POST-POLIO 2012

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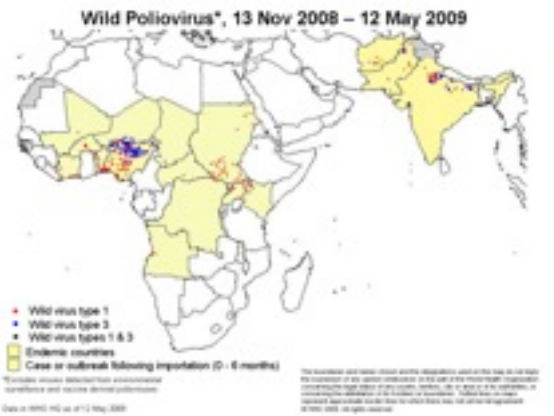
May 20, 2012 Orange County PP Support Group

WHAT WE DO KNOW

ACUTE POLIO IS STILL WITH US

WHO has a target of 2013 for complete eradication of wild-type polio infection



- **Wild Poliovirus (WPV) cases**

Total cases	**Year-to-date 2012**	**Year-to-date 2011**	**Total in 2011**
Globally	55	153	650
- in endemic countries	52	4	341
- in non-endemic countries	3	99	309

NATURAL HISTORY (1)

- Typically 30-50 years after the acute episode, about 50% of survivors noted insidious onset of:

- Excessive fatigue (>80%)
- Muscle/joint pain (60-80%, ?secondary)
- New weakness/atrophy (40-50%)
- Cold intolerance (25%)
- Dysphagia/breathing/sleep changes (10-20%)

NATURAL HISTORY(2)

- Symptoms would be noted in areas previously affected by polio.
- However, 10-20% of survivors of non-paralytic polio noted similar symptoms.
- Symptoms commonly caused functional declines in mobility, ADLs, and general health (impacted by complications of injuries, immobility, weight gain, etc.).

DIAGNOSTIC CRITERIA FOR PPS (1)

- Prior episode of acute polio.
- Period of neurologic recovery, followed by at least 15 years of functional stability.
- Gradual (or abrupt) onset of new weakness or muscle fatigability, with or without generalized fatigue, muscle atrophy, or pain
- **Exclusion of other medical, orthopedic, or neurologic conditions.**

DIAGNOSTIC CRITERIA FOR PPS (2)

- One-third of polio survivors with new symptoms will have an unrelated medical, orthopedic or neurologic condition.
- One-third will be experiencing deterioration of previously stable orthopedic problems (old fusions or tendon/muscle transfers, secondary arthritic change in spine or joints).
- Only one-third will actually have true new progression of motor unit dysfunction.

AGING WITH A DISABILITY

STATIC OLD NEUROLOGIC DEFICITS ARE RISK FACTORS FOR FUTURE NEW NEUROLOGIC PROBLEMS

- Survivors of acute polio with remote neurologic deficits have a 40% risk of developing new progressive muscle weakness (SORENSON ET AL. 2002).

- Similar delayed progressive decline is seen in survivors of other conditions (myelopathy) that injure anterior horn cells (NARAYANASWAMI ET AL., *J NEUROL SCI* 184:11, 2001)

- ?POST-GUILLAN BARRE, POST-EARLY STROKE

EPIDEMIOLOGY

- Retrospective studies by the Mayo Clinic (Windebank et al. 1991) and others estimate that 40-50% of survivors of acute polio will experience new neuromuscular problems.

- Prospective studies of these cohorts have not shown increasing percentages, which suggests a specific sub-population at risk.

PREDICTIVE FACTORS FOR PPS

Trojan et al., *Am Acad PMR*, 1994

- Risk Factors--1. Severity of acute illness (?) 2. Time since acute illness 3. Overuse (activity-related persistant muscle pain or fatigue)
- Not Risk Factors-- 1. Age at acute onset 2. Severity of deficit (?) 3. Gender (?)
- **Residual deficit, overuse, time/aging>>>**

Risk factors for post-polio syndrome among an Italian population: a case-control study.

Bertolasi L, Acler M, Dall'ora E, Gajofatto A, Frasson E, Tocco P, Turri M, Ferlisi M, Fiorini M, Pimazzoni F, Squintani G, Martini M, Danzi B, Monaco S
Section of Neurology, Department of Neurological, Neuropsychological, Morphological and Motor Sciences, University of Verona, Piazzale L.A. Scuro 10, 37134, Verona, Italy,
Neurol Sci. 2012 Jan 14. [Epub ahead of print]

Post-polio syndrome (PPS) is a clinical syndrome of new weakness, fatigue and musculoskeletal pain occurring in a variable proportion of polio survivors decades after acute disease. To date, several risk factors for PPS development have been reported, although the etiology of this disorder remains elusive.

Using a case-control design, we aimed to assess risk indicators for PPS in a group of Italian polio survivors. Subjects with prior poliomyelitis attending the rehabilitation hospital of Malcesine, Italy, were the target population. Patients with PPS, diagnosed according to the European Federation of Neurological Societies criteria, served as cases, while patients not meeting diagnostic criteria for PPS were used as controls.

All subjects were assessed through a structured questionnaire made of 82 questions and neurological examination. The association with investigated risk factors (sex, age at polio onset, age at onset of symptoms, extension and severity of polio, employment) was analyzed by the calculation of the odds ratio.

A total of 161 out of 391 eligible patients met the adopted diagnostic criteria for PPS, giving a frequency of 41.2%. Symptoms most frequently complained by PPS patients were loss of muscle strength, loss of resistance, loss of muscle volume and generalized fatigue.

Female gender, the presence of respiratory disturbance during the acute phase of polio and the use of orthoses and aids during the recovery and stabilization represented independent risk factors for PPS in the studied population.

PROSPECTIVE STUDY OF POLIO SURVIVORS W/O NEW SYMPTOMS

- The Mayo Clinic (Dr. Eric Sorenson) has followed 50 polio survivors since 1987.

- They re-examined 23 of them in 2002 (15 years later) for neurologic disability, isometric strength, and on electromyogram testing--number of motor units and size of remodeled motor units.

- All 23 (100%) had gradual decline in these #'s.
- Only 10 (43%) had symptoms of post-polio.
- These 10 had had the highest neurologic disability in 1987, ie. Poorer "physical best" after initial recovery.
- So over a 15 year period polio survivors most likely to develop symptoms of post-polio were those with the greatest residua from their acute polio.

SO, SURVIVORS WITH GREATER RESIDUAL FUNCTIONAL DEFICIT (GREATER MOTOR UNIT REMODELING?) ARE AT INCREASED RISK TO DEVELOP SYMPTOMS OF PPS

- The NIH (Dr. M. Dalakas) and others (Dr. D. Wiechers, Dr. N. Cashman) have shown that recovered motor units supply more muscle fibers, have weaker muscle connections, are continuously remaking these connections, and have greater demands on their metabolism for energy. They are "unstable."
- If energy demand increases (overuse) or energy supply decreases (aging), motor units will be lost (TAM SL, ETAL. 2002).

CURRRENT UNDERSTANDING OF CAUSATIVE FACTORS FOR PPS

- Polio survivors with greater motor unit remodeling and greater residual functional deficits are at greatest risk to develop symptoms of post-polio syndrome (SORENSON ET AL. 2002).

