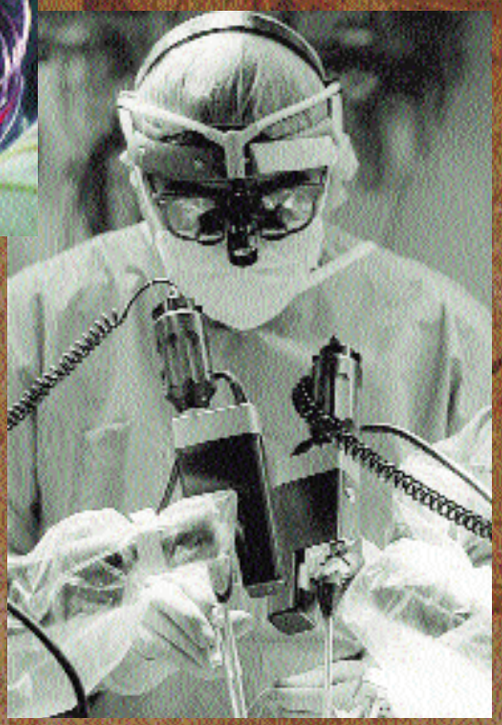
# STATE OF THE HEART

ADVANCING
CARDIOTHORACIC
SURGERY
THROUGH
BASIC AND
CLINICAL RESEARCH



Division of Cardiothoracic Surgery
Seymour Cohn Cardiac Surgical Research Program

SCHOOL OF MEDICINE
NEW YORK UNIVERSITY

**On the cover:** *No one combined art and science like Leonardo da Vinci, whose anatomical drawings of the heart grace this cover. In Leonardo's day, doctors relied more on art than science to mend damaged hearts. Today, both are still needed to deliver the best cardiology care. This is evident in the work of the Division of Cardiothoracic Surgery, whose master surgeons employ all the latest techniques and technologies and, through a rigorous program of clinical and basic research, play a vital role in furthering the state-of-the-art in cardiac surgery.*

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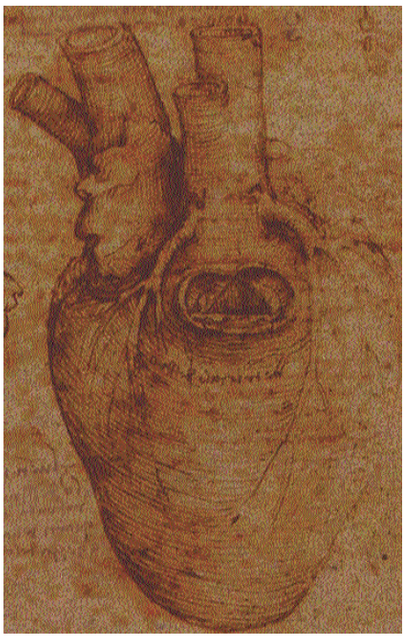
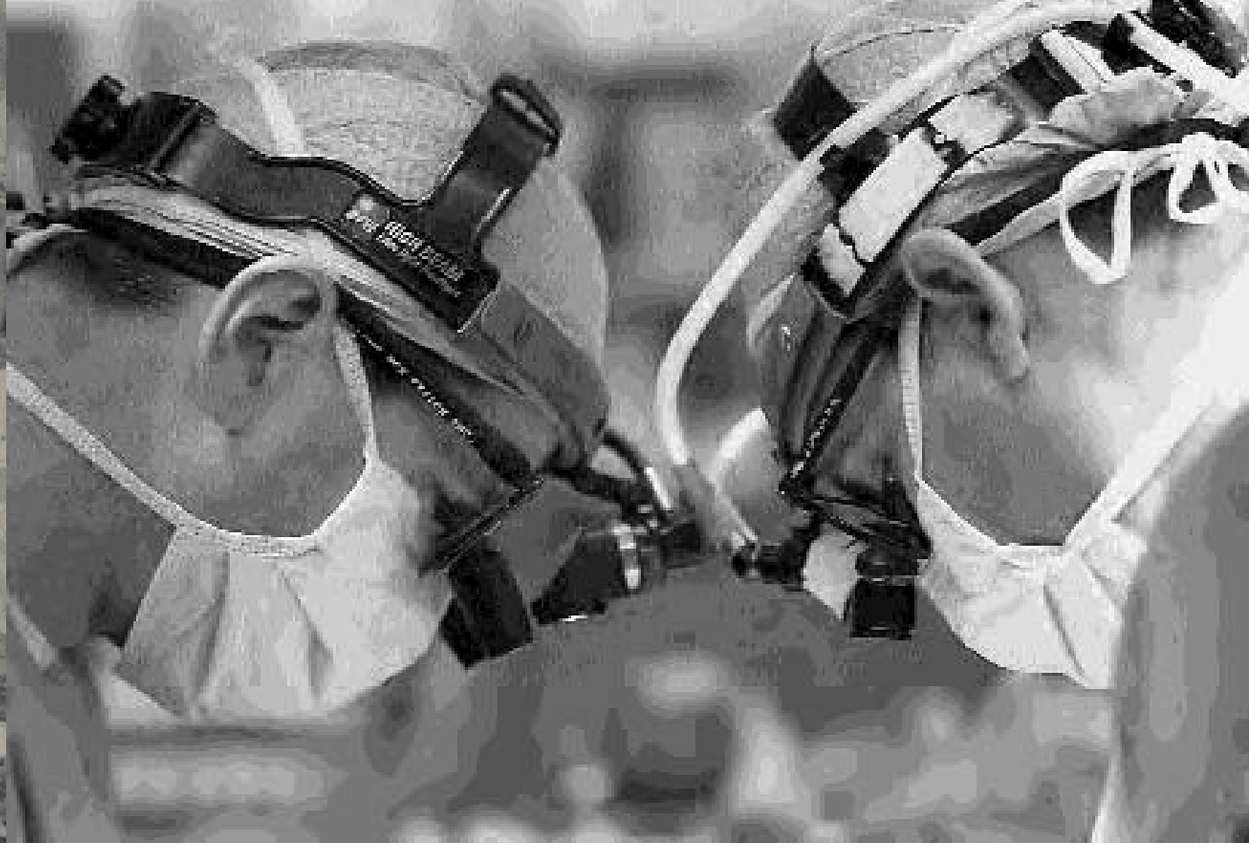
# STATE OF THE HEART

