HeartWATCH

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Texas Heart® Institute

at St. Luke's Episcopal Hospital

THI Experience Suggests That Off-Label Use of Low-Dose Recombinant Activated Factor VII Is Safe and Effective

Abstract: According to a recent review of Texas Heart Institute experience, off-label use of low-dose recombinant activated factor VII can safely and effectively control bleeding in surgical patients.

In 1999, recombinant activated factor VII (rFVIIa) was approved by the Food and Drug Administration (FDA) for treating hemophilia patients with inhibitors. Since then, off-label use of rFVIIa to control excessive bleeding in surgical and trauma patients has increased, as has the incidence of associated thromboembolic complications.

In early 2004, the US military began using rFVIIa in Iraq to control severe bleeding in combat casualties. In December 2004, a *New England Journal of Medicine* report (2004;351:2471–5) noted a worrisome rise in late thromboembolic complications (eg, pulmonary embolism and deep venous thrombosis) in seriously injured soldiers transported home from overseas. Within a year, according to the *Baltimore Sun*, Army doctors at Walter Reed Medical Center in Washington, DC began to suspect that such complications might be related to rFVIIa. More recently, a report in *JAMA* (2006;295:293–8) noted that almost 40% of the rFVIIa-related adverse events reported to the FDA so far have been thromboembolic, and most of those have been attributable to off-label use.

Unfortunately, the scantiness of dosage data from Iraq and in the literature has hindered not only the establishment of a standardized dose for off-label use but also any meaningful evaluation of the potential association between off-label use and thromboembolic complications.

Recently, though, a team of researchers at the Texas Heart Institute at St. Luke's Episcopal Hospital (THI at SLEH) tackled these questions by retrospectively reviewing the institution's experience with off-label administration of rFVIIa to control refractory bleeding during cardiac surgery or intracranial hemorrhagic episodes.

"There's no doubt that rFVIIa can effectively stem surgical, traumatic, and intracranial bleeding," says O.H. Frazier, MD, director of Cardiovascular Surgical Research at THI, "but most published studies have involved very small patient populations and have used the dose approved for hemophilia, namely, 0.09–0.12 mg/kg. In our opinion, the large size of this dose has probably caused most of the thromboembolic events reported so far."

"Our study strongly contradicts the adage that 'more is better' and clearly shows that a relatively low rFVIIa dose (1.2 mg) improves the patient's coagulation response without unduly raising the risk of thromboembolism."

In their review, the THI investigators identified 246 patients who received rFVIIa between January 2004 and November 2006 and divided them according to whether they received a low cumulative dose (1.2 mg only) or a high one (2.4 mg or more). The 2 groups were then compared in terms of rFVIIa's safety and effectiveness.

"We included all cases of off-label rFVIIa use during the study period to ensure that our findings could be widely applied, to offset the limitations imposed by the uncontrolled, single-center nature of our study, and to offset the fact that many of our patients, especially in the high-dose group, were very sick," notes Brian A. Bruckner, MD, a cardiovascular surgery resident at THI and a research team member.

"Most of our patients received individual doses of 1.2 mg, primarily for fear that a larger dose might cause thrombosis," says Dr. Bruckner. "Fortunately, this ensured that the findings of our retrospective review would be based on a dose lower than those reported in the literature or anecdotally by the military and would, therefore, be extremely meaningful."

Reassuringly, Dr. Bruckner and colleagues found that off-label use of rFVIIa effectively controlled bleeding in most of their patients. More important, they found that thromboembolic complications occurred much more often in patients receiving the higher doses (38% [32/83] vs 3.7% [6/163]).

"Our study strongly contradicts the adage that 'more is better' and clearly shows that a relatively low rFVIIa dose (1.2 mg) improves the patient's coagulation response without unduly raising the risk of thromboembolism," says Dr. Frazier. "However, because off-label use remains experimental and also costly, at about $1200 a dose, all reasonable attempts should be made to stabilize and optimize the clotting cascade in cases of excessive perioperative and postoperative bleeding before resorting to rFVIIa." ●

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Percutaneous Transseptal Circulatory Assist Device Bridges Patients to Recovery From Myocarditis

Abstract: The TandemHeart is easier to insert than a traditional left ventricular assist device and provides greater hemodynamic support than an intraaortic balloon pump.

