POLIO NETWORK NEWS

International Polio Network

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U.S. Polio Survivors: The Numbers from Two Sources

Morbidity and Mortality Weekly Report, printed and distributed by the Massachusetts Medical Society, annually publishes *"Summary of Notifiable Diseases, United States."* The following charts were compiled using their 1987, 1988, and 1989 editions. The 1989 edition was published October 5, 1990.

Each edition carries this statement and should be noted:

"Data in this summary should be interpreted with caution. Some diseases such as plague and rabies that cause severe clinical illnesses and are associated with serious consequences probably are reported quite accurately. However, diseases such as salmonellosis and mumps that are clinically mild and infrequently associated with serious consequences are less likely to be reported. Additionally, subclinical cases are seldom detected except in the course of special studies. The degree of completeness of reporting is also influenced by diagnostic facilities available, the control measures in effect, and the interests and priorities of state and local officials responsible for disease control and surveillance. Finally factors such as the introduction of new diagnostic tests (e.g., for hepatitis B) and the discovery of new disease entities (e.g., infant botulism and legionellosis) may cause changes in disease reporting independent of the true incidence of disease. Despite these limitations, the data in this report have proven to be useful in analyzing trends.

"Mortality data are from the National Center for Health Statistics. Each year these data are also published in Vital Statistics of the United States, Vol. II. Data on notifiable diseases before 1960 are obtained from publications of the National Office of Vital Statistics."

From 1937-1950, the total cases included both paralytic and non-paralytic polio.

Year	Reported Cases	Year	Reported Cases
1937	9,514	1944	19,029
1938	1,705	1945	13,624
1939	7,343	1946	25,698
1940	9,804	1947	10,827
1941	9,086	1948	27,726
1942	4,167	1949	42,033
1943	12,450	1950	33,300
		Total	226,306
		(paralytic & non-paralytic)	

SOURCE: Summary of Notable Diseases, United States edition of the Morbidity and Mortality Weekly Report

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"Prescription for Weakness, Continued"

The following is the contribution of **Jacquelin Perry, M.D.,** Chief, Pathokinesiology/Polio Service, Rancho Los Amigos Medical Center, Downey, CA 90242 USA, to the panel "Prescription for Weakness" at the International Polio & Independent Living Conference in St. Louis. The other panelists were featured in ***Polio Network News*** (Vol. 6, No. 3).

DR. PERRY: Overworked muscles are causing polio survivors problems, so our program is aimed at saving muscles. The evidence at Rancho Los Amigos indicates that the target of the symptoms is the muscle. The symptoms represent accumulated strain from chronic overuse for many years.

David Bodian, M.D., identified that in acute polio in monkeys, 95% of the motor nerve cells were involved (or everything except 5% was involved). Even though the monkeys did not look paralyzed, polio was a very massive invasion. Also, he found that the average recovery of the nerves was 47%, but some monkeys had only 12% recovery and others had 91%. The number 91% always fascinates me because that says there was never 100% recovery. These data simply support that one can have muscle involvement that one was not aware of until a later challenge.

The other contributing factor to problems of today is the method of recovery of function. The Diagram B on page 2 shows three motor nerve cells (I,II,III), each activating a group (four) of muscle fibers. If we lose one nerve cell (Nerve Cell II _ _ _), the other nerves (Nerve Cells I & II) pick up part of the muscles, as shown by ▬. The result is less of an opportunity for the nerves to trade off between the muscles, resting them. (The diagram shows 3's and 4's when in reality there are 400 motor units and about 400 muscle fibers in each one.)

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"Prescription for Weakness"

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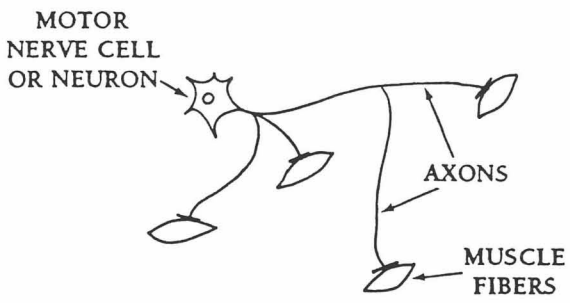

DIAGRAM A

Motor Unit: All the skeletal muscle fibers stimulated by a single motor nerve cell or neuron.

Neuromuscular Junction: The junction between a motor nerve cell, or neuron, and a muscle fiber.