## Advancing cardiothoracic surgery through basic and clinical research



One aspect of Leonardo da Vinci's genius was his ability to imagine the future, everything from flying machines to submarines. Where ordinary men saw impossibilities, he visualized solutions — based not on flights of fancy, but on sound scientific principles. It is this spirit of innovation that inspires the Division of Cardiothoracic Surgery at NYU School of Medicine. Cardiothoracic surgery programs are commonplace, and more than a few excel in providing patients with the latest techniques and technologies. Yet only a handful are also committed to imagining the future — in other words, to inventing, refining, and testing the next generation of therapies, and to teaching those clinical advances to surgeons around the world. That, in brief, is the mission of the Division of Cardiothoracic Surgery. The next renaissance in heart surgery is beginning at NYU.



## The problem: an epidemic of heart disease

Heart surgeons in the United States now perform about 750,000 operations a year. With stunning regularity and remarkable safety, leaky heart valves are repaired, clogged coronary arteries are bypassed, weakened hearts are replaced, congenital defects are corrected, and abnormal heart rhythms are eradicated — extending and improving the lives of people of all ages, from day-old infants to nonagenarians.

The death rate from heart disease has been on the decline for years, thanks to advances in surgery as well as in interventional cardiology (e.g., angioplasty), medical management, and prevention. Improvements in cardiovascular care are largely responsible for the rise in average life expectancy during the latter half of the 20th century.

Nonetheless, heart disease remains the leading cause of death in America. Almost one million lives are lost to cardiovascular disease each and every year. Some 60 million people currently suffer from such heart-related ailments as arrhythmias, congestive heart failure, and coronary artery disease. The economic cost is enormous, amounting to $300 billion in annual health expenditures and lost productivity. The social cost is incalculable.

**Research of such breadth and depth can be found in a handful of medical centers. One of those is NYU, whose cardiologists and cardiothoracic surgeons have been leaders in the field for generations.**

## The remedy: research

What, then, is the solution for our national epidemic of heart disease? In a word: research. Advances in care will emerge only if we make the investment in cardiovascular research, everything from basic studies of molecular biology and genetics of heart cells and blood vessels to clinical trials of new surgical procedures.

Research of such breadth and depth can be found in only a handful of medical centers. One of those is NYU, whose cardiologists and cardiothoracic surgeons have been leaders in the field for generations. In the 1940s, for example, Drs. Andre Cournand and Dickinson Richards, cardiologists at Bellevue Hospital, NYU's longtime clinical partner, pioneered the technique of cardiac catheterization, which allows easy access to the heart through the peripheral veins — an innovation that transformed the practice of cardiology and earned the pair a Nobel Prize. Two decades later, Dr. Frank C. Spencer's seminal work on coronary artery bypass grafting and other techniques helped form the foundation of modern-day cardiac surgery. Building on Dr. Spencer's innovations, NYU's Dr. George Green was the first surgeon in the country to use an internal mammary artery for a coronary artery bypass graft, significantly improving the durability of this surgical procedure.

In the 1980s, Stephen Colvin, M.D., now Chief of the Division of Cardiothoracic Surgery at NYU School of Medicine, introduced into the United States a new surgical technique for repairing leaky mitral valves, a tremendous advance over valve replacement. He and his colleagues also spent years perfecting the use of intraoperative echocardiography (an ultrasound technique for assessing blood vessels around the heart), significantly lowering the risk of stroke during surgery. In addition, studies at NYU have produced safer

methods of cardioplegia (protecting the heart when it is stopped) during surgery and better biocompatible surfaces that reduce the impact of heart-lung machines.

## The tradition continues

NYU's impressive tradition of innovation continues. Today, within the newly created Seymour Cohn Cardiac Surgical Research Program, NYU's cardiothoracic surgeons are devising a new generation of surgical techniques and technologies. One of these is minimally invasive cardiac surgery, which allows major heart repairs to be made with minor incisions — perhaps the most significant advance in the field in a generation. NYU's cardiothoracic surgeons are also leading the advancement of radiofrequency ablation, a means for eliminating abnormal heart rhythms; laser revascularization, a technique for reestablishing blood flow to compromised tissue; and robotically assisted surgery, a futuristic way of extending the surgeon's reach. Harnessing the power of modern electronics, NYU is bringing high-definition video into the operating room, providing a remarkable visualization tool for surgeons. In addition, computer programs are being designed to simulate cardiac surgery, creating a lifelike educational tool for surgeons in training.

Also of note, is the Division of Cardiothoracic Surgery's research database, which the Division has amassed by following every one of its patients for life. From this one-of-a-kind database, surgeons are learning how to tailor surgery to the individual patient, thereby reducing risks and improving outcomes.

