



Polio Survivors' Page

The Late Effects Of Polio: An Eleven Year Experience Managing Post Polio

Vancouver 1992

The original effects of the polio virus

In order to more easily understand the late effects of polio, it is important to remember the original effects of the poliomyelitis virus on the body. The portal of entry for the polio virus was oral and the virus infection in its first stage was in the gut cells lining the intestines. Many people infected with the virus at this stage thought that they simply had gastrointestinal flu with the symptoms of diarrhea and nausea. For a significant percentage of the people infected with the virus, the disease ended at this point. But for some, the virus continued to multiply and spilled over into the blood stream, signalling the viraemia stage of the infection. Symptom then were not unlike a more generalized influenza, with fever, chills, malaise and achiness. Once again, for a significant percentage of the originally infected patients, the disease process ended there. However, in a small percentage of the originally infected patients, the virus was able to move into the central nervous system to infect the anterior horn cells (see diagram). Those were the individuals who got "paralytic" polio. The distribution of weakness or paralysis depended on which anterior horn cells were involved; spinal anterior horn cells involvement resulted in weakness or paralysis in the arms, legs, and trunk to one degree or another, while bulbar (brainstem) anterior horn cell involvement resulted in visual, swallowing, or breathing difficulties in any combination. The anterior horn cell or motor neuron as it is also called is the nerve cell which innervates the skeletal muscle fibres. The motor neuron (anterior horn cell) and all the muscle fibers that it innervates is called the motor unit. Remember this definition, as many of the speakers will make mention of it in discussing the late effects of polio.

It is this period of fever, weakness, paralysis, and muscle pain that many polio survivors (or their parents) remember. It was at the time when infected motor neurons were dying, leaving all the muscle fibres they innervated orphaned or denervated. If all the motor neurons that supplied a particular muscle died, the result was complete paralysis of that muscle. If only a percentage of the motor neurons died, the muscle was weakened, not completely paralysed.

Many polio survivors remember having muscles completely paralysed that started to move again, although weakly, after a period of just a few weeks. That occurred because some of the anterior horn cells were thought to have died. These non-functioning anterior cells were not dead just stunned by the swelling caused by adjacent nerve cell destruction. At any rate as days and weeks passed, the swelling subsided and the surviving anterior cells began to wake up and work again. Kenny hot packs and stretching helped control the pain and contracture of the denervated muscle. And with time and exercise, the muscle started to get stronger.

Over the course of months and years, many polio survivors got considerably stronger in a previously weakened or paralysed muscle and were able to discard braces or wheelchairs. This was not only because of hard work and exercise, but also because of a phenomenon called SPROUTING. It seems that the denervated or orphaned muscle fibres within the same muscle sent out a kind of chemical distress signal that causes tiny sprouts to start growing from the terminal nerve branches of neighbouring, surviving motor neurons. Very slowly these sprouts grew over to the orphaned muscle fibres and reinnervated them,

causing the motor unit to grow in size. In fact, some motor units sprouted three to four times as many muscle fibres as Mother Nature had originally intended. as a result, polio survivors felt stronger, and this pattern of strength and weakness remained stable for the next twenty years.

THE LATE EFFECTS OF POLIO

Since 1981, four hundred and eighty three post-polio patients have been seen at St. Mary's Hospital Post Polio Clinic. When the data from the Alta Bates-Herrick and the Santa Clara Post Polio Clinics is added, there is a wealth of statistics and information. In all, seven hundred and eleven patients have been re-examined in the Bay Area Post Polio Clinics. The ages of those examined ranged between thirty and eighty-six. The following material is based in large part on these statistics.

FATIGUE: The most frequently complained of symptom was unaccustomed fatigue (79%). During the past decade, a number of investigators have looked at the problem using a variety of research tools, including muscle biopsies, electromyography, immunologic and metabolic blood studies, biomechanical and gait analysis, and psychometric testing. The picture that has emerged from this data suggests that after thirty years, the metabolically overburdened surviving motor neurons appear to have become incapable of supporting the integrity of all the distal nerve terminals, resulting in defective neuromuscular transmission. To better understand this, try to visualize what happens at the junction of the nerve and the muscle under the usual circumstances. The electric impulse travels from the anterior horn cell, down the nerve fibre to the tiny terminal nerve endings, which contract the individual muscle fibres. The arrival of the electrical impulse at the terminal nerve endings causes the release of a chemical (acetylcholine) which in turn causes the the electrical impulse to penetrate into the muscle resulting in contraction of the tiny muscle fibre. In polio survivors, repeated discharges of the large re-innervated motor unit result in a failure of some of the muscle fibres to fire, thereby not contributing to the force of contraction. Polio survivors experience this as fatigue or a loss of stamina.

