Fifth Cardiothoracic Surgery Fellows Conference (CHEST 2008)

Doing the right thing at the right time in the right patient is the essence of decision-making for a surgeon—the theme of the full-day Fifth Cardiothoracic Surgeons Fellows Conference at CHEST 2008. Good decisions are those that are in the best interest of the patient. Unfortunately, bad decisions may appear to be good decisions because the surgeon sees them as such due to faulty information, inexperience, poorly informed judgement, wishful thinking for a good outcome, or cognitive biases, pointed out Peter McKeown, MBBS, FCCP.

Bad decision-making is not inevitable due to any cause, if the surgeon uses skills that foster the making of good decisions:

- Maximize preoperative information—about the patient, from the literature, and from experience;
- Ask another surgeon for opinion and perspective;
- Focus on the issues presented by the patient and the procedure;
- If intuition suggests that all is not right, pay attention and investigate;
- Practice extrapolative thinking;
- Learn from mistakes—yours and those of others; and,
- Avoid anecdotal information, pay attention to evidence-based information.

Because decisions can be skewed by actions in the operating room, everyone who will be in contact with the patient should be familiar with, and follow, safety checklists.

<u>Acute Postoperative Complications of Cardiothoracic Surgery</u>

Good, prompt decision-making is essential when acute postoperative problems arise after cardiothoracic surgery, a topic discussed by Loren J. Harris, MD, FCCP. Major postoperative issues after cardiac surgery include hemorrhage, neurologic complications, renal/hepatic failure, endocrine abnormalities, and stroke. Pulmonary edema is a major acute postoperative complication of lung resection.

Hemorrhage After Cardiac Surgery

As cardiac surgery procedures become more complex and more older, sicker patients undergo operations, risk for postoperative hemorrhage increases. Postoperative bleeding influences surgery outcome by increasing risk for transfusion-related complications, risk for infection, length of stay, cost, and in-hospital mortality.[1] Risk for postoperative bleeding is influenced by surgical technique, defects in hemostatic mechanisms, medications, and organ dysfunction. Meticulous postoperative management is critical, especially in the first two postoperative hours, to reduce risk for hemorrhage.

Neurologic Complications After Cardiac Surgery

Neurologic complications including stroke, delirium, metabolic encephalopathy, and cognitive dysfunction are not uncommon; delirium and cognitive dysfunction may occur in up to 80% of patients postoperatively.[2] Most common causes of metabolic encephalopathy are medicines administered or withheld, renal/hepatic failure, endocrine disorders and sepsis. Treatment is indicated by identification of the cause.

Stroke occurs in 3.0 to 6.0% of cardiac surgery patients postoperatively, and incidence can be much higher in patients with multiple risk factors such as hypertension and a history of cardiovascular events.[3] Embolic stroke is more frequent than hemorrhagic or ischemic stroke, but all should be suspected initially. Risk is evaluated and/or reduced by adequate intra- and postoperative assessment including imaging as indicated. Treatment of postoperative stroke is indicated by identification of cause and risk for stroke-related complications or mortality.

Pulmonary Edema After Lung Resection

This acute syndrome may occur after lung resection, including lobectomy and wedge resection.[4] The pathophysiology is a complex interplay of factors including fluid administration. Appropriate intra- and postoperative measures may prevent development of the syndrome.[5]

Incidence is reported from 4.0 to 10.0%. Recognition may be delayed due to the often subtle initial presentation; rapid development of serious or critical symptoms may follow the initially mild presentation. Treatment is largely supportive.

<u>Surgical Treatment of Atrial Fibrillation</u>

Atrial fibrillation (AF) is a cardiac arrhythmia for which surgical treatment is an option in select patients. Evidence-based guidelines for surgical management of AF include replacement of common terms for AF presentation with a precise nomenclature.[6] AF presentation now has a nomenclature that begins with a first-detected episode, pointed out John C. Alexander, MD, FCCP.

AF that occurs more than once is called recurrent and is classified as:

- Paroxysmal, terminating usually within 48 hours;
- Persistent, requiring electric or pharmacologic cardioversion; and.
- Permanent, not responding to cardioversion.

Surgical approaches to treatment of cardiac arrhythmias include procedures such as pacemaker implantation, surgical treatment of Wolf-Parkinson-White syndrome, and surgical treatment of ventricular tachycardia. The Maze procedure for treatment of AF, developed by James L. Cox. MD, has been performed since 1987 and has undergone evolution into procedural approaches identified as Maze I, II, III and IV.

