HeartWATCH

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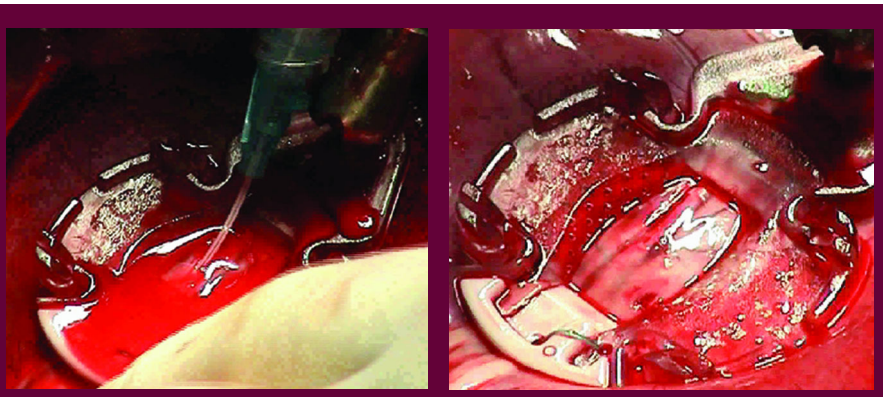
TEXAS HEART® INSTITUTE

at St. Luke's Episcopal Hospital

Biocompatible Polymer May Improve Visualization During Off-Pump Coronary Artery Bypass Procedures

Abstract: A temperature-sensitive polymer is being tested for its ability to keep the operative field bloodless during off-pump coronary artery bypass grafting.



Graft anastomotic site during (left) and after (right) infusion of a biocompatible polymer (Pleurogel) in an experimental porcine model. A relatively bloodless operative field is created.

Coronary artery bypass graft (CABG) surgery can be done on either a stopped or a beating heart. The beating-heart, or off-pump, approach only recently entered mainstream clinical practice. It has quickly gained acceptance, however, owing to technical improvements that have reduced the invasiveness of the approach and to increasing awareness of the potential hazards of cardiopulmonary bypass and aortic manipulation, especially in older and sicker patients. Yet, despite evidence that the outcomes of off-pump and on-pump CABG procedures are similar (*Circulation* 2005;111:2858–64), the off-pump technique has still not been fully embraced by the surgical profession.

"A big reason for this is the perceived technical difficulty associated with off-pump procedures," says William E. Cohn, MD, director of Minimally Invasive Surgical Technology at the Texas Heart Institute at St. Luke's Episcopal Hospital (THI/SLEH). "And one of the difficulties occasionally encountered in off-pump CABG surgery is maintaining a completely bloodless operative field at the graft anastomotic site."

Current methods of maintaining anastomotic hemostasis during off-pump CABG procedures include the use of sutures, surgical tape, and shunts. However, asymmetric noncompressible atherosclerotic plaque and back-bleeding from arterial side branches occasionally cause blood to leak into the anastomotic site and obscure it.

This difficulty is compounded during limited-access off-pump CABG and has often proved to be a prohibitive hurdle in the evolution of closed-chest robotic CABG.

"During traditional on-pump CABG surgery, an assistant has access to suction blood from the operative field," explains Dr. Cohn. "During off-pump procedures performed through small incisions, however, an assistant may not be able to obtain adequate exposure to do so. This has proven especially problematic in robotic cases. In cases where anastomotic visualization is obscured by bleeding, conversion to standard CABG is frequently necessary."

In light of this problem, Dr. Cohn and a team of researchers have been evaluating a biocompatible polymer for its potential to improve hemostasis and maintain a bloodless field, thus facilitating a variety of off-pump CABG procedures, including perhaps totally endoscopic CABG. The transparent polymer, known chemically as poloxamer 407 and commercially as Pleurogel (Pleuromed Inc., Lincoln, MA), solidifies at body temperature and dissolves into a liquid at cooler temperatures.

