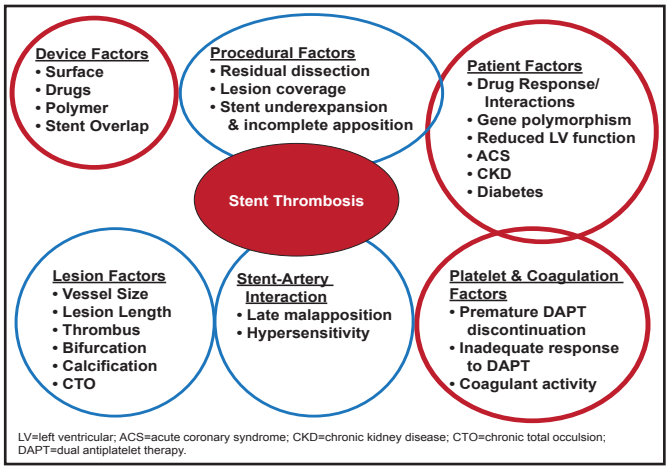
A Practical Guide to the Management of Subacute Stent Thrombosis

Written by Maria Vinall

The etiology of stent thrombosis is multifactorial, involving issues that are related to the patient, lesion, device, procedure, platelet and coagulation factors, and stent-artery interactions (Figure 1). Stent thrombosis is associated with a high mortality rate and needs to be recognized and diagnosed promptly. Hany Eteiba, MD, Glasgow Royal Infirmary, Glasgow, Scotland, discussed a stepwise practical guide to managing this challenging condition.

It is well documented that stent thrombosis can occur long (>1 year) after stent implantation and that it occurs equally with bare mental (BMS) and drug-eluting (DES) stents. Often, there is an association with interruption in dual antiplatelet therapy (DAPT). The clinical outcome following stent thrombosis is poor for patients with either BMS or DES [Burzotta F et al. *Eur Heart J* 2008]. In one study, after 2 years, the recurrence rate for stent thrombosis with DES was in excess of 5% and the mortality rate was ~20%, regardless of whether the thrombosis occurred early (<30 days), late (31 to 365 days), or very late (>1 year) after stent implantation [Kimura T et al. *Circulation* 2010].

Figure 1. Multifactorial Nature of Stent Thrombosis.



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Proper management of stent thrombosis begins with a correct diagnosis. Since stent thrombosis usually presents with ST-segment elevation myocardial infarction, the possibility should be considered, even if it has been many years since stent implantation and even in the case of a BMS. In particular, there should be a high level of suspicion following cessation of DAPT [Airoldi F et al. *Circulation* 2007]. Since it is likely that a high thrombotic burden is caused by this event, rapid initiation of adjunctive pharmacotherapy with intravenous antiplatelet agents (eg, glycoprotein IIb/IIIa antagonists) and/or oral antiplatelet therapy (eg, prasugrel, ticagrelor) should be considered. Anticoagulation with weight-adjusted unfractionated heparin can be used, although bivalirudin is a reasonable alternative that is associated with less bleeding than heparin.

Rapid and careful diagnostic angiography should be considered. Radial access may make sense in centers with experience, bearing in mind that since the thrombus often propagates proximally, it will be difficult to see much in the distal vessel. It is also important to consider that there might be new disease that is adjacent to the stent, particularly in early stent thrombosis. 'Stent boost' technology, a new technique that improves fluoroscopy-based assessment of stent expansion, may also be useful for more slender patients. The next step is wiring, with