Problems reported with two heart rescues

Cardiopulmonary resuscitation (CPR), a standard emergency treatment for sudden heart failure, appears futile in many elderly people, according to a new study. Reviewing medical charts of 503 elderly patients resuscitated after cardiac arrest, researchers found that only 3.8 percent left the hospital alive. In previous studies including both young and old patients, about 15 percent survived to leave the hospital.

Donald J. Murphy of the George Washington University Medical Center in Washington, D.C., and his colleagues identified several factors affecting post-CPR survival among patients aged 70 and older. Resuscitated patients who were alone when their hearts stopped fared worst, with fewer than 1 percent surviving long enough to leave the hospital. But even among those attended by hospital personnel when the arrest occurred, only 10 percent survived.

Murphy notes that serious illnesses or certain abnormal heart rhythms can lead to cardiac arrest, and while medics can restart the heart, they can't reverse the course of the disease. He details his group's results in the Aug. 1 ANNALS OF INTERNAL MEDICINE.

In an accompanying editorial, Philip J. Podrid of the Boston University School of Medicine calls the study's results "depressing." However, he told SCIENCE NEWS, "I don't think it calls into question the value of CPR. I think it calls into question the value of resuscitation of elderly patients who have chronic diseases."

Physicians attending the elderly generally agree they should discuss CPR survival statistics and "do-not-resuscitate" orders with virtually every aged patient entering a hospital or nursing home. Murphy, however, located evidence of such discussions in only 21 of the 503 charts reviewed.

"You look at CPR attempts on TV and it looks like a pretty benign procedure that works most of the time," Murphy says. "That's not the case at all."

CPR is not the only cardiac emergency procedure receiving scrutiny in recent weeks. For decades, scientists have injected solutions of sodium bicarbonate (baking soda) into the blood of cardiac arrest patients to correct excess acidity, or acidosis. But some research in animals has suggested it may do just the opposite. Now, in the July AMERICAN JOURNAL OF MEDICINE, researchers report the first controlled study showing that bicarbonate can have similar harmful effects in humans.

Studies in dogs demonstrate that when insufficient oxygen is available to tissues, bicarbonate increases rather than decreases acidosis (SN: 5/18/85, p.311). Normally, when muscles can't get enough oxygen, they make lactic acid, causing acidosis. A healthy heart can handle the situation, but a diseased heart provides tissues with only the bare minimum of oxygen. A vicious circle ensues. Without enough oxygen, the liver – which normally removes lactic acid – can't do its job. Starved for oxygen, the heart's efficiency plummets.

Bicarbonate breaks down in the blood, releasing carbon dioxide, which can increase acidosis in cells. It may also reduce oxygen availability by binding the gas more closely to hemoglobin in red blood cells.

Bicarbonate appears to cause the same problems in people with congestive heart failure, a condition study coauthor Allen I. Arieff calls "just shy of cardiac arrest." He and his colleagues at the University of California, San Francisco, injected either saline or bicarbonate solution into patients undergoing evaluation for congestive heart failure. "These human studies completely support the animal work," Arieff says. "If there is any problem with oxygen getting to the tissues, bicarbonate does exactly the opposite of what you'd like it to do." In contrast, he notes, it safely relieves acidosis in patients without heart disease.

In 1986, prompted by the animal studies and a lack of clear evidence showing bicarbonate's benefits in cardiac arrest, the American Heart Association (AHA) recommended limiting its use. According to Joseph P. Ornato of the Medical College of Virginia in Richmond, who heads the AHA's subcommittee on cardiac emergencies, Arieff's "very enlightening" human study is "driving the nail even deeper into the coffin." – *S. Hart*

Cutting away DNA the mitochondrial way

When British researchers last year showed that a deletion of DNA within the mitochondria of cells caused a series of related muscle ailments, they revealed a new type of disease-causing genetic defect. Now a team at Emory University in Atlanta suggests it has unraveled the basic mechanism causing the loss of mitochondrial DNA.

"We think we understand how the deletions occur, that the deletions are a direct result of the normal replication process and that the deletion process can occur anytime during [fetal] development," team leader Douglas C. Wallace reported last week at the annual Short Course in Medical and Experimental Mammalian Genetics in Bar Harbor, Maine. "This is a very interesting class of mutation. They are spontaneous mutations; they are not inherited."

Mitochondria serve as power plants inside cells, producing adenosine triphosphate, the key fuel used by cells. A human cell contains 300 to 600 mitochondria, each harboring four to 10 double-stranded circular bits of DNA that hold a few dozen genes. These genes are distinct, and replicate separately, from those packed on the rod-like chromosomes inside the cell nucleus.

Mitochondrial genes reside on two concentric circles of DNA called the heavy and light strands. During DNA replication, these strands separate, and each becomes a template upon which a new, identical strand is made. Wallace and his colleagues have identified a series of direct repeats – short segments of DNA with identical sequences of the nucleotides that make up DNA. They propose that during replication of a DNA strand, one repeat can mistakenly join to an identical repeat site further along the strand, creating a loop that breaks off.

"Our model is that during this period when a single-strand region is bowed out, you could have base pairing between this upstream repeat and this downstream repeat to give you [a loop]," Wallace explains. The shortened DNA piece then serves as a template for DNA replication, and all subsequent copies of the strand will lack any sequences lost when the loop broke off.

The process is vaguely analogous to a loop in a river that gets eliminated when the river eats through the land within the loop, shortening the river's course. In mitochondrial DNA, however, the lost loop contains information vital to cell functioning. Because the rate of DNA replication is proportional to its length, the mitochondrion produces the shorter, defective DNA faster. Thus an increasing percentage of mutant mitochondrial DNA gets passed on to descendants of the original defective cell. Eventually, the percentage becomes so great that the cell cannot function properly.

"What's amazing is that depending on when [in fetal development] a deletion occurs, different organ systems are involved," Wallace says. "If you have the deletion very, very early, then all cells will have the deletion and all cells will be affected. But if the mutation occurs very, very late, just at the end of development, then just the cells to be derived from that [mutated cell] will have the deletion."

Several groups have found that the same mitochondrial DNA deletion can cause a variety of ailments, depending on the fetal stage at which the mutation occurs. Wallace's group recently discovered that a specific deletion can cause a wide range of eye problems, from ophthalmoplegia (a loss of eye movement in the socket) to Kearns-Sayre syndrome, which includes ophthalmoplegia, night blindness, uncoordinated gait, deafness and abnormal heart rhythm. – *P. Young*