Polio Biology IV
Polio And Limiting Variables

Eddie Bollenbach

A Lincolnshire Post-Polio Library Publication
20th May 1999

In the natural sciences the topic of "limiting reagents" presents a challenge to undergraduate college students. A typical problem involving "limiting reagents" goes something like this: suppose you want to produce the chemical silver iodide. You make the following two elements react: silver and iodine. If you mix 1 gram of silver and 1 gram of iodine together, and they react, which one will run out first? To find this answer calculations must be made by a student with some knowledge of introductory college chemistry. One of the two ingredients will be used up. This will stop the reaction. Some excess amount of the other will remain after the reaction has stopped. The reagent (silver or iodine) that is used up first limits the extent of the reaction because it is gone. Without it there can be no more silver iodide produced.

The aforementioned example can be applied to biological and medical problems too. For example, if a marathon runner runs faster than his ability to provide oxygen to the fuel within his muscles he will exhaust himself. He needs oxygen and fuel (food) but his limiting factor here is oxygen. On the other hand if he doesn't eat for a day or two before his race he may become exhausted and perform poorly not because of a limit of oxygen but because of a limit of fuel. In both cases we can understand poor performance due to the limiting effect of one essential component of muscular performance.

Polio imposes a change to an individual's limiting variables. During the fatigue, exhaustion, and pain of post-polio syndrome something has run out. Because of the damage and remodeling of our neuromuscular system's anatomy and physiology, post-polio fatigue/pain states are caused by different limiting variables than those which stopped our able bodied athlete above in his tracks. I've been thinking about this for a while, particularly when someone barks about performance enhancers like creatine, various amino acids, magnesium supplements, herbs, mestinon, and a host of other products. These could really help a lot if they were limiting factors for the polio survivor. For example, if high energy compounds were in short supply inside our muscle fibers creatine could supply the missing energy and restore normal muscle kinetics. But if there are too few muscle fibers with normal energy within them creatine shouldn't help much. So, are any of these limiting? If the answer is no then what is the limiting variable in post-polio syndrome?

A hallmark of human anatomy and physiology is complexity. A good example of this is the fact that pain and fatigue can be often be relieved by small doses of antidepressants. This works for reasons completely outside of the limiting variable analysis. For example, normal muscle tension may exhaust post-polio muscles but if a drug can drop the muscle tension below that which is normal for an individual he will feel

better. There are a number of other examples and some of the chemicals PPS patients use that make them feel better should be used, even though they do not represent limiting variables.

To improve endurance, strength, muscle power, and muscle recovery after exercise for those with PPS we must examine limiting variables. Every credible study done to date implicates the neuromuscular system. That is, the nerve muscle unit that results in muscle contraction. Whether the trouble in PPS starts deep in the nerve cell bodies inside the spinal cord or at the nerve muscle junction, peripherally, the problem is still the motor nerve and its muscle. There are not enough motor units functioning normally in a person with PPS. The normal fibers are then driven over the threshold of normal function and so they act up. The "acting up" is the pain/fatigue and other symptoms associated with the disability. I believe the limiting variable in PPS is the number of normally functioning striated muscles enervated by motor nerves. To treat this situation properly we must conserve the overworked motor neurons. Then this leads to other problems because of the complexity of human anatomy and physiology I mentioned above.

Some of us feel so bad when we experience the affects of PPS that we get into bed, sit around, and rest too much. Then we don't feel better because we, paradoxically, are on a downward functional spiral. I want to write this again. I believe the limiting variable in PPS is overuse of muscles with too few skeletal fibers normally attached to motor nerves. But what about the muscles which aren't affected to the point where their limiting variable is too few fibers? By over resting them can we impose on them another limiting variable and make ourselves worse? When we rest good muscles day after day they become deconditioned. They then lose essential proteins for normal function, the ability to process oxygen and utilize energy, and even lose the ability to properly burn fuel. They all get exhausted but not for the same reason our polio affected muscles do. How can we prevent this?

What can we do while conserving our affected muscles? Can we address the limiting factors that contribute to post-polio derived morbidity while restoring what become limiting factors in other muscles due to a lack of conditioning? I believe so and in doing so we can maximize our health while minimizing our symptoms. In the next installment of this column I will share some of my ideas about how this can be accomplished.

▲Top of Article▲

Content Catalogue | Source Catalogue

Reception | Library | Networking | Directory | What's New?

The Lincolnshire Post-Polio Network
Registered Charity No. 1064177
An Information Service for Polio Survivors and Medical Professionals

All enquiries, book requests, medical article requests, membership fees, items for newsletters and donations to
The Secretary, Lincolnshire Post-Polio Network
PO Box 954, Lincoln, Lincolnshire, LN5 5ER United Kingdom
Telephone: +44 (0)1522 888601
Facsimile: +44 (0)870 1600840
Email: info@lincolnshirepostpolio.org.uk
Web Site: www.lincolnshirepostpolio.org.uk

this site. However, we do not accept liability for any damage resulting directly or otherwise from any errors introduced in the transcription. Neither do we accept liability for any damage resulting directly or otherwise from the information available at this site. The opinions expressed in the documents available at this site are those of the individual authors and do not necessarily constitute endorsement or approval by the Lincolnshire Post-Polio Network.

Document preparation: Chris Salter, Original Think-tank, Cornwall, United Kingdom.
Created: 20th May 1999
Last modification: 21st January 2010.