Perhaps the most unusual aspect of the Division is its commitment to basic research. The thrust of this work is to understand, at the cellular and molecular levels, the response of blood vessels to angioplasty or bypass surgery — procedures for reopening or bypassing clogged arteries. Many patients who undergo these procedures must be retreated because the vessels reclose. "Determining why this happens and how to prevent it is one of the great challenges in cardiology," says Aubrey Galloway, M.D., Professor of Surgery and Director of Cardiac Surgical Research at NYU.

## Research, treatment, and teaching

The Division of Cardiothoracic Surgery is much more than a research center. The Division's nine primary surgeons perform more than 1,800 operations annually, delivering their unique blend of scientific and compassionate care to patients from across the New York Metropolitan area and around the world. "The main focus of our studies is to develop technologies and techniques that allow us to do our work — heart surgery — with superior outcomes and faster recoveries," explains Dr. Colvin. "The bottom line is to deliver better health care."

**"THE MAIN FOCUS OF OUR STUDIES IS TO DEVELOP TECHNOLOGIES AND TECHNIQUES THAT ALLOW US TO DO OUR WORK — HEART SURGERY — WITH SUPERIOR OUTCOMES AND FASTER RECOVERIES."**

Rare among cardiac surgery programs, the Division employs every treatment option, for example, valve repair as well as replacement and minimally invasive as well as traditional open-heart approaches. "We don't hold to the belief that any one intervention is ideal for a given condition," says Dr. Galloway. "We specialize in minimally invasive surgery, for example, but it is not appropriate for every patient. A great deal of our clinical research effort has gone into risk stratification — finding out which treatment is best for a particular patient."

The Division is also committed to teaching and training, through both traditional residency and fellowship programs and innovative methods of distance learning. Heralded worldwide, NYU's cardiac surgeons are regularly invited overseas to lend their expertise to peers in lesser developed countries. For years, the Division has been sponsoring the care of sick children from medically underserved regions the world over, bringing them to NYU for care. Expanding upon this work, members of the Division have formed a nonprofit venture called For Children Worldwide, whose mission is to help the medically underserved help themselves. The organization aims to address a range of medical and social issues.

As the following stories illustrate, even more innovations in cardiothoracic surgery are certain to emerge from NYU. Future advances cannot be guaranteed, of course. However, they can be nurtured and cultivated, for progress in medicine comes primarily from planning and dedication — and from continued support from friends and benefactors. Thanks to the generosity of the Duke of Milan, Leonardo da Vinci created many masterpieces. With your help, the Division of Cardiothoracic Surgery can create more of its own.

*For more than a century, innovations in surgery have been emerging from NYU and its longtime clinical partner, Bellevue Hospital. Continuing that tradition, the Division of Cardiothoracic Surgery today offers patients an array of new technologies and treatments, while running a diverse program of basic and clinical research.*

*Dr. Stephen Colvin, Chief of Cardiothoracic Surgery (above), a pioneer of mitral valve repair surgery, and Dr. Aubrey Galloway, Director, Cardiac Surgical Research recently developed a new annuloplasty band (inset), which is surgically implanted to support faulty mitral valves.*

## A Unique Combination

**By combining patient care and clinical research, the Division's nurse practitioners bring the latest advances directly to the bedside.**

As any patient knows, doctors are one part of the health-care equation. Nurses are another. Without them, little care would get delivered. And little clinical research would be conducted.

Whenever the Division of Cardiothoracic Surgery begins a clinical trial of a new drug or device, a good portion of the work falls to nurse practitioners Patricia Ursomanno, M.S.N., and Julie Delianides, M.A., both of whom hold the title of Research Coordinator. The two nurses are responsible for recruiting patients, ensuring that trials meet regulations of the FDA and the IRB (the Institutional Review Board, NYU's internal overseer of patient research), gathering data and

# REPAIR don't replace

**It is now well accepted that mitral valve repair is preferable to replacement, thanks to an NYU surgeon who refined the technique, introduced it into the United States, and proved its worth in clinical trials.**

The same task performed repeatedly is bound to feel routine — except when the activity is heart surgery and the surgeon is Stephen Colvin, M.D., Chief of the Division of Cardiothoracic Surgery. As Dr. Colvin enters the O.R. this morning — for about the 10,000th time in his career — the intensity that fills the room is palpable. But in this citadel of medicine, brimming with the latest technology, what stands out most is the artistry of a master surgeon, who with several small incisions and a few strands of thread can make a patient whole again. On this occasion, the task at hand is a minimally invasive mitral valve repair, an operation that only a few surgeons in the world have come to perfect. Dr. Colvin was one of the first.

*Dr. Stephen Colvin*

As a young surgeon, Dr. Colvin trained with Alain Carpentier, M.D., the renowned French heart surgeon. In the 1970s, Dr. Carpentier was developing a technique for repairing, instead of replacing, leaky mitral valves. (The mitral valve regulates blood flow from the left atrium to the ventricle.) Dr. Colvin brought the technique back to NYU, where he and his colleagues spent years refining it, first in the laboratory and then in clinical trials. At decade's end, they introduced the repair in the United States.

"Heart surgeons had come to rely on mechanical replacement valves, mainly because of their durability," says Dr. Colvin. "The drawback is that patients have to take anticoagulants the rest of their lives, which are not without risks or side effects. In most cases, we are talking about relatively young women of child-bearing age, who would have to take these medications for decades. Animal tissue valves or mechanical valves are other options, but they tend to wear out after ten years or so. If you're in your thirties or forties, you're looking at two or three additional operations."

