MAYO CLINIC

CARDIOVASCULAR UPDATE

CLINICAL CARDIOLOGY AND CARDIOVASCULAR SURGERY NEWS

volume 6
number 2
2008

Inside This Issue

Frequent Premature Ventricular Contractions: A Treatable Cause of Cardiomyopathy

Samuel J. Asirvatham, MD

During the past decade, radiofrequency ablation (RFA) has revolutionized care for patients with commonly occurring arrhythmias, including atrial fibrillation, atrial flutter, and supraventricular tachycardia. Even complex arrhythmias such as ventricular tachycardia and ventricular fibrillation are now being treated with advanced imaging, mapping, and ablation systems.

Premature ventricular contractions (PVCs), when occurring sporadically, are considered normal. Patients with cardiomyopathy often have more frequent PVCs, and by themselves the PVCs are not thought to confer incremental risk for sudden death beyond that represented by the patient's depressed ventricular function.

Which Came First?

"When PVCs and cardiomyopathy coexist, 2 possibilities need to be considered: first, that the PVCs are a result of the myocardial disease process giving rise to depressed ventricular function, that is, the PVCs result from the cardiomyopathy; or second, that the PVCs, because of their frequency, cause myocardial dysfunction and give rise to the cardiomyopathy (tachycardia-related cardiomyopathy)," says Samuel J. Asirvatham, MD, an invasive electrophysiologist at Mayo Clinic in Rochester. "A recent target for RFA has been the site of origin for frequent PVCs, curing certain patients' cardiomyopathy."

Case History

A previously active 19-year-old man presented with fatigue and exertional dyspnea. Echocardiography revealed systolic dysfunction and an ejection fraction of 26%. Further investigations were negative for coronary artery disease, coronary anomalies, ventricular dysplasia, or evidence of myocarditis. Frequent PVCs were seen on a routine 12-lead electrocardiogram (Figure 1). A 24-hour Holter monitor recording showed 28,000 PVCs, nearly all of similar QRS morphology. A 9-month trial of β-blockers at increasing doses was ineffective in reducing PVCs, decreasing symptoms, or improving ventricular function. Subsequently, an electrophysiologic study and RFA procedure were performed. A single focus giving rise to the PVCs was mapped to the region of the left coronary cusp of the aortic valve. Radiofrequency energy was delivered at the site and eliminated the PVC. The patient felt much better 3 months after the ablation, and repeated echocardiography showed an improved ejection fraction of 67%. No recurrence of PVCs or ventricular dysfunction was noted at follow-up 1 year after ablation.

Comment on the Case

Clinicians encounter a large number of patients who have cardiomyopathy and PVCs noted on Holter monitor. "How does one recognize which of these myriad patients represents an opportunity to effect cure from myocardial dysfunction by ablating their PVCs?" asks Dr Asir-

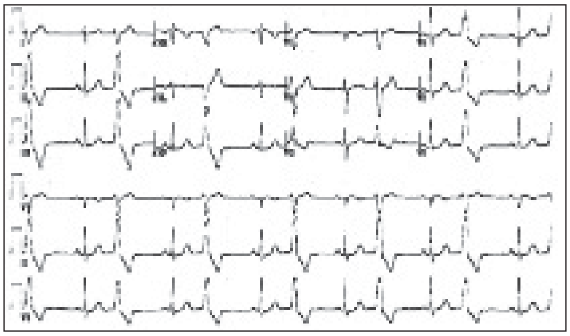

Figure 1. A 12-lead electrocardiogram of a patient with incessant PVCs (more than 30,000 PVCs per day). The morphology of the PVCs is consistent with a right ventricular outflow tract origin. Note the left bundle branch block pattern, tall positive R-waves in leads II, III, an aVF, and the simultaneously negative QRS complex in leads aVR and aVL. This patient's ejection fraction normalized after ablation of these incessant PVCs.

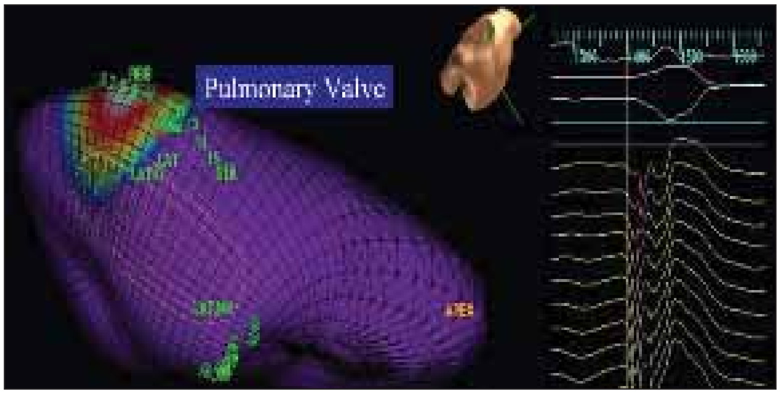

Figure 2. Noncontact map that identifies the origin of PVCs, in this instance arising from above the pulmonary valve. Myocardial extension above the semilunar valves may give rise to ventricular tachycardia or frequent ectopy and can be targeted for radiofrequency ablation.