In preclinical experiments in a porcine model, Dr. Cohn and his colleagues have infused the polymer through an arteriotomy into the coronary lumen near the intended site of anastomosis. The polymer then solidifies and occludes the artery. After bypass is complete, the occlusion is irrigated with cold saline solution to dissolve the solidified polymer, which passes through the coronary microcirculation without causing myocardial injury and is then filtered out of the bloodstream by the kidneys.

"In our experiments, Pleurogel coronary occlusion reduced bleeding from about 5 mL/min before its application to about 0.5 mL/min afterward," says Dr. Cohn. "Once solidified, the polymer also successfully maintained the cylindrical geometry of the occluded artery and, because of its transparency, allowed more precise suturing of graft anastomoses."

"Currently, some surgeons feel that off-pump CABG is more technically demanding than the traditional on-pump approach, but with practice and improved techniques this gap can be closed," notes Dr. Cohn. "Using a biocompatible material such as Pleurogel to keep the operative field relatively blood-free and well visualized during off-pump procedures may be one potentially safe and effective way to do this." ●

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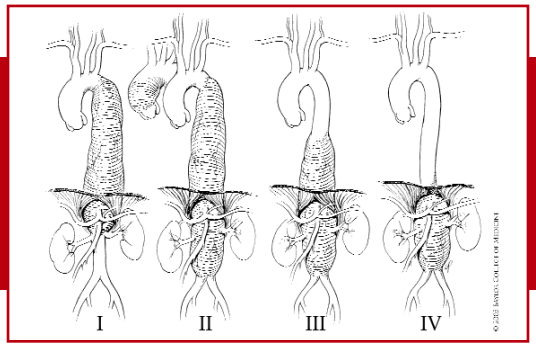
Multimodality Approach for Organ Protection During Extensive Thoracoabdominal Aortic Aneurysm Surgery

Abstract: A multimodality approach has proved successful in protecting vital organs during extensive operations on the thoracoabdominal aorta.

Although the results of surgical repair of thoracoabdominal aortic aneurysms (TAAAs) have improved in recent years, postoperative paraplegia/paraparesis (P/P) remains a risk if spinal cord ischemia occurs. To prevent ischemic complications, large study, Dr. Coselli reported that LHB reduced the risk of P/P in patients with extent II aneurysms; the incidence remained similar in patients with extent I aneurysms despite significantly longer clamp times in the LHB group (*Semin Thorac Cardiovasc Surg* 2003;15:325–32).



The Crawford classification for thoracoabdominal aneurysms based on the extent of aortic involvement.

Joseph S. Coselli, MD, chief of Adult Cardiac Surgery at the Texas Heart Institute at St. Luke's Episcopal Hospital (THI/SLEH), has developed a multimodality approach that has successfully decreased the incidence of these dreaded complications in patients with extensive TAAAs (Crawford extent I and II).

This approach includes moderate heparinization (1 mg/kg); generalized permissive mild hypothermia (32–34°C); cold, crystalloid perfusion of the renal artery ostia whenever possible; left-sided heart bypass (LHB); sequential aortic clamping; reattachment of patent, critical intercostal arteries; selective perfusion of the celiac axis and superior mesenteric arteries; and cerebrospinal fluid (CSF) drainage. The rationale for this approach has evolved as Dr. Coselli's TAAA series has grown to become the largest in the world.

For example, Dr. Coselli routinely administers a moderate heparin dose just before the aorta is clamped or LHB initiated.

"Heparin helps preserve the microcirculation and prevent embolization," he says, "and we haven't seen increased bleeding at this dosage."

Left-sided heart bypass provides distal perfusion to the viscera, kidneys, lower extremities, and lower intercostal and lumbar arteries. In a

"By reducing intercostal ischemic time," says Dr. Coselli, "LHB allows the aorta to be clamped safely for longer than 30 minutes, which is often necessary in these more extensive operations."