The Maze procedure's rationale is to create a physiologically appropriate pathway for atrial electrical activity and ablate or block pathways that are physiologically inappropriate. Two mechanisms contribute to the origin of AF—focal triggers and substrate maintenance of inappropriate electrical activity. Focal triggers initiate AF in early paroxysmal and persistent stages. Pathophysiologic changes in substrate cause dysfunctional cellular activity that is continuous and permanent. The Maze procedure's re-routing of electrical activity restores normal sinus rhythm.

The triggers that initiate and maintain AF have been mapped to the left atrium in the majority of patients, and more specifically to the pulmonary veins.[7] Ectopic triggering may also initiate from mitral valve pathology. Mapping of inappropriate electrical activity provides information for the surgeon to elect the type of procedure—full Maze, left-sided Maze, closed left-sided Maze.

Radio-frequency ablation (Maze IV) may be considered for patients with selected characteristics.[8] Using either surgery or radio-ablation, the Maze procedure creates scar tissue that blocks pathways for inappropriate electrical activity and funnels sinoatrial node activity to the atrioventricular node.
Postoperative issues after AF surgery are anticoagulation for as long as deemed necessary, rhythm management, and fluid management.

Surgical Decision-Making for Post-Myocardial Infarction Complications: Consideration for the Use of Mechanical Circulatory Support and Cardiac Transplantation

Cardiogenic shock after acute myocardial infarction (AMI) has a fairly low incidence but accounts for most deaths from AMI, noted Andrew J. Lodge, MD. A number of reports published over the past 10 years have advocated an aggressive approach to the complication using mechanical support.[9-12] For some patients, aggressive treatment may be used as a bridge to cardiac transplantation.

Mechanical support options are:

- Intra-aortic balloon pump (IABP);
- Extracorporeal membrane oxygenation (ECMO); and,
- Left ventricular assist device (LAVD), which may be implantable, temporary or percutaneous.

All of these options have advantages and disadvantages. How, then, are decisions made regarding which option is the best for an individual patient?

Reports of well-designed trials provide some evidence, but a strategy for decision-making should be multifaceted:

- Choice must often be made urgently, and all necessary information may not be available;
- Nevertheless, choice must be made using the best judgement possible, involving multidisciplinary perspectives; and,
- Practical issues, such as the patient's insurance coverage and social/family support, should be given due consideration.

Earlier definitive intervention may reduce risk for infection, malnutrition and end-organ dysfunction. If mechanical support is considered for early intervention, issues to include in decision-making are the condition of the patient, likelihood of success, comorbidities, patient's eligibility for cardiac transplant, need for biventricular support, and status of anticoagulation.

Intravascular Thoracic Artery Repair

About 15,000 new cases of descending thoracic aorta aneurysms (DTA) are diagnosed annually. Ruptured DTA causes about 2,500 deaths annually. DTA surgical repair is performed on more than 5,000 patients annually. Alberto Pochinetto, MD, cited the data in discussing basic principles of thoracic endovascular intervention.

Prevalence of DTA increases with age and smoking history. With the aging of the US population, DTA will likely be seen more frequently, and surgeons will be called upon for more DTA interventions.

Thoracic endovascular aneurysm repair (TEVAR) of DTA is successful in the great majority of patients. TEVAR does not involve excising the aneurysm. Rather, an endoluminal device is placed over the thoracic artery to provide a hemostatic seal that excludes the aneurysm from the circulation. TEVAR is usually carried out in patients with distal arch, descending or thoraco-abdominal aneurysms. Three endoluminal devices from three different manufacturers are available for consideration; the mechanical characteristics of each are important in making a choice for the individual patient.

Imaging at every point in the procedure is essential. Risk of vertebrobasilar artery ischemia requires consideration in planning the procedure and whether revascularization should be an option.

Treatment of aortic dissection must consider the type: Type A acute or chronic, Type B acute or chronic, and whether a Type B is uncomplicated or complicated by rupture. Treatment by endograft has been shown to result in better survival than medical or surgical treatment.[13] One-year survival data showed that survival with medical treatment was 72.5% and with endografting 94.9%.[14] Meta-analysis of 39 studies also showed better survival with stent-graft treatment than with medical treatment of aortic dissection.[15]

Spinal cord ischemia after endovascular stent repair of DTA has been reported to occur in 3.6% to 12.0% of patients in various studies. Incidence of postoperative stroke has been reported to vary from 2.3% to 8.2%. Strokes were reported to be more common in proximal extension aneurysms.[16] Risk of stroke is reduced by risk stratification using transesophageal echocardiogram and intravascular ultrasound to locate mobile atheromas, limit and guide manipulation, defer patients at high risk, divert atheroemboli using an appropriate procedure, and by neuromonitoring of high-risk patients.[17] University of Pennsylvania Health System initial experience with thoracic stent grafting in 93 patients resulted in perioperative mortality in 3.3%, spinal cord ischemia in 5.4%, vascular complications in 14.1%, and endograft leak in 12.0%.