The initial reaction of the surgical community was not uniformly positive, however. But ultimately, the results supported the NYU approach, revolutionizing the way cardiologists address mitral valve disease. It is

maintaining the database, and following patients during hospitalization and after discharge. It's meticulous, painstaking work, considering that some of the studies have more than 1,000 enrollees and proceed indefinitely.

Mrs. Ursomanno and Ms. Delianides first came to NYU in the eighties, steadily working their way up the nursing career ladder. Years ago, Division Chief Stephen Colvin, M.D., urged them to become nurse practitioners (the top clinical level in the profession), foreseeing the need for more staff members versed in patient management and clinical research.

In an unusual arrangement, both nurses now split their time between clinical research and clinical care, ensuring continuity of care for patients enrolled in the trials. "It also makes us better practitioners," says Ms. Delianides. "We learn so much about the different cardiac problems from the studies. And then we transfer this information to our colleagues by teaching the nurses and residents on the floors."

Adds Mrs. Ursomanno: "It's a unique combination, the research and the clinical care. It fosters a remarkable sense of professionalism, on top of a high level of warmth and caring."

*Research Coordinators Julie Delianides, left, and Patricia Ursomanno.*

now well accepted that for most patients valve repair is the ideal therapy, and that the surgery should be performed as early as possible, when the risks of treatment are lowest. "With mitral valve repair, you don't have to take anticoagulants, and, in most instances, it is just as durable as a replacement. And patients have less bleeding, fewer infections, better heart function, and a higher survival rate," says Dr. Colvin.

Ultimately, NYU was able to convince the medical community of the value of mitral valve repair because it had the best scientifically on its side — data. "We decided to follow every one of our patients from the beginning, bringing them back every six months for checkups and echocardiograms," Dr. Colvin explains. "From this data, we published numerous reports demonstrating the benefits of valve repair. We also showed that certain types of mitral valve disease do not make for good repairs. I think we have shown to most people's satisfaction that, in the right patients, repair is superior to replacement."

## Arteries, not veins

**A PIONEER OF CORONARY ARTERY BYPASS GRAFT SURGERY, NYU CONTINUES TO LEAD THE WAY BY USING MAMMARY ARTERIES INSTEAD OF LEG VEINS WHENEVER POSSIBLE, IMPROVING THE REPAIR'S LONGEVITY.**

*Dr. Rick Esposito*

*Dr. Alfred T. Culliford*

One of the most common operations, coronary artery bypass graft (CABG) surgery, is performed everywhere, from community hospitals to big-city academic medical centers. Does hospital size and location matter? Not necessarily. What's important is the hospital's experience — the more CABG operations it performs, the better the results. Another critical factor is whether the hospital is practicing the state-of-the-art. Unfortunately, when it comes to CABG surgery, many hospitals are not.

Recent studies clearly show that when bypassing clogged coronary arteries, it is preferable to use mammary arteries rather than leg veins. The problem with vein grafts is that they have a greater tendency to close over time. According to Rick Esposito, M.D., Associate Professor of Clinical Surgery at NYU School of Medicine, about 40 percent of vein grafts develop significant blockage within ten years, while only 10 percent of mammary artery grafts suffer blockage within that time period.

"The use of mammary arteries prolongs survival, delays the need for reintervention, and minimizes recurrent heart attacks and angina," says Dr. Esposito. "As an institution, NYU has embraced mammary grafts as the best option. One artery graft is good, and two is even better. We try to use them as often as we can."

Many other hospitals do not, mainly because CABG surgery with artery grafts is significantly more complex and laborious than surgery with vein grafts.

The advantages of using mammary artery grafts in CABG surgery are not well known among the general public. According to Alfred T. Culliford, M.D., Professor of Clinical Surgery and an expert in CABG surgery, "People want to know about options such as minimally invasive surgery, which is all well and good, but they also ought to ask their surgeon whether they are going to get two mammary grafts. In terms of survival and quality of life, that's where the greatest difference is, which has been demonstrated in any number of studies. Mammary artery bypass grafts are the closest method for a complete cure for coronary disease that currently exists."

Dr. Culliford also has extensive expertise in the surgical treatment of elderly patients with valvular or coronary artery disease, and he is noted for his work in the repair of complex thoracic aortic aneurysms (abnormally dilated blood vessels).

# Heart surgery on Monday, playtime on Wednesday

**A mother and daughter learn firsthand how advances in heart surgery are improving clinical care.**

Kim Brockway was still reeling from the news that her newborn baby, Ella, had a touch of jaundice when it was discovered that the little girl also had an atrial septal defect, a hole between the two upper chambers of the heart, short-circuiting the normal flow of blood. Ella's life was not in immediate danger, and there was a chance the hole would heal on its own. But that wasn't enough reassurance for this first-time mom. "With all the postpartum chaos, I completely lost it," says Ms. Brockway. "I was hysterical."

Ella, on the other hand, was thriving, and for a time it looked as if she would beat the odds. But the hole persisted; surgery loomed on the horizon. At 18 months of age, Ella's heart began to enlarge. It was time for the operation. But with what approach? A traditional sternotomy, in which the heart is reached by dividing the breastbone, or a new minimally invasive technique, which requires only minor incisions ? And which surgeon? All signs pointed to minimally invasive surgery (see p. 9), which would cause far less trauma and less scarring than the traditional procedure, and to Stephen Colvin, M.D., a pioneer of the technique.

The Brockways went to see Dr. Colvin. A journalist by vocation, Ms. Brockway grilled the surgeon for an hour. "He made us feel so at ease," she says. "Sometimes you have to go by your gut, and we decided that Dr. Colvin was the one."

