Cardiac Electricians

Radio waves can cure a racing heart

By KATHY A. FACKELMANN

While no medical remedy can tame that fluttering feeling caused by a new romance, a cadre of cardiologists can bring relief to some of the millions of men and women who suffer from a congenital defect that leaves its victims prone to far riskier palpitations.

Roughly one in every 200 people in the United States suffers from a type of rapid heartbeat known as paroxysmal supraventricular tachycardia (PSVT), in which more than one electrical circuit connects the heart's upper and lower chambers. Persons born with this defect can suffer spells of rapid heartbeat, dizziness, weakness and chest pain. In rare cases, these individuals may lose consciousness or even die.

Now, several teams of cardiologists report a "remarkable" new treatment that uses radio waves to destroy the abnormal electrical circuit responsible for the rapid heartbeat.

"These patients are truly cured," says Jerry C. Griffin of the University of California, San Francisco (UCSF). Reports by Griffin's team, as well as several other groups, together represent the largest human trials of the unconventional therapy. These studies make a "major contribution" to the field of cardiology, says Jeremy N. Ruskin of the Massachusetts General Hospital in Boston.

A healthy heartbeat starts when a specialized natural "pacemaker" in the upper right chamber (atrium) of the heart fires an electrical signal. This "sinus node" impulse spreads across both atria causing them to contract. As it continues on, the impulse activates a specialized set of muscle fibers that contract like muscle cells but carry electrical impulses like nerve cells. These fibers transmit the impulse to the heart's lower chambers, or ventricles, causing them to contract and pump blood.

Normally, each electrical impulse takes a one-way trip from the atria to the ventricles and then fades away. But in persons afflicted with PSVT, the impulse continues to travel – in some cases via an extra strand of muscle fibers – back to the atria. The resulting continuous electrical circuit bypasses the heart's normal method of regulating the beat, allowing the atria and ventricles to contract very rapidly.

Indeed, PSVT victims can experience bouts of tachycardia in which the heart abruptly starts to pump three times faster than the normal rate of 60 to 100 beats per minute. Because the fist-sized organ can't pump blood efficiently at those speeds, PSVT sufferers can become dizzy or even faint during these spells. Sometimes the palpitations start for no apparent reason. Other times, vigorous exercise – such as a game of tennis – seems to trigger a tachycardia attack.

While some people suffer several spells a day, others develop the potentially dangerous heart flutterings only once or twice a year. The severity of these events also varies. Palpitations can fade spontaneously after just one minute or continue for hours – sometimes necessitating a trip to the emergency room.

"It can be very symptomatic, very disabling and disruptive to the life of an otherwise young and healthy individual," Griffin says. The problem can even result in job loss, especially among airline pilots and other transportation workers who might endanger the lives of others if they passed out during a tachycardia attack. Even where safety isn't an issue, the condition can lead people to restrict exercise and other daily activities in an attempt to avoid the frightening loss of control that these episodes bring.

In the past, most people prone to PSVT faced lifelong reliance on drugs to prevent a racing heart. In very severe cases, doctors turned to open heart surgery to sever the abnormal pathway. Though this drastic procedure promised a regular heartbeat, it carried a high risk of serious complications, including death.

Ten years ago, UCSF cardiologist Melvin M. Scheinman developed the first nonsurgical treatment for cases of rapid heartbeat, including PSVT. It involved snaking a thin, flexible catheter through blood vessels leading to the heart. Once inside the heart, electrodes on the catheter's tip zapped the abnormal cardiac circuit with a powerful surge of electric current – a microscale version of the shock therapy commonly used to jump-start the cardiac muscle of heart attack victims.

Because of its potential for serious or fatal injury, the technique remained a last resort, suitable only for the most severe cases. For example, the shock could spark a small explosion in the cardiac tissue, damaging large areas of the heart. And even if all went well, the electric current ablated not just the abnormal pathway but the normal electrical circuit as well. Thus, people who opted for this procedure required an artificial pacemaker implant to stimulate each heartbeat.

Several years ago, electrophysiologists began experimenting with a safer, easier-to-control energy source. Over the past two months, several teams have reported dramatic success using radio waves to eliminate the aberrant electrical conduits in PSVT patients.

In one study, Griffin and his UCSF colleague, cardiologist Michael D. Lesh, used radio-wave therapy to treat men and women suffering from Wolff-Parkinson-White syndrome. People born with a susceptibility to this common form of PSVT possess an extra fibrous circuit connecting the heart's upper and lower chambers. During a PSVT attack, electrical impulses passing down their normal conduction fiber will suddenly begin cycling back into the atria via the extra fiber.

By converting what had been essentially an electrical dead-end street into a continuous loop, the auxiliary fiber allows each electrical impulse to stimulate the atria and ventricles multiple times, causing the telltale palpitations.

Prior to treatment, Griffin and Lesh "map" the faulty circuits by inserting electrode-tipped catheters into blood vessels, including the femoral veins in the groin. Using X-rays as a guide, they advance the catheters along the veins and into the heart. Then the researchers trigger episodes of tachycardia and record the heart's electrical signals, a process that helps them identify the extra circuits.

Later, they snake yet another catheter through a vein and into position alongside the auxiliary cardiac fibers. When the researchers blast a short pulse of radio-frequency energy along this catheter, a small, targeted region of the heart tissue – including the aberrant loop – heats up and dies.

The treatment cured 79 of 91 volunteers (87 percent), including several who possessed more than one auxiliary fiber, says Lesh, who reported the team's data May 31 at the World Symposium on Cardiac Pacing and Electrophysiology, held in

Washington, D.C.