Interestingly, all polio survivors have defective neuromuscular transmission, but not all survivors complain of decreased stamina, so clearly all other factors must play a role. The number of surviving motor units is probably an important factor, as well as the force generated during a particular task. Improper pacing during day-to-day activities and deconditioning following illness, surgery, or trauma are also factors to be considered. Finally, some polio survivors complain of sleepiness as well as decreased stamina, and the "mental fatigue" may result from the stress of chronic pain or the stress of dealing with additional disability. All of these problems as well as suggested solutions will be discussed during the conference.

WEAKNESS: Four hundred and ten (58%) of the polio survivors examined in the Bay Area's Post Polio Clinics were found to have new or increasing weakness. This determination was made on the basis of the patient's history, including functional abilities, the physical examination, and appropriate laboratory studies, including electromyography (EMG), x-rays and CT scans, MRI (Magnetic Resonance Imaging), metabolic or electrolyte studies, and pulmonary function testing with blood gases. Try as we did, we were usually unable to track down old muscle testing records, but when they were available, they were also used.

A significant number of the patients had new or increasing weakness for reasons not directly related to their polio residuals. Radiculopathy (pinched nerve root) accounted for 10% (forty patients) of the total with new weakness. A few other cases were not at all related to old polio residuals and included three individuals who developed multiple sclerosis, three with peripheral neuropathy, one with brachial plexitis, and one with lithium toxicity. All of these cases underscore the importance of careful examination in order to rule out the other treatable cases of weakness. Not every ill can be blamed on the late effects of polio!

Having stated that, we note that there were a large number of patients who did have increasing weakness which were directly attributable to the late effects of polio. One hundred and fourteen patients (28% of the total with new weakness) had acute overwork weakness, while two hundred and eleven (48%) were

diagnosed with post polio muscular atrophy are one and the same. We have chosen to separate them for record keeping purposes and for prognostic reasons.

The idea of overwork weakness is not a new one. Dr. Bennett, the former medical director of Georgia Warm Springs, described it clinically in 1958, and there are other less well articulated references to worsening weakness in polio survivors going back nearly one hundred years in the medical literature. Clinically, polio survivors who have engaged in excessively strenuous activities like tennis, weight lifting, stair climbing or the like have noted the sudden onset of weakness in particular muscle groups overused in that particular activity. The muscle may lose more than a full grade of strength on the manual test. But with proper rest, the strength may return to nearly the level it was prior to the strenuous activity that some of the terminal nerve endings die back, leaving many of the muscle fibres of the same motor unit orphaned again. If the weakened muscle group is allowed to rest (by stopping the offending activity or bracing, for example), new sprouts will grow out and recapture the lost fibres. The number of surviving motor units in a particular muscle, the pattern of muscle are crucial variable.

Chronic overwork weakness, or what has been called post polio muscular atrophy (PPMA), differs in as much as there is no singular event of strenuous activity or exercise that signals the onset of increasing weakness. Rather there is a very slow and gradual loss of strength with accompanying atrophy of a particular muscle group. And no amount of rest will reverse the weakness. It appears, once again, that the overburdened motor unit is the common problem. The variables appear to be the intensity of work of work imposed on a particular muscle group by the function required of it over a long period of time. The overburdened motor unit is unable to send out new sprouts to capture the orphaned muscle fibres, which have become denervated slowly from "pushing" in order to complete ordinary day-to-day activities. It is also possible that the persistent, forceful contractions over time cause internal derangement of individual muscle fibres.

The discussion of increasing weakness can sometimes be anxiety provoking. Listen carefully to the speakers and their suggestions. Talk it over with your families and other polio survivors. And remember the four post polio "P's" of the ninties: pacing, practice, perseverance, and patience!

WORSENING RESPIRATORY PROBLEMS: Of the total number of patients seen in the Bay Area's Post Polio Clinics, only one hundred and fifteen (16%) were classified as having worsening respiratory problems. This included people who required supplemental oxygen at night time, increased mechanical assistance like IPPB during the day, more effective mechanical assistance necessitating a change in the type of ventilator, and those who began using positive pressure by mouth ventilation at night. There were other respiratory problems, but these were not included in the statistics. Recurrent bronchitis was a frequent enough problem to warrant mentioning, even though the patients for whom it was a problem had a perfectly adequate and no difficulty handling secretions. Except for two patients, there were no immune abnormalities. The problem seems to be more of a chemical bronchitis (as opposed to infection) caused by night-time aspiration of tiny amounts of stomach acid, which reflexes from the stomach into the esophagus because of hiatus hernia. Fully one hundred and sixty-seven polio survivors (23%) have symptomatic indigestion secondary to hiatus hernia. The figure may be so large in polio survivors because of the high percentage of scoliosis, which is usually associated with chest wall rotation. There are other effects of scoliosis on weakness of the deep breathing or coughing muscles. Despite reports of sleep apnea in polio survivors, we have seen only one documented case.