- Overuse of unstable motor units and mechanisms that relate to aging act as triggers for post-polio syndrome.

- Mechanisms of inflammation may contribute to motor unit dysfunction or other symptoms of post-polio.

MECHANISMS THAT RELATE TO AGING

- Many researchers have shown that the motor unit can maintain its level of maximal recovery for at least 15 years, before "wear & tear," aging, or other factors begin to take their toll.
- "Wear & tear" may reflect the damage accumulated by chronic repairs and a constant crisis in energy production.
- Aging is characterized by several factors that might be modifiable.

OTHER FACTORS RELATED TO AGING

- **GENETIC**
- "LONGEVITY" GENES
- GENES TURNING OFF (eg. protein synthesis,growth factors)
- GENES TURNING ON (and then stealing resources needed by other genes)
- GENES THAT ARE GOOD IN THE YOUNG BUT BAD IN THE OLD (eg. growth slowing genes)
- GOOD GENES THAT GO BAD (mutations)
- BAD GENES THAT SHOW UP LATER IN LIFE (programmed cell death factors)

- **FREE RADICAL BUILD UP**

- **HORMONE CHANGES**

- **THE IMMUNE SYSTEM**

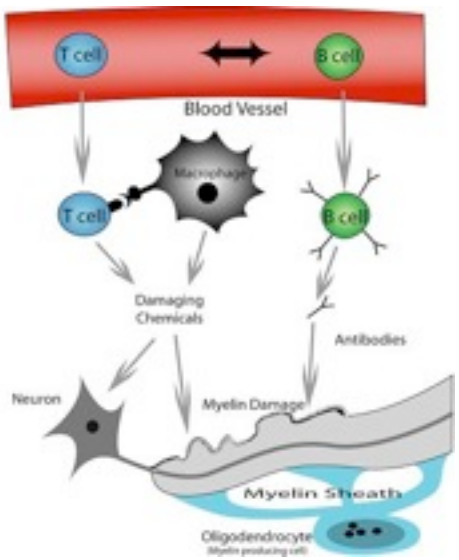
MECHANISMS OF INFLAMMATION MAY CONTRIBUTE TO MOTOR UNIT DYSFUNCTION AND OTHER SYMPTOMS OF PPS

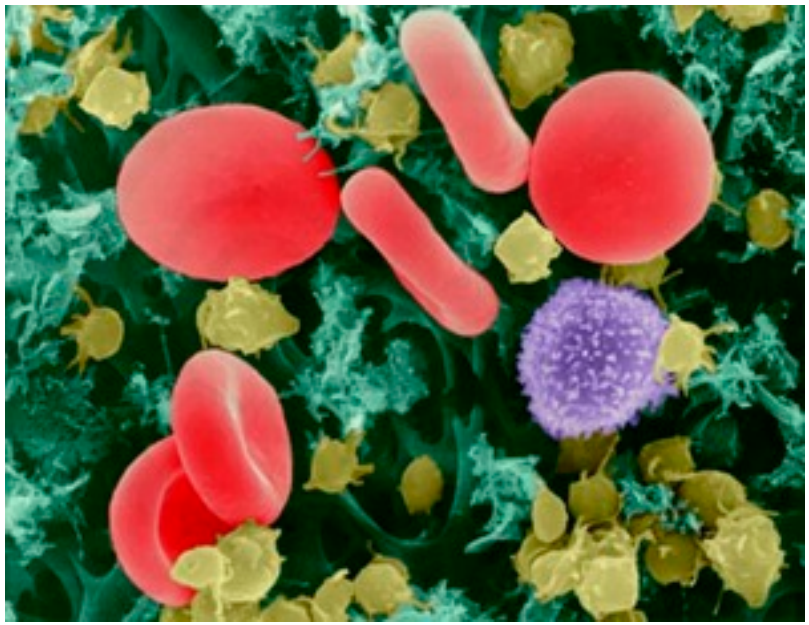
- GONZALEZ ET AL. 2002 Showed increased amounts of certain inflammatory cytokines (tnf-α, ifn-γ, il-4, and il-10) in spinal fluid and blood of polio survivors with symptoms of pps.
- These were at the same level as seen in spinal fluid of patients with MS, a well-known neuro-inflammatory disease.
- These cytokines are associated with damage to nerves and may directly cause sleepiness, fatigue, and depression

Immune Treatment

www.ucsf.edu

www.jyi.org





Markers of Post-Polio Syndrome

- **The Relationship of Inflammatory Markers with Clinical Parameters in MS and PPS**

  Trojan DA, Arnold DL, Da Costa D, et al.

  Presented at the Neurology meeting May 2007

TNF alpha and other inflammatory markers are increased in both MS and PPS, providing support for an inflammatory etiology for both conditions.

Inflammatory markers (TNF alpha, leptin, IL-6) are associated with certain clinical parameters in PPS (TNF alpha with increased pain and leptin with body mass index and increased total percentage of body fat).

Taking the Pulse of New Research
Update on Immune Treatments

- **From the Scandinavian groups who have explored the role of the immune system in PPS (old viral debris activating the immune system to make anti-motor neuron inflammatory chemicals that cause motor nerve dysfunction and central fatigue)—**

- **Treatment with IVIG reduced the levels of some of the inflammatory chemicals (IFN-gamma, TNF-alpha) present in PPS. Further trials needed to assess relief of symptoms. Gonzalez H et al. 2004; J Neuroimmunol. 150:139-44.**

- **Case report of a woman with PPS treated with IVIG showed improved strength and reduced fatigue. Farbu E et al. 2004; Tidsskr Nor Laegeforen 124:2357**

Effect of intravenous immunoglobulin in patients with post-polio syndrome -- an uncontrolled pilot study.

Kaponides G, Gonzalez H, Olsson T, Borg K.

- **OBJECTIVE: To analyse changes in muscle strength, physical performance and quality of life during IVIG treatment in PPS patients.**
- **DESIGN: Open clinical trial. Patients: A total of 14 patients (6 women, 8 men; mean age 57 years, range 43-67 years) were included in the study.**
- **INTERVENTION: Treatment with 90 g IVIG (30 g daily for 3 days).Main outcome: Muscle strength, measured with dynamic dynamometry, muscle function, by means of performing the 6-minute walk test, and quality of life, analysed by means of the SF-36 questionnaire, were performed before and after treatment.**
- **RESULTS: For quality of life there was a statistically significant improvement for all but one of the 8 multi-item scales of SF-36 when comparing data before and after treatment with IVIG. The multi-item scale most improved was Vitality. There was no significant increase in muscle strength and physical performance.**
- **CONCLUSION: Data indicate that IVIG may have a clinically relevant effect, with an improvement in quality of life. The effect may be due to a decrease in an inflammatory process in the central nervous system, which earlier has been reported in patients with past-polio syndrome after IVIG treatment. Since a possible placebo effect cannot be**

Intravenous immunoglobulin for the post-polio syndrome: a randomized controlled trial.

Gonzalez H, Stibrant-Sunnerhagen K, Sjoberg I, Kaponides G, Olsson T, Borg K

Lancet Neurology 2006 Jun; 5(6):493-500.

