Heart attack: The biochemical insults

Coronary heart disease is characterized by these events: An artery or arteries bringing blood to the heart close down. Oxygen and sugar in the blood cannot get through to the heart, creating a state called "ischemia." If this deprivation lasts long enough, heart muscle is permanently damaged—a heart attack takes place. If a person experiences a severe enough heart attack or enough heart attacks, his heart stops functioning, and he dies.

Defining the biochemical responses of heart tissue to deprivation of oxygen and sugar has enormous clinical importance. If the sequence of biochemical events leading to the death of heart muscle could be defined, it might be possible to salvage damaged cells and to stimulate repair of them. But investigators have had trouble unmasking such events in intact animals, perfused hearts or strips of heart muscle.

Now an ideal model for studying the effects of oxygen and sugar deprivation has been found by Joanne S. Ingwall, Marlene DeLuca and Harley D. Sybers of the University of California at San Diego, and by Kern Wildenthal of the University of Texas Health Science Center at Dallas. It is the fetal mouse heart. They report their findings in the latest (July) PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES. "This model," they claim, "permits assessment of interventions designed to stimulate repair processes and to salvage damaged cells."

Ingwall and her team thought that the fetal heart might make an ideal model for studying the effects of oxygen and sugar deprivation because it can be kept beating in culture for weeks and it responds to drugs and hormones just as the adult heart does. So they obtained fetal mouse hearts and attempted to determine the effects of oxygen and sugar deprivation on the cellular process of glycolysis, whereby sugars are broken down, and on the cellular process of oxidative phosphorylation, whereby sugar in the presence of oxygen is converted into energy molecules known as ATP. ATP molecules are needed by all tissues of the body, but the energy requirement of the human heart is the greatest of any body tissue.

Three to four hours of glucose deprivation in the presence of oxygen did not affect the content of ATP in the hearts, they found. However, deprivation of oxygen in the presence of glucose for four hours resulted in immediate loss of beating function and in a significant reduction in ATP levels. During sugar and oxygen deprivation or during oxygen deprivation alone, stored sugar was also decreased.

These and other results, they conclude, show that fetal mouse hearts in culture are responsive to oxygen deprivation alone and to oxygen and glucose deprivation together, and that the hearts can be used as models to assess the value of efforts to salvage the heart from damage from such deprivation. They have found, for example, that if they give sugar and insulin to some hearts deprived of oxygen and only sugar to other hearts deprived of oxygen, all the hearts regained the same levels of ATP (67 percent of normal). So sugar, they conclude, is clearly more important than insulin in helping the heart combat ischemia. However, glucose does not appear to be as crucial as oxygen. Continued glucose deprivation does not prevent resynthesis of ATP if oxygen is restored to the cultures.

Such findings, Ingwall told SCIENCE NEWS, provide biochemical support for the kind of therapeutic intervention many cardiologists now use on heart attack patients—drugs that minimize the heart's oxygen requirement so that damaged heart cells, which can operate only under low levels of oxygen, are not taxed. "We are currently testing a series of hormones and drugs on our models to see to what extent repair is possible," she says. ☐

A test to diagnose schistosomiasis


British Information Services

Phillips with disease detection plate.

Schistosomiasis, one of the most debilitating and widespread of the world's tropical diseases, afflicts more than 100 million people in Latin America, Africa and Asia (SN: 2/9/74, p. 88; 1/18/75, p. 44). Until now, methods of detecting the disease, including conventional blood tests, have been unreliable, because it is often mistaken for other worm diseases.

Now a team of researchers at the London School of Hygiene and Tropical Medicine has devised a simple, accurate blood test to diagnose schistosomiasis. The test involves making a highly purified solution of a protein antigen found in the schistosome, but not in other parasitic worms. The antigen is put on an agar plate. Then the blood of a person suspected of having schistosomiasis is mixed with the antigen. If antibodies in the blood react with the antigen, the person is infected. Thousands of tests have already verified the method.

The team, led by T. Phillips, has been experimenting with an automated technique for performing these tests in field stations as well as at base laboratories. They hope that it will be widely used in the field within a year. ☐

Glacier-top lake: Vanishes again

Lake Linda, a water-filled depression atop Lemon Glacier near Juneau, Alaska, is in fact more like a large pond, about the size of a football field, with a typical depth of about 40 feet. It is distinguished, however, by one unusual trait: It keeps disappearing. Poof (or slurp)—one day it's there and the next it's drained dry. The lake did its trick in 1969 and again in 1970. Then just last month, it did it again.

With virtually no warning, the level of the lake simply began to drop. A depth gauge emplaced by researchers studying the lake and its glacier showed that the surface was falling by more than a centimeter per hour. For three days the strange recession continued, representing a substantial water loss, although nothing approaching total banishment. Then, on the morning of the fourth day, the observers returned to check their gauge. The gauge wasn't necessary: Overnight, Lake Linda had run dry.

Strange as they are, the vanishing waters are not unique to Lake Linda. The same phenomenon, says James E. Bugh of the State University of New York at Cortland, is known in British Columbia, Iceland, coastal Greenland, coastal Scandinavia and even such far-removed regions as New Zealand and the Andes Mountains of South America. The cause of the sudden drainage, however, is not always the same.

Lake Linda's disappearing act is triggered when the accumulating weight of its water—there were 13 inches of rain in July, says Bugh—becomes great enough to reopen fissures and caves in the glacier beneath. The contents of the lake run out through the cracks, finally exiting, most of it in a single stream, through openings lower down on the sides of the glacier.

But Linda is just a little lake. In Iceland, Bugh says, much larger, deeper lakes sometimes drain abruptly by building up enough water pressure to literally lift the glaciers that enclose them, sometimes resulting in "a wall of water 50 to 100 feet high" rushing forth from beneath the icy skirts. Nor does the resettling of