Another strategy for reducing ischemic time is sequential aortic clamping.

"As the branch vessels are reattached," Dr. Coselli explains, "the clamp is moved along the graft sequentially (proximally to distally) to maintain distal perfusion and restore proximal blood flow."

Reattachment of critical segmental arteries is somewhat controversial, though most surgeons preserve at least some intercostal and lumbar arteries in the critical region between T8 and L1. However, THI/SLEH surgeons believe in a more aggressive approach.

"We oversew the segmental arteries proximal to T6 and reattach 1 to 4 pairs between T7 and L2," says Dr. Coselli. "We reattach more arteries in patients whose collateral flow is compromised or who have had previous aortic replacement operations."

Another important means of protecting the spinal cord is CSF drainage. During aortic cross-clamping, CSF pressure increases, impairing perfusion. In theory, decreasing the CSF pressure would increase perfusion and help protect the spinal cord. In a recent randomized trial, Dr. Coselli and colleagues demonstrated "an 80% reduction in the relative risk of postoperative neurologic deficits in 76 patients who underwent CSF drainage during extensive TAAA repairs" (*J Vasc Surg* 2002;35:631–9).

"On the basis of these data, we now drain CSF in our patients with extent I and II aneurysms," says Dr. Coselli. "We insert the drainage catheter just before we start the surgical procedure, and we drain enough fluid to maintain CSF pressures between 10 and 12 mm Hg. The catheter stays in place for 24 to 48 hours postoperatively to maintain the target CSF pressure."

The early postoperative period is critical, as postoperative bleeding and hypotension can cause ischemia and lead to renal failure or P/P.

"To best maintain a satisfactory balance between perfusing the organs and controlling bleeding," says Dr. Coselli, "we keep arterial pressures between 80 and 90 mm Hg."

With this multimodality approach, the incidence of P/P in Dr. Coselli's series of operations on extensive TAAAs has decreased to 3.3% for 699 extent I aneurysm cases and 6.4% for 751 extent II aneurysm cases. ●

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Contents

Interventional Cryoplasty Therapy for Occlusive Peripheral Arterial Disease

Abstract: Cryoplasty, a new interventional procedure that uses a nitrous oxide–filled angioplasty balloon, may offer a simple yet effective treatment option for blockages in the peripheral arteries.

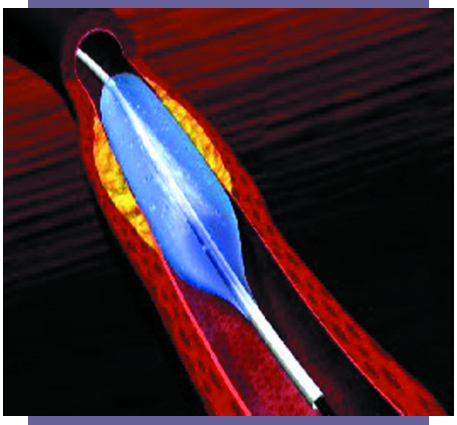
Approximately 8 to 12 million Americans have peripheral arterial disease (PAD), an obstructive disease of the aorta and its branches, including the iliac arteries and the femoral, popliteal, and distal tibial arteries in the legs. The most common form of PAD is caused by arteriosclerosis. Blood flow is obstructed not only to the distal arterial system but also to the nerves and tissues, which may result in limb loss.

One treatment option for PAD is angioplasty and stent placement. However, in 40% to 60% of patients who undergo such therapy, restenosis occurs, usually as a result of scar tissue inside the artery or stent. To address this problem, interventional cardiologists at the Texas Heart Institute at St. Luke's Episcopal Hospital (THI/SLEH) and elsewhere are investigating a new technique that may reduce the incidence of restenosis in peripheral arteries.

