Comments on Physiology

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First, a response to a letter in the March issue, commenting on my Jan-Feb column on fluid replacement. The letter, from a firm that manufactures an electrolyte supplement, took issue with my conclusion that electrolyte supplements are generally of no value to ultrarunners. That conclusion was based on the best scientific evidence currently available. I stand by the conclusion and will continue to do so until I see convincing research data to the contrary.

As the basis for my comments this time, I would like to use another contribution from the March UR. David Lori's "View From the Back of the Pack" was a highly perceptive look at the strategy of running long distances when the runner has relatively limited talent for such endeavors. What he arrived at empirically actually has a very sound basis in scientific fact, His terminology needs a little tightening up, but he's on the right track for how to finish when finishing is your primary goal.

I can recall reading a column by Dr. George Sheehan in a sports-medicine journal a couple of years ago, in which he lamented his failure to finish in the preceding Boston Marathon. As he described his last few miles on the course and his growing fatigue, I found myself joining in with the people along the racecourse imploring him to slow down and walk for a while. I even caught myself arguing the scientific merits of the strategy with him as I read of his increasing loss of muscular control and coordination. "For Pete's sake, George," I muttered to myself. "You, of all people, should understand what's happening. If you don't walk and give your muscles a chance to recover, you'll never make it."

He didn't. He didn't walk—and he didn't finish. He rode the last miles on the trolley. I may be thought of as too pragmatic in this regard, but my philosophy is that, as long as you're moving under your own power toward the finish line (walking, running, crawling), you're still 100% in the race. Some people seem to think that, if the entire distance is not traversed at a trot, they will forever lose their status as "runners." If the distance and your capabilities allow you to cover the course at a run, that's great. But most low-talent runners who tackle long distances find it much less humiliating to be caught walking than to have to read "DNF" after their names in the official results. In fact, a lot of runners, like David Lori, will actually find that they can cover the distance faster with intermittent walking than by trying to run all the way.

Intermittent walking makes a great deal of sense physiologically and, properly implemented, would convert a multitude of dropouts into credible finishers. Even for highly talented runners who are challenging very long distances, the strategy of placing walking breaks into the run can make all the difference to the outcome of the race. Although they are often employed out of necessity rather than design, these strategies employ some very important principles of recovery from fatigue that every distance runner should understand and learn to exploit.

First, we need to get our terminology straight. What Mr. Lori described in his account as LSD (long, slow distance) was not. What he was doing was interval running. His companion in the race—who doggedly stuck to a slow running pace until he had to drop out—he was running LSD. But, LSD is really not a race strategy; it's a training technique. And, as such, it produces certain conditioning effects, many of which would be surprising to most of the runners who practice it. To get a handle on the relative merits of LSD and interval running in training and in competition, let's look at some basic principles of fatigue and recovery, see how these processes are influenced by the running strategy you select and how both affect your physical conditioning and race performance.

If your PR for 10 km is 45 minutes, why can't you run 50 km in 3:45? Because, during the later stages of the run, certain fatigue processes begin to restrict your ability to maintain the higher work capacity. These processes affect everyone to some degree—and some runners to a very great degree. What are these processes? How do they affect runners of different capabilities? What can be done to limit their effects?

Fatigue is not a single, one-step event. It is a series of processes, each with a separate cause and effect, and frequently with some degree of interdependence with other fatigue processes. However, not all such processes apply to every kind of physical activity. For our purposes here, we only need to consider two: the exhaustion of certain kinds of fuel and the accumulation of lactic acid. Barring injury, which itself can often be a predictable secondary effect of fatigue, dropouts from long-distance races usually result from some combination of these two fatigue processes. Obviously, then, to avoid having to drop out, a runner should know how to avoid or overcome these effects of fatigue:

Every fatigue process is associated with a recovery process that serves to reverse the physiological effects of fatigue. Except in cases of injury, fatigue is always completely reversible. However, the kinetics (that is, the time course) of recovery may be quite different from that of the fatigue process against which it works. One striking example of this difference is the depletion of muscle glycogen, which can be accomplished in a few hours of hard exercise, but requires days for complete recovery. Yet, in some cases at least, the competing fatigue and recovery processes can be at work in the body at the same time—for example, the continued removal of lactic acid from working muscles to the liver for disposal.