The TandemHeart Percutaneous Transseptal Ventricular Assist System (PTVAS) (CardiacAssist Inc., Pittsburgh, PA) was introduced at the Texas Heart Institute at St. Luke's Episcopal Hospital (THI at SLEH) more than 3 years ago. Since that time, our center has implanted more than 80 of these devices (more than any other center in the world), using the TandemHeart not only for hemodynamic support but also for bridging to cardiac transplantation. Recently, THI at SLEH used the TandemHeart in another novel manner: as a bridge to recovery from myocarditis in 3 patients.

The TandemHeart is a left atrial-to-femoral artery bypass system that provides hemodynamic support during high-risk coronary interventions and postcardiotomy cardiac failure. The system can be implanted percutaneously within 30 minutes without the risks associated with surgical placement of a conventional left ventricular assist device (LVAD). Also, unlike an intraaortic balloon pump (IABP), the TandemHeart provides active hemodynamic support in patients who have little residual ventricular function.

"The TandemHeart fills the gap between LVADs and IABPs as a source of mechanical support," says Biswajit Kar, MD, an interventional cardiologist at THI at SLEH and assistant professor of Medicine at Baylor College of Medicine. "An LVAD must be inserted through a thoracotomy, which can be hazardous and time-consuming. An IABP is simple and safe to insert but provides little active hemodynamic support and depends on residual left ventricular function to be effective. In contrast, the TandemHeart can be quickly and easily inserted percutaneously and provides active hemodynamic support."

The TandemHeart consists of 3 subsystems: a catheter set, which includes a 21F venous inflow cannula that is inserted transseptally into the left atrium to aspirate oxygenated blood and a 9-17F arterial perfusion catheter that returns blood from the external pump to one or both femoral arteries; an external continuous flow pump, which provides flows of up to 4 L/min at a maximum speed of 7500 rpm; and an external controller, which is used to program and control the pump. The device can remain implanted for up to 3 weeks, and patients are confined to their beds for the duration of support.

The TandemHeart Percutaneous Transseptal Ventricular Assist System (PTVAS).

All 3 patients with myocarditis had refractory cardiogenic shock and were unlikely to have survived with IABP support alone. Open heart surgery for LVAD placement was thought to be unacceptably risky. All 3 patients underwent anticoagulation according to THI at SLEH protocol —intravenous heparin titrated to maintain an activated clotting time of ≥ 250 seconds during PTVAS placement and a subsequent activated partial thromboplastin time of 50 to 70 seconds.

According to Pranav Loyalka, MD, a cardiologist at THI at SLEH, TandemHeart use produced minimal complications. One patient required hemodialysis for the first 48 hours of PTVAS support, but advanced renal failure had been present before TandemHeart placement. The second patient developed ventricular tachycardia during device placement but was already predisposed to this arrhythmia, which caused no morbidity. The third patient had occipital strokes that were neither fatal nor disabling; it is unclear whether the strokes resulted from severe hypotension before device placement or from embolization during PTVAS support. Such embolization is extremely rare with THI's anticoagulation protocol.

"Because of its limited length of use, the TandemHeart will not suffice as a bridge to recovery for some patients with fulminant myocarditis; such patients will still require LVAD implantation or heart transplantation," says Reynolds M. Delgado III, MD, medical director of the department of Mechanical Assist Devices in Heart Failure at THI. "But in selected patients too sick for immediate LVAD placement or transplantation, the TandemHeart may serve as a bridge to recovery, LVAD placement (as a bridge-to-bridge), or even transplantation." ●

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Contents

Platelet Function Tests May Identify Patients at Risk of Perioperative Bleeding

Abstract: Newer tests of platelet function may help physicians decide when antiplatelet therapy in surgical patients poses an increased risk of perioperative bleeding and transfusion.