Surgery was scheduled in three weeks. For Ms. Brockway, every tick on the clock was excruciating. At one point she recalls Dr. Colvin saying, "This baby is going to be fine; the mother, I'm not so sure about."

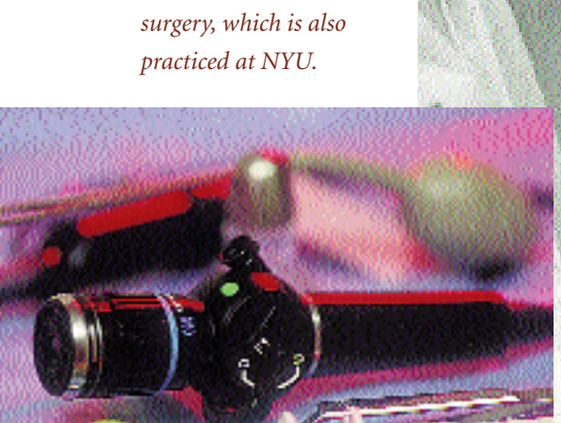
"The surgery was performed on a Monday morning," Ms. Brockway reports, "and Ella was home playing in her room on Wednesday afternoon. The recovery was so fast. She didn't even need a Tylenol. It has taken her longer to get over ear infections."

Two weeks later, Ella's heart had already returned to normal. The cosmetic results were equally pleasing: a tiny scar from a drainage tube, which will fade over time, and a two-to-three-inch scar on her chest, which will be hidden once she develops breasts.

"You would never know she just had heart surgery," says the relieved mom. "It's really a miracle. Now, if anybody in our family has so much as palpitations, they're heading to NYU."

# major surgery, MINOR

*Dr. Greg Ribakove, left, is one of the pioneers of minimally invasive heart surgery. (Inset) Tools used for minimally invasive thoracic , or chest, surgery, which is also practiced at NYU.*



# INCISIONS

**In the 1990s, the introduction of minimally invasive surgery revolutionized heart surgery. NYU's Division of Cardiothoracic Surgery was at the epicenter of this historic development.**

Every so often, a new technique or technology comes along that fundamentally alters the practice of cardiac surgery. The heart-lung machine and the idea of bypassing diseased coronary arteries are two notable examples. The latest milestone is minimally invasive heart surgery, a technique that drastically reduces both the trauma of operations and the time needed for recovery.

At the center of this revolution is Greg Ribakove, M.D., Associate Professor of Surgery at NYU. In the early 1990s, during a sabbatical year at Stanford University, where he had traveled to learn the art and science of heart transplantation, Dr. Ribakove was invited to join a secret research project started by two surgical residents. The young doctors had devised a novel method of performing heart surgery through tiny incisions. But now they needed the insight of an experienced surgeon, and Dr. Ribakove, with a strong clinical and research background, was the ideal choice.

*Dr. Aubrey Galloway*

## A fortuitous arrangement

"My initial reaction was that they had no chance at all," Dr. Ribakove recalls. "But they took me over to the research facility where they were producing the instruments, and it was clear that they had come up with a good idea." Dr. Ribakove agreed to work on the project, asking only that if the system reached clinical trials, NYU would be one of the primary sites involved. It was a fortuitous arrangement.

For months, Dr. Ribakove spent two to three days a week in the research laboratory developing the techniques for minimally invasive surgery. Upon returning to NYU in mid-1994, he introduced the system to his colleagues, Drs. Stephen Colvin, Aubrey Galloway, and Eugene Grossi. At first, they were skeptical. "There had been little new intellectual development in cardiac surgery for 15 years," explains Dr. Galloway, who is Professor of Surgery and Director of Cardiac Surgical Research. "Heart surgery was a mature field — or so we thought."

But this particular approach warranted a closer look, and so, with Dr. Ribakove in the lead, the NYU surgeons set up their own laboratory to test and refine the minimally invasive surgery system, ultimately making several important contributions.

Preliminary clinical trials were not launched until 1996. "I was glad there was this time lapse," says Dr. Ribakove. "It gave us enough time to build confidence in the equipment and modify the approach so that we had the best chance of success. We started a number of projects, first looking at recovery of heart function, then at mitral valve replacement, and then at coronary artery bypasses. The studies convinced us that you could use the equipment safely."

In the clinical trial, the NYU surgeons focused on mitral valve surgery, their area of greatest expertise. The tests were a success, and minimally invasive surgery soon became NYU's preferred approach for repairing and replacing heart valves and congenital heart defects and an option for certain coronary artery bypasses. Today, NYU is a leader in the field, training surgeons around the world and conducting approximately ten minimally invasive heart operations a week, more than any other hospital in the country.

## Convincing the skeptics

"However, there was — and still is — tremendous resistance in the cardiac surgical community," reports Dr. Galloway. Many surgeons, anxious about a technique that requires a whole new set of skills and equipment, claimed that minimally invasive surgery wouldn't be safe or cost-effective.

"We knew we would have to study every patient and let the data drive the process," says the surgeon. It was a

*Dr. Aubrey Galloway, an internationally recognized leader of minimally invasive heart surgery, scrubs for an operation.*

huge undertaking, but Dr. Galloway and his colleagues understood what it would entail, having enrolled and analyzed more than a thousand patients in previous studies of mitral valve surgery. Some 1,500 minimally invasive heart surgeries later, the NYU team has generated reams of data demonstrating the advantages of the minimally invasive approach over traditional sternotomy. Those benefits include less bleeding, less risk of arrhythmias (abnormal heart rhythms) or stroke, fewer infections and lung complications, shorter recovery times, and — no small benefit in the managed-care era — lower costs. Minimally invasive heart surgery, the team has determined, is particularly beneficial for elderly patients, who are especially susceptible to the trauma of conventional surgery.