- **OBJECTIVE: To analyse changes in muscle strength during IVIG treatment in PPS patients.**
- **DESIGN: Multicenter, double-blind, placebo-controlled trial. Patients: A total of 135 patients with increased cytokine levels in spinal fluid were included in the study.**

INTERVENTION: Treatment with 90 g IVIG (30 g daily for 3 days), repeated twice.

Main outcome: Muscle strength.

- **RESULTS: Patients receiving IVIG had an increase in muscle strength of 4.3 %. Patients receiving placebo had a decrease in muscle strength of 5.7 %.**
- **CONCLUSION: Data indicate that IVIG may have a clinically relevant effect, with an improvement in muscle strength. The effect may be due to a decrease in an inflammatory process in the central nervous system, which earlier has been reported in patients with past-polio syndrome after IVIG treatment. The placebo effect is ruled out by this randomized controlled study.**

Post-polio syndrome patients treated with IVIG: a double-blinded randomized controlled pilot study.

Farbu E, Rekand T, Vik-Mo E, Lygren H, Gilhus NE, Aarli JA.

Eur J Neurol. 2007 Jan;14(1):60-5.

- **OBJECTIVE: To investigate the possible clinical effects of IvIg in PPS.**
- **DESIGN: Double-blinded randomized controlled pilot study**
- **INTERVENTION: Twenty patients were randomized to either IvIg 2 g/kg body weight or placebo. Primary endpoints were changes in pain, fatigue and muscle strength 3 months after treatment. Surrogate endpoints were changes in cerebrospinal fluid (CSF) cytokine levels. Secondary endpoints were pain, fatigue and isometric muscle strength after 6 months.**
- **RESULTS: Patients receiving IvIg reported a significant improvement in pain during the first 3 months, but no change was noted for subjective fatigue and muscle strength. CSF levels of tumour necrosis factor-alpha (TNF-alpha) were increased compared with patients with non-inflammatory neurological disorders.**
- **CONCLUSION: The results are promising, but not conclusive because of the low number of patients studied.**

Effect of intravenous immunoglobulin on pain in patients with PPS

Werhagen L, Borg K.
Karolinska Institutet at Danderyd Hospital, Stockholm, Sweden.
J Rehabil Med. 2011 Nov;43(11):1038-40.

- **OBJECTIVE:**
- Pain is a common symptom that affects quality of life in patients with post-polio syndrome. An increase in cytokine in the cerebrospinal fluid suggests that inflammation is pathophysiologically important in post-polio syndrome. Intravenous immunoglobulin might therefore be a therapeutic option. The aim of this study was to analyse the effect of intravenous immunoglobulin treatment on pain in post-polio syndrome.
- **METHODS:**
- An uncontrolled clinical study. Patients with post-polio syndrome and pain (n = 45) underwent a neurological examination and were interviewed about pain before and 6 months after treatment with intravenous immunoglobulin. Pain intensity was measured on a visual analogue scale. The pain was classified according to the International Association for the Study of Pain criteria as neuropathic when it occurred in an area with decreased sensibility, or nociceptive when signs of inflammation and/or painful joints movements were present.
- **RESULTS:**
- After treatment 31/45 (69%) patients were improved, with a mean visual analogue scale decrease from 53 to 42 (p = 0.001). Eighteen patients (40%) had a decrease of 20 or more points on the visual analogue scale. The effect of treatment did not differ regarding age, gender and severity of disability.
- **CONCLUSION:**
- **Two-thirds of 45 patients with post-polio syndrome and pain reported a decrease on the visual analogue scale for pain after treatment with intravenous immunoglobulin, and 40% reported a decrease of 20 or more points on the visual analogue scale.**

IVIG treatment in post-polio patients: evaluation of responders.

Ostlund G, Broman L, Werhagen L, Borg K.
J Neurol. 2012 May 17. [Epub ahead of print]

The aim of this work is to evaluate the outcome of IVIG treatment in patients with post-polio syndrome (PPS) and to identify responders.

- The study included 113 PPS patients who had received one IVIG treatment in an open trial, prospective follow-up study. Clinical examination was performed and clinical data were retrieved from medical records. The short form 36 (SF-36), physical activity scale for the elderly (PASE), and the visual analogue scale (VAS) were used as measurements of quality of life, physical activity, and the intensity of pain. Data before treatment and at 6-month follow-up were collected. Analysis was performed in subgroups based on demographic and medical parameters.
- A statistically significant increase of the SF-36 sub domains bodily pain, vitality, social function, role emotional, and the mental compound score (MCS) was found at the 6-month follow-up. A significant decrease of pain was found in patients who reported pain intensity over VAS of 20 mm, in patients younger than 65 years of age and in patients who had paresis in the lower extremities. A trend was found in patients with PPS as the only diagnosis.
- **IVIG leads to increase of quality of life at 6-month follow-up for SF-36 regarding sub domains of bodily pain, vitality, social function, role emotional, as well as for pain. Age below 65 years, paresis in the lower extremities, and lack of concomitant disorders may be the main indicators for a future identification of responders.**

SIDE EFFECTS OF IVIG

- **Financial—FDA approved for certain hematologic immunodeficiencies only. Insurance companies may approve for certain immune-medicated neurologic conditions if the literature supports it.**
- **Headache, malaise, nausea, low-grade fever, urticaria, arthralgias, and myalgia. These symptoms typically resolve within a few days after their onset.**
- **Rare serious and potentially fatal side effects include: anaphylactic reactions, aseptic meningitis, acute renal failure, stroke, myocardial infarction, and other thrombotic complications. Many of these side effects have occurred in patients who have significant, underlying risk factors for the development of the event.**

WHAT WE ALREADY KNOW

- **New symptoms in a polio survivor are PPS only about 1/3 of the time.**
- **New symptoms may be due to another medical or neurological illness or to orthopedic problems, which must be identified and treated.**
- **Treatment of other illnesses in a polio survivor must be monitored relative to the sensitivities of PPS (eg. surgery, chemotherapy, use of cholesterol lowering medication).**
- **Polio survivors with symptoms of PPS must take care to modify lifestyle; avoid overuse; use assistive devices and bracing if appropriate; control weight gain, sleep problems, stress, and pain; and engage in non-fatiguing exercise for**

△CAUTION SIGNS ON THE ROAD TO POST-POLIO TREATMENT

- PPMA weakens nerve-muscle communication and performance, so drugs that affect those areas (tranquilizers, muscle relaxants, neuro- or myo-toxic agents—often used in anesthesia/surgery situations) should be used with caution.
- Pushing activity or exercise to the point of pain or fatigue will make PPMA worse. Repetitive actions are the most risky. Within these limits, anything is OK. ADLs must also be paced.
- Adaptive equipment and bracing will not as a rule cause more weakness, but may improve strength and performance via energy conservation and pain control.
- Polio survivors aren't immune to other diseases

I Believe the Standard Guidelines Still Hold

- **Make sure your symptoms are polio related and not due to other neurologic, orthopedic, or medical/ medicine issues.**
- **Use Rehab to develop a program of appropriate non-fatiguing exercise and reconditioning, assistive devices, pacing, and finding your limit.**
- **Do not push past the limit of pain and fatigue.**
- **No one is talking "Conserve to Preserve".**
- **Everyone needs a good PCMD, knowledgeable PT, and attention to good general health (weight control, exercise, assistive devices, relaxation training, sleep hygiene, emotional health).**