Platelet dysfunction due to antiplatelet medications is a significant contributor to perioperative bleeding. Many patients with cardiovascular disease receive antiplatelet therapy to prevent thrombosis and improve survival. Clopidogrel, a newer antiplatelet agent often added to aspirin therapy, is commonly used in patients with coronary artery disease. Patients receiving clopidogrel who require surgery may be at increased risk of bleeding complications. This situation is paradoxical because perioperative antiplatelet therapy has multiple anti-ischemic benefits, yet it can contribute to life-threatening complications in surgical patients.

The relationship between perioperative bleeding and antiplatelet therapy drew public attention when President Bill Clinton was hospitalized with chest pains and had to wait several days before undergoing coronary artery bypass graft (CABG) surgery. The delay was attributed to the increased risk of bleeding associated with the anticlotting medication he was given, on hospital admission, to prevent thrombosis. Because of the increasing popularity of antiplatelet therapy, its effect on platelet function deserves further study.

Arthur W. Bracey, MD, a cardiovascular pathologist at the Texas Heart Institute at St. Luke's Episcopal Hospital (THI at SLEH), is studying newer methods for evaluating platelet function in cardiac surgical patients.

"More than 15% of cardiac surgical patients experience significant perioperative blood loss and have to undergo blood transfusions, which carry a risk of infection, prolonged hospital stay, stroke, and death," says Dr. Bracey. "Because many cardiac surgical patients take antiplatelet drugs, we need to develop ways to predict who is at risk of bleeding complications in order to reduce transfusion rates and optimize surgical timing, thereby avoiding treatment delay."

Antiplatelet therapy can increase the risk of bleeding, but the effect of anticlotting medications on platelet function varies from patient to patient. Because of this variability, an effective method for testing platelet function to identify surgical candidates at greatest risk would be advantageous, and new systems are being studied. Platelet aggregometry, a laboratory-based test that takes 30 to 45 minutes to complete, measures platelet aggregation in response to an agonist such as adenosine diphosphate (ADP). Two newer tests—platelet function analyzer 100 and thromboelastography—are rapid bedside measures of platelet function. Researchers at THI at SLEH studied bleeding in clopidogrel recipients who underwent elective CABG surgery and found that ADP-mediated aggregometry was more accurate than other platelet function tests in identifying patients at highest risk of bleeding complications and transfusion requirements (*J Thorac Cardiovasc Surg* 2004;128:425–431).

> *"To improve transfusion management in clopidogrel-treated patients undergoing CABG surgery, we have designed a platelet transfusion algorithm based on platelet count, ADP-induced aggregation, and clinical observation."*

Although inconclusive, results of surgical timing studies in patients taking clopidogrel suggest that the risk of bleeding may persist for 3 to 7 days after discontinuation of therapy.

"To improve transfusion management in clopidogrel-treated patients undergoing CABG surgery, we have designed a platelet transfusion algorithm based on platelet count, ADP-induced aggregation, and clinical observation," says Dr. Bracey.

In the THI at SLEH study, use of this algorithm preoperatively reduced the transfusion rate in clopidogrel-treated patients, and significantly abnormal ADP-induced aggregation accurately identified most patients who required multiple transfusions. These results indicate that preoperative testing of platelet function with ADP-induced aggregation may be useful in deciding whether to delay or proceed with surgery in clopidogrel recipients.

Studies of platelet function are necessary to determine whether the benefit of reducing bleeding outweighs the risks of discontinuing antiplatelet therapy. Newer, accurate devices for platelet testing should help reduce the overall transfusion rate, improve patient outcomes, and decrease hospital costs.

"Although not widely available, these newer tests are being used at THI at SLEH to assess platelet function, and we continue to study this issue in hopes of reducing morbidity and mortality after cardiac surgery," says Dr. Bracey. ●

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THI Websites Honored

THI's **Heart Information Center** (texasheart.org/hic) won both the Health Improvement Institute's 2006 Aesculapius Award of Excellence and the eHealthcare Strategy & Trends publication's eHealthcare Leadership Distinction Award. The Heart Information Center's website is a bilingual heart-health resource for patients. THI's **Project Heart** (texasheart.org/projectheart) also won the Health Improvement Institute's 2006 Aesculapius Award of Excellence. Project Heart is an educational resource for teachers that provides curricula for kindergarten through sixth grade.

