Editor’s Perspective

Cardiac Surgery With Percutaneous Interventional Backup
A Paradigm Shift

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Interventional cardiology is now acknowledged as a discipline of medicine. It has all the essential ingredients of a medical subspecialty, including an Accreditation Council for Graduate Medical Education-accredited training program and an American Board of Internal Medicine board examination with certification. What is remarkable is the brief time over which these milestones have been achieved. Within the course of the careers of many of our peers, interventional cardiology did not even exist.

Interventional cardiology is a young discipline still being refined. The first coronary angioplasty was done in 1976, only 28 years ago. Compare this brief life span with the 16 years of formal education now required to train an interventional cardiologist. Nevertheless, memories are short and interventional cardiologists exist today who do not recognize the name of Andreas Gruentzig, who with the assistance of his wife Michalia and Walter and Maria Schlumpf crafted the first balloon catheters on Gruentzig’s kitchen table. Andreas was a pioneer and a true clinician–investigator. He was careful with the initial application of coronary balloon angioplasty, limiting its use to highly selected patients under a strict protocol that was designed to ensure safety and demonstrate the effectiveness of this revolutionary procedure.

Just as much as coronary disease was the target for this innovation so was coronary surgery. The motivation to develop percutaneous transluminal coronary angioplasty was to achieve coronary revascularization in a nonsurgical manner. In fact, the first published series of patients who were treated with this technique was entitled “Nonoperative dilation of coronary artery stenosis-percutaneous transluminal balloon angioplasty.” Then, cardiac catheterization was well established as a minimally invasive technique to obtain diagnostic information about cardiac anatomy and function, but aside from establishing atrial septal communication in congenital heart disease, catheterization had no real therapeutic role.

During a relatively short period of time, coronary angioplasty, now more commonly recognized as percutaneous coronary intervention (PCI), has become technically refined. Over-the-wire balloon catheters have replaced short fixed-wire systems, diameters of guiding catheters and balloon catheters have become smaller, and more durable and sophisticated intracoronary guidewires have been developed.

Initially, PCI was performed for patients who were otherwise destined for coronary artery bypass surgery (CABG). Because abrupt coronary occlusion was an ever-present potential complication of PCI, an operating room and surgical team were on standby when PCI was performed. In fact, patients were told they were scheduled for surgery, and PCI was being performed as an alternative procedure in an attempt to save them from surgery. Patient scheduled for PCI received a full-body surgical skin preparation.

In the early years of PCI, emergency rescue surgery was common. In Gruentzig’s first demonstration course of PCI, half of the patients undergoing PCI required emergency CABG and half of those went to the operating room with ST elevation, a consequence of PCI-induced acute coronary occlusion. Emergency surgical standby was clearly essential for patient welfare; as might be expected, this strategy limited the growth of PCI.

Postprocedural complications of PCI were common. After the PCI, patients were routinely admitted to the coronary care unit to ensure careful observation and attention to femoral artery sheaths that remained in place overnight while patients were fully anticoagulated. Late coronary occlusion was common and usually presented as acute myocardial infarction. In response, repeat PCI or CABG were performed as emergencies.

Once successful, the benefits of PCI were limited by the development of late lesion recurrence or restenosis. Refinements in PCI techniques and, in particular, the development of coronary stents greatly enhanced the durability and importantly the safety of PCI. Today, selected patients may be discharged from the hospital the same day as their PCI procedure. In instances where PCI is applicable for all significant lesions, patients can anticipate being symptom-free and have no evidence of ischemia on stress testing. Late recurrent symptoms of coronary artery disease are more likely to result from progression of coronary artery disease in sites remote from PCI than from restenosis.

Perhaps one of the most significant contributions of PCI is for patients with ST-segment–elevation myocardial infarction. ST-segment–elevation myocardial infarction most often results from unexpected acute coronary occlusion. PCI is incredibly effective in restoring antegrade blood flow and limiting myocardial necrosis. Unlike CABG, PCI can be initiated and completed within minutes from the onset of infarction. Accordingly, PCI has become the standard of care for patients with ST-segment–elevation myocardial infarction.
With these advances, the role for backup CABG has changed. Emergency CABG is now a rare occurrence largely because of the availability of coronary stents. At large institutions, recently reported rates of emergency CABG are now <0.5%. Previously, the need for emergency CABG had restricted PCI to hospitals with on-site CABG programs. Refinements in patient selection and the low absolute rates of emergency CABG have fostered the concept of PCI at hospitals without CABG capability. This strategy has been evaluated in randomized clinical trials and registries. With proper patient selection, PCI can be performed with results comparable with those of hospitals with on-site CABG.

