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Total Myocardial Revascularization Fifth International Symposium: An Introduction

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On March 15-16, 2002, an exceptional group of surgeons and physicians met at Tampa General Hospital to participate in the symposium *"Total Myocardial Revascularization Without Cardiopulmonary Bypass."* During this stimulating two-day meeting, the outstanding international faculty provided insight into this constantly evolving technology, expanding our knowledge of patient selection and surgical techniques, with a particular focus on how to ensure complete myocardial revascularization without the need for cardiopulmonary bypass.

Myocardial revascularization *without* the use of the heart-lung machine actually predates coronary artery bypass *with* the aid of cardiopulmonary bypass. In 1962, Sabiston performed the first coronary artery bypass graft on a beating heart using a vein as a conduit. Likewise, Kolessov revascularized the left side of the heart through a left thoracotomy in a series of patients without the use of a heart-lung machine. Using the left internal mammary artery, he grafted the left anterior descending coronary artery without resorting to a mechanical stabilization device. Kolessov's experience was eventually published in an American journal in 1967. Subsequent advances in the technology undoubtedly resulted from the pioneering contributions of many innovative surgeons, including Favaloro, Buffolo, and Benetti.

With the increased clinical use of the heart-lung machine and improved cardioplegic solutions, the initial enthusiasm for "off-pump" myocardial revascularization quickly abated. With the aid of cardiopulmonary bypass, operative techniques of heart surgery rapidly expanded, allowing surgeons to work within or around the heart, correcting congenital defects, replacing diseased valves, repairing aortic aneurysms and dissections, and ultimately addressing irreversible heart failure by transplanting the heart itself. Cardiac symptoms such as angina and dyspnea were also controlled by corrective cardiac surgery. Cardiac surgery made a mark in the field of medicine by significantly prolonging life as well as the quality of life.

As surgery evolved, so did other corollary disciplines such as anesthesia and intensive care practice. Now surgeons could tell the patient what to expect after the operation, how quickly he or she would recover, and how soon the patient would return to work and regain the full range of activities that had been lost due to disabling angina. Although this counseling was correct in many instances, on occasion a mentally alert patient would emerge from an operation with a decline in mental acuity or a loss of emotional stability. These patients were referred to our colleagues, the psychiatrists and psychologists, who began to investigate the quality of life for patients after open-heart surgery. The batteries of tests they administered identified a significant neurocognitive dysfunction in some heart surgery patients, a subtle impairment that persists in 27% of patients one year after surgery. Antidepressants and sleeping pills were readily prescribed for this condition. The cause of these unfortunate symptoms was initially not recognized as a complication of cardiopulmonary bypass. However, when pro-inflammatory cytokines of CPB patients were measured and compared with those of patients who had undergone operations not requiring the heart-lung machine, the latter patients exhibited a less pronounced inflammatory response, with less cognitive dysfunction in the early and late postoperative periods.

Even a cursory look at the human coronary anatomy reveals that most of the coronary arteries that require grafting are subepicardial. We perform coronary surgery largely on the surface of the heart. Therefore, there was no compelling reason not to again attempt to perform coronary artery bypass grafting without the use of the heart-lung machine. Initially, this surgery was performed with the help of primitive stabilizing techniques, such as by placing slings around the heart. Hemodynamic instability was commonly observed and, in many instances, conversion to pump-oxygenator support was required to complete the grafting.

Manufacturers of medical equipment made a major contribution by developing the first generation of stabilization devices, although these initially allowed revascularization only of the left anterior descending coronary artery. Access to the circumflex territory remained a problem, and inadequate revascularization (or "undergrafting") frequently occurred. Proponents of "on-pump" surgery focused on this limitation, and heart surgery reverted to a period when cardiopulmonary bypass seemed almost unavoidable.

To overcome this deficiency, a second generation of surgical tools, among them compression devices, was developed. Revascularization was now performed through a midline sternotomy, intra-coronary shunts were developed, and deep pericardial sutures were introduced by Lima. Other innovations became available to surgeons for further clinical development, and the stage was set for a second surge of progress. The introduction of apical suction devices, sometimes used in combination with compression devices, further improved the surgeon's "off-bypass" armamentarium. With these tools, in many centers cardiothoracic surgeons began to perform myocardial revascularization "off-bypass" in selected patients. However, the costs associated with off-CPB technology have

become increasingly questioned, and critical review of this issue by the surgical community is surely appropriate.

In our practice, myocardial multivessel coronary grafting is now achieved through a midline sternotomy and full heparinization, with the aid of a right-sided pleuropericardial window and the placement of deep pericardial sutures. Intermittent hypotensive anesthesia is combined with multimodality brain monitoring. Following coronary arteriotomy, in the event that desaturated blood returns from the distal vessel, a coronary shunt is inserted. At the completion of the distal and proximal anastomoses, coronary flow is measured. The heart-lung machine is assembled but not primed—none of our most recent 250 patients were converted to on-bypass revascularization.

During the symposium held in Tampa, three live surgeries were performed using different stabilization devices. The patients' angiograms were reviewed and important issues were discussed, such as the impact of cardiac manipulation-stabilization on systemic hemodynamics, the efficacy of multimodality brain monitoring during cardiac surgery, the sequencing of distal anastomoses, and why coronary flows should be measured following myocardial revascularization. Guidance was provided on how to initiate an "off-bypass" program and how to select patients for it. Initial experiences and outcomes from several new "off-bypass" programs were reported. At the end of two demanding but enjoyable working days, the faculty had become acquainted with the advantages in patient care offered by this form of surgery.

As with any evolving therapy, questions remain. For example, which patients will benefit most from "off-bypass" myocardial revascularization surgery? To answer this and other questions, a newly initiated Veterans Administration cooperative prospective study will compare outcomes of "off-bypass" and "on-pump" surgery. The study will eventually enroll 2,200 patients at 16 medical centers.

The participants in the Tampa symposium were encouraged to interact with their peers, the faculty, and representatives of industry. The enthusiasm that this meeting generated was such that another symposium on this topic will be held February 21–22, 2003, with Tampa again serving as the venue for a "brainstorming" discussion of new advances in "off-bypass" surgical techniques. We look forward to welcoming you then.