Only a handful of centers in the nation have been able to make the transition to minimally invasive valve surgery, but not because the approach is wanting. According to Dr. Galloway, a leading practitioner of the technique, most heart surgery programs lack the multidisciplinary team, the technology, the experience, and the patient volume to be successful with this demanding approach. In addition, programs often lack the ability to risk-stratify patients, that is, to determine which patients are appropriate candidates for which surgical approach — a major focus of the Division's clinical research program.

## "I had absolutely no pain"

To be sure, minimally invasive surgery is not for every patient. Still, the technique is revolutionary. Just ask Bobbie Phillips, 56, a secretary and bookkeeper at Suffolk County Community College. Ms. Phillips underwent minimally invasive valve replacement surgery at NYU. Four days later, she was home. "It was the most phenomenal operation," she says. "I had absolutely no pain. I was up walking and entertaining company in the hospital on my second day! I was ready to go back to work in three weeks. I'm so pleased with how I looked after the surgery, since the small scar just under the breast is almost invisible. It's important for a woman to feel comfortable with her body. A friend of mine has a scar from the traditional type of operation, and there's no comparison; she wishes minimally invasive surgery had been around when she had surgery."

## Traditional vs. Minimally Invasive Surgery

In traditional open-heart surgery, the heart is reached by cutting open the chest and dividing the breast bone — the most traumatic aspect of the operation — giving the surgeon room to connect the heart to the heart-lung machine and repair the heart. With the new minimally invasive surgical approach, the heart is reached via small incisions in the patient's chest, neck, and groin. The tubes for the heart-lung machine, a pair of balloon-tipped catheters, are threaded to the heart through the incisions in the neck and groin, while the repair itself is performed through a small incision between two ribs.

# Less is more

**Less-invasive techniques are also transforming thoracic surgery, a specialty concerned with repairing organs in the thorax, or chest.**

Like their counterparts in cardiac surgery, NYU's thoracic surgeons are focused on achieving the best possible outcomes with the least amount of trauma to the patient. Fortunately, the techniques of minimally invasive surgery also have great utility in chest surgery — especially in the hands of Lawrence Glassman, M.D., and Bernard Crawford, M.D.

Dr. Glassman, Assistant Professor of Cardiothoracic Surgery and Co-Director of Lung Transplantation at NYU, regularly uses minimally invasive techniques to obtain tissue for biopsies and to excise malignancies in the lungs, thymus, esophagus, and diaphragm.

He is also one of only a handful of surgeons to adapt these techniques to the treatment of hyperhidrosis, a rare condition characterized by excessive sweating. When the hands and armpits are affected, the problem can be treated by removing portions of the sympathetic nerve near the upper spine, an operation known as a sympathectomy. Dr. Glassman has starting conducting the procedure with slender scopes and operating instruments, which are threaded to the operative site through a small incision in the upper chest. The impact is so minimal that patients typically do not require hospitalization.

Dr. Crawford, Assistant Professor of Cardiothoracic Surgery at NYU School of Medicine and Director of the Division of Thoracic Surgery at NYU Downtown Hospital, has also embraced the "less is more" approach to surgery. One of his specialties is exposing the spine for orthopedic repairs, a procedure that he now does with minimally invasive techniques of his own design.

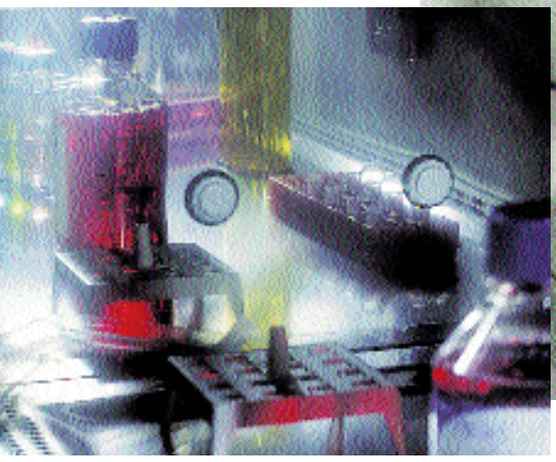
The surgeon has also devised a new way to close chest incisions, significantly reducing postoperative pain. Normally, chest incisions are closed by wrapping sutures around the ribs. But this can compress nerves that run along the lower ribs, causing weeks of pain after surgery. Dr. Crawford's solution is to drill small holes in the ribs. The sutures are threaded through, rather than around, the ribs, avoiding the nerves.

In addition, Dr. Crawford is known for his expertise in using the neodymium-YAG laser to reduce tumors or control bleeding inside the trachea. This delicate procedure, which few thoracic surgeons attempt, is not a cure, but it brings great relief to patients whose breathing is compromised by cancer.

*Drs. Lawrence Glassman (left) and Bernard Crawford (below) employ minimally invasive techniques in a variety of thoracic operations.*

# back to BASICS

**Why arteries reclose after angioplasty or bypass surgery is one of the most pressing questions in cardiology. Basic research into the cellular and molecular biology of blood vessels may provide the answer.**



*Dr. Paolo Mignatti, leader of the Division's basic research program.*

Cardiologists and cardiac surgeons have devised many types of therapies for clogged coronary arteries, notably balloon angioplasty and bypass surgery. Unfortunately, all are temporary fixes. For reasons that are not yet clear, when blood vessels are manipulated in these procedures, they slowly begin to close, a process called restenosis. Re-intervention is often required within five or ten years. This is a huge public health issue, considering that more than a million angioplasties and bypasses are performed each year in the United States.

