Coronary stents — implantation of foreign bodies into stenotic human coronary arteries: dream or nightmare?

Although conventional balloon angioplasty can provide effective treatment for patients with symptomatic coronary artery disease, it remains limited by the persistence of two problems: abrupt vessel closure early post-intervention and restenosis during follow-up. Stenting has become an effective treatment for abrupt or threatened vessel closure during conventional angioplasty. Prospective trials have demonstrated that its clinical efficacy is superior to that of conventional balloon angioplasty for primary restenosis prevention in focal lesions of native coronary arteries. Some cardiologists consider stents as a second breakthrough technology in that they not only may reduce the restenosis rate but can also improve any suboptimal angiographic result. In this context, it seems to be more than timely to define the ultimate role of stent therapy in 1997.

The first results of the implantation of coronary stents, which were primarily invented for the prevention of restenosis following balloon dilatation were published in 1987[1]. Abrupt vessel closure and saphenous vein graft lesions were also found to be important indications for the placement of a stent. Although at that time interest in the therapy was growing among scientists and cardiologists, there was only a moderate increase in the total number of stents implanted. Stents were not an essential part of the armamentarium of most interventional catheterization laboratories in the late 1980s. Several factors may have accounted for the moderate increase in stent implementation in the early years, among which subacute stent thrombosis, difficulties in accurate stent positioning and bleeding problems were three major reasons not to use stents and to trust in the efficacy of balloon angioplasty alone.

Based on technical improvements and alterations in the medical regimen pre- and post-stent placement, randomized trials comparing stenting with angioplasty were initiated for primary restenosis prevention and sudden or threatened vessel closure during angioplasty. The positive results of these randomized trials resulted in a dramatic increase of the number of stents applied. While stenting was the preserve of only a few centres until the early 1990s, it became ‘a must’ for almost all interventional catheterization laboratories in 1995. Stents were no longer only a mechanical support for the vessel wall in the subsetting of ‘bail out’ situations, such as abrupt vessel closure or bypass lesions, they were now a routine technique and became the surrogate of a philosophy that believed that the super-optimal angiographic result was the only appropriate treatment for symptomatic coronary artery disease. Since 1995, ‘stent fever’ has gripped cardiologists. In the United States in 1995 more than 110 000 stents were implanted, up from a few thousand in 1994[2]. Today, elective and emergency stenting are safe and feasible techniques in the hands of most interventional cardiologists. This, and a learning curve that is less steep than that associated with other techniques, such as laser angioplasty and atherectomy, explains the current success of coronary stents.

What factors have contributed to the improved safety and feasibility of stent deployment? One is certainly the evolution of stent designs and others are improved stent delivery, ultrasonic guidance of stent placement, high pressure dilatation post-stenting and alterations in medical therapy.

Stents can be distinguished by their configuration (mesh structure, slotted tube, coil), their composition (stainless steel, tantalum, biodegradable) and their type of delivery system (self-expanding, balloon-expandable)[3]. The first stent implanted in a human coronary artery was the wallstent, a self-expanding, wire mesh structure stent with a metal-to-surface ratio of approximately 20%. Although the stent had a high rate of acute closure, as reported in the European Registry in 1991, it has gone through a phase of revival as it is the stent of choice for vein graft lesions, shown in a subset of patients in multicentre trials[4]. The Palmaz–Schatz stent, a balloon-expandable stainless steel, slotted tube device was introduced in 1987 and worldwide is the most widely used stent. It was used in the Benestent I and Stress I trials, which showed a significant reduction of restenotic lesions post-stent implantation[5-6]. The Flexstent, the Multilink stent and the Micro stent are also balloon-expandable stainless steel stents. Firmly mounted onto the balloon they all offer good ‘trackability’.

In contrast to these stents, the Wiktor stent and the Cordis stent, which are also balloon-mounted, are composed of tantalum, which enables quick and good visualization. In comparison to stainless steel stents that are not firmly mounted onto the balloon, this can be a major advantage because...
impairment of the coronary vasculature and acute problems are obviously minimized absolute lumen diameter during follow-up. Although and only marginal, however significant, differences in the success of anticoagulation, longer hospital stays patient population with higher bleeding complications due to anticoagulation, longer hospital stays and only marginal, however significant, differences in absolute lumen diameter during follow-up. Although some of the acute problems are obviously minimized by using coated stents, as suggested in the Benestent II pilot trial\textsuperscript{[9]}, it remains to be seen if primary stenting will benefit the majority of patients treated with balloon angioplasty, especially if patients present with a good angiographic result and a residual stenosis of less than 20%.

The interventional cardiologist should analyse the available data on stenting and ask, for each patient: is stenting superior to PTCA in the left anterior descending artery, the circumflex artery, the right coronary artery? Which vessel sizes and which vessel morphology should be stented? Are bifurcational lesions and side branches indications for the placement of a stent? Is the use of multiple stents and stenting of ostial lesions associated with a lower restenosis rate? Are stents more successful in the setting of unstable syndromes or evolving myocardial infarction? Is new antiplatelet therapy an alternative in these patients?

The number of unanswered questions makes one wonder, why a purely mechanical and rather expensive approach for therapy of a systemic disease was rushed into common practice before careful research and further clarification of clinical indications could be implemented.

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References