Remote-Controlled Magnetic Catheter Promises to Improve Delivery of Therapeutic Stem Cells to Damaged Myocardium

Abstract: A preclinically tested remote-controlled magnetic catheter promises to improve the precision and effectiveness of transendocardial stem cell therapy.

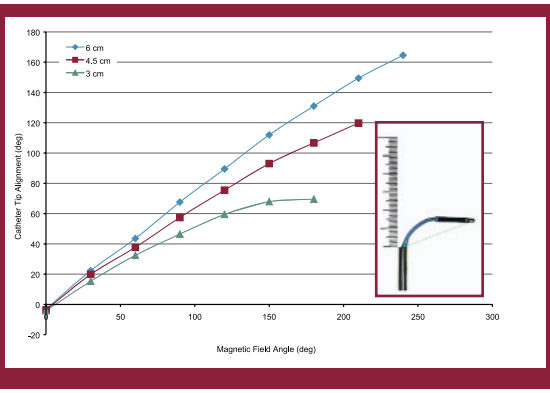
Researchers at the Texas Heart Institute at St. Luke's Episcopal Hospital (THI at SLEH) continue to pioneer cardiac stem cell therapy. Having addressed many technical, therapeutic, and ethical obstacles to its use (*Circulation* 2005;112:521–6; *Circulation* 2004;110 [Suppl II]:II-213–II-218), these researchers can now navigate a catheter to damaged myocardial tissues, map them, and inject them with therapeutic stem cells safely and effectively. The latest challenge is to optimize the requisite technologies, including delivery techniques.

"Injecting stem cells into heart muscle is very much like landing a jet on an aircraft carrier at sea," says Emerson C. Perin, MD, PhD, director of New Interventional Cardiovascular Technology at THI at SLEH. "We've figured out our approach, and now we're improving our plane, flight controls, and landing gear to make the task easier and more repeatable."

Several methods exist for delivering therapeutic stem cells to damaged myocardium (see *Heart Watch*, Fall 2005). The preferred method at THI at SLEH is manually guided transendocardial injection. A needle-tipped catheter is threaded into the femoral artery and guided to myocardial regions previously mapped as damaged but salvageable. The catheter's therapeutic payload is then injected into those areas. Although effective, this technique has drawbacks: the unlikely, but real, potential for vascular or myocardial perforation; the design of current catheter systems and the secondhand nature of manual navigation, which may adversely affect operator sensitivity and precision; and the potential exposure of medical personnel to angiographic radiation.

To address these concerns, Dr. Perin and his colleagues have begun preclinical testing of a relatively new remote-controlled magnetic catheter system (Stereotaxis, St. Louis, MO) for mapping and injecting stem cells into injured myocardium.

"The patient lies on a table between 2 fixed cylinders, each housing a computer-controlled magnet," says Dr. Perin. "A magnetic-tipped catheter is threaded into the patient's femoral artery and advanced to the ascending aorta. The physician then assumes remote control, steering the catheter from a nearby video station."



The plot of applied-field angle versus amount of catheter-tip deflection at different free lengths. Inset: Magnetic field angle of 120° produces the catheter deflection shown.

Remote control is achieved by altering the positions of the magnets in their housings relative to the patient. Each magnet generates a weak, but uniform, magnetic field, which in tandem with the other magnet's energy, can bend, flex, and maneuver the catheter within the heart. All magnet manipulations are stored in the computer's memory for later repetition, if needed.

Using a porcine model, Dr. Perin's group recently evaluated the feasibility of using this system to inject stem cells into the myocardium. They evaluated the system for its ability not only to inject the cells but also to inject them into specifically targeted regions. In the first phase, a dye was injected to show that the system worked; in the second phase, fluorescently stained mesenchymal precursor cells were injected.

"In both study phases, the system performed extremely well, with a successful injection rate of at least 95% and no pericardial effusion or epicardial bleeding," notes Dr. Perin. "The study also offered some very important insights into the technology's potential benefits."