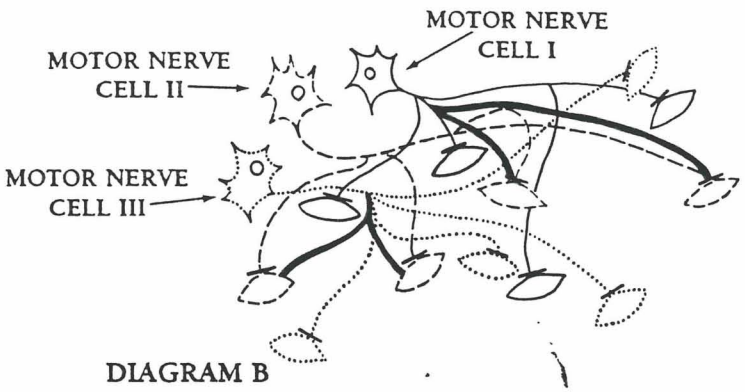

DIAGRAM B

When Motor Nerve Cell II is lost, Motor Nerve Cells I & III grow sprouts to pick up the orphaned muscle fibers. Shown by: ▬

This re-grouping is a nice substitutive way of recovering muscle use, but the resulting muscles are less efficient because a larger number of fibers is activated with each contraction.

At Rancho Los Amigos, we use dynamic electromyographic recordings of muscle action to determine the duration and intensity of an activity. During normal walking, the quadriceps show a peak effort equaling 30% of maximum ability as the limb is loaded. The effort lasts about 10% of the gait cycle and averages 20% of maximum strength. This means the thigh muscle controlling the knee has a short period of moderate effort and a long period to rest. If the average muscle action is under 20% maximum capability there is full oxygenation and no tissue stress for the brief period of peak effort. This avoids fatigue.

A record of a post-polio patient, complaining of thigh muscle fatigue, shows a very different picture. During walking, the electromyogram (EMG) of a patient with Grade 4 quadriceps showed a peak intensity of 100% as the limb was loaded, and the muscle action continued throughout the rest of the weight bearing period at an average intensity of 60% of maximum. Hence, there was overuse due both to prolonged activity and excessive intensity. In this case, the muscle was substituting for a weak calf muscle group.

Another important point about muscle action is the fact that speed reduces muscle strength. For example, a test of quadriceps strength against a rigid bar registers the most force (100%). When motion at the rate of 60 degrees per second is allowed, the person's maximum strength decreases 25%. Moving at 200 degrees reduces available muscle strength to 50%. Dynamic electromyographic recordings taken during these efforts show that the muscle was working equally hard during each test. The conclusion is that the faster one moves, the weaker are the muscles. So we recommend that polio survivors slow down.

A muscle is a very elaborate chemical plant that is a self-sufficient system and when you contract the muscle you get force. After the muscle is exhausted, it has to have time to repair itself because a contraction may have torn one of the fibers, and it has to have time to refuel itself so it can contract again. And so, what survivors need to do is give their muscles time for repair and refueling in order to be able to create force again. This is why rest periods are beneficial.

Functionally, a truly normal quadriceps exerts only 20% effort during walking. The quadriceps of a polio survivor may be working twice as hard. A muscle with 40% strength will be exerting two and a half times the normal effort and Grade 3 muscles will be working at 100%. Both situations are signs of overuse.

Survivors with Grade 3 muscles get by with postural substitutions which rely on ligamentous tension. For example, the knee is locked in hyperextension (back knee) so less muscular effort is needed. This introduces its own problems as ligaments also have a limited tolerance for stress. The clinical substitute is a brace, but some polio survivors substitute so cleverly that it is difficult to demonstrate improvement other than pain relief.

Polio individuals need to know their muscle strengths so they can plan safe levels of activity. The easiest way to assess a patient's strength is by a manual muscle

test. It is a convenient clinical procedure, but it must be interpreted carefully or weakness will be missed. A muscle which can accept all resistance given by the examiner is graded as Grade 5 (normal). Instrumented measurement of true normal and post-polio "normal" has shown that a Grade 5 quadriceps averages only 50% of true normal. Similarly, hip extension is only 75%. (These discrepancies were first demonstrated by Beasely, and we have found the same differences.) Grade 4 (good) means the individual can accept moderate but not full resistance, representing only 40% of true normal strength. Grade 3 (fair) indicates the individual can move the limb though its full range but not accept any additional resistance. This is about 20% of normal.