Robotic and Minimally Invasive Valve Surgery

Fully robotic surgery is still largely in experimental stage. The technique that is commonly called “robotic” is actually computer-enhanced surgery visualization with a human surgeon in full control. The concept for “surgery at a distance” was fostered especially by US armed forces concern for being able to provide surgical care to injured soldiers where no live surgeons are present.

Technical developments have evolved over a period of years. Laparoscopic surgery is an early entrant into the development of minimally invasive procedures in which surgery is performed “at a distance” by a surgeon using specially designed instruments. Video-assisted thoracic surgery (VATS) was a further step in minimally invasive “surgery at a distance.” Mitral valve repair is carried out by minimally invasive “robotic” techniques. A cryogenic minimally invasive Maze procedure for treatment of atrial fibrillation is being developed. In 2007, 1,189 cases of “robotic” cardiac surgery were done in the United States. There are currently 320 surgery teams with robotic experience in the United States.

Describing approaches developed at his East Carolina Heart Institute, L. Wiley Nifong, MD, reported results from 400 computer-enhanced "robotic" minimally invasive mitral valve repair procedures. Complications in the 400 reported cases included:

- Operative deaths 0.2%;
- In-hospital deaths 1.7%;
- Return to OR for bleeding 3.5%;
- Myocardial infarction 1.0%;
- Stroke 0.5%;
- Transfusions 23.3%;
- Perfusion complications 0.0%;
- Pleural effusion 8.2%;
- Reoperation for band dehiscence 1.5%; and,
- Reoperation for other causes 2.2%.

Echocardiographic follow-up at 6 months showed no mitral regurgitation in 42.9% of patients, trace of regurgitation in 31.1%, mild regurgitation in 22.5%, and no patients with severe regurgitation.

Advanced robotic technology is being developed at numerous medical and science centers and surgeons can expect to have more robotic devices to use in the future.

Surgical Interventions in Coronary Bypass: New Approaches and Techniques

New medical/surgical technology is constantly being offered for evaluation and use by surgeons. Should a surgeon be the first to adopt and use new technology, or is it more reasonable to wait for its documented performance in practice? William

Cohn, MD, asked the question in discussing new approaches and technology in cardiac surgery.

A surgeon has incentives to be an early adopter of new technology. Use of new technology can give a surgeon competitive advantage, may result in better care for patients, and can make the surgeon a leader in technical advancement. New technology has been a major factor in improving results of coronary artery disease surgery, and has permitted surgical interventions to be offered to older and more seriously ill patients.

Development of technical and minimally invasive surgery procedures is ongoing with the goal of decreasing the invasiveness of coronary artery bypass grafting (CABG). Unlike the minimally invasive approach, conventional CABG requires a 30-centimeter incision in the chest, splitting the sternum, cannulating the aorta, initiating cardiopulmonary bypass, cross-clamping the aorta, and stopping the heart.

Cardiopulmonary bypass (patient on-pump) induces a cascade of potentially harmful events—e.g., complement activation, endotoxin release, activation of leukocytes, expression of adhesion molecules, and release of inflammatory mediators. When CABG is performed “off-pump” by use of technical advances and minimally invasive procedure, many of the events associated with on-pump CABG are avoided, risk for needing postoperative transfusion is reduced, and risk for postoperative renal failure is decreased. However, on-pump CABG should not be totally abandoned; rather, it should be used when its use appears likely to be the optimal choice for an individual patient.

Technology is being developed to improve long-term patency of saphenous vein grafts (SVG) in CABG. The failure of SVG over a 15-year period has been documented in the literature.[17] SVG failure has a number of causes—e.g., intimal hyperplasia, accelerated atherosclerosis, size mis-match, poor-quality vein, graft twisting or kinking, and technical errors. Intimal hyperplasia is a major cause of failure underlain by biologic response to a thin-walled vein substituting for an artery. A technical advance uses a molecular "decoy" placed in the vein to block gene expression that leads to intimal thickening. Another emerging technology to improve SVG long-term patency is use of a sirolimus-eluting wrap placed external to the CABG anastomosis to attenuate intimal proliferation. Drug-eluting stents developed over the past decade are used to inhibit re-stenosis in CABG grafts.

