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.

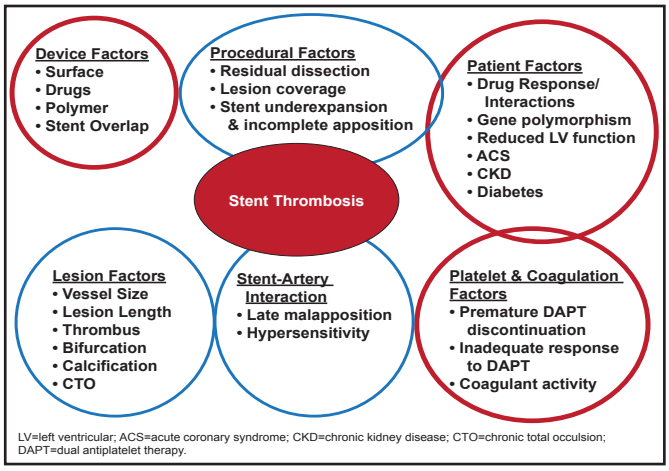
A Practical Guide to the Management of Subacute Stent Thrombosis

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

consideration for whether rewiring or a support wire is needed. Thrombectomy should be attempted before any other instrumentation. A smaller catheter with stylet (eg, Pronto LP) is often easier and can also be used to administer adenosine or intracoronary GP IIb/IIIa antagonists if there is slow/no reflow. Intravascular ultrasound (IVUS) is strongly recommended at this point to assess the intraluminal anatomy. Optical coherence tomography imaging is more sensitive than IVUS and can provide even more information, such as the extent of new intimal coverage. Reintervention depends on the cause of the stent thrombosis. In the case of stent strut malapposition, an appropriate intervention is IVUS-guided noncompliant balloon to high-pressure angioplasty, whereas if there is no mechanical problem or malapposition and the problem is inappropriate DAPT cessation, it may be sufficient to do plain balloon angioplasty with high-pressure semicompliant balloon to ensure that the stent is wide open. It may not be necessary to do more than pharmacological thrombectomy. Restenting should be avoided when possible, as it has been associated with worse outcomes [Burzotta F et al. *Eur Heart J* 2008]. Slow flow is an independent predictor of poor outcome, and use of glycoprotein IIa/IIIb to improve flow should be considered. Finally, post-reintervention management is dependent on the cause of the thrombosis; however, other factors that should be considered include platelet function testing (eg, VerifyNow) and the use of newer ADP receptor blockers (eg, prasugrel/ticagrelor) for 1 year as well as patient education, particularly if compliance is an issue.

In the management of stent thrombosis, early and accurate diagnosis is critical and should be followed by appropriate pharmacology and intervention. IVUS is vital for a good reintervention. Restenting should be avoided if possible, and careful thought should be given to appropriate antiplatelet therapy and patient education.

Borderline (Intermediate) Coronary Plaques

Written by Phil Vinall

Angiographic assessment of coronary lesions with intermediate severity (ie, luminal narrowing with a diameter stenosis >40% but <70%) continues to be a challenge. Magdy Rashwan, MD, University of Alexandria, Alexandria, Egypt, discussed some of the techniques that can be used to assess these lesions and how their composition affects prognosis.

Fractional flow reserve (FFR) is a useful technique for measuring the functional severity of narrowing in the coronary arteries, as it can measure the pressure gradient and flow across different regions. FFR is the standard in many catheterization labs; however, it is an invasive technique. Several studies have assessed the correlation between noninvasive approaches and FFR results to determine the quality of the correlation.

Lockie and colleagues recently reported that high-resolution 3.0 T cardiac magnetic resonance (CMR) perfusion can detect hemodynamically significant coronary stenosis, as determined by FFR [*J Am Coll Cardiol* 2011]. In contrast, a poor correlation between stenosis severity, as determined by computed tomography coronary angiography (CTA) or conventional coronary angiography, and ischemia that is measured by FFR was previously shown [Meijboom WB et al. *J Am Coll Cardiol* 2008]. These results were recently confirmed by Voros and colleagues, who showed better functional correlation with intravascular ultrasound (IVUS) than with CTA [*J Am Coll Cardiol Intv* 2011]. Prof. Rashwan said that in the catheterization lab, the ideal assessment for intermediate lesions is by FFR or IVUS; however, for a noninvasive approach, myocardial perfusion by MRI is the most promising technique.

The PROSPECT trial was a large, prospective, natural history study in 700 patients with acute coronary syndromes (ACS). Subjects were enrolled after undergoing successful and uncomplicated percutaneous coronary intervention for the treatment of all coronary lesions that were believed to be responsible for the index event and after the completion of any other planned interventions. The primary purpose of the study was to confirm the hypothesis that ACS arises from atheromas with certain histopathological characteristics and that these characteristics are not necessarily dependent on the degree of angiographic stenosis at the site. Grayscale and radiofrequency intravascular ultrasonographic imaging was used prospectively to characterize coronary atherosclerosis before longitudinal follow-up. Although the major adverse coronary events (MACE) that occurred during the 3 years of follow-up were equally attributable to recurrence at the site of culprit lesions and to nonculprit lesions, the nonculprit lesions were frequently angiographically mild, and most were thin-cap fibroatheromas or were characterized by a large plaque burden, a small luminal area, or some combination of these characteristics [Stone GW et al. *New Engl J Med* 2011]. Prof. Rashwan also presented data from a very recent (unpublished) study from Vazquez and colleagues, showing the correlation between plaque composition of intermediate lesions and the incidence of MACE. In that study, higher calcium density corresponded with fewer MACE, while a larger plaque burden, fibrofatty area, and fibrofatty percent corresponded with higher rates of MACE.

Plaque stability deserves an important consideration and is related to its histological composition. In a recent study,