In this technique, called cryoplasty, an angioplasty balloon is filled with liquid nitrous oxide. The liquid converts into gas, which is segregated within an inner balloon (PolarCath System; CryoVascular Systems, Inc., Los Gatos, CA) so that the gas cannot escape. This liquid-to-gas conversion inflates the balloon at the site of the blockage. It also decreases the balloon's surface temperature to –10°C, which in turn alters the plaque's response to angioplasty. Instead of mounting an inflammatory response, the plaque cells undergo apoptosis, or programmed cell death. Because apoptosis is a noninflammatory process that does not cause vascular scarring, the risk of restenosis is theoretically lessened.

Zvonimir Krajcer, MD, director of the Peripheral Vascular Disease Service, recently led a clinical trial of this therapy at THI/SLEH.

"Approximately a year ago, we started a clinical trial to evaluate the effect of cryoplasty in patients who had previously undergone surgery or balloon angioplasty and stenting and had developed restenosis," says Dr. Krajcer. "The restenotic lesions were located in the renal, innominate, subclavian, iliac, femoral, popliteal, or tibioperoneal arteries.



Schematic showing deployment of a nitrous oxide–filled balloon in a peripheral artery. (Reprinted with permission from CryoVascular Systems, Inc.)

We also evaluated the benefit of cryoplasty for treating complex infrainguinal disease, including limb-threatening ischemia."

In the study, 58 patients were observed for up to 1 year after cryoplasty. Of the 64 blockages treated—mainly in the thighs, abdomen, or lower legs—only 3% became restenotic enough to require repeat angioplasty with stenting. Of the 27 patients with critical limb ischemia (a painful condition caused by blockages in lower leg arteries), none had to undergo foot or leg amputation, a common sequela of this condition.

"Our procedural success was 100%. In all patients, stenosis was reduced to <20%. Only 2 patients required stents," says Dr. Krajcer.

These early findings have also revealed an important effect of cryoplasty on the overall rate of arterial dissection. After cryoplasty therapy, the dissection rate is only 6.6%, compared with 40% to 70% after conventional angioplasty.

"In this study, the dissection rate was significantly lower than in any other study involving the use of an interventional technique under similar circumstances," says Dr. Krajcer.

"To determine the long-term benefits of cryoplasty and the most favorable indications for this technique, longer follow-up observation in a larger number of patients will be needed. On the basis of our preliminary results, however, we are optimistic that cryoplasty will greatly benefit our patients with PAD." ●

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Dr. Krajcer receives research/grant support from Boston Scientific Corp. (Natick, MA), which distributes the PolarCath System, and is a member of the speakers' bureau for Cryovascular Systems, Inc.

Clinical Trials Update

THI/SLEH is participating in a multicenter randomized controlled trial of 2 pulsatile left ventricular assist devices as destination therapy in end-stage heart failure patients ineligible for transplantation. The RELIANT (Randomized Evaluation of the Novacor LVAS In A Non-Transplant Population) trial will determine whether the survival of patients supported with a Novacor Left Ventricular Assist System (World Heart Corp., Ottawa, Ontario, Canada), which is currently approved as a bridge to transplant only, is equivalent to that of patients supported with a HeartMate VE/XVE (Thoratec Corp., Pleasanton, CA), which is approved as destination therapy. Approximately 390 patients will be enrolled at a total of 40 centers.

COX-1 Gene Transfer Technique Shows Promise for Preventing Restenosis After Angioplasty

Abstract: Gene therapy research currently underway at the Texas Heart Institute may someday prevent arterial restenosis after angioplasty.