JOINT AND MUSCLE PAIN: Various musculoskeletal aches and pains were a problem for five hundred and fifty-nine polio survivors (74%). Many people had more than one site of pain, and had been bothered by one pain or another for many years. As you can see from the statistics that follow, most polio survivors suffer from chronic pain, which for some can be quite disabling. Our statistics break down the different sources of pain, thereby providing a convenient framework for discussion of the management of specific pain problems.

Nearly all polio survivors (99% of our patients) had scoliosis when seen in the Post Polio Clinics. Scoliosis per se does not hurt, but the long standing effects of rotation and curvature of the spine have been associated with conditions that do hurt. We found that one hundred and seventy-eight people (34%) had facet arthropathy or wear-and-tear arthritis of the little joints of the spine. Two Hundred and sixteen (41%) had degenerative disc disease, sometimes in combination with facet arthropathy. Sixty-seven (12%) had pain in the back and legs or in the neck and arms due to radiculopathy (pinched nerve root). Fifty-nine patients (11%) had lumbar spinal joint pain. All but one of these people were long-time wheelchair users with pelvic obliquity associated with scoliosis. Three patients had piriformis syndrome.

The other joints in addition to the ones of the spine showed signs of wear-and-tear arthritis. As in the case of the back, abnormal biomechanics and overuse (or sometimes abuse) causes wear and tear or degenerative arthritis. The shoulder was affected in one hundred and sixteen people (22%), while the knee was affected in one hundred and eleven (21%) polio survivors. Degenerative arthritis was present in the top in fifty-eight (11%), in the ankle/foot in thirty-one (4%). Interestingly, if a leg was braced because on the unbraced side, which had been the side of major weight bearing for years.

In addition to joint pain, there were a number of soft tissue sources of pain. Bursitis/tendinitis was generally associated with underlying arthritic changes and was present in one hundred and seventy-one patients (32%). Carpal tunnel syndrome, usually associated with cane walking or pushing a wheelchair. Fibrositis or myofascial pain syndrome, with underlying degenerative changes in the spine, was present in sixty-eight patients (13%). Fifty-nine individuals (11%) complained of muscle tension headaches, which was associated with degenerative cervical changes. Fifteen patients (3%) complained of burning and tingling in the hand and arm due to ulnar compression neuropathy from leaning on their elbows of the wheelchair armrests. Other compression neuropathies causing pain and discomfort included tarsal tunnel syndrome (not unlike carpal tunnel syndrome, but in the foot) and lateral femoral cutaneous neuropathy. Finally, there were eleven cases of thoracic outlet syndrome, associated with chronic slumped shoulders. We did not collect statistics on fractures.

As with all chronic pain syndromes, treatment with narcotic pain relievers is not generally indicated because of the addiction problem associated with long-term (longer than two weeks) usage. All of the other means of dealing with chronic pain will be discussed along with specific commentary about management of the above listed musculoskeletal problems.

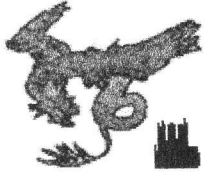
COLD INTOLERANCE: Forty-one percent of the polio survivors complained of worsening cold intolerance. For nearly everyone it was not a new problem, but one that had been present since the onset of polio to a less bothersome degree. There seem to be two manifestations of the problem. One we have dubbed the "purple foot syndrome" which is characterized by painful coldness in one or more limbs, usually in the limb most affected by residual atrophy. Spouses also complain of the problem, especially in the middle of the night! It appears that some of the sympathetic nerve fibres were affected originally and these fibres are the ones that constrict the blood vessels of the skin in response to cold. Normally, when we are exposed to cold, the blood vessels of the skin constrict to shunt blood away from the surface of the skin down to the underlying bone and muscle where heat radiates away from the affected limb and it cools down. The best treatment is an elastic stocking and good woolly socks, foot warmers at the bottom of the bed, and an insensate spouse!

The other part of the problem is decreased muscular performance in the presence of cold. Many polio survivors find they are unable to swim in an unheated pool, or they have more trouble walking in cold weather. This is explained by the fact that when muscle is cooled, defective neuromuscular transmission is made worse. Refer back to the section on fatigue to refresh your memory about defective neuromuscular transmission. If you suffer from cold intolerance, you can only be advised to try to avoid cold exposure and "button up your overcoat".

The statistics and information provided in this handout are merely an outline of the late effects of polio.

The other speakers will flesh out the details of the various problems, and more importantly, provide you with some solutions.

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Original Document Preparation: Tom Dempsey.

Document Reference: <URL:<http://www.eskimo.com/~dempt/vanc92.htm>>

Last modification: 10th January 1998