Because of the confusion about Grades 4 & 5, I obtain instrumented test values (i.e. Cybex or other devices) when the patient's general strength is in this range so true strengths are known. Then the patient and I can plan an appropriate activity pattern.

At Rancho Los Amigos we have five programs. These are life-style management, exercise, orthoses, medication, and surgery. The programs differ a bit between the patients with primarily muscular complaints and those with joint problems.

Our major technique is to assist our patients in life-style modification to reduce strain. The program involves myself who sells the program to the patient, if necessary, and the physical therapist and occupational therapist suggesting ways to make life-style modifications.

Orthoses (braces) are very often used to reduce the strain of weak muscles. About 75% of our patients are on life-style modification and 60% of them have braces. (We also try exercise but we will describe that program later in the conference.) We also do surgery in about 8% of the cases.

With individuals with joint pain, we use orthoses a little more and life-style modification less. The reverse is true with individuals with muscle fatigue and pain. Exercise is of less value and surgery of more value for the patients with joint problems.

We ask every new patient to estimate what they could do at the best time of life and what they can do now. What we have learned from about 200 patients is that both the muscle group and the joint group have already voluntarily reduced their activity by about 50%. We also have learned that the people who had enough muscle weakness to strain their joints have always had less activity.

In planning what to do, both the intensity and the duration of the muscular effort must be considered. The standard is 100% of your strength, not what is normal. If the task is strenuous (hard) and you must exert 75% of ***your*** strength, use of the muscle(s) should be brief or only 10% of the activity cycle (i.e. the time it takes to walk one stride.) A weak muscle survives by being active only momentarily. In contrast, if the muscle must be active for a long time, such as 50% of the stride, the vigor of the effort can be only 35% of maximum strength without causing strain. These percentages of muscular effort relate to the number of muscle fibers which must be active at that time. It also is an indirect indication of the amount of pressure occurring within the muscle. At 20% effort the muscle pressure is low and oxygen can travel to all of the cells. Higher pressure begins to limit the dispersion of oxygen. This in turn restricts the refueling and repair processes active muscles need.

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"Prescription for Weakness"

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The calf is the muscle group we use the most during walking and standing and is most likely to be overused. A functional relationship was found between the measure strength of the calf muscles and the post-polio patients' walking speed. The weaker the muscles, the more slowly the person walked. If you are having symptoms, you will demand less of your muscles if you go more slowly.

What has been our success? We determine success by using the simple scale that patients felt better, worse, or experienced no change . Life-style modification provided some improvement for 95% of the patients with muscle symptoms. Ten percent had no change and 2% continued to get worse. Improvement varied from mild to moderate. In patients with primarily joint complaints, the results were similar. Even in the exercise group, 91% still required life-style modification. So life-style modification is the key.

What about medication? Because pain is a sign of injury, increased tension, swelling or inflammation, or even tearing, I have a hard rule. I will not prescribe pain medication. (I know my patients get them from other people, but I do not prescribe them.) One has to plan a life-style that does not cause pain. I would feel as though I were double-talking, if I said, "Do not get pain," and then prescribe something to cover it up. We do use anti-inflammatory medication, because it does reduce inflammation which is swelling in the tissues. If we can reduce that, we can avoid some of the injury to the muscles. (I know you are thinking, "Well, that it is a pain medication.")

When do we use surgery? The purposes are to correct obstructive deformities or relieve muscle strain. The most common problem is "equinus," a fixed downward foot position. When the deformity is at the ankle, the heel cord is surgically lengthened. If the deformity is in the foot, we will do an osteotomy (a wedge resection and rotation of the foot). We now have an orthopedist in our clinic who specializes in the foot, and we are doing more and more surgery. We protect the surgery with a brace for several months and so far only one patient has needed to continue brace use.

Muscle strain at the ankle and knee is being relieved by tendon transfers which improves weight bearing stability. At the ankle, the muscles which control the foot joints and toes are moved to the back of the heel to supplement the weak and painful calf muscles. At the knee, the hamstring muscles are transferred to remove the strain on weak quadriceps by improving knee extension stability. For both procedures the results have been good, but we cannot "guarantee" how long these transferred muscles will be adequate. At the time of the surgery, the muscles being transferred had not become painful, and they showed good polio patient record on a gait test.

As a general rule, I say that you can do anything that does not hurt and does not cause fatigue for more than ten minutes. It has been brought up many times that none of us can tell you exactly what you can do because you all have very different habits. You do have to figure it out for yourself, but these are the rules we practice at Rancho Los Amigos.