Electronics Olympic-Style

Miniaturized radio transmitters, broadcasting heartbeat and muscle activity, are a new tool in athletic training

BY JULIE ANN MILLER

An athlete during training may check his or her pulse by placing a finger on an artery of the neck. It's a crude measurement for the complex body processes that contribute to running a four-minute mile, batting .400, doing a double somersault in the air or schussing down the slopes.

A better understanding of the mechanics of athletic performance could aid athletes in mastering skills and pushing themselves to, but not beyond, the limit. But who could row a crew-boat or play volleyball weighed down with measuring devices, burdened with gadgets or tethered with electric wires?

The solution to the problem may lie in the same device being used to monitor animals in the wild: a miniaturized radio transmitter that broadcasts physiological measurements. Scientists have recorded heart rate and body temperatures of alligators diving, ground hogs burrowing and rabbits crouching in fear (SN:9/15/79, p. 186). Now sports physiologists are beginning to use similar broadcasts to monitor athletes performing in the field.

The key to such monitoring, both for athlete and alligator, is a very small transmitter that doesn't annoy the wearer. One such broadcast device is only 16mm across and weighs 5 grams, including its hearing aid battery. While the animal monitoring devices have an electrode inserted into the brain, the instruments for human use pick up signals across the skin and are attached simply with suction cups. Their transmission is detected by an FM receiver and converted into a visual display. The development of the technique has been dependent on technological advances in receivers used for commercial stereo equipment. Ronald Zemen of Midgard Electronics, one company making a biotelemetry system, says that they modify a Japanese commercial, high-quality tuner to make it compatible with an oscilloscope or a chart recorder and add a very effective "lock" to continually fine-tune the receiver to the telemeter broadcast signal.

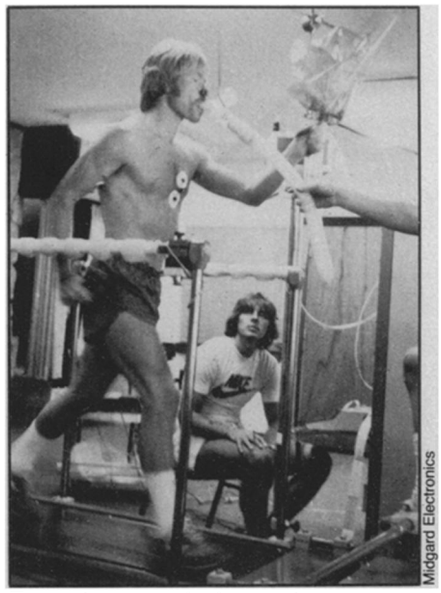
"Biotelemetry can aid athletes to learn more about themselves," says Gene "Topper" Hagerman of the Sports Physiology Laboratory at the U.S. Olympic Training Center. He sees its most immediate application as measuring heart rate of athletes during training to continually monitor how hard they are working in order to achieve the proper intensity of stress. And if an athlete has a specific problem, such as falling apart in the homestretch of a race, a coach could tell whether that correlates with a change in heart rate. Biotelemetry is already being used, for instance, in monitoring the heart rates of crew members as they row.

A more ambitious goal for sports physiology is to correlate athletic excellence with patterns of muscle activity. In this application, the telemetry device broadcasts electrical signals from muscles. Muscle activity has been more difficult to monitor than heart rate, because muscle movements tend to add confusing noise to the activity signal. However, Hagerman says that the Midgard telemetry system he tested last summer gave clear muscle activity recordings.

The first use of muscle activity monitoring will probably be to add another dimension to muscle strength, power and endurance testing. A more sophisticated use would be to analyze specific muscle activities during athletic performance. Hagerman speculates that the first step would be to choose a specific sport and a group of muscles crucial to that activity. Sports physiologists would then need a baseline; they would have to determine patterns of muscle activity among the better athletes and also among "grass roots" participants. Hagerman suspects that correlations between ability and specific muscle activity would become evident, and such information could be used for better training of young athletes.

One obstacle to widespread and effective use of biotelemetry in athletics is its cost. "It's awfully expensive, most definitely," Hagerman says. Midgard Electronics will soon raise the cost of its system to $1,500. Another problem is the wide geographic distribution of U. S. athletes in most sports, making it difficult to do extensive, repeated measurements. "Ongoing monitoring is the key," Hagerman insists.

When asked whether biotelemetry could make athletic training easier, Hagerman says he expects it instead to make training more directly applicable to the skills. A coach and athlete may more clearly understand the relationship between specific forms of training and performance. "But training is training," he concludes. "Hard work will never be replaced by any machine." □



Transmitters attached to suction cups on chest and right biceps broadcast heart and muscle activity while Ken Alligood, a member of the U.S. Biathlon team, undergoes oxygen measurements. "Topper" Hagerman observes Alligood simulate cross-country skiing by striding on a treadmill and working hand pulleys. In the Biathlon event competitors ski and shoot rifles at targets.

Telemetry for Medicine

Monitoring patients, as well as athletes, is an open challenge for biotelemetry. Small transmitters broadcasting physiological measurements can make less cumbersome such routine procedures as cardiac stress testing. With telemetry, a patient can exercise and be monitored without being burdened by wires running to recording equipment.

A variation on the transmitter, a tiny wireless microphone, is being used at Massachusetts General Hospital to observe continuously infants at high risk for Sudden Infant Death Syndrome. It picks up a baby's breathing noises and sounds the alarm if breathing stops.

Physical therapy is another area in which biotelemetry soon may have an important role. Research is beginning that assesses the heart and muscle activity of stroke and paralysis victims. The intention is to guide the patient's efforts to relearn motor skills. Again, as with athletic skills, baseline data must be collected describing in terms of electrical muscle activity the body's movements.