To some extent, the roles between PCI and cardiac surgery have become reversed. Initially, cardiac surgery rescued PCI, and now there are several scenarios wherein PCI compliments or salvages patients who have had cardiac surgery. A common instance relates to patients who have had coronary bypass surgery and experience graft stenosis either acutely or later during follow-up. Myocardial ischemia early, sometimes immediately, after bypass surgery is commonly because of the narrowing of the distal graft anastomotic site. Although the suture line is fresh and presumably nonexpansible, balloon angioplasty at the distal anastomosis has been effective in treating this surgical complication. Furthermore, over time venous bypass grafts can undergo degeneration and can develop significant atherosclerotic stenoses that can cause ischemia. Repeat CABG is often a complex alternative for such patients. PCI may be particularly effective in this situation. Although embolization of lesion debris limits the suitability of such lesions for PCI, intragraft filters attenuate the adverse consequences of distal embolization. Furthermore, PCI of the coronary artery supplied by the stenosed venous bypass graft may be feasible. PCI of native coronary arteries is less likely to result in distal embolization or restenosis than PCI of vein grafts.

Because PCI has become more refined, interventional cardiologists have expanded their skills to address issues related to structural acquired heart disease. These techniques have become important therapies for patients who have undergone surgical implantation of cardiac valves. Tissue valves are used commonly, especially in older patients where the life of the valve might outlast that of the patient. Such valves do not require chronic anticoagulation therapy. Advances in tissue valve design features and preservation techniques have enhanced the durability of tissue valves such that their use is now more common. Nevertheless, deterioration of valve leaflets may result in valvular insufficiency, often of sufficient magnitude to cause recurrence of symptoms. Certainly, repeat surgical valve replacement is an option. Percutaneous valve-in-valve replacement, however, seems to be an effective alternative to repeat cardiac surgery for this condition. In an early report, percutaneous valve-in-valve therapy was performed in the aortic mitral, pulmonary and tricuspid positions. The reduction in valve regurgitation was substantial and consistent across valve locations. Mortality at 30 days was 4.2%, and the majority of patients became New York Heart Association class I or II.

Periprosthetic leak is another condition wherein the interventional cardiologist provides support for the cardiac surgeon. Although uncommon, periprosthetic leaks, even if small, can result in significant clinical concerns such as heart failure or significant hemolytic anemia. Interventional cardiologists have been able to implant vascular plugs and ductal or septal occluders and seal leaks. In 1 report, 115 patients had occlusion of paravalvular leak attempted for 141 defects. Procedural indications included heart failure and hemolytic anemia. Selected patients required guidewire exteriorization. Devices were successfully implanted in 125 defects (89%). Complications at 30 days included a mortality rate of 1.7% and stroke rate of 2.6%.

A similar approach has been described for selected patients with left ventricular pseudoaneurysm. Based on unique anatomic characteristics, the left ventricle is entered from either a transseptal or a transapical approach, and self-expanding vascular plugs or septal occluders are deployed. In one small series, no subsequent myocardial rupture was observed for an average follow-up of 18 months.

Clearly, clinical scenarios now exist wherein the interventional cardiologist provides backup support for the cardiac surgeon. The important issue, however, is not who supports whom but that there is a legitimate mandate for a close, collaborative working relationship between cardiac surgeons and interventional cardiologists. There are many examples where the training programs for cardiac surgery now include substantial trainee exposure to diagnostic catheterization and the performance of catheter-based interventional procedures. On the cardiology side, certain larger programs now have interventional cardiologists who specialize in structural procedures only. These individuals no longer perform PCI. With time, we might see cardiac surgeons who work with the structural interventional teams who become more expert at structural procedures than the coronary interventionist. The rationale for this paradigm shift is a determination of what is in the patient’s best interest. Always, this concern should be first and foremost.

Disclosures
None.

References


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