Clinical Trials for Motor Performance

RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED TRIALS OF PYRIDOSTIGMINE (similar *non*-results seen with Modafinil/Provigil)

- **Trojan et al., *Neur*, 1999**
- **Multicenter**
- **126 patients with PPS**
- **6-months**
- **60mg three times/day**
- **Very weak muscles were slightly stronger.**
- **IGF-1 was slightly increased**
- **<u>NO SIGNIFICANT CHANGE</u> was seen in quality of life, isometric strength, fatigue, or serum IGF-1 levels.**

- **Nollet et al., *AAN*, 2002**
- **Single center**
- **67 patients with PPS and abnormal single-fiber EMG**
- **14 weeks (3 1/2 months)**
- **60mg four times/day**
- **Timed walking improved 6% in normal sized motor units.**
- **<u>NO SIGNIFICANT CHANGE</u> in isometric strength, fatigue, or EMG.**

STUDIES WITH INSULIN-LIKE GROWTH FACTOR 1

- Trojan et al., *J Neurol Sci*, 2001--although IGF-1 supports terminal axon sprouts of nerve to muscle and appears to decline with age, serum levels did not correlate with isometric strength, fatigue, or quality of life.
- This is despite the non-statistically significant trend to improved recovery from fatigue reported by Miller et al., *AAN*, 1997.

WHY DRUGS FAIL IN PPS

Lessons from a clinical trial

Marinos C. Dalakas, M.D. Neurology 1999; 53:1166

- Unstable neuromuscular junctions are present in all PPS muscles, but not all cause symptoms. Improving junction stability may have no effect on symptoms.
- PPS nerve fiber sprouting is already at its maximum, so that growth factors that induce more sprouting may be redundant or even harmful to the overextended nerve.

EVIDENCE-BASED MEDICINE AND POST-POLIO SYNDROME (I)

- There is an enormous body of literature that shows that rehabilitation (therapeutic exercise, conditioning exercise, energy conservation, adaptive devices and bracing) is able to stop the progression of symptoms and improve function and quality of life in patients with PPMA.
- Improving one part of the elephant results in overall improvement (pain management, pulmonary or sleep interventions, weight and nutrition concerns, stress and depression)

EVIDENCE-BASED MEDICINE AND POST-POLIO SYNDROME (II)

- On the downside,

  > no drug

  trials have yet shown statistically significant benefits for PPMA itself.

  > aging

  and motor unit loss are important factors, but restorative therapies (growth factors, stem cells) are still years away.

  > the exact

  causative mechanisms are not yet fully known, so curative therapies cannot yet be rationally designed.

EDUCATIONAL IMPERATIVE

- The March of Dimes has issued a report for physicians that outlines the best practices in diagnosis and care of post-polio syndrome.
- This report has been publicized by the American Medical News and has been reprinted in the Medical Board of California ACTION REPORT, which is mailed to all physicians licensed in California.

WHY THE NEED TO INCREASE AWARENESS?

- Polio survivors report poorer functional status and health-related quality of life, than non-polios.
- The life-altering effects of PPMA have not been adequately addressed by health care providers.
- Many publications indicate that polio survivors are best served in multidisciplinary clinics staffed by knowledgeable professionals.

Treating Post-Polio Syndrome
First, Do No Harm

- **"I've never heard of this condition before." (No excuse in this era of the Internet)**
- **"I'm not the right kind of specialist."**

  (Depends what end of the elephant you're on)
- **"Maybe there's something particular about this disease that if I don't know what it is, I'll recommend something wrong."**
- **"There's no evidence-based treatment that I can justify recommending. Just quit your job and get your wheelchair now."**

SOME PRACTICAL POINTS ABOUT MANAGEMENT

- *What's the best way to follow a patient's progress?*
- Annual visits to review current symptoms and benefits of symptomatic treatment and to coordinate care with other providers.
- Systematic strength testing to look for areas of improvement or worsening.
- Tests used to make the diagnosis of PPS (eg. EMG) don't have to be repeated unless something is getting worse or something new is happening.
- If something new is happening, it doesn't necessarily have to be due to the post-polio.

Kudos to the OC PPMA Support Group

- Email from Baldwin Keenan 3/11/2011

- **In the first quarter of 2012, probably February**, a group of us will be asked to participate with physicians and other polio specialists in a Webinar to Kaiser physicians which will be CME accredited. Dr. Phan, their physiatrist in Downey will likely lead the Webinar.

  This PPS-CME Webinar will be ongoing and expanded year by year.

  A DVD of the Webinar will be made available to non Kaiser Physicians. I do not know if some of the professional medical academies would be willing to give CME credit for doctors who view the DVD and respond to a accompanying test. Kaiser will not be offering non Kaiser docs CME credit.

NEW RESEARCH PUBLICATIONS

- There was only one new abstract at the American Academy of Neurology meeting last month and it was about vaccination.
- **A search of PubMed from May 2011 through today yielded 44 articles, of which 28 were about vaccination, 16 about PPS.**
- ClinicalTrials.gov lists 40 trials, of which 29 were about vaccination, 11 about PPS. 9 studies were completed, 2 are still open (glutathione, UBE).

Cochrane Database Syst Rev. 2011 Feb 16;(2):CD007818.

Treatment for postpolio syndrome.

Koopman FS, Uegaki K, Gilhus NE, Beelen A, de Visser M, Nollet F
Department of Rehabilitation, University of Amsterdam Academic Medical Center, PO Box 22660, Amsterdam, North Holland, Netherlands, 1100 DD.

Postpolio syndrome (PPS) may affect survivors of paralytic poliomyelitis and is characterised by a complex of neuromuscular symptoms leading to a decline in physical functioning. The effectiveness of pharmacological treatment and rehabilitation management in PPS is not yet established.

- **OBJECTIVES:**
- To review systematically the effects of any treatment for PPS compared to placebo, usual care, or no treatment.
- **SEARCH STRATEGY:**
- We searched the following databases on 1 October 2010: Cochrane Neuromuscular Disease Group Specialized Register, the Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE, PsycINFO and CINAHL Plus from inception to September2010
- **SELECTION CRITERIA:**
- Randomised and quasi-randomised trials of any form of pharmacological or non-pharmacological treatment for people with PPS. The primary outcome was self-perceived activity limitations and secondary outcomes were muscle strength, muscle endurance, fatigue, pain and adverse events.
- **DATA COLLECTION AND ANALYSIS:**
- Two authors independently selected eligible studies, assessed risk of bias and extracted data.

MAIN RESULTS:

Nine pharmacological (modafinil, intravenous immunoglobulin, pyridostigmine, lamotrigine, amantadine, prednisone) and three non-pharmacological (muscle strengthening, rehabilitation in a warm climate (i.e. temperature ± 25°C, dry and sunny) and a cold climate (i.e. temperature ± 0°C, rainy or snowy), static magnetic fields) studies were included in this review. None of the included studies was completely free from any risk of bias and the most prevalent risk of bias was lack of blinding.There is moderate quality evidence that intravenous immunoglobulin has no beneficial effect on activity limitations and there is inconsistency in the evidence for effectiveness on muscle strength and pain. Results of one trial provide very low quality evidence that lamotrigine (sodium channel blocker/glutamate release suppressor) might be effective in reducing pain and fatigue, resulting in fewer activity limitations. Data from two single trials suggest that muscle strengthening of thumb muscles (very low quality evidence) and static magnetic fields (moderate quality evidence) are beneficial for improving muscle strength and pain, respectively, with unknown effects on activity limitations. Finally, there is evidence varying from very low quality to high quality that modafinil, pyridostigmine, amantadine, prednisone and rehabilitation in a warm or cold climate are not beneficial in PPS.