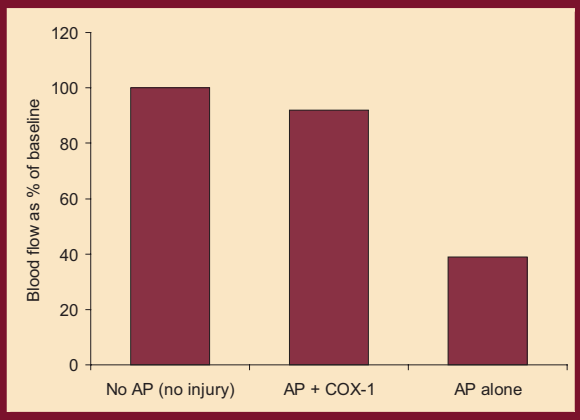
The possibility of restenosis is an important concern for patients who have undergone arterial balloon angioplasty. The restenosis rate 16 months after coronary angioplasty is estimated to be 19% (*Ital Heart J* 2003;4:271–80); within the first 3 years after peripheral angioplasty, it may approach 50% to 80%, especially in patients who have diabetes or require angioplasty of narrow arteries below the knee.

These high restenosis rates are partly attributable to processes that begin immediately after angioplasty and that are related to dilation and rupture of atherosclerotic plaque by the balloon catheter. Although the resulting vessel-wall trauma is necessary, it triggers a local signal cascade that causes vascular smooth muscle cells to proliferate and migrate to the injured area. This process, together with fibrosis inside the artery and constrictive remodeling of the artery's external layer, can make the lumen nearly as small as it was before angioplasty.

One potential way to lower the risk of restenosis is to expose the injured artery to cyclooxygenase-1 (COX-1), which is involved in the production of prostaglandins that stimulate vasodilation and deter thrombosis. To do this effectively, however, COX-1 must be introduced into the artery soon after injury and must continue to be expressed there for up to several days.

Currently, a series of experiments involving transfer of the COX-1 gene to injured arteries are underway at the Wafic Said Molecular Cardiology and Gene Therapy Research Laboratory at the Texas Heart Institute at St. Luke's Episcopal Hospital. To mimic the clinical scenario of postangioplasty restenosis, the researchers use Watanabe heritable hyperlipidemic rabbits, which develop severe hypercholesterolemia and atherosclerotic plaques similar to those found in humans. One of the laboratory's studies was recently reported in the journal *Circulation* (2005;111:1833–9).

"We performed balloon angioplasty in 1 carotid artery in each rabbit," explains Pierre Zoldhelyi, MD, director of the laboratory, "causing the same sort of arterial injury that occurs in human angioplasty patients. We then treated each injured artery with a replication-deficient adenovirus containing either no foreign genes or the full-length human COX-1 cDNA."



Effect of COX-1 gene transfer (COX-1) on blood flow 28 days after balloon angioplasty (AP) in atherosclerotic arteries.

Of 43 rabbits treated, 22 received the COX-1–bearing adenovirus (AdCOX), and 21 received the control adenovirus. The rabbits were sacrificed 3, 14, or 28 days after treatment, and both the injured and uninjured carotid arteries were harvested from each rabbit.

Of the injured arteries taken from the rabbits sacrificed 3 days after treatment, the AdCOX-treated segments produced substantial amounts of prostacyclin and prostaglandin E1—both powerful vasodilators and antithrombotic agents. Although the increased focal synthesis of these chemicals was no longer detectable in arteries harvested 14 days after treatment, the beneficial effects persisted. Twenty-eight days after treatment, blood flow was much better in the injured carotid arteries of the AdCOX rabbits (92% of normal) than in those of the control rabbits (39% of normal). This was true even though AdCOX did not appear to inhibit neointima formation, a central mechanism of restenosis.

"The protective effects of AdCOX are due primarily to its substantial and lasting vasodilatory and antithrombotic effects on the injured artery," Dr. Zoldhelyi explains. "Although this doesn't prevent neointima formation, it does prevent constrictive remodeling. In fact, the COX-1 produced by AdCOX dilates the artery beyond its normal diameter, somewhat as stents do. This dilation appears to fully compensate for the potential reduction in luminal area caused by neointima formation."