vatham. Most patients with cardiomyopathy (ischemic and nonischemic) will have relatively infrequent PVCs (fewer than 5,000 per day), and the morphology of these extrasystoles will vary. Often, at least 5 or 6 clearly different morphologies will be noted on careful review of 24- or 48-hour Holter monitor recording. Relatively healthy patients with no clinical evidence of ischemia or myocarditis who had more than 10,000 PVCs in a 24-hour period are more likely to have a reversible cause of cardiomyopathy caused by the PVCs. Importantly, the PVCs appear to be arising from a single focus, as recognized by an identical QRS morphology for each of these beats. Further, often the PVC morphology is of either right or left bundle branch block pattern, with a strong inferior axis (tall R-waves) in leads II, III, and aVF (Figure 1). These differences are summarized in the Table.

Anatomic Substrate for Frequent Ectopy

In the patients where PVC ablation completely reverses myocardial dysfunction, there is no underlying pathology in the ventricular myocardium. What then gives rise to these frequent PVCs? The answer to this question is not completely known, says Dr Asirvatham. However, anatomic dissections have shown myocardial sleeves that extend beyond the semilunar valves of the great arteries (Figure 2). This structure is analogous to the finding of myocardial extension into the pulmonary veins, now thought to be the substrate for most patients with atrial fibrillation. The eventual successful site of ablation and the QRS morphology described in many patients with PVC-induced cardiomyopathy is consistent with arrhythmia that originates at or near the semilunar valves. Other possibilities include embryonic remnants of conduction tissue or autonomic ganglia located near the valves causing the arrhythmia.

Radiofrequency Ablation

Because the cause for the frequent PVCs is a localized area of myocardium, radiofrequency ablation is highly effective and often curative. Spontaneously occurring PVCs or those induced with adrenaline-like drugs are mapped to find the earliest myocardial site of activation before the onset of the surface QRS complex. This earliest site is then targeted for radiofrequency energy delivery, which then ablates (burns) the source of the PVC.

Technological Advances That Aid Ablation

Several difficulties arise when attempting to ablate frequent ectopy. Various new technologies have been developed to specifically address the commonly encountered sources of difficulty.

The ventricular outflow tract and the fascicular system represent among the most complex anatomic structures encountered by ablationists (Figure 3). To aid accurate mapping and identification of the exact site of origin of an abnormal electrical signal and to catalog activation times in the 3-dimensional complex geometric milieu, electroanatomic mapping (cataloging activation point in 3 dimensions) and intracardiac ultrasound have been developed. Use of these advanced technologies has greatly facilitated the treatment of these difficult arrhythmias.

PVCs may be very infrequent or may be associated with significant hemodynamic consequences (ventricular tachycardia) such that detailed point-to-point mapping is precluded. In these situations, an intracavitary balloon catheter that does not make contact with the myocardial wall can be very helpful. This system (noncontact mapping) theoretically allows the exact definition of the site of origin to origin of ventricular tachycardia, even from a single beat of arrhythmia (Figures 4 and 5).

Table. PVCs and Cardiomyopathy

	PVCs associated with cardiomyopathy	PVCs causing cardiomyopathy
Patient characteristics	Older patients with known cardiovascular disease	Otherwise healthy individuals
Comorbid conditions	Hypertension, ischemic heart disease, myocarditis, family history of myocardial disease	Often no prior cardiac or major medical or family history
Ejection fraction	Depressed	Depressed
Frequency of PVCs	<5,000/24 hours	>10,000/24 hours, often >20,000/24 hours
Pattern of PVCs	Multiple morphologies	Monomorphic
QRS morphology	Nonspecific	Outflow tract morphology (right or left bundle branch block pattern with inferior axis) Fascicular morphology (typical right bundle branch block pattern with superior axis)
Response to radiofrequency ablation	Only required if associated with ventricular tachycardia that has been triggering frequent ICD shocks No effect on the ventricular function	Normalization of ventricular function frequently seen