- **AUTHORS' CONCLUSIONS:**
- **Due to insufficient good quality data and lack of randomised studies it is impossible to draw definite conclusions on the effectiveness of interventions for**

A brief history of postpolio syndrome in the United States.

Halstead LS
National Rehabilitation Hospital, 102 Irving Street NW, Washington, DC 20010, USA.

Arch Phys Med Rehabil. 2011 Aug;92(8):1344-9. Epub 2011 Jun 12.

This is an overview of the history of the late effects of polio in this country from 1980 to the present in the context of the broader and much longer history of acute poliomyelitis.

Books, articles, conference proceedings, and other relevant historical resources that dealt with polio-related issues from January 1, 1980, through December 31, 2009, were reviewed.

The mean number of articles published per year was calculated for 5-year intervals beginning in 1980; the number of postpolio support groups and polio-dedicated clinics was compiled from directories published annually by Post-Polio Health International at 5-year intervals from 1985 to 2010.

Beginning in the mid-1980s, the number of articles published each year increased dramatically, peaking during the years 1995 to 1999 when a mean of 48.2 articles were published each year. This figure steadily declined over the next 14 years.

Support groups and clinics showed a similar pattern of rise and fall, with a maximum of 298 support groups and 96 clinics in 1990 and a decline to 131 and 32, respectively, by 2010.

During the 1980s and early 1990s, there was a period of optimism that energized research, clinical, and self-help initiatives. As the limits of these efforts became apparent during the late 1990s and early 2000s, resources and activities declined as the postpolio community continued to age and decrease in size.

Regardless of these trends, there are still thousands of survivors who continue to require skilled physiatric management as they cope with advancing age and declining function.

The Remaining Articles

- 4 medical case reports
- 1 orthopedic case report
- 2 on IVIG (previously profiled)
- 1 epidemiologic study (previously profiled)
- **2 quality of life studies**
- **3 dealing with fatigue**
- **1 on restless legs syndrome**

Quality of Life

- **Post-polio syndrome: impact of hope on quality of life.**
- Shiri S, Wexler ID, Feintuch U, Meiner Z, Schwartz I
- Department of Physical and Medical Rehabilitation, Hadassah UniversityHospital, Mount Scopus, Jerusalem, Israel.
- Disabil Rehabil. 2012;34(10):824-30. Epub 2011 Dec 10.
- **PURPOSE:**
- To determine the effect of future-oriented coping strategies on the quality of life (QOL) of individuals with post-polio syndrome (PPS).
- **METHODS:**
- A correlative study, in which a cohort of 61 patients was surveyed and a group of 40 healthy, age-matched individuals served as controls. Patients were surveyed as to their QOL, levels of hope and utilization of proactive coping, employment status and degree of functionality.
- **RESULTS:**
- PPS patients had lower total, physical and mental QOL indices compared to controls. Future-oriented coping strategies associated with hope were positively associated with physical and mental QOL in the PPS group, but not in the controls. In a multivariate analysis, hope and employment status predicted higher QOL among those with PPS.
- **CONCLUSIONS:**
- Future-oriented coping strategies, particularly hope are distinctively associated with improved QOL benefits in PPS patients. Fostering future-oriented coping related to hope may improve the self-perceived mental and physical status of patients with PPS.

- **Assistive technology and prediction of happiness in people with post-polio syndrome.**
- Spiliotopoulou G, Fowkes C, Atwal A.
- Brunel University, School of Health Sciences and Social Care , Uxbridge, UB8 3PH , UK.
- Disabil Rehabil Assist Technol. 2012 May;7(3):199-204. Epub 2011 Oct 6.

- PURPOSE: To explore the relationship between level of happiness in people with post-polio syndrome (PPS) and assistive technology (AT) by taking into account confounding factors such as age, gender and house composition.
- METHOD: Existing data from 218 adults with PPS, who had completed a cross-sectional survey conducted by the British Polio Fellowship in 2007, were used for a secondary quantitative analysis. Ordinal logistic regression was applied to determine whether ownership of or the need for AT predicted happiness in people with PPS.
- RESULTS: Ownership of AT did not predict happiness, whereas **the perceived need for AT was a significant predictor of feeling less happy** ($p = 0.028$). Among the different types of AT needed, only need of home adaptations combined with major equipment was close to being significantly associated with less happiness ($p = 0.078$). Being older ($p < 0.001$) and living with a partner ($p < 0.001$) significantly increased the likelihood of feeling happier.
- CONCLUSION: The findings indicate the importance of the contribution of need for AT in explaining happiness in people with PPS.
- The fact that users reported unmet equipment needs urge for increased user decision making and better understanding of why perceived needs are not resolved.

Fatigue

- Arch Phys Med Rehabil. 2011 Nov;92(11):1796-801.
- **Pain and fatigue in persons with postpolio syndrome: independent effects on functioning.**
- Jensen MP, Alschuler KN, Smith AE, Verrall AM, Goetz MC, Molton IR.
- Department of Rehabilitation Medicine, University of Washington School of Medicine, Seattle, 98104-9612, USA.
- **OBJECTIVES:**
- To better understand the importance of pain and fatigue in relation to functioning, and to investigate the role that age plays in these relationships in individuals with postpolio syndrome (PPS).
- **DESIGN:**
- Cross-sectional, community-based survey of 446 individuals with PPS.
- **MAIN OUTCOME MEASURES:**
- Physical functioning (Patient Reported Outcomes Measurement Information System Physical Functioning item bank items), psychological functioning (Patient Health Questionnaire-9), pain intensity (0-10 numerical rating scale [NRS]), and fatigue (0-10 NRS).
- **RESULTS:**
- Pain and fatigue make independent contributions to the prediction of physical and psychological functioning. Depression was more severe in the middle-aged (≤64y) group than in the young-old (65-74y) or middle-old to oldest (≥75y) groups, although the associations between pain and fatigue and both physical and psychological functioning are similar across all age cohorts.
- **CONCLUSIONS:**
- Complaints of pain or fatigue in patients with PPS who are older or elderly should not be attributed "merely" to the process of aging. The findings also support the need for clinical trials to develop and evaluate interventions that may help patients with PPS function better by treating pain and fatigue, as well as the negative effects that these symptoms can have on functioning.