In one patient, a coronary artery that supplies the heart with blood did undergo a brief spasm – a problem that subsided when the researchers injected a drug that dilates blood vessels. Overall, however, the UCSF group discovered no long-lasting ill effects of the procedure.

Lesh says the radio-frequency technique appears safe and effective. "While the procedure is new and long-term outcome of these patients awaits further study, we feel this may be offered as an alternative to lifelong medical therapy or surgery," he says.

Two studies detailed in the June 6 NEW ENGLAND JOURNAL OF MEDICINE add to the procedure's promise.

In one report, Ralph Lazzara and his colleagues at the University of Oklahoma Health Sciences Center in Oklahoma City describe their treatment of 166 people with Wolff-Parkinson-White syndrome. In this study, the radio-frequency procedure chalked up a 99 percent success rate; 164 of 166 treated patients experienced no recurring tachycardia during the study period, Lazzara notes.

In 15 volunteers, however, the initial therapy failed, necessitating a follow-up treatment. Lazzara attributes those failures to the minute size of the fibers targeted for destruction. In some cases, he notes, the pretreatment, diagnostic mapping missed one of the auxiliary fibers responsible for a looped circuit. However, a second radio-frequency ablation of the affected tissue brought complete relief to all 15.

Only three patients experienced serious complications, including one case where the heart's lining became infected, Lazzara says.

In the other new study, cardiologist Fred Morady and his colleagues at the University of Michigan Medical Center in Ann Arbor focused on 106 men and women with PSVT. Forty suffered from Wolff-Parkinson-White syndrome; the rest possessed a different type of abnormal electrical circuit. By combining the diagnostic mapping and radio-frequency ablation into a single operation, the researchers cut the treatment time to an average of just two hours.

Morady's team used catheters to map the problem pathway, and then used other catheters to destroy the faulty circuit with radio-frequency energy. Overall, the therapy ended tachycardia episodes in 37 of the 40 people with Wolff-Parkinson-White syndrome and in 57 of the other 62 PSVT patients, for success rates of 93 and 92 percent, respectively.

Major problems surfaced in two of the 102 patients. One woman suffered a heart attack immediately after the radio wave treatment. In another case, the researchers damaged the heart's normal conduction pathway; this man ultimately needed an artificial pacemaker.

In the June 29 LANCET, German scientists describe their use of radio waves to stop tachycardia attacks in 105 men and women with various forms of PSVT, including Wolff-Parkinson-White syndrome. The team, led by Karl-Heinz Kuck of the University Hospital Eppendorf in Hamburg, reports curing 89 percent of the volunteers with the catheter technique.

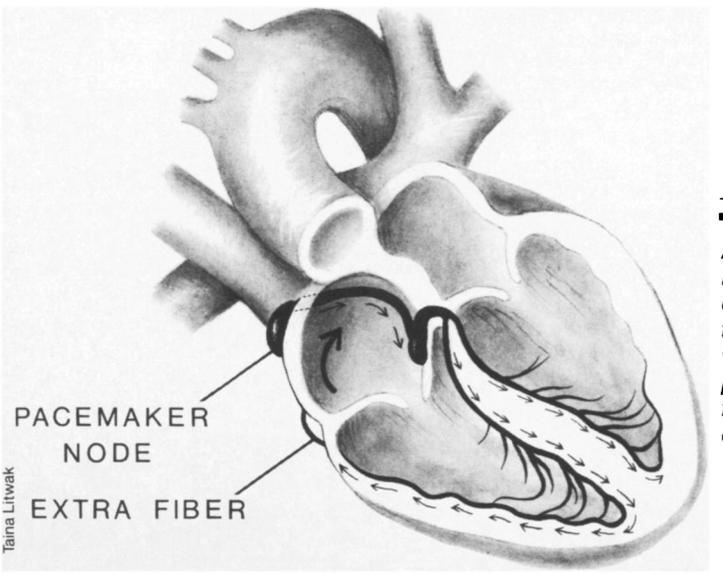
Though the researchers spearheading the recent trials consider the technique's overall track record spectacular, they point to the occasional complications as proof that the experimental therapy involves some risk – albeit a low one.

"The really important thing for all of us who are cautious about the future is long-term follow-up," Lazzara says. For example, tissue burned by the radio-frequency zapping eventually dies and leaves a tiny scar. Lazzara wonders whether that scar might cause problems later, especially in people who already have heart damage due to coronary artery disease.

But for most people, the benefits of treatment far outweigh its risks, he and other investigators maintain. That's why Griffin's team recommends the treatment to anyone subject to heart palpitations of 300 beats per minute – a condition that can result in sudden death. The UCSF team also will perform the procedure on any chronic tachycardia sufferer who cannot tolerate drugs that slow a racing heart. Such drugs sometimes fail to control the episodes. In other cases, they may provoke serious side effects, including a dangerously irregular heartbeat, Griffin notes.

For milder cases of rapid heart rate, physicians often leave the treatment choice to the patient. Some people, especially young adults, find the threat of these sudden attacks very frightening, yet they don't want to take medication, Griffin explains. Some simply prefer the risks of the new procedure to the uncertainties of drug therapy.

Says Griffin: "There are some patients who say: 'I simply do not want to take drugs the rest of my life if there is a curative procedure available.'" □



Taina Litwak

A regular heartbeat relies on a tiny electric current generated by a specialized pacemaker in the heart's right atrium. The electrical signal causes the atria to contract; then the signal travels along specialized fibers to the ventricles, causing the ventricles to contract. Finally, this signal dies out. However, for people with PSVT, the signal continues to travel via an extra fiber, a process that forms a continuous circuit that causes episodes of extremely fast heart rate.