Published in final edited form as:

Semin Thorac Cardiovasc Surg. 2007 ; 19(4): 279–280.

Minimal-Incision Cardiac Surgery: Introduction

Y. Joseph Woo

For decades, the standard median sternotomy incision, with its straightforward physical access to and maximal visualization of all of the cardiovascular structures, has been the incision of choice for virtually every cardiac surgical procedure. More recently, and especially over the past decade, innovation, technology, and patients' strong wishes for less-invasive surgical procedures, have directly challenged this central dogma. Creative and pioneering surgeons have harnessed engineering advances in circulatory systems, medical devices, operative instruments, and multimodality imaging and have developed a variety of new approaches for use in cardiac surgery. This issue of *Seminars in Thoracic and Cardiovascular Surgery* offers a compilation of a broad range of cardiac surgery procedures that can be conducted either through alternate, very small incisions and ultimately, without incisions. The primary focus of many of the articles is on elucidating specific intraoperative details with abundant photographs as well as videos available in the electronic manuscript versions.

Dr. Valavanur Subramanian and his colleagues lead off by detailing a variety of approaches to coronary artery bypass grafting involving multiple permutations of transthoracic and transabdominal routes for single and multivessel revascularization. The outstanding results from well over one thousand cases of minimally invasive coronary bypass are described and exemplify this group's expertise.

Dr. Friedrich Mohr and I then discuss alternate approaches to valve surgery. This article primarily addresses the partial upper sternotomy for aortic valve surgery and the right mini-thoracotomy for mitral valve surgery, specifically focusing upon comprehensive intraoperative strategies, procedural details, and potential pitfalls. Also featured are approaches to the tricuspid valve, pulmonic valve, robotics, and videos of minimally invasive beating heart valve surgery.

Further expanding upon this topic, Dr. Lars Svensson describes his approach to minimally invasive valve and ascending aortic and arch surgery. This article details a novel approach to complex aortic arch aneurysm reconstruction combining minimally-invasive, off-pump aorto-innominate/carotid bypass followed by endovascular stent grafting of the distal ascending and aortic arch.

Moving to even smaller incisions for valve replacement, Drs. John Webb and Sam Lichtenstein detail their pioneering work on transcatheter aortic valve replacement via transvenous, transarterial and most recently, trans-apical approaches. The procedure is beautifully captured in two intraoperative video-angiograms.

Dr. Randall Wolf then extensively details a pioneering procedure that he developed, the minimally-invasive MAZE for lone atrial fibrillation ablation. His operation combines bipolar epicardial radiofrequency ablation of the pulmonary veins with autonomic ganglia ablation and intraoperative electrophysiologic testing.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Dr. Pedro del Nido provides a broad overview of multiple minimally invasive approaches to congenital heart surgery in children including partial sternotomy, thoracoscopic, robotic, and hybrid procedures which combine surgical and transcatheter interventions. Such techniques have been used in over 2000 children at the Boston Children's Hospital over the past decade. Dr. del Nido's article also serves as an excellent introduction to the novel, emerging field of image-guided interventions. In September 2006, the NHLBI convened a working group comprised of clinicians, scientists, and engineers, chaired by Dr. del Nido and Dr. Ajit Yoganathan to explore the current state-of-the-art in advanced imaging-guided cardiovascular surgery and catheter-based interventions, with the goal to identify areas for the NIH to consider expanded, targeted research funding. The discussions included three-dimensional optics, echocardiography, fluoroscopy, computed tomography, magnetic resonance, real-time multimodality imaging, specialized instrumentation, haptics, miniaturization, robotics, automation, hardware/software demands, and computation modeling of flow dynamics and tissue mechanics. The executive summary can be found at:
<http://www.nhlbi.nih.gov/meetings/workshops/image-guided.htm>

To provide a vision further into the future of minimally invasive cardiac surgery, three cutting-edge intraoperative imaging modalities presented at this NHLBI working group are previewed in this issue of Seminars. Dr. Ivan Salgo highlights the versatility of high-resolution three-dimensional transesophageal and intracardiac echocardiography not only for diagnostic cardiac examination but also for real-time imaging guidance in novel surgical repair of cardiac defects. Drs. Keith Horvath and Elliot McVeigh detail their groundbreaking research in live MRI-guided valve surgery. Finally, Dr. Warren Grundfest describes the use of near infrared spectroscopy to see directly through blood. This technology provides real-time intravascular optical imaging of intracardiac structures in a normally perfused and beating heart. In this article are videos of the first application in humans, showing a normal, fully functioning tricuspid valve through multiple, entire cardiac cycles.

These and other novel technologies on the immediate horizon will be rapidly translated into clinical practice. This is an exciting period of innovation in cardiac surgery. Surgeons have refined minimally invasive operations, continue to develop new approaches, and will devise entirely new operations. This issue of Seminars provides a panorama of the present and a glimpse of the future.