"Because the flexible magnetic catheter can be bent acutely, it will facilitate the mapping and treatment of conventionally hard-to-reach areas, such as the high anterior cardiac wall," says Dr. Perin. "Moreover, the catheter needle often causes a premature ventricular contraction, which is a sensitive predictor of successful injection at that site."

"Our next step is to confirm the preliminary findings, evaluate the system's safety, and compare the device with current catheter technology in larger preclinical and clinical studies," says Dr. Perin. "There's no doubt, though, that remote-controlled magnetic delivery of stem cells will work." ●

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Smithsonian Displays the Liotta-Cooley Artificial Heart

The Liotta-Cooley artificial heart, the first total artificial heart implanted in a human, went on display beginning in February at the Smithsonian's National Museum of American History in Washington, DC. The display is part of the museum's "Treasures of American History" exhibit. On February 14, the Smithsonian held a noon talk, "A Cure for the Broken Hearted: Artificial Hearts in America—An American Heart Month Event," that included a history of the Liotta-Cooley heart and of other artificial heart technologies. For more information, visit the museum's website at http://americanhistory.si.edu.

Bloodless Liver Resection Highlights Blood-Conservation Techniques

Abstract: A case of complex liver resection to remove a large cholangiocarcinoma in a Jehovah's Witness demonstrates the usefulness of a variety of blood-conserving techniques.

Although administration of whole blood is routine and often life-saving during major surgery, it has several disadvantages. Adequate amounts of donated blood are not always available, and obtaining blood can be expensive. Additionally, although donated blood is screened, the transmission of blood-borne diseases remains a possibility. Furthermore, in cancer patients, blood transfusion can have immunosuppressive effects that may promote disease progression or concomitant infections.

For these reasons, blood conservation and alternatives to transfusion can be important for surgical procedures in which substantial blood loss is expected. The effectiveness of several blood-conservation techniques was recently demonstrated during a complex liver resection performed at the Texas Heart Institute at St. Luke's Episcopal Hospital (THI at SLEH). The patient, a 49-year-old female Jehovah's Witness, had a large intrahepatic cholangiocarcinoma that chemotherapy had failed to control.

"Jehovah's Witnesses are forbidden by their religion to accept transfusions of donated whole blood or blood products," explains Omar Barakat, MD, of the Center for Liver Disease at SLEH, who performed the procedure in collaboration with THI's program for transfusion-free surgery. "Removing a large tumor from an area as highly vascular as the liver would once have been too risky in these patients because of the significant blood loss involved. In this case, however, the judicious use of certain drugs, devices, and techniques enabled us to resect the liver successfully."

One such technique is acute normovolemic hemodilution (ANH), which involves removing one or more units of whole blood immediately before surgery and replacing them with an acellular fluid (eg, normal saline or albumin) to maintain adequate blood volume and reduce the number of red blood cells lost through intraoperative bleeding. The withdrawn blood is reinfused near the end of the procedure. In the present case, 1 unit of blood was removed and stored at room temperature but in circuit with the patient until the resection was completed.

Preoperative, Intraoperative, and Postoperative Techniques Used to Reduce or Eliminate the Need for Blood Transfusion

Preoperative
- Identifying patient-, medication-, or procedure-related risks for increased bleeding
- Administering folic acid, iron, or erythropoietin
- Discontinuing or modifying anticoagulation therapy

Intraoperative
- Meticulous dissection
- Frequent use of electrocautery
- Acute normovolemic hemodilution (ANH)
- Administration of coagulants (eg, factor VII, antifibrinolytics) or hemostatic drugs (eg, aprotinin, tranexamic acid, topical hemostatics) as needed
- Cell-salvage
- Use of artificial blood substitutes
- In liver operations:
  - total vascular isolation (TVI)
  - regional perfusion with preservative fluid
- In heart operations:
  - avoiding cardiac catheterization close to surgery (ie, using echocardiography)
  - reducing size of bypass circuit
  - maintaining relative normothermia, if possible

Postoperative
- Rewarming (with blankets)
- Adhering to a transfusion algorithm
- Minimizing number of blood draws
- Using pediatric blood tubes
- Administering folic acid, iron, or erythropoietin
- Lowering the hematocrit threshold for blood administration

The removed blood was replaced with normal saline. After this blood was readministered, the postoperative hematocrit was 35%—just below the normal range.