Dr. Zoldhelyi and colleagues are attempting to improve on their results by using longer-lasting viral vectors with no known toxicity and by testing other cDNAs alone or in combination with the COX-1 cDNA. The National Heart, Lung, and Blood Institute of the National Institutes of Health has expressed interest in supporting a phase I study of AdCOX in a small number of humans. These efforts may someday produce a postangioplasty treatment that will prevent restenosis. ●

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Texas Heart Institute Builds on Long Experience With Mechanical Circulatory Support Devices

Abstract: Since 1969, more than 570 mechanical circulatory support devices for severe heart failure have been implanted at the Texas Heart Institute.

The first artificial heart

implantation was performed at the Texas Heart Institute at St. Luke's Episcopal Hospital (THI/SLEH) in 1969. Since then, our heart failure specialists and cardiovascular surgeons have amassed the world's largest and most varied experience in the development and clinical use of mechanical circulatory support (MCS) devices for treating severe heart failure. More than 570 of these devices—including ventricular assist devices (VADs), aortic counterpulsation pumps, and total artificial hearts—have been implanted at THI/SLEH.

"Our experience testifies that, despite optimal medical or surgical management, the failing human heart inevitably reaches a point where it can no longer pump blood effectively without mechanical assistance," says O.H. Frazier, MD, director of Cardiovascular Surgical Research at THI/SLEH. "It also emphasizes that simply replacing failing hearts with healthy ones has not turned out to be the ultimate answer and that we need to develop pumps that can be left in place for long periods."

Historically, mechanical devices were used mainly to provide short-term support during cardiogenic or postcardiotomy shock or as bridges to transplantation in patients with ischemic or idiopathic cardiomyopathy. Now they are also being used as sources of acute support during high-risk percutaneous interventions or off-pump coronary artery bypass procedures, as short- or long-term bridges to recovery, and even as destination therapy.

Since the 1980s, THI/SLEH has helped develop and study several long-term MCS devices currently in use. The pulsatile HeartMate vented electric left ventricular assist device has been approved as a bridge to transplantation by the FDA and is currently the only MCS device approved for destination therapy. The Jarvik 2000 Heart (Jarvik Heart, Inc., New York, NY) and the HeartMate II (Thoratec Corp., Pleasanton, CA)—small, axial-flow VADs based on the principle of Archimedes' screw— are currently in clinical trials as bridges to transplantation. The pulsatile AbioCor Implantable Replacement Heart (AbioMed, Inc., Danvers, MA) is nearing completion of a pilot trial as destination therapy in 15 severely ill patients ineligible for transplantation. In all 3 of these trials, some patients have been discharged home, an important goal of long-term MCS therapy.

Recently, THI/SLEH has become involved in several multicenter clinical trials of innovative, magnetically driven continuous-flow pumps for short-term support. These include trials of the TandemHeart percutaneous VAD (CardiacAssist, Inc., Pittsburgh, PA) for support during cardiogenic shock, during high-risk coronary interventions, or as a bridge to transplantation; the Levitronix CentriMag (Levitronix LLC, Waltham, MA), which can be attached to cardiopulmonary bypass cannulas already in place, for support during cardiogenic shock; and the Orqis Cancion Cardiac Recovery System (Orqis Medical Corp., Lake Forest, CA), which is delivered percutaneously to the descending aorta, for support of patients with decompensated heart failure.

"Axial-flow pumps have great potential because they are much smaller and easier to implant, and this gives them a distinct advantage over the larger implantable pulsatile pumps, which often can't be used in smaller patients," says Dr. Frazier. "However, whereas the small axial-flow pumps are more effective in heart failure patients with some cardiac reserve or preserved heart function, the pulsatile pumps may better support patients who have more impaired function."