"Solving this mystery is one of the fundamental questions in cardiology," says F. Gregory Baumann, Ph.D., M.B.A., Research Professor of Surgery at NYU and the Division's Associate Director of Surgical Research.

"The ultimate solution can come only from basic science," adds Paolo Mignatti, M.D., Ph.D., Research Associate Professor of Surgical Research and Cell Biology. "It is not a matter of fine-tuning surgical techniques. The problem is a biological phenomenon that we still don't understand."

Aubrey Galloway, M.D., Director of Cardiac Surgical Research at NYU, came to the same realization several years ago and took an unusual step (for a surgical service) of launching a basic research program into the cellular and molecular biology of blood vessels, with the ultimate goal of developing gene therapies to prevent restenosis.

One member of the Division's basic research team is Dr. Baumann, who is investigating the earliest cellular changes in a vein after it is grafted. "Within minutes of implantation, the endothelial cells that line the inside

of the vein slough off, and the smooth muscle cells — the next, thickest layer of the vein — start to divide and migrate inwardly, narrowing the diameter of the vessel."

The behavior of these cells is confounding. "Ordinarily," he says, "smooth muscle cells have an extremely low rate of division and don't migrate. Some pathologists describe it as an overly exuberant reaction to injury — the injury coming from the grafting process itself or the higher blood pressures the vein encounters in its new location."

Dr. Baumann believes that an extreme version of a procedure known as endarterectomy might be a solution. "Instead of reopening the diseased vessel with angioplasty or bypassing it," he says, "you excavate the interior of the existing vessel and leave behind a thinner wall with a larger opening — sort of a Roto-Rooter approach. This removes all the smooth muscle cells, the ones that cause the thickening. The outermost layer is, in most cases, strong enough to continue to act as a conduit for the blood." The approach is being tested in animal models at NYU.

Dr. Baumann is optimistic about endarterectomy — to a point. "There are literally hundreds of papers showing that you can stop the process of restenosis in animal models in a variety of ways. No clinically relevant methods have ever been developed, however. What works in animals doesn't always seem to work in humans very well," he notes.

Dr. Baumann is also collaborating with a team of molecular biologists who are attacking the problem at a more fundamental level. "We are trying to figure out the signaling mechanisms in cells that are activated in response to various stresses, such as changes in blood pressure," explains Dr. Mignatti, the team leader.

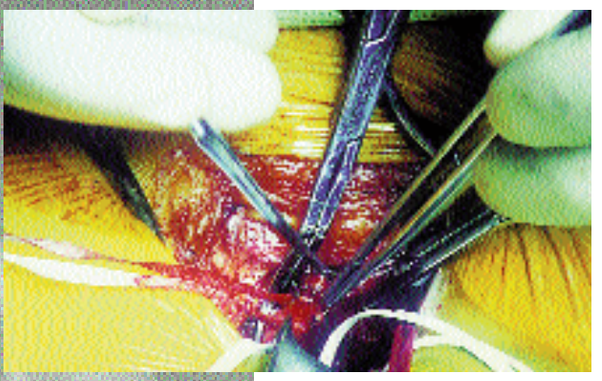
The researchers are particularly interested in MAP (mitogen-activated-protein) kinase pathways, which carry signals from outside the cell to the cell's nucleus. Once in the nucleus, the cell's central control station, the signals activate factors that modulate the expression of genes that play a role in cell death, proliferation, and migration.

Thus, MAP-kinase pathways present numerous possibilities for intervention with gene therapy. "Before implanting the graft, maybe it can be engineered to express a new gene that will activate or inhibit these pathways," reports Giuseppe Pintucci, Ph.D., Research Assistant Professor of Cardiothoracic Surgery.

The team is also investigating the molecular biology of angiogenesis, or blood vessel formation. Instead of treating or replacing diseased coronary arteries, it may be possible through gene therapy to stimulate the formation of new vessels, thereby improving blood flow to the heart.

Only time, and a lot of work, will tell. "When you study something, you never know what you are going to find, or whether it is going to be useful," says Dr. Mignatti. "Just think of Archimedes. Three thousand years ago when he elaborated his theories, people probably thought they were minor things. But we wouldn't have been able to go to the moon without his simple calculations. That encourages us to move forward, knowing that every single piece of information we find may eventually contribute to patient care. And that is the ultimate goal."

*(Above) Dr. Giuseppe Pintucci, basic researcher; (Below) Dr. Gregory Baumann, Associate Director of Surgical Research, and Denise Sennett, Cardiac Research Nurse Practitioner.*



*Arms of a surgical robot being tested in an FDA-approved clinical trial. HDTV images (inset), a valuable adjunct to robotic and minimally invasive surgery, give surgeons remarkably clear images of the operating field.*

# the FUTURE

**By harnessing the power of computers, high-speed telecommunications, and robots, NYU is extending and enhancing the capabilities of heart surgeons, offering a glimpse at the future of cardiac surgery.**

If Leonardo da Vinci were around today, it wouldn't be hard to picture him tinkering with computers, robots, and other advanced technologies. He would probably feel right at home in the Seymour Cohn Cardiac Surgical Research Laboratory at NYU, where investigators are busy imagining the future of cardiac surgery.