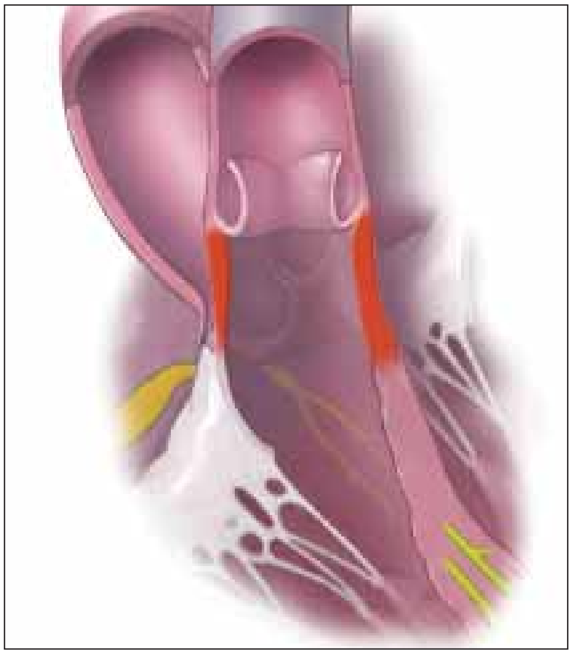

Figure 3. Diagram showing the complex anatomy of the outflow tracts. The right ventricular outflow tract is superficial and to the left of the left ventricular outflow tract. Note the close relationship of the coronary arteries to the posterior wall of the right ventricular outflow tract. With appropriate precautions, ablation can be successfully performed in most parts of the right and left ventricular outflow tracts.

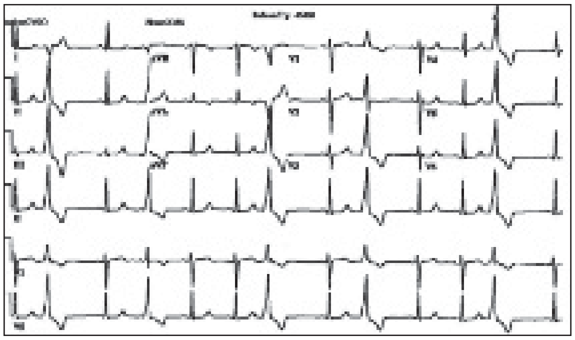

Figure 4. A 12-lead electrocardiogram obtained in another patient with cardiomyopathy and incessant PVCs. In this instance (compare with Figure 1), the PVCs show a right bundle branch block origin, although with the continued finding of a tall R-wave in leads II, III, and aVF. This is consistent with origin in the left ventricular outflow tract either above or below the aortic valve.

The risks associated with radiofrequency ablation for PVCs depend in part on the ventricular chamber in which radiofrequency energy is delivered. While bleeding, infection, and cardiac perforation may occur with any ablation procedure, thromboembolic stroke is specific to ablation in the left-sided circulation. Another potential hazard for bleeding in the left-sided circulation is injuring the coronary arteries when ablating above the semilunar valve. Using intracardiac ultrasound, coronary angiography, or both can mitigate this risk.

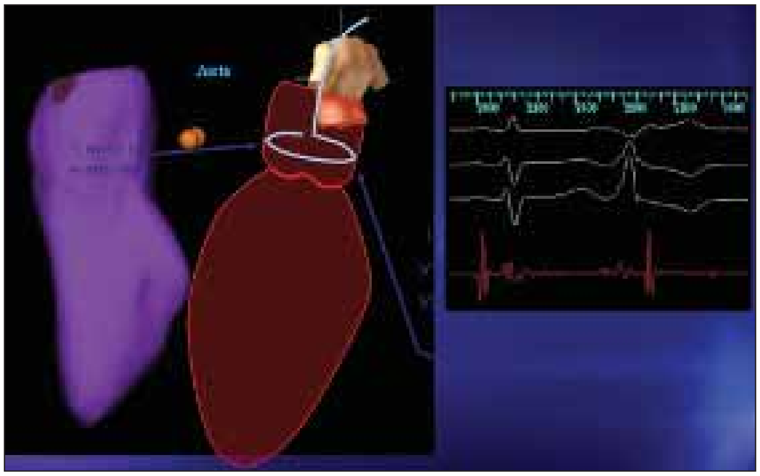

Figure 5. In this patient (Figure 4), detailed mapping of the right ventricular outflow tract and the aortic root using a circumferential catheter identified the true origin close to the ostium of the left main coronary artery. Ablation electrically isolating the aortic root was successful in eliminating PVCs in this patient.

Role for Medical Therapy and Device Implantation

In some patients with frequent PVCs, despite using the criteria mentioned (Table), it can be difficult to counsel patients on the likelihood that ablating their PVCs will improve ventricular function. Here, the electrophysiologist must also decide that if ablation is not to be performed, then because of the decreased ventricular function, defibrillator implantation for the primary prevention of sudden cardiac death may be required. A useful maneuver in that instance is to use antiarrhythmic therapy to ameliorate PVCs and see if there is a response in ventricular function. In general, antiarrhythmics are not particularly effective in suppressing frequent PVCs. An exception to this rule is the drug amiodarone. While amiodarone successfully decreases PVC frequency, its adverse effect profile precludes long-term use, particularly in young patients. Thus, when doubt exists as to whether PVCs in a given patient are causing cardiomyopathy, a brief trial of amiodarone (3 to 6 months) can be instituted. "If, when PVCs subside, cardiac function improves, then amiodarone can be discontinued and the PVC focus targeted for ablation using one of the advanced imaging/mapping systems," says Dr Asirvatham. "On the other hand, if there was no discernible benefit to getting rid of PVCs on ventricular function recovery, then the risks involved with ablation are not warranted unless the PVCs themselves are symptomatic."