- Arch Phys Med Rehabil. 2011 Jul;92(7):1126-33.
- **Fatigue and aging with a disability.**
- Cook KF, Molton IR, Jensen MP.
- Department of Rehabilitation Medicine, University of Washington School of Medicine, Seattle, WA, USA. karonc2@u.washington.edu
- **OBJECTIVE:**
- To compare self-reported fatigue in 4 disability populations with age-matched, U.S. population norms. We assessed fatigue and age in a sample of individuals with spinal cord injury (SCI), postpolio syndrome (PPS), multiple sclerosis (MS), and muscular dystrophy (MD).
- **DESIGN:**
- This study used survey responses and published age cohort means for fatigue to test the hypothesis that fatigue would be higher in each of 4 clinical samples than the U.S. population norm. We also hypothesized that, for clinical samples, the mean fatigue reported within age cohorts would be higher than the general U.S. population norms for those age ranges derived in the Patient-Reported Outcomes Measurement Information System (PROMIS).
- Participants (N=1836) were persons with MD (n=337), MS (n=580), Post-polio (n=441), and SCI (n=478).
- **RESULTS:**
- Individuals with disabilities reported higher levels of fatigue than the normative PROMIS population. In the normative population, self-reported fatigue was substantially lower in age cohorts from middle age to retirement age. However, individuals with disabilities did not demonstrate this age cohort effect.
- **CONCLUSIONS:**
- Individuals with disabilities are not only at greater risk to experience fatigue, but this risk, relative to normative values, increases with age. More research is needed to determine the specific negative impact of fatigue symptoms on functioning in individuals with disabilities as they age.

- Arch Phys Med Rehabil. 2011 Jun;92(6):899-904.
- **A 5-year longitudinal study of fatigue in patients with late-onset sequelae of poliomyelitis.**
- Tersteeg IM, Koopman FS, Stolwijk-Swüste JM, Beelen A, Nollet F; CARPA Study Group.
- **Collaborators (11)**
- Stolwijk-Swüste JM, Tersteeg IM, Beelen A, Nollet F, Lankhorst GJ, Dekker J, van Dijk GM, Post B, de Haan RJ, Veenhof C, Speelman H.
- Department of Rehabilitation, Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands.
- **OBJECTIVES:**
- To study the severity and 5-year course of fatigue in patients with late-onset sequelae of poliomyelitis (LOSP) and to identify physical and psychosocial determinants of fatigue.
- **DESIGN:**
- Prospective cohort study with 5 measurements over 5 years. Patients with LOSP (N=168); 89% of the subjects completed the study.
- **MAIN OUTCOME MEASURES:**
- Fatigue assessed with the Fatigue Severity Scale (FSS). Potential determinants were perceived physical functioning, bodily pain and mental health, extent of paresis, walking capacity, comorbidity, sleeping disorders, coping, and social support. Associations were investigated by multivariable longitudinal analysis using generalized estimating equations.
- **RESULTS:**
- The mean FSS score ± SD at baseline was 5.1±1.4, which did not change significantly during the 5-year follow-up. Reduced physical functioning, increased bodily pain, reduced sleep quality, more psychologic distress, and higher

Restless Legs Syndrome

- Parkinsonism Relat Disord. 2011 Aug;17(7):563-4. Epub 2011 Jun 2.
- **Restless legs syndrome in post-polio syndrome: a series of 10 patients with demographic, clinical and laboratorial findings.**
- Marin LF, Carvalho LB, Prado LB, Quadros AA, Oliveira AS, Prado GF.
- Neuro-Sono Sleep Center, Universidade Federal de São Paulo, Rua Claudio Rossi 394, Sao Paulo, SP, Brazil.
- **BACKGROUND:**
- Few studies have described the occurrence of restless legs syndrome in post-polio syndrome.
- **METHODS:**
- We studied 10 consecutive patients with post-polio syndrome and symptoms of restless legs syndrome. We look at demographic, clinical and laboratorial data.
- **RESULTS:**
- A remarkable finding was the concomitant onset of symptoms of both diseases, suggesting a possible underlying mechanism. Severity of restless legs symptoms was moderate to very severe.
- **CONCLUSION:**
- Epidemiological studies with larger samples are needed to better establish the relationship and the incidence of restless legs syndrome in post-polio syndrome.

NEW RESEARCH INITIATIVES from Polio Health International (PHI)

- **The Research Fund will award its seventh grant in the year 2012, with the funds distributed in 2013.**

  The postmark deadline for Phase 1 is Friday, May 4, 2012.

- **THE SIXTH AWARDS (2011)**
  PHI awarded $25,000 each to two research groups. One was from the University of Michigan (Glutathione) and the other was from Hadassah Medical Center in Jerusalem (Epidemiology of Post Polio in the Near East).
- **THE FIFTH AWARD** (2009)
  PHI awarded $25,000 to team from University of Insubria, Varese, Italy, led by Antonio Toniolo, MD, PhD, Professor of Medical Microbiology and Virology. The study, **Persisting Noninfectious Fragments of Poliovirus in PPS Patients: Virus Detection and Susceptibility to Antiviral Drugs,** will complete the sequencing of the genome of persistent fragments of poliovirus strains and compare them to wild-type polioviruses.

Glutathione and Health With Post-Polio Syndrome

- **Sponsor:** University of Michigan
- **Collaborator:** Penn State University
- **ClinicalTrials.gov Identifier:** NCT01402570
- Glutathione is a dietary supplement and an antioxidant.
- Subjects will take 1000 mg per day for three month.
- Each capsule contains 500 mg glutathione.
- Other Name: 500 Ultrathione, GSH, and l-glutathione.

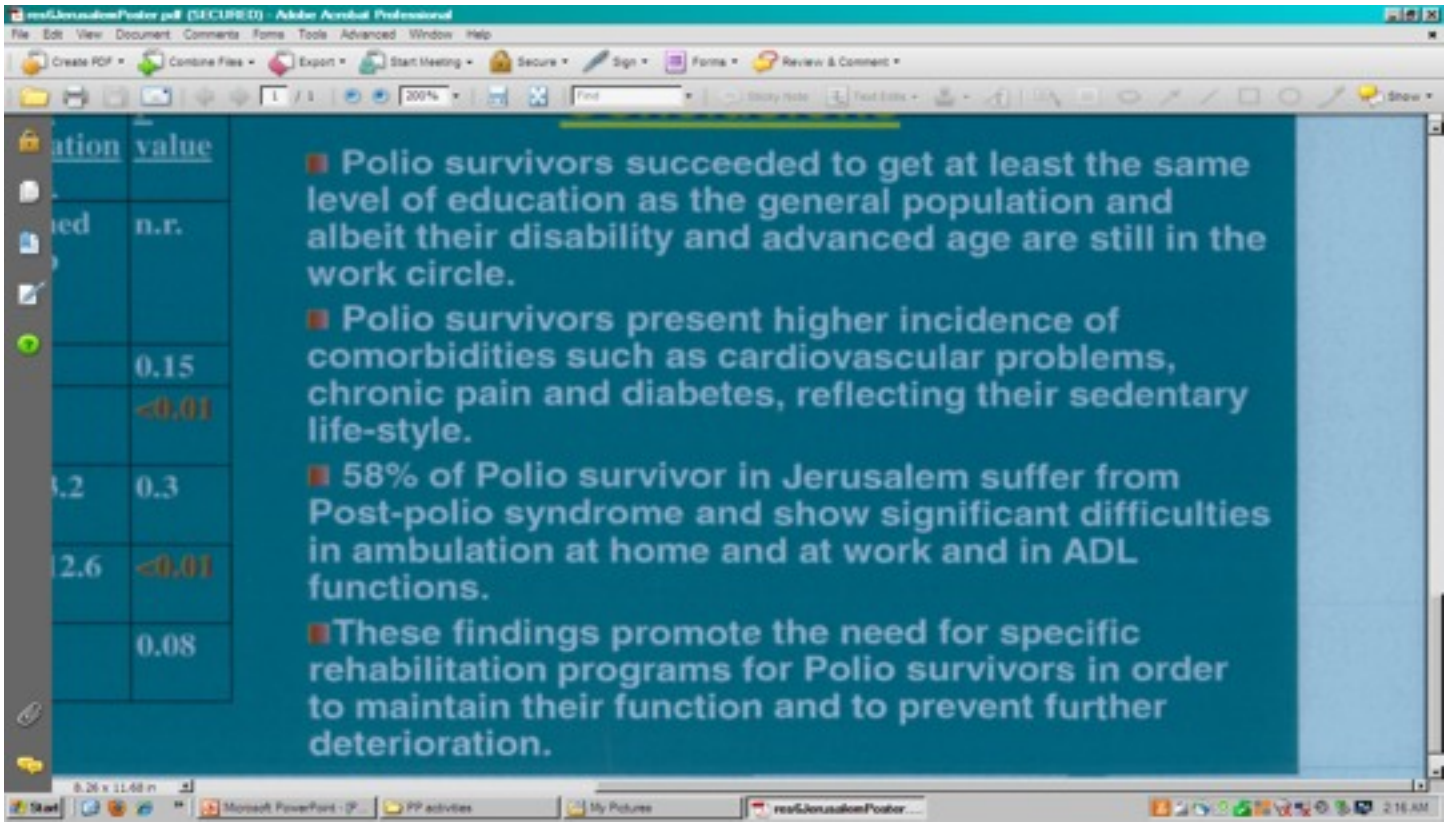
- Examine the effect of oral glutathione supplementation on people with late effects of **poliomyelitis** on measures of fatigue, physical functioning, sleep disturbance and emotional distress.
- In this study, the subject's function, sleep patterns and emotional distress will be monitored before and after taking a glutathione supplement.