Other blood-saving techniques used included frequent electrocauterization to prevent bleeding during meticulous hepatic dissection. The liver was also subjected to total vascular isolation (in which the liver is completely mobilized and its major connecting vessels are occluded), venovenous bypass, and in situ hypoperfusion with a preservative solution during transection.

Blood-conservation efforts continued postoperatively. Blood testing was limited, and, when it was necessary, pediatric-sized blood tubes were used. Also, to promote red blood cell production, erythropoietin was administered throughout the patient's in-hospital recovery period. (Erythropoietin administration can be valuable before surgery as well, but in this case, the patient's preoperative hematocrit was already high enough.)

Although some postoperative complications occurred (a right pleural effusion and a biliary leak from the liver's surface), they were controlled effectively, and the patient was discharged from the hospital 16 days postoperatively. Four months later, her cancer had not returned despite her refusal of further chemotherapy.

"This is an excellent example of how complex procedures can be performed in highly vascular areas without the need for transfusion," says John R. Cooper, Jr, MD, interim chief of Cardiovascular Anesthesiology at THI. "In this case, we had a cell-saver system standing by, but we did not have to use it, so we were able to avoid the destruction of platelets and removal of clotting factors that these systems cause. Instead, we used ANH, which preserves all blood components, in combination with several other blood-conserving techniques."

Dr. Barakat adds, "We believe that these methods can reduce the necessity for transfusion in a variety of surgical procedures and, given the value of avoiding transfusion wherever possible, in many kinds of patients." ●

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Parametric Imaging Is a New Echocardiographic Tool for Evaluating Heart Health

Abstract: New imaging modalities allow rapid depiction and quantification of myocardial function in a color-coded parametric display of combined anatomic and physiologic data.

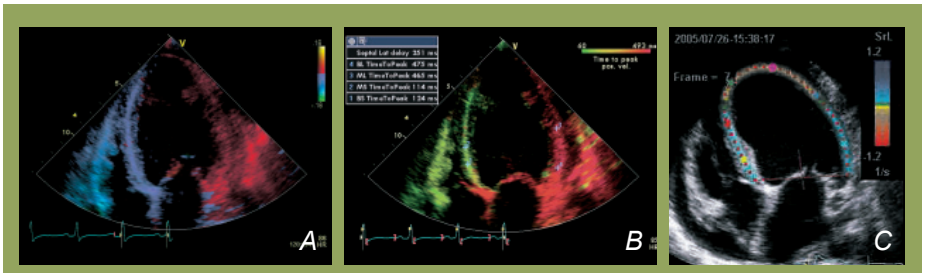
First used clinically more than 50 years ago, echocardiography has undergone remarkable changes during the last decade. New forms of parametric echocardiography allow the viewer to "see" certain physiologic parameters that are too subtle to be appreciated by conventional echocardiographic examination. Traditional echocardiography uses ultrasound to create a moving, monochromatic, gray-scale image that vividly depicts the heart's dynamic motion. However, the human eye cannot reliably detect small differences in the timing of contractility across different myocardial segments.

In addition, traditional ultrasound imaging methods cannot detect abnormalities in the speed of the heart's contraction and relaxation. These small differences in the timing and speed of contractility are associated with different forms of cardiac pathology. Parametric imaging modalities improve on traditional echocardiography by using increasingly sensitive and specific parameters to provide a moving anatomic and functional display for assessing cardiac function.

According to Raymond F. Stainback, MD, director of Noninvasive Cardiac Imaging at the Texas Heart Institute at St. Luke's Episcopal Hospital (THI at SLEH), "These novel parametric imaging techniques involve color coding certain physiologic parameters and superimposing the color-coded information over the anatomic images. This process allows us to quickly identify subtle heterogeneities of function within the heart muscle that can't readily be seen on a purely anatomic, monochromatic image."