Physicians should be aware that certain patients who are otherwise healthy but present with myocardial dysfunction and have documented frequent monomorphic PVCs can benefit and sometimes be cured of their cardiomyopathy with radiofrequency ablation of the PVC focus.

Henry H. Ting, MD

STEMI Protocol at Mayo Clinic Rochester Reduces Time to Treatment in Acute Myocardial Infarction

In patients with ST-elevation myocardial infarction (STEMI), the prompt restoration of coronary blood flow reduces infarct size and improves survival. Delays in patient presentation to the emergency department, diagnostic difficulties, transport times, and impediments to rapid administration of fibrinolytic therapy or mobilization of the cardiac catheterization team can prolong the time to treatment for these patients. Mayo Clinic in Rochester has implemented an evidence-based protocol to improve time to treatment for patients presenting with STEMI to its Rochester hospitals and a regional network of 28 hospitals located within a 150-mile radius of Rochester, Minnesota. This quality improvement project has been led by Henry H. Ting, MD, an interventional cardiologist at Mayo Clinic in Rochester.

"Fibrinolytic agents are most effective when administered within 2 to 3 hours from symptom onset when primary percutaneous coronary intervention (PCI) cannot be performed rapidly," says Dr Ting. "The ACC/AHA Guidelines recommend a door-to-balloon time of less than 90 minutes for all patients with STEMI, including those who present directly to or are transferred to a PCI center, to maximize myocardial salvage and survival." Less than 25% of acute care facilities in the United States have 24/7 on-site PCI capabilities, so there is additional interest in reducing time to treatment for these patients who require transfer to a PCI-capable hospital.

Dr Ting continues: "There is an important gap in current understanding of how to implement processes and systems of care for timely reperfusion to a regional population and regional network of hospitals. We designed an evidence-based protocol and implemented this in real-world practice to improve time to treatment and outcomes in patients presenting with STEMI to both Mayo Clinic in Rochester and regional hospitals, with and without on-site PCI capability."

The protocol includes emergency department activation of the cardiac catheterization laboratory without review or approval by cardiology, a single call system to activate the entire catheterization team, and a commitment from the catheterization lab to be fully operational within 30 minutes after activation.

Specific process changes have been implemented:

- Prioritizing electrocardiography in all patients presenting with chest pain within 5 minutes.
- Empowering the emergency department physician to directly activate the cardiac catheterization laboratory team without requiring a cardiovascular medicine consultation.
- Parallel-display paging process to activate the cardiac catheterization team.
- Web-based, prospective data acquisition for continuous quality improvement.

These changes have resulted in a reduction in the median door-to-balloon time from 98 minutes in May 2003 to 67 minutes in May 2008 (31.6% decrease).

Patients who present to regional hospitals are treated with a fibrinolytic agent, followed by early invasive PCI (within 3 hours after onset of symptoms) or transferred for primary PCI (if onset of symptoms occurred more than 3 hours previously). The 28 regional hospitals located within 150 miles of Rochester have an estimated time of less than 120 minutes from first hospital door to primary PCI at Saint Marys Hospital in Rochester. Patients undergo early rescue PCI for suspected failure to reperfuse after fibrinolytic administration and undergo routine elective catheterization within 24 to 48 hours if reperfusion has been achieved. Inclement weather prohibits helicopter and ground transport up to 5% of the time. Patients who are at high clinical risk (such as cardiogenic shock or persistent ventricular arrhythmias), have contraindications to fibrinolytic therapy, or have an uncertain diagnosis, including equivocal electrocardiographic findings, are transferred for primary PCI.

Specific elements of the transfer protocol include the following:

- Standardized protocol for selecting fibrinolysis or primary PCI as the reperfusion strategy.

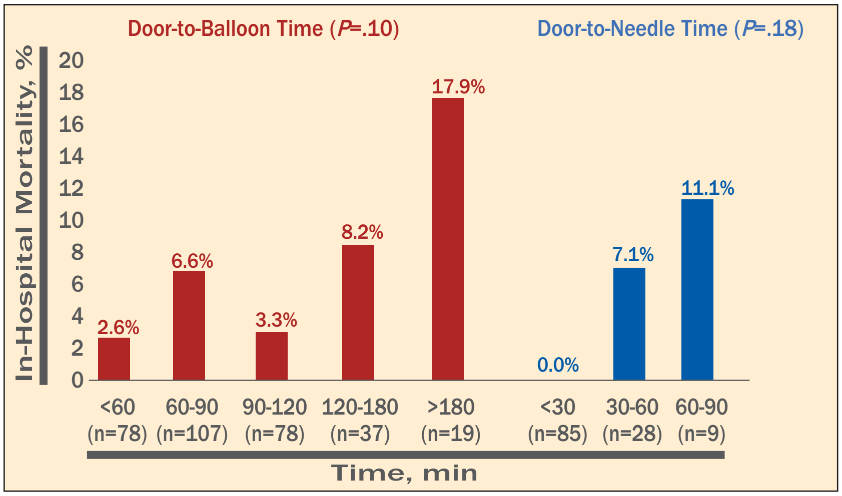

Figure 2. Relation of door-to-balloon time (left) and door-to-needle time (right) to in-hospital mortality.

