Biomedicine

Ron Cowen reports from Washington, D.C., at a meeting of the Federation of American Societies for Experimental Biology

Cocaine and the nervous system

Len Bias didn't have a chance. Minutes after the University of Maryland basketball player overdosed on cocaine, he developed an erratic, uncontrollable heartbeat. He died June 19, 1986, a casualty of a heart syndrome known as sudden death.

For several years, researchers have studied animal models of cocaine-related sudden death in hopes of finding the causes of this rapid and unpredictable form of heart failure. Scientists have proposed that cocaine exerts its lethal influence by stimulating the sympathetic nervous system, which accelerates heart rate. But a new study of cocaine-infused dogs indicates the drug may have an additional – and more critical – effect on another part of the nervous system. The finding suggests new treatments for cocaine overdose, says biophysicist Stephen S. Hull, who led the study.

Hull and his co-workers at the University of Oklahoma and Corazonix, Inc., in Oklahoma City, found that cocaine appears to inhibit the parasympathetic nervous system, which normally acts as a protective "brake" to slow a rapidly beating heart. "Rather than [just] jazzing the accelerator, cocaine [primarily] acts to release the brake," he explains.

Hull's team detected two clues pointing to cocaine's deadly link with the parasympathetic nervous system. For one, they observed that cocaine caused severe arrhythmia by increasing both blood pressure and heart rate in the 10 dogs under study. Normally, Hull says, elevated blood pressure prompts the brain to stimulate the parasympathetic nervous system and thus to lower the heart rate. He and his colleagues reasoned that the stimulation had little effect because cocaine had disrupted the parasympathetic system.

They also found that the low dose of cocaine used in their study – comparable to about one-thousandth the typical street dose – markedly reduced the degree of heart rate variation among both healthy dogs and those at high risk for sudden death. Proper functioning of the parasympathetic system, Hull notes, determines the brain's ability to vary heart rate widely – a necessary control for a healthy heart.

Hull says the findings suggest that heart-stabilizing drugs that activate the parasympathetic nervous system may improve survival of overdose victims. Electrical stimulation of the vagus nerve, which contains parasympathetic fibers leading to the heart, may be another possible treatment, he adds. People who overdose on cocaine "should be treated with antiarrhythmic drugs just as if they were heart attack patients," Hull asserts, "even if they don't appear to have symptoms."

Salt's added injury to arteries

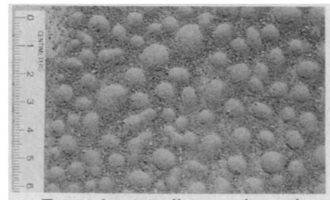
Salty diets may damage arteries even without causing large increases in blood pressure, animal studies indicate. Louis Tobian and Susan Hanlon of the University of Minnesota Hospital in Minneapolis initially fed a high-salt diet to rats resistant to salt-induced high blood pressure. They also administered a steroid hormone that causes the kidneys to retain salt. The researchers later divided the rats into two groups: About half were put on a low-salt regimen, and the rest resumed the high-salt diet. The average blood pressure of both groups remained only slightly elevated throughout the study, Tobian says. But by 15 weeks, all 49 rats in the high-salt group were dead, while the 51 on the low-salt diet continued to thrive.

The researchers examined the brains of the dying rats and found small areas of dead tissue. Tobian thinks the damage resulted from salt-induced arterial wounding and narrowing, which cut off blood supply to surrounding brain cells. "Salt's infamy goes beyond its effect on blood pressure," Tobian says. He suggests this injury may explain the high stroke incidence among people in northern Japan (SN: 4/22/89, p.250), who eat high-salt diets comparable to those of the test rats.

Earth Sciences

Mysterious Mima mounds: Seismic source?

A fluke observation involving a doghouse and an eruption of Mount St. Helens may solve a geologic mystery that has puzzled scientists for more than 150 years.



Experimentally produced mounds

Mima mounds near Rock Lake, Wash.

Satkoski/Geology v. 18, p.283

Mima mounds – rounded piles of soil standing as high as 3 meters – appear clustered in diverse spots around the world and "may have generated a greater variety of hypotheses than any other geologic feature," says Charles G. Higgins of the University of California, Davis. In the past, scientists have attributed these mounds to factors ranging from burrowing gophers to plant roots. But a serendipitous series of events leads geologist Andrew Berg to propose earthquakes as the cause.

While constructing a doghouse in 1980, Berg happened to hammer on a piece of plywood covered by a fine coat of volcanic ash from the Mount St. Helens eruption that spring. Berg, who works for the U.S. Bureau of Mines in Spokane, Wash., noticed that the pounding produced a pattern of bumps in the ash that looked suspiciously like miniature versions of the Mima mounds common near his home. In his off hours, Berg repeated the experiment under more controlled conditions. He observed that the vibrations from several hammer blows sorted the material, causing soft sediments to form mounds separated by coarser-grained material – a feature characteristic of some Mima mounds.

Berg thinks the experimental mounds arise because vibrational waves traveling through the plywood interfere with each other, causing certain locations to vibrate heavily while others remain still. A similar interference pattern of earthquake waves, he reasons, could create Mima mounds in areas where a thin layer of loose soil rests on a flat section of rock or hard soil. Because repeated hammer blows to the plywood did not erase the mounds, Berg believes they are stable once formed and would not fall apart during repeated earthquakes.

The hammer experiment does not prove the earthquake hypothesis, Berg notes in the March GEOLOGY. Nonetheless, he calls the evidence "extremely compelling." His theory would explain why Mima mounds form in many earthquake-prone areas around the world that have markedly different climates.

A horse to fit in your lap

Paleontologists have discovered fossils of cat-sized horses that scampered across northwestern Wyoming about 50 million years ago, during the Eocene epoch. Called *Hyracotherium sandrae*, the newly identified species is the oldest known horse in North America, reports Philip D. Gingerich of the University of Michigan in Ann Arbor.

H. sandrae, which resembled a Siamese cat in size and build, shared the landscape with other early forms of modern mammals such as primates and small, deer-like animals, whose fossils also appear at the Wyoming site. Scientists have found no predecessors to these species in North America, suggesting they migrated there after evolving on another continent, says paleontologist Gregg Gunnell of the University of Michigan, who studies the Wyoming fossils with Gingerich. At that time in Earth's history, land bridges may have connected North America to Europe and to Asia, Gunnell adds.