Tissue Doppler imaging (TDI), a new parametric ultrasound technology, uses color-coded pixels that represent the anatomic myocardium to depict myocardial tissue velocities in the heart throughout the cardiac cycle. By analyzing changes in the color pattern within the anatomic image, this method can be used to accurately identify regions of myocardial dysfunction.

"TDI has been used successfully to detect cardiac dyssynchrony in patients with heart failure. In such patients, the ventricles do not beat in synchrony and, therefore, do not pump effectively. We can use TDI to help select patients in whom cardiac resynchronization therapy will improve left ventricular dyssynchrony, since not all patients benefit from this therapy. TDI has great clinical potential, and as more validation studies are published, this technology will be used to assess cardiomyopathies, coronary artery disease, and many other cardiac abnormalities," says Dr. Stainback.



Three examples of echocardiographic apical 4-chamber views. **A**) Tissue Doppler imaging (TDI) in a patient with abnormal electrical conduction (left bundle-branch block) and ventricular dyssynchrony. Normally, the left ventricle should become entirely red and then entirely blue as the heart muscle contracts and relaxes in a uniform fashion. In this example, the heart is obviously "out of sync" because one half is red (contracting) while the other half of the ventricle is blue (relaxing). **B**) Summated TDI imaging: orange represents left ventricular muscle that is abnormally late in reaching its peak contractile velocity (green = normal). **C**) Strain-rate imaging using speckle tracking.

Another new imaging modality derived from TDI velocity information is strain-rate imaging (SRI), which provides high-resolution evaluation and quantification of regional myocardial function. Strain is another word for deformation, which refers to the shortening and lengthening of the myocardium, and strain rate is the speed at which this deformation occurs. Because strain is produced by shortening of the myocardial fibers, strain and strain rate may depict myocardial contractility better than TDI does. Strain images can be generated from tissue-velocity information or from a new modality called speckle tracking. Still in the early investigational stages, speckle tracking involves following discrete, brightly echoic intramyocardial pixels (speckles) during the cardiac cycle and measuring the distance (strain) and rate (strain rate) by which the speckles approach each other to reflect myocardial movement and contractility.

"We are only beginning to understand the power of SRI. This sophisticated tool has many potential clinical applications, including detection of ischemia, differentiation of viable myocardium from scar tissue, and identification of rejection in cardiac transplant patients," says Dr. Stainback. "Because of these revolutionary advances in echocardiography, we are finding new clinical applications for older techniques and developing cutting-edge modalities with novel uses—all of which are helping us take better care of patients with heart disease." ●

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Cover: Paperweight donated by The Honorable and Mrs. James A. Baker III 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

Congestive Heart Failure Symposium
April 18, 2007 • Houston, TX
Register online at: cme.texasheart.org

Selected Upcoming National and International Meetings

American College of Cardiology 56th Annual Scientific Session
March 24–27, 2007 • New Orleans, LA

International Society for Heart and Lung Transplantation 27th Annual Meeting and Scientific Sessions
April 25–28, 2007 • San Francisco, CA

American Surgical Association 127th Annual Meeting
April 26–28, 2007 • Colorado Springs, CO

European Society for Cardio-Vascular Surgery
May 17–20, 2007 • Venice, Italy

American Society for Artificial Internal Organs
June 7–9, 2007 • Chicago, IL

International Society for Heart Research 19th World Congress
June 22–26, 2007 • Bologna, Italy
Scientific Chair: James T. Willerson, MD

Western Thoracic Surgical Association 33rd Annual Meeting
June 27–30, 2007 • Santa Ana Pueblo, NM

American College of Chest Physicians
October 20–25, 2007 • Chicago, IL
Abstract submission: April 30, 2007

American Heart Association Scientific Sessions 2007
November 4–6, 2007 • Orlando, FL
Abstract submission: April 2–June 1, 2007

For information about the Texas Heart Institute 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, visit cme.texasheart.org.

For 16 consecutive years, the Texas Heart Institute at St. Luke's Episcopal Hospital has been ranked among the top 10 heart centers in the United States by *U.S. News & World Report*'s annual guide to "America's Best Hospitals."

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