- Immediate availability of a receiving cardiologist to discuss the patient's case with the regional physician and initiate transfer.
- A central transport center to select the mode of transfer with the shortest time by air and ground ambulance services.
- Helicopter "hot load" with the engine left running to mini mize ground time.

In the United States, the median time is 180 minutes from first door to balloon for STEMI patients requiring transfer. In the Mayo Clinic regional network, this time has decreased from 202 minutes in December 2004 to 107 minutes in May 2008 (47% decrease).

In-hospital mortality as a function of door-to-balloon and door-to-needle times is shown in the Figure on page 4. In-hospital mortality was 1.1% if door-to-balloon time or door-to-needle time was achieved in less than 30 minutes.

"We have demonstrated that door-to-treatment times can be significantly reduced by a concerted effort to streamline every step in the evaluation and treatment of patients presenting with STEMI," says Dr Ting. "Furthermore, we achieved this performance not by having smarter cardiologists, faster helicopters, or newer stents. Rather, these improvements were achieved by redesigning systems of care to allow our excellent staff to close the gap between ideal, recommended care and routine, actual care."

For additional information about the regional STEMI protocol at Mayo Clinic in Rochester, please contact coordinator M. Christine Bjerke, RN, at 507-266-3259.

UNDER THE STETHOSCOPE

by Clarence Shub, MD

Acute Myocardial Infarction

- Gallop sounds, if carefully sought, are common in acute myocardial infarction, especially S4. On palpation, a presystolic impulse (A wave) and, less commonly, a palpable rapid filling wave can be appreciated. An audible S3, when heard, usually represents left ventricular (LV) failure.
- Right ventricular (RV) infarction should be suspected in the presence of inferior wall myocardial infarction, increased jugular venous pressure, clear lung fields, and hypotension. Patients with RV infarction can lie flat without dyspnea, in contrast to patients with LV failure in whom pulmonary edema is common.
- A new systolic murmur may represent papillary muscle dysfunction or rupture, ventricular septal rupture, or tricuspid regurgitation, secondary to RV infarction. The systolic murmur of ischemic papillary muscle dysfunction may be variable and even disappear if ischemia is treated and relieved.
- Although ventricular free wall rupture usually results in sudden death or tamponade with shock, patients with subacute rupture may present with chest pain and a pericardial rub.
- Patients with ventricular septal rupture can remain supine, but patients with papillary muscle rupture typically develop pulmonary edema with orthopnea. The intensity of the mitral regurgitant murmur in the latter varies and can be minimal or absent. A palpable thrill is only rarely present, although in patients with ventricular septal rupture, a palpable thrill is more common.
- A pericardial friction rub characteristically is found 2 to 3 days after onset of acute myocardial infarction and is often intermittent but may persist for days or weeks. Delayed appearance of a rub suggests the possibility of Dressler syndrome.

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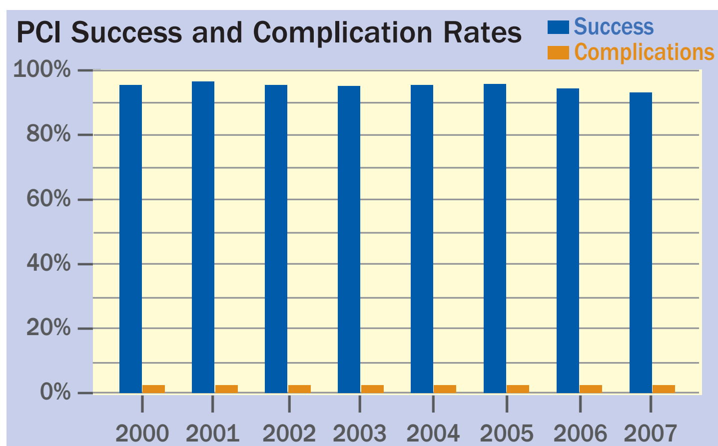
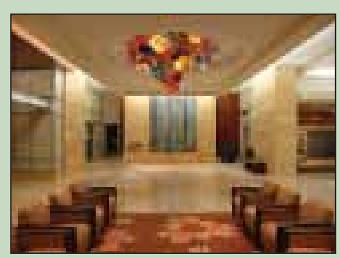
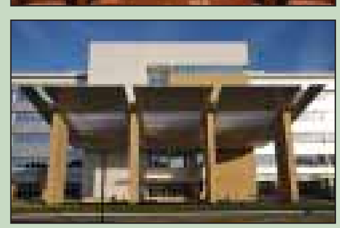