The problem of anatomic size restriction has been encountered with all total artificial hearts to date. Laboratory researchers at THI/SLEH are addressing this problem in a novel way by using dual axial-flow pumps, such as the Jarvik 2000 or the MicroMed DeBakey VAD (MicroMed Technology, Inc., Houston, TX), in tandem as an artificial heart. ●

Some Mechanical Circulatory Support Systems Used at Texas Heart Institute (THI)

Device	Year First Used Clinically at THI	Total No. of Patients Supported at THI	Original Intended Use
HeartMate IP LVAD	1986	87	Bridge to transplantation
HeartMate VE/XVE LVAD	1991	141	Bridge to transplantation; destination therapy
Jarvik 2000 Heart VAD	2000	54	Bridge to transplantation
AbioCor TAH	2001	5	Destination therapy
TandemHeart pVAD	2003	21	High-risk PTCA support; cardiogenic shock
Levitronix CentriMag VAD	2003	17	Postcardiotomy support
HeartMate II LVAD	2003	8	Bridge to transplantation

Source: Texas Heart Institute.
LVAD, left ventricular assist device; pVAD, percutaneous ventricular assist device; PTCA, percutaneous transluminal coronary angioplasty; TAH, total artificial heart; VAD, ventricular assist device.

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New School for Cardiac Support

THI/SLEH has established an educational Center for Cardiac Support, the first program of its kind in the United States. The Center's School for Cardiac Support, with a faculty of experienced cardiovascular surgeons, cardiologists, and circulatory support specialists, will train allied health professionals in the set-up, operation, and maintenance of mechanical circulatory support devices in patients with advanced heart failure.

Physician Education Aims to Blunt Cardiovascular Effects of Obesity, Diabetes, and Metabolic Syndrome

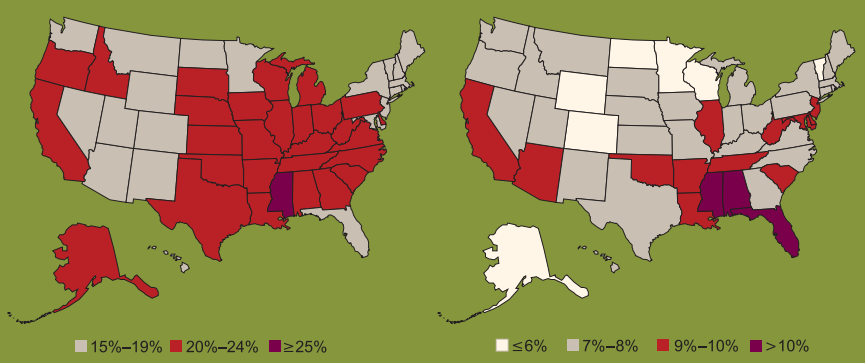
Abstract: A Texas Heart Institute–sponsored program is educating community physicians about managing obesity, diabetes, metabolic syndrome, and their cardiovascular effects.

Metabolic syndrome denotes a cluster of cardiovascular risk factors that includes abdominal obesity, diabetes, high serum triglyceride levels, low serum high-density lipoprotein (or "good cholesterol") levels, and high blood pressure. The US Centers for Disease Control (CDC) estimate that the syndrome affects 27% of American adults, up from 23% in the early 1990s, and that this increasing prevalence portends higher rates of cardiovascular disease in the future (*Diabetes Care* 2004;27:2444–9). The increase in the syndrome's prevalence has been especially pronounced in women and in ethnic groups such as Mexican Americans.

The components of metabolic syndrome combine with other environmental and genetic factors such as inactivity, smoking, diet, menopause, sex, and advancing age to create an insidious spectrum of subclinical disease. Systemically, the end result may be blindness, kidney failure, and limb neuropathy. At the cardiovascular level, subclinical coronary calcification, carotid stenosis, inflammation, and endothelial dysfunction can lead to a full-blown myocardial infarction or stroke and ultimately to congestive heart failure.

Late last year, a binational study jointly conducted by the CDC, the Mexico Secretariat of Health, and the Pan American Health Organization (PAHO) found that persons living along the 2,000-mile-long border between the United States and Mexico have higher rates of diabetes, overweight, and obesity than does the entire population of either country. The health organizations estimated that about 1.2 million of the border's 8 million residents, most of whom are Hispanic, have type 2 diabetes and that 4.3 million are either overweight or obese.

