should continue to expand the list of infections that can cause TM. As we learn more about what organisms are found in TM patients, we should be able to explain more of the idiopathic cases. It is also hoped that we will be able to better understand the causes of TM and perhaps minimize the disability or prevent cases due to infectious causes.

Levy: I'm speaking with Andrea Behrman today. Dr. Behrman is an Associate Professor and researcher in the Department of Physical Therapy, University of Florida, and is involved in work that I have known as body weight suspended treadmill training.

Body Weight Suspended Treadmill Training Or Locomotor Training

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Is body weight suspended treadmill training an accurate title?

Behrman: If you read in the scientific literature, you will find that this intervention is referred to as treadmill training, body weight support treadmill training, or maybe even suspended treadmill training. I prefer "locomotive training." Body weight support refers to the device, whether it be an air-compression system, or a crank, or something else to help support the person's body weight. Treadmill -- we understand what that is. The equipment merely affords the environment in which we train. A treadmill with a harness is the best equipment available today with which to apply the training principles. However, the equipment may change as technology advances. So, I'm going to suggest we call this intervention "locomotor training."

Levy: So it is really not the equipment that makes the difference.

Behrman: Right, the equipment is a means. The process is more important. The process here is a transmission of sensory information that resembles walking to the spinal cord and brain. This includes joint angles, joint positions, the speed of the limb as it moves through space, timing and weight bearing. We used to believe the brain would issue the executive command or signal to walk to the muscles via the spinal cord. The spinal cord acted like a telephone cable and simply carried commands to the muscles. It turns out the spinal cord is not just a telephone cable but actually is, to some degree, "smart." If the sensory information that is provided to the spinal cord looks like walking, the spinal cord can recognize this information and responds by generating a stepping pattern of muscle activity.

Levy: So if the spinal cord is intact below the level of injury, it doesn't necessarily need the brain to generate muscle activity. Your work has focused on applications to actual human patients with spinal cord injury, but my understanding is that this work originated with animal studies. In particular, a cat can have complete severance of the spinal cord and still have a walk in certain circumstances.

Behrman: Basic scientists performing animal experiments have determined the spinal cord does make a contribution to the control of locomotion, so that it does have its own circuitry that can generate a stepping pattern. When the cat with the severed cord is placed on a moving treadmill with the body weight support, it can walk. However, the cat cannot walk off the treadmill and go climb a fence or chase mice. The cat still needs an intact connection from the brain to the spinal cord to walk at will. A cat with a completely severed spinal cord walks faster as the treadmill speeds up. But this is due to the sensory drive of the treadmill and not from a willful decision to speed up.

Levy: Locomotor training involves suspending a person from a harness while over a moving treadmill. Why is the suspension of weight needed? Why not bear full weight? What does a treadmill do that something else might not do?

Behrman: Many people with spinal cord injuries are too weak to hold themselves upright against gravity. The way we have compensated for this in the past might have been to place a brace around a person's knee or ankle to prevent buckling or to use assistive devices such as walkers or canes. The walkers and canes improved stability by providing a larger base of support. They also reduced the amount of weight born in the legs by transferring some of that weight through the arms. However, leaning forward, and loading the arms while gripping the walker produces very different sensory messages to the spinal cord than normal walking with the trunk upright, arms swinging fully. It may be that changing the typical arm task from swinging to weight bearing or changing the hip position diminishes the spinal cord's capability of producing a stepping response.

There are four potential advantages to gait training with a body suspended treadmill system. First, the person can be aligned into an upright posture similar to that of normal walking. Over time the amount of body weight support will be reduced; in other words, more and more load is being returned to the individual to control. We may begin training at 40-50% of an individual's body weight and reduce it over time. Second, some people gain a feeling of security knowing that they can't fall. Third, the treadmill assists in driving the person's legs and is helpful in providing an adequate speed of walking for training. This speed is often unattainable by the individual's control of walking over ground. Finally, there are the trainers who are going to help move the legs through a pattern very similar to walking which are critical to perform the training. Trainers may help to place a foot, assist with knee extension, or aid in timing between legs. All of these elements in combination make up the training.

Levy: How old is this therapy? Where did it come from?

Behrman: The therapy itself is still experimental and is being developed as we speak and thus is not available in most clinics today. It developed out of the basic sciences by researchers that were interested in understanding the nervous system and how it controls movement and, in particular, walking or locomotion. With animal models, neuroscientists examined how the spinal cord itself functions. They found an inherent rhythm generator within the spinal cord which goes, goes, goes, goes. It will even persist without sensory drive to it. With the sensory drive, it generates motor output. Some people call this activity "central pattern generation." Researchers from the mid-70s or earlier have pursued this work, such as Grillner, Edgerton, Rossignol, and Barbeau. Some of the more clinical work has been only in the last ten years or so starting with Wernig in Germany and Barbeau in Canada. Basic science work in animals has been translated somewhat to the human model by Harkema and Edgerton in California.

Levy: How many clinical trials are you aware of now?

Behrman: Barbeau in Canada conducted a clinic study using similar training to this in stroke populations. In the United States, a clinical trial is underway right now; it is sponsored by the National Center for Medical Rehabilitation Research and will continue for about four more years. It is a randomized clinical trial for acute spinal cord injury, comparing traditional therapy to this new locomotive training. The website for this clinical trial is: http:// www.rctinsci.medsch.ucla.edu/.

Levy: Tell me more about a clinical trial and what we can expect?