IN THE NEWS

Mayo Clinic in Jacksonville Opens New Hospital

Mayo Clinic's new hospital opened in Jacksonville on April 12, representing a long-awaited dream of creating a fully integrated medical campus with inpatient and outpatient services "under one roof." The new hospital serves Jacksonville residents as well as regional, national, and international patients. The new 650,000-square-foot hospital combines the best of high technology and safety with the highest level of patient care and attention. Modern equipment and advanced technologies are used in a nurturing, friendly environment, merging the art of healing with the science of medicine. Currently, the hospital has 214 beds; long-range plans allow for further expansion up to 16 floors and 500 beds to meet future market needs. The surgical suite includes 16 oversized operating rooms, and the intensive care/critical care unit has 30 beds. Computerized systems and Mayo's electronic medical record help expedite the flow of decision-making information to physicians. The Emergency Department, open to all, has a special chest pain observation unit, a comprehensive stroke center, and a helicopter landing pad for air ambulance service.





Minimally Invasive Robotic and Thoracoscopic Cardiac Surgery

Rakesh M. Suri, MD, DPhil, and Harold M. Burkhart, MD

The use of high-definition imaging systems and robotic technology now allows complex cardiac surgery to be carried out via small incisions with the complete avoidance of sternotomy. The putative benefits of such an approach include a decreased length of ventilator support, decreased blood transfusion, shorter hospital stay, decreased postoperative functional limitation, and quicker return to normal activity. The current role of minimally invasive and robotic surgery in the cardiovascular surgery practice at Mayo Clinic in Rochester includes mitral valve repair, tricuspid valve repair, atrial fibrillation surgery, and congenital surgery.

"Although cardiac surgery performed via a median sternotomy provides excellent exposure to the heart and great vessels, the necessary limitation in upper extremity mobility while sternal union occurs often precludes early return to functional activity," according to Rakesh M. Suri, MD, DPhil, a cardiovascular surgeon at Mayo Clinic in Rochester.

From an anatomic perspective, surgical access to the mitral and tricuspid valves along with the atria and the interatrial septum can be obtained easily via an incision in the right chest. "A small right anterolateral thoracotomy permits direct visualization of the atrial aspects of the atrioventricular valves," says Harold M. Burkhart, MD, a cardiovascular surgeon at Mayo Clinic in Rochester. "It is this convenient alignment that potentiates the ability to perform intracardiac procedures through a small, well-tolerated incision in the right chest wall."

Figure 1. The newest high-definition robotic system allows 3 instruments to be used concurrently in addition to the high-definition camera. The instrument arms are inserted gently between the patient's ribs and were designed to mimic the movements of a surgeon's hands.

Facilitating Technology

Whenever the heart is opened, even though the incisions are considered "minimally invasive," cardiopulmonary bypass is necessary to ensure a still, bloodless field during surgical manipulation of intracardiac structures. Traditional aortoatrial cannulation performed via median sternotomy has evolved into a small 1.5- to 2-cm groin incision for near-percutaneous femoral arterial/vein cannulation, permitting full cardiopulmonary bypass support. Cardiac arrest is achieved by using a transthoracic cross-clamp and direct cardioplegia instilled into the aortic root.

The distance to the atrioventricular valves makes the right mini-thoracotomy approach using only the naked eye more challenging than conventional open surgery. The technically simplest option to facilitate surgical visualization is a thoracoscopic approach using a high-definition video thoracoscope and long, shafted instruments. "The appeal of this approach is that it is simple, requires minimal equipment, and may be quickly set up and dissembled," says Dr Suri. "The limitations of thoracoscopic surgery include suboptimal exposure in certain situations and the relative difficulty of performing fine technical manipulations at the valve/subvalvar level." Despite this, mitral and tricuspid valve procedures along with congenital, atrial septal, and arrhythmia surgery can all be performed using a purely thoracoscopic approach.

The next tier of technical sophistication in minimally invasive valve surgery involves use of a robotically assisted platform (da Vinci Surgical System; Intuitive Surgical, Sunnyvale, California). The robotic system has a central computer processor that allows the surgeon to manipulate multiple instruments simultaneously (Figure 1). The high-definition robotic system currently in use at Mayo Clinic allows 3 instruments to be used concurrently in addition to the camera, permitting the surgeon to shift quickly between control of the dynamic atrial retractor and robotic arms to expose, visualize, and manipulate cardiac tissue. The robotic arms are designed to mimic the movements of a surgeon's hands. The surgeon operates from a console, surrounded by a 3-dimensional view of the operative field. "The computer processor reproduces hand movements of the surgeon in a scaled manner, translating them into real-time movement of instruments mounted on robotic arms through chest wall ports," says Dr Burkhart. The robotic instruments are not only shafted (long conventional instruments with a shaft but no articulation) but also "wristed," thereby permitting more natural manipulation of suture and tissue. Robotic technology allows the surgeon to approach and, in some instances, exceed the level of technical precision possible with a traditional open-chest approach.

