

POST-POLIO HEALTH

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Overuse and Disuse Weakness

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Summary

Overuse can be defined as the chronic overloading of muscles in daily life activities resulting in physical complaints such as muscle fatigue and pain. Overuse can develop in case of a reduced capacity of muscle to endure loads due to paresis (slight or partial paralysis), but also when normal muscle is chronically overloaded, for instance when a muscle has to compensate for other paretic muscles. This paper focuses on the overload of muscles but other structures such as tendons, ligaments and joint capsules may also suffer from overuse symptoms.

The treatment of overuse is individual and starts with a careful analysis of capacities and demands in daily life activities, which is followed by an individually tailored treatment plan containing a mixture of lifestyle alterations, bodily aids, environmental adaptations and exercise.

Overuse and cardiorespiratory conditioning

The symptoms of post-polio syndrome (PPS) such as muscle pain, increased fatigue after physical activity and delayed recovery following physical activity may signify that muscles are overused in conducting ordinary daily life activities.^{1,2} Support for such a chronic overuse of muscles in people with prior polio has been found in studies showing elevated levels of serum creatine kinase that were related to the distance walked during the previous day,³ and in studies showing a type I fibre predominance in lower leg muscles supposedly due to fibre type transformation from chronic overload.^{4,5}

Also, PPS subjects recover slower from fatiguing exercise than stable polio subjects.^{6,7} Another factor that is said to contribute to the symptoms is a poor cardiorespiratory condition.⁸⁻¹⁰ However, the cardiorespiratory condition of polio subjects was not worse than that of healthy, comparably active subjects.¹¹ In this study it appeared that the reduced submaximal performance capacity of the polio subjects was strongly correlated with the limited available muscle capacity and the effectiveness of movement was diminished compared with the control subjects.

Lower concentrations of some oxidative enzymes in muscles of polio subjects have also been reported while other oxidative enzymes were within normal ranges.^{12,5,13} The clinical significance of these findings has been debated.¹⁴

It is important to distinguish between complaints of overuse in muscles with polio residua and in nonaffected muscles. The latter may result from increased compensatory muscle activity. This has been shown for upper extremity complaints¹⁵ and may also be found in back muscles and leg muscles in case of postural deviations and altered gait patterns.

Abilities and disabilities

A decline in the ability to perform activities was mainly found for walking, climbing stairs and for transferring.¹⁶⁻²² In a recent study, physical functioning declined



Dr. Nollet at PHI's Ninth International Conference on Post-Polio Health and Ventilator-Assisted Living, June 2005.

little over a 6-year period.²³ In agreement with the concept of overuse was the finding that the extent of paresis was the only prognostic factor for a decline in functioning. A significant increase in "handicap severity" for mobility, occupation and social integration was found in PPS subjects over a period of 4-5 years, while in non-PPS subjects the "handicap severity" remained unchanged.²⁴

In a recent study it was shown that energy cost of walking increased linearly with increasing severity of paresis of the legs.[unpublished data] Thus a reduced

physical capacity was associated with an increased energy demand for a functional task, i.e., walking.

Management including treatment

No curative treatment is available for PPS. Management of PPS is preferably multidisciplinary in order to restore the balance between decreasing capacities and the demands for daily living.

Pharmacological treatment

At present no medication for PPS symptoms is available. Pyridostigmine is the only drug that has been investigated in randomised double-blinded trials.^{25,26} In a multicenter study, pyridostigmine was found not to be effective.²⁵ In selected patients with proven neuromuscular transmission defects pyridostigmine did not reduce fatigue, although a limited beneficial effect on physical performance was found.²⁶

Multidisciplinary management

To reduce overuse and rebalance capacities and demands, conservative management consists of three essential components: exercise, assistive devices and lifestyle changes. Therefore, PPS patients are best treated within a multidisciplinary, specialized rehabilitation setting. Since individuals show considerable differences in polio residua, treatment is individually adjusted and should be preceded by a thorough customised medical and functional evaluation.

Exercise

Exercise can optimise cardiorespiratory fitness and may add to the patient's sense of well-being.²⁷⁻²⁹ Exercise should be nonfatiguing and performed at sub-

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Nollet has co-authored 17 publications related to post-polio problems. To request a listing of his publications and for a bibliography of the 34 references used in preparing his conference presentation, email info@post-polio.org or f.nollet@amc.uva.nl.

The Academic Medical Center serves as the national referral site for the late effects of polio in the Netherlands. In the past, Nollet and his colleagues have studied the relation between functioning, abilities and impairments, and changes over time in polio survivors. They also conducted a randomized controlled study on pyridostigmine (Mestinon®). Currently, they are running a prospective study of changes in health status focusing on the influence of aging and comorbidities, and a study on carbon leg braces and the effect on energy cost of walking and functioning.

There are about 13-15,000 polio survivors in the Netherlands with a population of 16 million. For more information about the nation's polio survivors, contact the Post-Polio Support Group of the Dutch Association for Neuromuscular Diseases (VSN) at www.vsn.nl or by emailing Anita Driessen (anita.driessen@vsn.nl).

maximal levels to avoid overloading of the limited muscle capacity. Exercise can improve muscle strength, especially in case of disuse and muscle groups which are only moderately affected.³⁰ Intensive strengthening exercises are not generally recommended, although they may occasionally be indicated. Functional training may also be useful to improve the efficiency of ambulation.

Orthoses and assistive devices

Braces may be helpful to support weak muscles and to stabilize joints. The condition of existing, often old, braces should be carefully examined and judged whether they are still adequate based on biomechanical evaluation of walking abnormalities.^{31,32} Assistive devices include crutches, wheelchairs, motorized scooters and home adaptations such as elevators or seating devices in the kitchen or shower. All of these devices should be individually indicated.

Lifestyle changes

Pacing of activities and taking rests are of major importance to relieve symptoms. It has been shown that upper extremity complaints often result from overuse of shoulder and arm muscles.³³ Usually PPS patients have successfully learned to deny their symptoms from childhood and to achieve a "normal" life.³⁴ Therefore, they may have great difficulty with adapting their lifestyles to their decreasing abilities and psychological support may be indicated. ●

Patient work-up: In our hospital, the diagnostic workup of an individual suspected of overuse contains some specific elements according to standard protocol.

Computerized tomography (CT or CAT scan) of muscle tissue: At reference level, transversal scans of the body are made to reveal signs of subclinically affected muscles resulting in atrophy and/or fatty infiltration of muscles. This is extremely informative for the large muscle groups of the trunk and the lower extremities because these muscles may appear normal from strength testing while in fact they are not.

Analysis of gait: This may provide detailed information on gait abnormalities and (compensatory) functional (over) loading of muscles.

Patient treatment: Patients are evaluated by a multidisciplinary team specialized in neuromuscular disorders. The key players are the physical therapist, the occupational therapist and the social worker. If necessary the psychologist, the orthotist and the orthopaedic shoemaker can be added. After the evaluation by each team member a treatment plan is formulated and executed.

Specific elements in the treatment plan include:

- ❖ a starting point of the problems as prioritized by the individual;
- ❖ an evaluation of daily life activities with a diary inventory;
- ❖ involvement of the family members in altering daily life behaviour;
- ❖ if possible, an individualized aerobic exercise program, and
- ❖ specific products, such as orthoses and assistive devices.

The treatment plan also includes group therapy. We have developed a 12-week program together with the Rehabilitation Center in Amsterdam aimed at providing practical tools to change behaviour in daily life. Each week deals with another topic, e.g., work, family, sitting and standing, and so on. The program consists of theory and practice exercises, with group interaction as an essential component.