Behrman: A clinical trial does not necessarily answer all the questions definitively. Different research questions are asked during the trial and may generate other questions. Outcomes may vary according to the population, medications, or other elements that are necessary or pertinent.

Levy: So, what we are talking about now is a new therapy that is still not standard therapy. There is some reason in initial studies to be encouraged that some form of body suspension that allows an upright posture can be helpful, that some type system to move the lower limbs or what we think is to mimic normal gait can be helpful in restoring gait. You have worked with some patients with this. Tell me about your biggest successes and the limitations of those patients. What can they do and what do they have trouble with? Do they look totally normal? Do they look somewhat normal? Are they still using devices? And tell me about some of the patients who haven't benefited very much.

Behrman: Successful locomotor training and outcomes do not mean that after training the individual walks exactly as they walked before a SCI. But I think people see gains in their mobility and the amount of time they walk. They may still require some assistive device because of the community they live in, for example, with uneven terrain. They may not have developed adequate balance. This training primarily addresses the need to reciprocally move one's limbs necessary for walking. Two other components to walking are the need to balance while walking and the need to adjust to one's environment.

Levy: Walking is a complex activity. It depends on strength and coordination. It depends on an ability to change the program depending on challenges in the environment. It depends on having, basically, a reciprocal gait activity or gait pattern. The body suspended treadmill training seems to be able to restore some elements that might not be accessed in traditional physical therapy. It doesn't necessarily replace all of the elements. How much any given individual will benefit is hard to predict before that patient is evaluated. Some important factors include the level and completeness of injury, how weak or strong a person is, whether there are contractures, and whether the bones are strong enough to accept weight. It is uncertain now how much influence the time from the injury is but there may be a suspicion that sooner might be better than later. The presence of

contractures, perhaps certain medications, may have a negative effect on walking. We are not sure, but there are some animal models that say some of the medications that help reduce spasticity may also have the effect of retarding the neural response to certain training. Is that a fair estimation?

Behrman: All are correct. Let me comment on the last, though. Again, that is something that we don't know. We don't know the interactions of some of these spasticity-reducing medications on the training or a lot of the other activities.

Levy: What lessons has this therapy taught us that allows us to be more hopeful than we might have been. Is there any reason to be more optimistic about the potential for functional restoration than we were ten years ago?

Behrman: Yes. I think we talked a little bit about this, but one view that we have had is that the spinal cord is simply a telephone cable that carries messages. But, evidence from scientists indicates that there is circuitry within the spinal cord itself that can contribute to the control of walking. If we can tap this ability in physical rehabilitation, it may further enhance the ability to walk after SCI. Another view has been that the damage after SCI is permanent. This is beyond our current discussion, but there are certainly researchers who are examining regeneration or growth strategies after injury. Growth stimulants or growth factors or transplants may help resolve, somewhat, some of these disconnections or make more appropriate connections in the spinal cord. It turns out that the spinal cord really can learn very similarly to the way that the brain can learn. In the past we assumed that the recovery of walking, as you and I know it, was not possible based on the anatomy and physiology of the spinal cord. Now there is an abundance of opportunity to facilitate this recovery of walking. Think about other individuals with other pathologies or neurological problems. If I have had a stroke, my spinal cord is still intact. Now, some of the input from the brain is altered but I still have an intact cord itself. Maybe we can use information from the spinal cord to teach the brain something. So, we are kind of working in reverse here. I think that is the opportunity. Perhaps it is not a permanent loss. It may be repairable and if it is repairable, then specific training may stimulate and drive the repair in the right direction.

Levy: So, we are presenting a new hopeful therapy. It is not standard therapy and it is not something that someone is likely to be able to go to their local PT gym now and enroll in. What advice would you give to somebody who has got a disability from a spinal cord injury or a stroke or some other process?

Behrman: Stay in the best shape you can and the best level of fitness that you can. For each person that may be a little bit different. If you have the opportunity to stand, for example, then stand. Standing is a great way to maintain the joint flexibility of your knees and ankles. For some people standing is not available. If not, then a person should make sure to try to lie on his or her stomach to maintain hips flexibility. You never know what advance is coming down the road. Lung capacity is important. Smoking is not beneficial for walking or other activities. Persons who have joint and muscle flexibility and are more fit will be in a better position to accept the opportunity to pursue walking or whatever therapy may be available in the future. Another important element is to stay informed. There are many other sites or opportunities to communicate with others or learn about research all the way from scientific literature to the science section of the New York Times to websites. There are popular magazines, such as New Mobility or Paraplegia News that will have articles to websites on National Institute of Health and the Veterans Affairs research. So, I would recommend that persons read, stay in touch, and keep fit.

Attempting To Recognize Transverse Myelitis Subtypes

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Transverse myelitis is a syndrome of spinal cord dysfunction in which most of the functions, namely motor, sensory and sphincterial are compromised to some degree below a definable sensory level. In more than 80 % of cases, the peak of dysfunction is seen within l0 days. Before the onset of neurological symptoms, non-specific symptoms, such as fever, nausea and muscle pain occur. Initial neurological signs are paresthesias, backache and paresis of legs. Sphincter dysfunction often occurs when weakness and sensory disturbances are present. Thoracic level occurs in 80 %, while cervical and lumbar levels occur in 10% each. In the clinical setting, it is often difficult to distinguish among the various possible causes of TM. MS is often considered a strong possibility, which might not always be the case. Retrospective analyses have provided