Obviously, the goal of every endurance athlete is to minimize the effects of fatigue and, whenever possible, to emphasize the processes of recovery. This is accomplished both through training techniques and with the strategies employed in competition. Training develops those systems in the body that are susceptible to fatigue, and conditions them to function at the highest possible efficiency. It also can enhance certain of the recovery processes. Running strategy acknowledges the runner's limitations and established conditions in which the balance between fatigue and recovery can be optimized during competition. Thus, for distance runners, we need to discuss specifically if and how interval training and LSD serve to condition the body to minimize the depletion of essential fuel and the accumulation of lactic acid, and how racing strategies can help you get the most out of your capabilities.

Long-distance running is most often considered to be an aerobic (purely oxygen dependent) activity. However, certain running muscles are required to function anaerobically (independent of oxygen and with the production of lactic acid) even at a slow pace. This anaerobic component is greater in those runners who do not have high talent for distance running; that is, do not have high aerobic capacity. It is also greater if they are more poorly conditioned The reason is that low aerobic capacity and/or poor aerobic conditioning limit the rate at which the body can obtain and make use of oxygen in the muscles. Because of this, such athletes must use a greater proportion of oxygen-independent (anaerobic) metabolism to satisfy the energy demand. This requirement for anaerobic metabolism accelerates the fatigue process in two ways. First, anaerobic oxidation uses only carbohydrate fuel (which is never abundant in the body) and it uses 20 times more fuel to produce the same amount of energy as that produced when more oxygen is available. So, when this kind of metabolism is required, the muscles use up fuel very rapidly. And, when the supply of carbohydrate fuel is exhausted, energy demand has to be reduced (you have to slow down) to a level that can be supported completely by your ability to supply oxygen. The second way that anaerobic metabolism can contribute to fatigue is by producing lactic acid, which can accumulate in the muscles and limit their work capacity.

The ability to minimize anaerobic metabolism during running is, in part, a matter of conditioning. Oxygen uptake capacity can be increased through conditioning and, as the ability to deliver oxygen to the muscles is enhanced, the proportion of required anaerobic work will decrease. In addition, training-induced increases in aerobic capacity also can be expected to increase the body's ability to dispose efficiently of lactic acid accumulations in the muscles. What kind of training schedule will provide the best opportunity for such increases in oxygen uptake capacity? Not LSD! In fact, long, slow distance running is fundamentally a very inefficient way to acquire conditioning.

Aerobic capacity is best developed through interval running—short, hard intervals. You develop the aerobic system by challenging the key elements of the system—respiration and circulation. You do very little of that when you run LSD. To affect aerobic conditioning, you have to get the heart and breathing rates up—and keep them up for a reasonable amount of time. How high and for how long? That depends on where you are in your conditioning program. You should be able to tell what constitutes a challenging heart rate for you and I believe that even as little as 10 minutes at a time can do some good. Another important aspect of this kind of training is that it can be accomplished with almost no accumulations of lactic acid. That's something else you can't do with LSD.

Let's say an average runner uses a total of 400 calories of energy in 30 minutes of running at a slow, steady pace. Aerobic conditioning will be minimal in this training session because the demands on the cardiopulmonary system are minimal at such a pace. Yet, if the runner is one of the back-of-the-pack crowd, lactic acid levels can be expected to build during the session both because the runner has only average capacity and because there is no opportunity for recovery during sustained running. On the other hand, if the athlete does the same 400 calories of output in intervals—say 10 to 20 seconds of hard running followed by 10 to 20 seconds of walking, repeated for 30 minutes—the average heart rate will be considerably higher during the session and lactic acid accumulations will be almost insignificant. The high heart rate is essential for aerobic conditioning. The reason the lactic acid remains low, of course, is, that the walk breaks allow recovery to occur—both by eliminating lactic acid and by restoring oxygen reserves in the muscles, which will help minimize the need for anaerobic metabolism in the next interval.

So, interval training can give you benefits that can't be achieved with the same amount of energy output doing LSD. Then, why even do LSD? Aside from the pure fun of it, I'm not sure. I suspect that its primary benefit is the building of strength. Frankly. I don't recommend it for back-of-the-pack distance runners. Rather, I recommend what might be called "distance intervals," the sort of thing that David Lori described in his article referred to above. I believe that, both for training and competition, the inclusion of intermittent walk breaks is the only sensible strategy for low-talent runners.

This strategy permits two important things: (1) a faster pace during running; and (2) a needed opportunity for recovery during the run. My bet is that the average back-of-the-packer, by including a 5-minute walk break every 2 to 2+ miles, will soon find that the same distance can be covered in an equal or faster time and that the physical after-effects of the workout or race will be significantly less noticeable. It's just common sense. When you want to get from here to there in the fastest time your capabilities will allow, use a strategy that will permit you to make the maximum use of those capabilities.