"As these and many other epidemiologic studies tell us, conditions are ripe for an upsurge in cardiovascular disease related to diabetes and metabolic syndrome, especially here in our part of the country," says Reynolds M. Delgado III, MD, a staff cardiologist and heart failure specialist at the Texas Heart Institute at St. Luke's Episcopal Hospital (THI/SLEH).



Prevalence of obesity and diabetes in US adults, 2001. (Source: US Centers for Disease Control and Prevention.)

"This looming pandemic can be blunted, though, by addressing the problem throughout the continuum of care—from patient to community physician to specialist."

For the last 2 years, Dr. Delgado and THI/SLEH have arranged and sponsored an annual symposium to educate community physicians in the Rio Grande Valley of South Texas about the latest advances in treating cardiovascular disease. This year's program, now available online, in part focused on current guidelines for diagnosing and managing the risk factors of obesity, hypertension, diabetes, and dyslipidemia.

"Our program dovetails nicely with the CDC's and PAHO's desire to reduce the effects of diabetes and obesity on border dwellers through education," says Dr. Delgado. "In this case, we aren't addressing patients directly but the community physicians who care for them."

"The goal is to give these physicians the tools to prevent or treat cardiovascular disease before it becomes debilitating," says Dr. Delgado. "So, we highlight the medical options, which include weight loss through daily exercise and diet, reduction of blood glucose levels and blood pressure with drugs, and reduction of triglyceride levels with statins. We also educate them about the surgical measures that are available when the cardiovascular system finally succumbs to damage inflicted by metabolic syndrome or its components." ●

For more information:

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View CME Archives Online

Selected Texas Heart Institute–sponsored physician education programs are now available for viewing online. New presentations will be added on a regular basis.

- **Advances in the Treatment of Cardiovascular Disease**
  (From South Padre Island, TX, April 23, 2005)
  CME credit available online
- **Current Issues in Cardiology**
  (From Orlando, March 5, 2005)
- **6th Symposium on Cardiac Arrhythmias**
  (From Houston, February 19, 2005)

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Cover: Crystal sculpture donated by Burlington Resources for the Celebration of Hearts display in the Wallace D. Wilson Museum of the Texas Heart Institute at St. Luke's Episcopal Hospital—The Denton A. Cooley Building.

Calendar of Events

Texas Heart Institute Continuing Medical Education Symposia

Texas Heart Institute 6th Annual Texas Update in Cardiovascular Advancements
Program Director: James T. Willerson, MD
September 24–25, 2005 • Houston, Texas

American Heart Association Satellite Symposium
Evolving Standards in Cardiovascular Care
Program Directors: James J. Ferguson III, MD; James T. Willerson, MD; R. David Fish, MD; Zvonimir Krajcer, MD
November 12, 2005 • Dallas, Texas

Texas Heart Institute 7th Symposium on Cardiac Arrhythmias
New Pharmacologic and Interventional Strategies
Program Director: Ali Massumi, MD
February 18, 2006 • Houston, Texas

Selected Upcoming National and International Meetings

American Heart Association Scientific Sessions 2005
November 13–16, 2005 • Dallas, Texas

Society of Thoracic Surgeons 42nd Annual Meeting
January 30–February 1, 2006 • New Orleans, Louisiana
Abstract submission ends August 8, 2005

American College of Cardiology 55th Annual Scientific Session
March 12–15, 2006 • Atlanta, Georgia
Abstract submission begins August 31, 2005
Abstract submission ends October 5, 2005

International Society for Heart and Lung Transplantation 26th Annual Meeting and Scientific Sessions
April 5–8, 2006 • Madrid, Spain

For information about the CME activities listed above, please e-mail cme@heart.thi.tmc.edu or call 832.355.2157. To view selected CME presentations and other physician resources online, please visit www.texasheartinstitute.org/doctors1.html.

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