One of their visionary projects is surgical robotics. For those wary of the idea, it is worth noting that surgical robots are not meant to replace real-life surgeons, but to extend and enhance their capabilities. This is important in light of the growing reliance on minimally invasive surgery, in which surgeons operate by manipulating long, narrow instruments inserted through small incisions in the patient's body. The technique is as difficult as it sounds. "Imagine holding the top of a 24-inch-long pencil and trying to connect dots that are less than a half-millimeter apart, and you get a sense of what minimally invasive surgery is like," says Eugene A. Grossi, M.D., Associate Professor of Surgery and Director of the Research Laboratory, who is leading the Division's robotics efforts.

Thus, it is no surprise that only a third of heart surgeons nationwide have mastered the art of minimally invasive surgery. In the short run, robotics may make the technique easier and better. And down the road, the technology may create a whole new field of remote-access telesurgery.

The regular use of robots in the O.R. may not be far off. In May 2000, members of the Division conducted the nation's first minimally invasive robotic valve-repair surgery, part of an FDA-approved clinical trial. The operation, and several others performed since, was a success.

To use the robot, Dr. Grossi sits at a computer workstation a few feet away from the patient, remotely controlling three robotic arms on the operating table. While viewing the operative site on a video monitor, he manipulates the workstation's conventional minimally invasive instrument handles, as the robotic arms replicate these movements deep within the patient.

One benefit of robotic support is that it eliminates any human hand tremor. Another advantage is that it allows the surgeon to scale his or her natural hand movements to micro-movements inside the patient's body, a critical advantage when working on tiny structures such as blood vessels or valve leaflets. Robotics could conceivably be used in conjunction with high-speed telecommunications so that a surgeon in New York could conduct surgery anywhere in the world — in a rural hospital or in a battlefield hospital a continent away.

*(Above) Dr. Eugene Grossi, right, and Dr. Angelo La Pietra set up the surgical robot for a laboratory test. (Below, left) Dr. Grossi controls the robot from a computer workstation.*

## A revolution in surgery — in living color

Another glimpse of cardiac surgery's future can be seen in Dr. Colvin's pioneering use of high-definition television (HDTV). With the advent of minimally invasive heart surgery, it has become increasingly difficult for surgeons to see and work within the limits of the small incisions. To address this challenge, an experimental, high-definition micro-video Sony camera system was adapted to the O.R. by Allan Katz, Dr. Colvin's lead engineer. Images captured by the camera, when viewed on a high-resolution HDTV monitor, give surgeons remarkably wide and clear views of the operative field, many times better than afforded by the naked eye or conventional surgical loupes.

"HDTV has taken us to the highest level in our efforts to deliver better care with less trauma," states Dr. Colvin. "This tool helps us in our various training initiatives, as we transmit actual surgeries, including new techniques and innovations, in real-time to our colleagues at home and abroad. And it is a valuable addition to our research in robotics-assisted surgery."

The Division's application of HDTV to cardiac surgery is the first of its kind in the world.

Leonardo would be impressed.

# with your SUPPORT...

**...EVEN GREATER ADVANCES IN CARDIOTHORACIC SURGERY ARE ATTAINABLE.**

*Seymour Cohn*

As these pages illustrate, the Division of Cardiothoracic Surgery's dedication to excellence in practice, research, and education is helping to usher in the next renaissance in heart surgery.

Just around the corner are new treatments such as laser revascularization, new technologies such as surgical robotics, and improved methods of minimally invasive surgery. Better treatment strategies are waiting to be gleaned from the Division's unique research databases. The promise of gene therapy is in our future, but the foundation of this futuristic treatment is now being built in the Division's basic research program.

Grants from government and contracts with industry cover only a portion of the costs. Thus, your help is needed to continue the Division's pioneering work. Many giving opportunities are available. There are professorships to be endowed, research laboratories to be named, research projects to be supported, and fellowships to be sustained.

With generous support from friends across the country, we have made significant progress toward our fundraising goals. In early 2001, for example, Seymour Cohn, Chairman of the Board of Sylvan Lawrence Company, a New York City real estate investment company, gave $5 million to NYU School of Medicine to expand its cardiac surgery program. The money will be used to endow a chair in cardiac surgery, intensify research in cardiac surgery, and establish a pediatric cardiology catheterization laboratory.

Yet there is so much more to be done. Join us in our campaign to discover solutions to the nation's epidemic of heart disease.

*Support for the Division of Cardiothoracic Surgery's research programs will benefit countless patients like Ella Brockway (below, right), who underwent minimally invasive heart surgery at NYU.*

## Your support can come in many ways

The most direct way to make a contribution to our research efforts is to write a check. However, there are other forms your gift can take that both allow you to make a larger commitment and at the same time potentially benefit your estate, your children, or yourself.

For example, trusts can be created that will provide current or retirement income to you or a beneficiary while ultimately supporting our programs. These life-income arrangements can provide income-tax and estate-tax advantages, and may even increase the income now available from the donated assets. Trusts can also be created that provide current income to our programs for a predetermined number of years, with the trust's prinicipal returned to you or your heirs with significant gift- and estate-tax savings. Your will can direct a specific amount, or designate a percentage of your residual estate, to benefit our research. Gifts of insurance policies that have served their purpose can provide a convenient way to make a gift. Real estate can be given outright, or given now while reserving the right to reside there for life. Gifts of securities that have grown in value are a frequent form of giving, offering the possibility of significant tax advantages by avoiding capital gains tax on the appreciated value.

Whatever the means, we welcome your further inquiry regarding gifts to support our research efforts.

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