Robotic Mitral Valve Repair

Mitral valve repair bestows a survival benefit in those with severe mitral valve regurgitation due to leaflet prolapse in the absence of symptoms—even when ventricular function is normal. The availability of reproducible valve repair techniques as a safe and durable alternative to prosthetic replacement has dramatically influenced the indications for surgical intervention in patients with mitral regurgitation due to leaflet prolapse. With successful valve repair, patients who maintain sinus rhythm resume full activities without the need for chronic anticoagulation. The evolution in operative techniques has led to predictable and durable results after mitral valve repair. "In our practice at Mayo Clinic in Rochester, more than 95% of patients with pure mitral valve regurgitation due to degenerative disease undergo valve repair rather than prosthetic replacement," says Dr Suri.

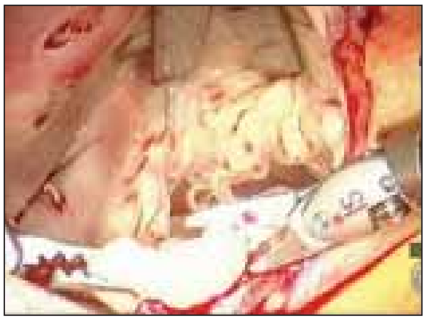


Figure 2. Intraoperative view through the robotic camera of a triangular resection being performed on a prolapsing segment of a myxomatous mitral valve leaflet.

Figure 3. Intraoperative view through the robotic camera of suture reconstruction after removal of prolapsing leaflet tissue.

Figure 4. Intraoperative view through the robotic camera of the completed repair after triangular resection, suture reconstruction, and posterior annuloplasty band insertion.

The "Mayo mitral repair" differs from techniques used at other institutions and is based on the premise that eliminating only the redundant prolapsing leaflet edge from the coaptation margin using a simple triangular resection (Figure 2) followed by suture reconstruction (Figure 3) is sufficient, expedient, and durable. All repairs are protected with a 63-mm posterior annuloplasty band anchored between right and left fibrous trigones (Figure 4). Anterior leaflet pathology is routinely corrected by resuspension of the leading edge using artificial neochordae. Bileaflet disease is addressed using a combination of these techniques. With simplified methods of leaflet repair and annuloplasty reinforcement, the rate of reoperation after correction of posterior leaflet prolapse at Mayo Clinic is approximately 0.5% per year, and rates of reintervention after repair of anterior or bileaflet prolapse are similarly low (1.6% and 0.9% per year, respectively). Indeed, the durability of mitral repair for all leaflet prolapse subsets in the current era is similar to that seen after mitral valve replacement (re-repair rate of 0.74% per year overall).

Despite the proven advantages, the psychological barrier associated with the referral of an otherwise healthy, asymptomatic patient for cardiac surgery has in some instances prevented the widespread acceptance of early mitral valve repair for leaflet prolapse in some areas, even to centers where the incidence of repair (rather than replacement) is higher than 95%. Mayo mitral valve repair techniques are perfectly suited to the robotic platform. Robotically assisted mitral valve repair of middle scallop posterior leaflet prolapse at Mayo Clinic currently involves a traditional posterior resection precisely performed using the 3-dimensional 10 magnification with the high-definition robotic camera. The leaflet is then reconstructed robotically with a 2-layer polypropylene suture closure. A standard-length 63-mm posterior annuloplasty band is then anchored into the posterior mitral anulus between right and left fibrous trigones using interrupted sutures placed by robotic instruments; the annuloplasty band both reduces the posterior mitral anular circumference and protects the leaflet closure. The placement of artificial neochordae is similarly done using the robotic platform. Visualization of the subvalvar apparatus (composed of the papillary muscles and chordae tendineae) is sometimes difficult via median sternotomy, leading to the labeling of anterior/bileaflet prolapse as "complex" valve disease. In contrast, using robotic assistance, the surgeon's view of the mitral valve is often direct and uncompromised. The surgeon is able to precisely determine which leaflet segments are unsupported and resuspend them to the appropriate lengths with artificial neochordae. Robotic instruments are suited to tailoring neochordae by referring to the lengths of more normal adjacent cords. "The robotic platform allows us to perform the same mitral repair as we would via an open-chest sternotomy through small ports in the right chest wall," says Dr Burkhart.

Robotic Atrial Septal Defect Repair

Surgical techniques have also evolved in the repair of atrial septal defects, including the patent foramen ovale. Currently, when surgical closure is required for atrial septal defects, the procedure can be performed by accessing the heart through the right chest with small port incisions and robotic assistance. Cardiopulmonary bypass techniques are similar to those of the robotically assisted mitral valve repair. The defect may be closed primarily or with a pericardial patch harvested with the aid of the robotic instruments.