The Other Clinical Trial

- **Arm Cycling to Improve Fitness in Polio Survivors**
- **Sponsor:** Royal College of Surgeons, Ireland
- **Collaborators: Post Polio** Support Group Ireland Beaumont Hospital
- **ClinicalTrials.gov Identifier:** NCT01271530
- The aim of this study is to investigate the effect of upper limb cardiovascular training on fitness, energy cost of walking, fatigue and pain in 120 polio survivors.
- Upper Limb Ergometry Cardiovascular training will be performed using upper limb ergometers at home for 8 weeks. Each subject will receive an individually prescribed programme and will begin exercising for at least ten minutes per day three days per week. If an individual has difficulty exercising for 10 minutes continuously, the 10 minute session may be broken into 2-3 minute bursts of exercise, with one minute rests. Subjects will aim to increase exercise durations to 20 minutes per day five days per week and will exercise at moderate to high intensities.

Epidemiological Characteristics of Polio and Post-Polio Patients in Jerusalem

136 polio survivors compared with matched controls



May 20, 2012 Orange County PP Support Group

POST-POLIO CLINIC DIRECTORS TELECONFERENCES

- Sep 2011—Dr. Marny Eulberg (Denver) on PPS education
- Oct 2011—Dr. Fred Maynard on Osteoporosis
- Nov 2011—Dr. Lisa Kay (Denmark) on Bladder Problems
- Jan 2012—Carolyn Kelley RPT on Update on PPS Questionnaire related to falling, fear of falling and depression

Registry for Polio Survivors

- https://www.conemaugh.org/apps/postpolio/

- **The John P. Murtha Neuroscience and Pain Institute, Johnstown, Pennsylvania, launched an online registry of polio survivors to promote research about the late effects of polio and post-polio syndrome.**

  5-10 minutes of on-line questions

  Your identity is kept confidential

Resources

WWW.POST-POLIO.ORG

WWW.NCBI.NLM.NIH.GOV/ENTREZ (PUBMED)

WWW.CLINICALTRIALS.GOV

Common Questions and Concerns

- Regaining strength in muscles that seem to be getting weaker.
- Pain and fatigue--what to do about them.
- Swallowing problems and other bulbar dysfunction
- Anesthesia when surgery is needed.

Questions Submitted for Today

Breathing and Sleep

- 1) What is underventilation and how is it different from sleep apnea?

>>>

- 2) What are the appropriate tests for each and how/where do I get them?

- 3) Sleep labs often only look for apneas/hypopneas and do not measure CO2 levels that would catch underventilation. Are there any local sleep labs that do end-tidal C02 or transcutaneous CO2 monitoring?

Capnography is the monitoring of the concentration or partial pressure of carbon dioxide in the respiratory gases. Its main development has been as a monitoring tool for use during anaesthesia, intensive care, and emergency medicine, where minute to minute CO2 changes can be a warning of an acute event.

>>>

- 4) When are ABGs really necessary? Whenever underventilation is suspected.

- 5) Absent evidence of muscle weakness, should I be using bilevel ventilation (BIPAP) or CPAP? The Old Wives feel that BIPAP is preferable all the time.

Thanks to Wikipedia

- The term **respiratory failure**, in medicine, is used to describe inadequate gas exchange by the respiratory system, with the result that arterial oxygen and/or carbon dioxide levels cannot be maintained within their normal ranges.
- A drop in blood oxygenation is known as hypoxemia; a rise in arterial carbon dioxide levels is called hypercapnia. The normal reference values are: oxygen PaO_2 greater than 80 mmHg (11 kPa), and carbon dioxide $PaCO_2$ less than 45 mmHg (6.0 kPa).
- Classification into type I or type II relates to the absence or presence of hypercapnia respectively.

Type I respiratory failure

- is defined as hypoxia without hypercapnia, and indeed the PaCO2 may be normal or low. It is typically caused by a ventilation/perfusion (V/Q) mismatch; the volume of air flowing in and out of the lungs is not matched with the flow of blood to the lungs. The basic defect in type 1 respiratory failure is failure of oxygenation characterized by:
  - PaO2low (< 60 mmHg (8.0 kPa))
  - PaCO2normal
- This type of respiratory failure is caused by conditions that affect oxygenation such as:
- Parenchymal disease (V/Q mismatch)
- Diseases of vasculature and shunts: right-to-left shunt, pulmonary embolism
- interstitial lung diseases: ARDS, pneumonia, emphysema

Type II respiratory failure

- PaO2 decreased
- PaCO2 increased
- pH decreased

- Type 2 respiratory failure is caused by inadequate ventilation; both oxygen and carbon dioxide are affected. Defined as the build up of carbon dioxide levels (PaCO2) that has been generated by the body. The underlying causes include:
- Increased airways resistance (chronic obstructive pulmonary disease, asthma, suffocation)
- Reduced breathing effort (drug effects, brain stem lesion, extreme obesity)
- A decrease in the area of the lung available for gas exchange (such as in chronic bronchitis).
- Neuromuscular problems like, GBS, myasthenia gravis, motor neuron disease
- Deformed (kyphoscoliosis), rigid (ankylosing spondylitis), or flail chest.
- Body compensates by breathing faster & generating a high bicarbonate level.

Ann Rehabil Med. 2012 Feb;36(1):126-32. Epub 2012 Feb 29.

The Significance of Transcutaneous Continuous Overnight CO(2) Monitoring in Determining Initial Mechanical Ventilator Application for Patients with Neuromuscular Disease.

