GIVING HEARTS EXTRA MUSCLE

Sometimes wounded hearts need a little support. Other muscles are being conscripted to help.

By JOANNE SILBERNER

Repair jobs on ailing hearts range from drug therapy to total replacements. Why not, some heart researchers are asking, try patching things up with muscle tissue from elsewhere in the body? The concept is being translated into reality on both the animal and human levels. Animals have received everything from muscle patches on the heart to independent pouches hooked into the circulation, and three people so far have received muscle "autotransplants."

The first human procedure was done in February 1985 on a 37-year-old woman who had a large tumor in her heart. When surgeons Alain Carpentier and Juan Carlos Chachques of the University of Paris's Hôpital Broussais removed the 1.4-kilogram tumor, they reinforced the thin muscle wall that remained with a "borrowed" muscle from her lower back, the left latissimus dorsi.

George J. Magovern and his colleagues at Allegheny General Hospital in Pittsburgh have boosted two damaged hearts with autotransplants. One was performed in a five-hour operation in September 1985, on a 46-year-old woman with a ventricular aneurysm — a weakened section in the critical pumping portion of the heart. The surgeons removed the aneurysm, then stitched together the remaining muscle, reducing the size of the heart. To boost the heart's pumping ability, they brought the patient's left latissimus dorsi around to the heart, without severing its nerve, major artery and vein. They then wrapped the muscle partway around the heart and stitched it in place. Eight days later, Magovern and his colleagues began using a pacemaker they had hooked to the latissimus dorsi to stimulate it intermittently. Gradually they worked it up to full-time beating in synchrony with the heart.

Magovern says his patient, minus 20 to 30 percent of her heart, has returned to homemaking in Beaver Creek, Pa. He told SCIENCE NEWS he did a similar operation on another patient in February 1986, but declined to discuss the details of that operation until the transplanted muscle is functioning as intended, which can take several months.

Magovern, who has been working on the concept for 10 years, became interested in the ability of other muscles to take on the duties of the heart after seeing a patient whose pacemaker lead had shifted so that it butted up against the chest muscle instead of the heart. The muscle, being stimulated to contract 72 times a minute, had grown to twice its normal size, indicating that stimulated noncardiac muscle is capable of taking on full-time work.

He and the French group employed pedicle grafts—freeing muscles from the body without severing their main nerves, arteries and veins—and attached them to the patients' hearts. Plastic surgeons routinely use pedicle grafts in such operations as breast augmentation.

Larry W. Stephenson of the University of Pennsylvania in Philadelphia, who discussed his work on heart muscle augmentation at the recent American Heart Association science writers' seminar in Sarasota, Fla., says there are several candidate muscles for pedicle grafts to the heart. After removal of one of the two latissimi dorsi, which stretch down the sides of the torso, "a person would have problems on crutches, but otherwise there'd be little noticeable effect," Stephenson says. In dogs, he has made grafts from diaphragm muscle, and he says that the rectus abdominus (stomach) and pectoralis (chest) muscles could also be used.

Based on years of animal research, Stephenson says that grafts, overlays or even independent pumping chambers made of rolled-up muscles may eventually be useful in treating certain congenital diseases in which the heart is too small. He also expects that some form of the procedure will have a role in repairing congestive heart failure. Each year, 10,000 people in the United States develop this condition as a result of scar tissue in the heart, and despite drugs half of them die within 12 months.

Other options currently open to congestive heart failure patients are heart transplants and artificial hearts. According to Stephenson, autotransplants offer advantages over both of these techniques. Unlike a transplanted heart, the booster tissue for an autotransplant is home-grown and so no lifetime regimen of immune-suppressive drugs is needed. Another drawback in heart transplant surgery is the difficulty of finding a suitable donor heart; with autotransplants, the donor is always there and willing.

The still-experimental artificial heart doesn't have a stellar track record (SN: 2/22/86, p. 122). It requires that anticoagulant drugs be administered in amounts that will prevent blood from clotting around the foreign material without causing excessive bleeding. Moreover, an artificial heart requires an external power source. The autotransplant, in contrast, is powered by a small internal pacemaker similar to those used to control erratic hearts.

There are still hurdles to overcome, however. The main one is getting noncardiac muscle to put in a full day's work. Unlike heart muscle, skeletal muscle is designed to work only occasionally and for short periods of time.

The problem stymied some of the initial attempts at cardiac augmentation, Stephenson says. "Investigators have thought about [transplanting muscle into the heart] for years," he says. "But [skeletal muscle] could not provide the type of relentless work that cardiac muscle could."

Skeletal and cardiac muscle are structurally different—for example, power-producing mitochondria constitute 55 percent of the cell volume in cardiac cells but only 2 to 5 percent of a skeletal muscle cell. But as athletes know, skeletal muscles can be trained.

