

## Scenery afforded visibility protection



U.S. Forest Service

*Keep America beautiful is the philosophy behind new air-pollution rules signed into law Nov. 26. What the Environmental Protection Agency seeks to do is protect America's national parks, forests and major wilderness tracts from the obscuring ravages of haze and plume blight. Phase one in this campaign to literally increase the visibility of our natural scenic splendors concentrates on plumes because their origins, usually a single or small group of smokestacks, are relatively easy to determine. In contrast, haze is generally due to polluted air masses that may stretch hundreds of miles, last for long periods and gather clouding particulates from a multitude of sources. As a result, regulations won't tackle the complex haze problem unless and until scientific monitoring techniques are developed to provide better data. For now, states must submit plans to EPA explaining how they will enforce use of best-available pollution-control equipment by industry and protect visibility from new industrial polluters.*

## New research on CPR questions mechanism

Any of the thousands of persons whose lives have been saved by cardiopulmonary resuscitation (CPR) can attest to the efficacy of the chest compression/artificial respiration technique. The question unresolved since the procedure was introduced in 1960 is just how CPR moves blood out of the chest cavity.

The generally accepted presumption has been that externally applied pressure on the chest catches the heart between the breast bone and backbone, creating a blood-pumping bellows. But prompted by the finding that coughing alone can move blood when the heart is stopped and the observation that during CPR pressure in the heart chambers is roughly equal to pressure within the chest cavity, scientists are taking a second look at the assumption. Some CPR researchers now feel that the increased pressure in the thorax generated by chest compression or coughing is what forces blood from inside the chest out to the body, with the heart merely a passive conduit.

The question may ultimately have practical significance — if increased pressure is moving more blood to the vital organs, then CPR could be improved through techniques to increase pressure, such as forcing air into the lungs during chest compression and using an abdominal

binder. But the researchers are careful to warn that the question requires long-term study before any practical changes in CPR are made.

The question, as it evolved at the recent American Heart Association convention, pits proponents of intrathoracic pressure against believers in cardiac compression. The AHA is waiting for more evidence, but meanwhile has changed the official appellation for CPR from closed chest cardiac compression to external chest compression.

A series of animal studies from the University of Southern Maine in Portland, Purdue University in West Lafayette, Ind., and the University of Pittsburgh showed no change in blood flow and cardiac output during CPR whether or not the thoracic cavity is vented to eliminate pressure buildup. The group concluded that intrathoracic pressure could not be a significant cause of blood movement, or they would have measured far less blood flow in the vented chest.

But their results contradict a Johns Hopkins study presented by Myron Weisfeldt. He and his colleagues found that across a broad range, intrathoracic pressure appears to determine pressure in the aorta and the right atrium of the heart. (These relationships were not altered by

venting the thoracic cavity, because the tubes used to vent the cavity are not as effective in lowering pressure as other methods, Hopkins's Nisha Chandra explains.)

Other information presented at the meeting in support of the Hopkins group was a study by a University of California at Los Angeles group that shows that blood leaves the thorax only when intrathoracic pressure rises.

The heart compression proponents admit that the pressure rise may affect blood movement. Back in the 1960s, says the University of Pittsburgh's Peter Safar, "We were among the first two groups which showed blood flow during CPR can be improved by ventilating lungs during chest compression." The question, he says, is a matter of degree. "We don't disagree that overall intrathoracic pressure fluctuations are a frequently important mechanism in standard CPR. But we cannot predict in a given patient how much blood flow is caused by direct heart compression and how much is caused by intrathoracic pressure fluctuation."

The Hopkins group, using simultaneous ventilation with chest compression in carefully monitored human trials, indirectly measured blood flow to the head through the carotid artery and found it more than doubled. Pressure studies appear to show that in only 20 percent of the patients was blood movement due to direct cardiac compression, while in 80 percent flow was due to the pressure differential, says Chandra.

Since the major aim of CPR is to deliver blood to the vital organs, the real question is whether pressure-augmented CPR delivers more blood. Both groups are currently studying the problem. Whatever the answer, both sides agree that a high intrathoracic pressure is at work in a remarkable finding by J. Michael Criley of the University of California at Los Angeles. Criley has found that coughing is the best CPR of all. "In a cough you take a lungful of air and cork the glottis," he explains, which closes off the air outlet and greatly increases intrathoracic pressure. In dogs, he has found that one cough moves two and a half times the amount of blood to the brain as a normal heartbeat. The procedure is more difficult to apply to humans, since they must sense that their heart has stopped. One heart patient who went into ventricular fibrillation shortly after the technique had been explained was able to cough for the 92 seconds it took to set up a defibrillator. A doctor whose heart was fibrillating was able to cough all the way to the hospital.

"If you feel you're losing consciousness, it might be a very good way to bail yourself out," Criley says, though coughing is not the path to take when you feel the pain of a heart attack. The trick will be in figuring a way to alert a person to cough in the 15 seconds between heart stoppage and loss of consciousness. □