Conclusion

Mayo Clinic patients now benefit from less invasive robotic and thoracoscopic methods of performing traditional cardiac surgical procedures. Complex valve repairs and congenital procedures along with arrhythmia surgery are routinely and successfully carried out, with the same excellent results achieved by conventional techniques.

Upcoming Courses

Continuing Medical Education, Mayo Clinic

To request additional information or to register, unless noted otherwise, please call 800-323-2688, e-mail cme@mayo.edu, or visit www.mayo.edu/cme.

Success With Failure: New Strategies for the Evaluation and Treatment of Congestive Heart Failure
Aug 3-6, 2008, Whistler, BC
Phone: 800-283-6296; e-mail: cvcme@mayo.edu

Mayo Interventional Cardiology Board Reviews
Sep 19-21, 2008, Rochester, MN

Mayo Cardiovascular Review Course for Cardiology Boards and Recertification
Sep 20-25, 2008, Rochester, MN

Mayo Cardiovascular Review Course for Electrophysiology Boards and Recertification
Sep 25-28, 2008, Rochester, MN

Human Factors in Healthcare: Practical Applications for Improving Patient Safety
Oct 1-3, 2008, Rochester, MN

Coronary Artery Disease: Prevention, Detection and Treatment
Oct 6-8, 2008, Las Vegas, NV
Phone: 800-283-6296; e-mail: cvcme@mayo.edu

Mayo Clinic Nutrition in Health and Disease
Oct 9-10, 2008, Chicago, IL

Pediatric Cardiology Board Review Course
Oct 15-18, 2008, Rochester, MN
Phone: 507-266-0676

Continuing Medical Education, Cosponsored With American Society of Echocardiology

To request additional information or to register, unless noted otherwise, please phone 507-266-6703 or e-mail echocme@mayo.edu.

21st Annual Echocardiographic Symposium at Vail: New Technologies, Live Scanning, and Clinical Decision Making
Aug 10-14, 2008, Vail, CO

16th Annual Echocardiograph for the Sonographer
Sep 21-23, 2008, Rochester, MN

3rd Annual The Beat Goes On
Sep 25-28, 2008, Orlando, FL

24th Annual Echocardiography in Pediatric and Adult Congenital Heart Disease
Oct 5-8, 2008, Rochester, MN

6th Annual Cardiovascular Ultrasound: From Pictures to Information
Oct 15-19, 2008, Phoenix, AZ

5th Annual New Approaches and Procedures in Nuclear Cardiology and Cardiac CT: State-of-the-Art Update for Office-Based Practice
Oct 23-25, 2008, Orlando, FL

Other Education Opportunities

34th Ten-Day Seminar on the Epidemiology and Prevention of Cardiovascular Disease
Jul 27-Aug 8, 2008, Tahoe City, CA
Phone: 888-242-2453; e-mail: scientificconferences@heart.org

Basic Cardiovascular Sciences Conference 2008—Heart Failure: Molecular Mechanisms and Therapeutic Targets
Jul 28-31, 2008, Keystone, CO
Phone: 888-242-2453; e-mail: scientificconferences@heart.org

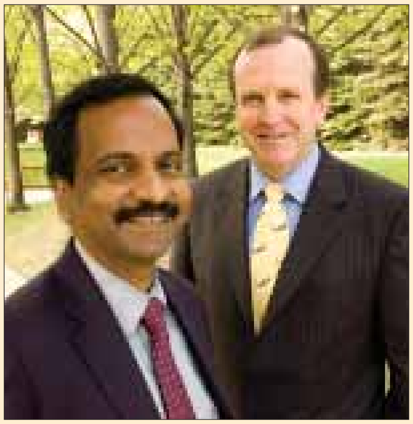
62nd High Blood Pressure Research Conference 2008
Sep 17-20, 2008, Atlanta, GA
Phone: 888-242-2453; e-mail: scientificconferences@heart.org

American Heart Association Scientific Sessions 2008
Nov 8-12, 2008, New Orleans, LA
Web: scientificsessions.americanheart.org

Teaching Skills Workshop for Emerging Faculty Program
Nov 20-22, 2008, Washington, DC
Web: acc.org/education/programs/programs.htm

International Stroke Conference 2009
Feb 17-20, 2009, San Diego, CA
Web: strokeconference.org

Recognition



The Mayo School of Graduate Medical Education has presented Teacher of the Year awards to cardiologists Samuel J. Asirvatham, MD, and Malcolm R. Bell, MD.

Apoor S. Gami, MD, received the Outstanding Achievement in Clinical Cardiovascular Disease 2008 Award. He completes his cardiovascular fellowship this year and will join Midwest Heart Specialists, in Elmhurst and Naperville, Illinois.

Cardiovascular Update is written for physicians and should be relied upon for medical education purposes only. It does not provide a complete overview of the topics covered and should not replace the independent judgment of a physician about the appropriateness or risks of a procedure for a given patient.

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