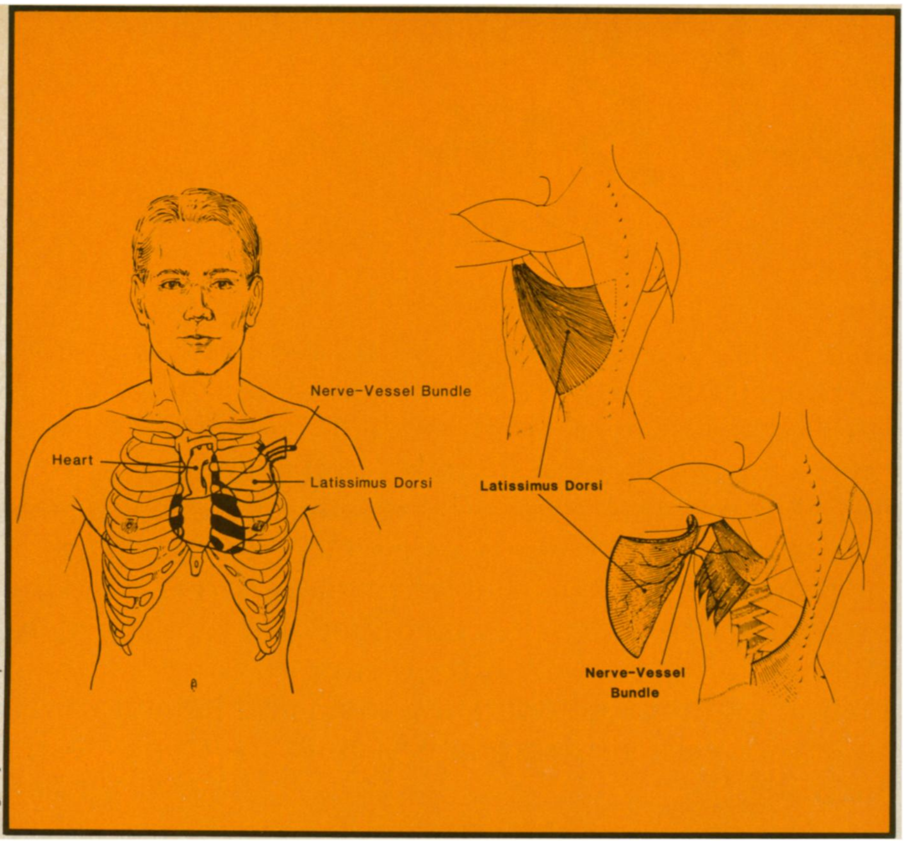
Skeletal muscles are a mix of slow-twitch fibers, designed to resist fatigue, and fast-twitch fibers, which enable intense periods of work. Stimulating skeletal muscles with electricity can increase the proportion of slow-twitch muscle, Stephenson and others have observed.

Stephenson's group initially concentrated on finding the best way to electrically condition skeletal muscles, and was able to keep conditioned muscles beating with a pacemaker for a year or longer. Recently they compared electrical conditioning with allowing the muscle a rest period of several weeks in its new locale before firing it up. They found that a combination of the two resulted in the most fatigue resistance.

They also started out studying patches sewn into the heart; now, in dogs, they are working with pouches made of latissimus dorsi "wrapped like an ice cream cone," attached to a pacemaker and hooked into the circulation. The pouches sit behind the dogs' right legs, where they don't hinder the animals' activity, and can pump as much as two-fifths of what the heart can, Stephenson says.

In humans, he says, such a pump could lessen the burden on ailing hearts by delivering 2 liters of blood a minute – one-third the normal output of the heart. The operation would be easier and less expensive than implanting an artificial heart and could be ready for human use in two to five years, he estimates. "We know it will eventually work," he says.

Richard A. Clark, chief of surgery at the National Heart, Lung, and Blood Institute in Bethesda, Md., commenting on heart muscle transplants in general, says, "It will probably take a considerable period to learn the limitations of the procedure as well as its attributes." However, he adds, "Muscular augmentation by some other muscle as a general concept is valid. I think it has potential." □



Allegheny General Hospital

In the heart-wrap procedure performed at Allegheny General Hospital, the left lattissimus dorsi was isolated with its nerve-vessel bundle intact, brought through the ribs and wrapped around the heart.

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The nature/nurture controversy is more than a curiosity keeping social scientists happy. Hundreds of billions of dollars are at stake. For starters, it keeps social scientists employed in large numbers, and influential. Psychologists' theories are implemented by the Department of Health and Human Services and numberless state and community social service, welfare and education organizations. After all, if genes primarily determine our nature, what's left for the "human betterment" industry to do? Only by claiming the supremacy of environment in determining behavior can psychologists, psychiatrists, behaviorists, etc. justify today's vast expenditures by the education-welfare establishment.

Whether Skinner and crew should be permitted to continue calling themselves scientists is another topic. Maybe sufficient proof has been accumulated by microbiologists, neurophysiologists and other "hard" scientists in fields of behavior and personality to allow a challenge to social science orthodoxy and to reclaim the honorable title of scientist.

Brigitte Whitaker
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A peach's family tree

Luther Burbank was a renowned plant breeder, but he did not develop the Elberta peach as stated in "The importance of being inventive" (SN: 2/22/86, p. 123). Elberta originated from a seed of Chinese Cling planted by Samuel Rumph of nearby Marshallville, Ga., in 1870. It was named for his wife. A second seed from this tree produced the famous Georgia Belle peach. Burbank did patent July Elberta peach, a completely different peach of unknown parentage. July Elberta was quite successful but did not have the historical impact of Elberta.

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USDA Fruit Breeders
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Vaccine vs. blood screen?

Obviously if an AIDS vaccine becomes a reality ("AIDS vaccine research: Promising protein," SN: 3/8/86, p. 151), those harboring the disease will carry the same antibodies as a vaccinated person. How then will we protect our blood bank by antibody detection?

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According to Howard Streicher of the National Cancer Institute in Bethesda, Md., it's an interesting question but the problem is not likely to keep researchers up at night. While antibodies produced in response to a vaccine might indeed give a false positive result on current screening tests, it's quite possible that when – and if – a vaccine is developed, the problem could be avoided by fine-tuning the tests. For example, if a vaccine is based on protein from the AIDS virus's surface, the screening test could check for the presence of antibodies to proteins from the viral core. –L. Davis

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