Decision-Making for Benign and Malignant Esophageal Lesions

Benign disorders of the esophagus are classified as motor disorders or benign lesions including Barrett's esophagus, and hiatal hernia. Esophageal malignancies are most commonly early or advanced carcinoma, with other tumors less frequent. Symptoms common to esophageal disorders are dysphagia, pain, regurgitation, heartburn, and weight loss. Diagnostic studies, used as appropriate and indicated, are radiographic, endoscopic, motility study, and 24-hour pH testing.

David W. Johnstone, MD, FCCP, discussed decision-making in the context of case presentations of patients with (1) Barrett's esophagus, a condition that increases risk for adenocarcinoma, (2) adenocarcinoma, and (3) esophageal diverticula.

Guidelines for the diagnosis, surveillance and treatment of Barrett's esophagus, a benign but pathologic change in distal esophageal epithelium, were published in 2008 by the American College of Gastroenterology.[18] Highest incidence of the condition is in Caucasian males; about 50% of patients are symptomatic. Confirmation of a diagnosis may be by radiographic or endoscopic examination. Choice of treatments includes resection, photodynamic therapy, endoscopic mucosal dissection, and radiofrequency ablation. Selection of a procedure is dependent on surgical expertise, the patient's age and comorbidities, and the patient's preference.

Workup for adenocarcinoma of the esophagus, a cancer associated with Barrett's esophagus, can include esophagoscopy and endoscopic ultrasound (EUS),[19] computerized tomography (CT), and positron emission tomography (PET). EUS, CT and PET can all be useful in staging of disease and identification of distant metastases.[20] Choice of treatment may include surgery, chemotherapy, radiation or combinations of therapeutic modalities.[21] Minimally invasive esophagectomy is a newer technique.[22]

Esophageal diverticula are one of a number of possible causes of reflux and associated symptoms. Diagnostic procedures include barium esophagram, endoscopic examination, and CT. Surgery to dissect and reduce the anomaly is the procedure of choice.

<u>Decision-Making in Benign and Malignant Lung Disease</u>

David C. White, MD, approached his subject with discussion of three topics:

- Diagnostic evaluation of the solitary pulmonary nodule;

- Staging of non-small cell lung cancer; and,
- Operative approaches.

Differential Diagnosis of the Solitary Pulmonary Nodule

Among the numerous possible causes of a solitary pulmonary nodule, the more common and serious are non-small cell lung cancer, pulmonary metastases from a distant site, granuloma, and hamartoma. Risk of malignancy increases with age and smoking history. Radiographically larger nodules are more likely to be malignant. Radiographic patterns of lesions can be helpful in differentiating benign from malignant lesions. PET scanning after cancer diagnosis can be helpful in staging. In an instance where a PET scan is positive for the nodule but negative elsewhere, mediastinoscopy is a reasonable next diagnostic step. Mediastinoscopy can provide sensitivity/specificity that complements PET scanning.

Evidence-based National Comprehensive Cancer Network (NCCN) Guidelines in Oncology provide recommendations for evaluation, staging and treatment of non-small cell lung cancer.[23]

Good decision-making in diagnosis and treatment of benign and malignant lung diseases is based on:

- Clinical and radiographic features useful in establishing a risk profile;
- Assuming that the solitary pulmonary nodule in a high-risk patient is malignant until proven to be benign;
- Appropriate radiographic and pathologic staging; and,
- Using evidence-based guidelines to improve outcomes.

Lung Transplant Update

The number of lung transplantation procedures performed annually has been increasing at a steady rate since the mid-1980s. The number of bilateral/double lung transplants has in recent years increased more rapidly than single-lung transplants. The number of heart-lung transplants performed annually has been declining since the mid-1990s.

Unfortunately, said Wickii T. Vigniswaram, MD, FCCP, more people on the waiting list for a lung transplant are dying before a lung is allocated for them. Patients with chronic obstructive pulmonary disease (COPD) tend to survive longer while waiting for a lung than do patients with more aggressive disease, such as idiopathic pulmonary fibrosis. COPD is by a considerable margin the most frequent indication for single-lung transplantation. Cystic fibrosis is the most frequent indication for bilateral/double lung transplantation., followed closely by COPD.

Survival of all patients for whom any follow-up is known, using the Kaplan-Meier method of calculation, shows survival the highest at 10 years for cystic fibrosis patients, lowest for patients who had COPD and iatrogenic pulmonary fibrosis. Using the same method, survival of bilateral/double lung transplant patients is shown to be better than that of single lung transplant patients at 10 years postoperatively.[24,25]

Among all causes of death for adult lung transplant recipients 1992-2006, bronchiolitis emerges as the cause of more deaths than any other single cause after one year.

A new system for allocating donor lungs is now in place. Factors predicting waitlist survival and transplant survival are given consideration; factors predicting transplant survival are likely to put a patient higher on the waiting list.[26,27]

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