Lee SK, Kim DH, Choi WA, Won YH, Kim SM, Kang SW.
Department of Rehabilitation Medicine and Rehabilitation Institute of Muscular Disease, Yonsei University College of Medicine, Seoul 135-720, Korea.

- **OBJECTIVE:**
- To reveal the significance of continuous transcutaneous carbon dioxide (CO(2)) level monitoring through reviewing cases which showed a discrepancy in CO(2) levels between arterial blood gas analysis (ABGA) and continuous transcutaneous blood gas monitoring.
- **METHOD:**
- Medical record review was conducted retrospectively of patients with neuromuscular diseases who had started home mechanical ventilation between June 2008 and May 2010. The 89 patients underwent ABGA at the 1st hospital day, and changes to their CO(2) level were continuously monitored overnight with a transcutaneous blood gas analysis device. The number of patients who initially appeared to show normal PaCO(2) through ABGA, yet displayed hypercapnea through overnight continuous monitoring, was counted.
- **RESULTS:**
- 36 patients (40.45%) presented inconsistent CO(2) level results between ABGA and continuous overnight monitoring. The mean CO(2) level of the 36 patients using ABGA was 37.23±5.11 mmHg. However, the maximum and mean CO(2) levels from the continuous monitoring device were 52.25±6.87 mmHg and 46.16±6.08 mmHg, respectively. From the total monitoring period (357.28±150.12 minutes), CO(2) retention over 45 mmHg was detected in 198.97 minutes (55.69%).
- **CONCLUSION:**
- Although ABGA only reflects ventilatory status at the puncturing moment, ABGA results are commonly used to monitor ventilatory status in most clinical settings. In order to decide the starting point of home mechanical ventilation in neuromuscular patients, continuous overnight monitoring should be considered to assess latent CO(2) retention.

New “Treatment” for Muscle Cramps

- I recently was sick with a flu-like illness and took Delsym to help with the symptoms. I realized that the entire time I took it, I had no muscle cramps and NO PAIN.

- **Delsym** is an American brand of over-the-counter cough medicine owned by Reckitt Benckiser. It is different from most brands of cough medicine in that the active ingredient is "time released". The time release feature allows the drug to suppress the cough reflex for a longer period of time. similar to Tussionex (also The active ingredient per teaspoon (5 mL) is dextromethorphan polistirex, equivalent to dextromethorphan HBr 30 mg.
- Dextromethorphan is also being investigated as a possible treatment for neuropathic pain and pain associated with fibromyalgia.

- Expert Rev Clin Pharmacol. 2011 May;4(3):379-88.
- **Targeting N-methyl-D-aspartate receptors for treatment of neuropathic pain.**
- Zhou HY, Chen SR, Pan HL.
- Department of Anesthesiology and Perioperative Medicine, Unit 110, The University of Texas MD Anderson Cancer Center, 1515 Holcombe Boulevard, Houston, TX 77030, USA.

- Neuropathic pain remains a major clinical problem and a therapeutic challenge because existing analgesics are often ineffective and can cause serious side effects. Increased N-methyl-d-aspartate receptor (NMDAR) activity contributes to central sensitization in certain types of neuropathic pain. NMDAR antagonists can reduce hyperalgesia and allodynia in animal models of neuropathic pain induced by nerve injury and diabetic neuropathy. Clinically used NMDAR antagonists, such as ketamine and dextromethorphan, are generally effective in patients with neuropathic pain, such as complex regional pain syndrome and painful diabetic neuropathy. However, patients with postherpetic neuralgia respond poorly to NMDAR antagonists. Recent studies on identifying NMDAR-interacting proteins and molecular mechanisms of increased NMDAR activity in neuropathic pain could facilitate the development of new drugs to attenuate abnormal NMDAR activity with minimal impairment of the physiological function of NMDARs. Combining NMDAR antagonists with other analgesics could also lead to better management of neuropathic pain without causing serious side effects.

Weakness and Pain

- I have lumbar facet arthritis and in non-polio affected population this can cause pain and weakness. How can this be differentiated from polio weakness (an EMG is going to show old polio effect whether there is a problem or not). I'm concerned that it is not being treated to prevent further disability. Diagnostic facet block.

- My torn rotator cuff and associated weakness/pain was relegated to polio until a shoulder society surgeon repaired it. So, how many problems are not being surgically repaired/addressed because the clinicians attribute orthopedic problems to old polio vs the same problems the general population has? (I have family history of shoulder/back/knee problems and none of them had polio).

- How do I get treatment other than pain medication?

>>>

Adjuvants to Use with Analgesics

- **Ice, heat, topical agents ("icy-hot", lidocaine, NSAID, capsaicin)**
- **Position change or support/bracing**
- **Massage**
- **TENS**
- **Acupuncture (may not work if patient using opiates)**
- **Relaxation techniques—biofeedback, self-hypnosis**
- **Muscle relaxants**
- **Hypnotics**
- **Anti-depressant medication**
- **Anxiolytics, anti-histamines**
- **Acetaminophen**

Autoimmune Problems

- I've recently been diagnosed with an auto-immune disease---Sjogren's. I am so fatigued. Could this be connected to my PPS? My rheumatologist doesn't seem to know much about PPS.

Polio and History

- Was Sister Kenny treatment for polio ever accepted by the medical establishment? Between 1934 and her death in 1952 Kenny and her associates treated only a few thousand patients, but her methods were used to treat many thousands of polio victims throughout the world. Their testimony to Sister Kenny's healing is part of her legacy, as is *The Kenny Concept of Infantile Paralysis, and Its Treatment* (known as the "Red Book" and written by Dr. John Pohl in collaboration with Kenny). Her most enduring legacy is the Minneapolis Sister Kenny Rehabilitation Institute.

- Where and when was the FIRST case of Polio in the United States?

- **1789 - British physician Michael Underwood provides the first clinical description of polio, referring to it as "debility of the lower extremities."**
- **1840 - German physician Jacob von Heine publishes a 78-page monograph in 1840 which not only describes the clinical features of the disease, but also notes that its symptoms suggest the involvement of the spinal cord.**
- **1894 - The first major polio epidemic reported in the United States occurs in Vermont, consisting of 132 total cases, including some adults.**

- Is Polio eradicated in the United States?
- **1979 - The last indigenous transmission of wild polio virus occurs in the U.S. All future cases are either imported or vaccine-related.**
- **1994 - The entire Western Hemisphere is certified as "polio free."**

Orthopedic Interventions

- Tell me about my Lohman Transplant surgery. What was the purpose of it? Fascia muscle was stripped from my weakest leg and transplanted across my stomach. Surgery was done by Dr. Lohman & Dr. Luck at Children's Hospital in Los Angeles in the late 1950's. I had the surgery seven years after my original polio diagnosis. I've asked several physicians over the years but none were familiar with the surgery. Flaps, acellular dermis, mesh.
- I'm currently wearing leg brace to the knee to support/align left ankle. The ankle is bone-on-bone and ankle fusion has been recommended. I can walk for about one hour with over-the-counter stretchable ankle wraps, half a day with the leg brace. Will I still need to wear a leg brace with ankle fusion? No
- Has ankle fusion become more commonplace operation for polio cases? No, but modifications of old fusions may be required.

There will be an Annular Solar Eclipse occurring on 20th May 2012 (5:30 – 7:30pm)