The Polio Body

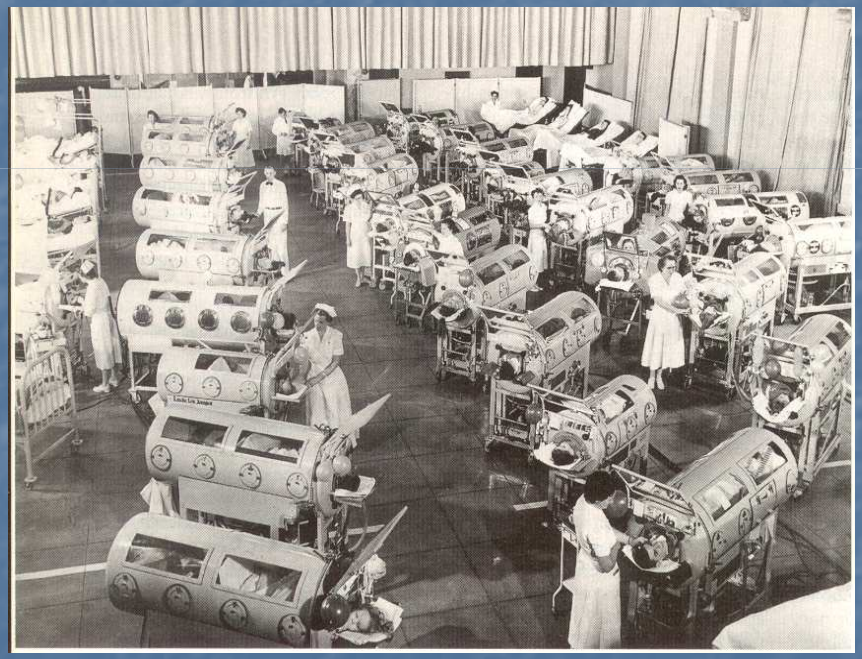
Dr. Stephen de Graaff
MBBS FAFRM

HISTORY OF POLIO

- Polio has been around since antiquity
- Egyptian wall plaque depicting a young man with a withered leg, leaning on a staff; 1550 – 1300 BC
- A skeleton of a 20 years old female who may have suffered from polio, found recently at Tell Abraq in United Arab Emirates; 3000 – 2000 BC

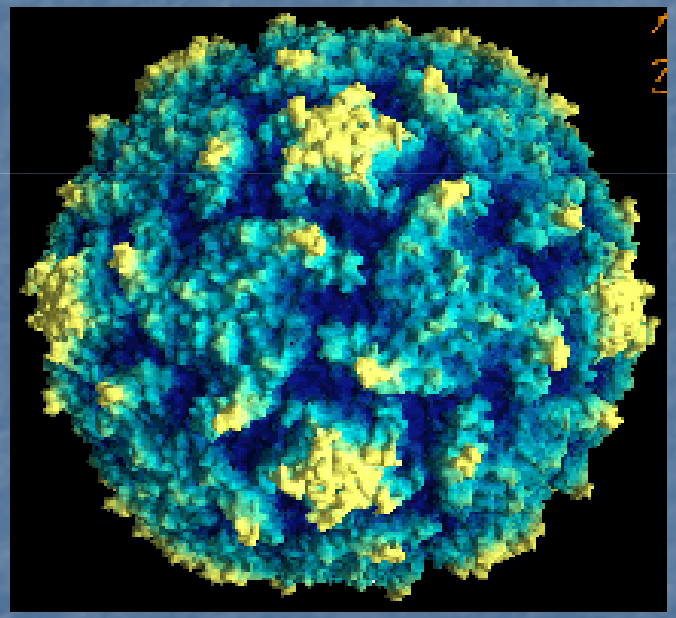
Polio epidemics in Australia

- Major epidemics in 1930s, 1940s and 1950s
- 20,000 to 40,000 cases between 1930 – 1960
- Mass immunisation commenced in 1956
- Last epidemic was in 1956
- Last case of Wild Polio reported in 1988
- Last case of Polio- June 2007 (Student returning from Pakistan)



The polio virus

- enterovirus of picornavirus group.
- enters the body by oral ingestion
- replicates in the lymphoid tissue
- 95 to 99% remain asymptomatic
- invasion of the anterior horn cells of the central nervous system in 1 to 5%
- Only 1 to 2% of all those infected develop paralysis



POLIOVIRUS INFECTION

- Most people infected during epidemics are asymptomatic
- 5% present with minor illness – fever, malaise, sore throat, anorexia, headache *(abortive polio)*
- 1% present with aseptic meningitis *(non-paralytic polio)*
- 1% develop muscle weakness *(paralytic polio)*

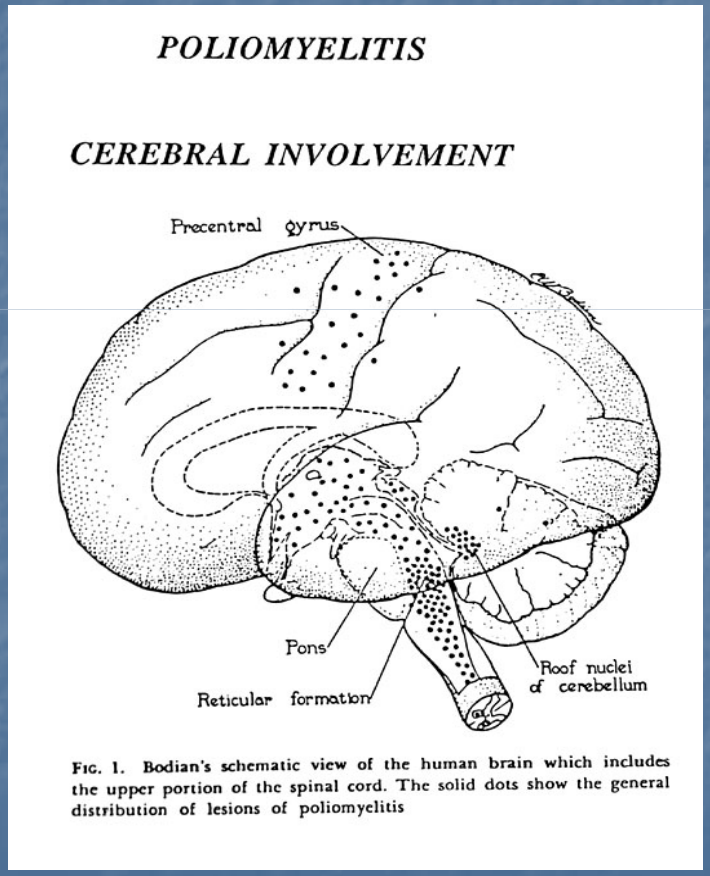
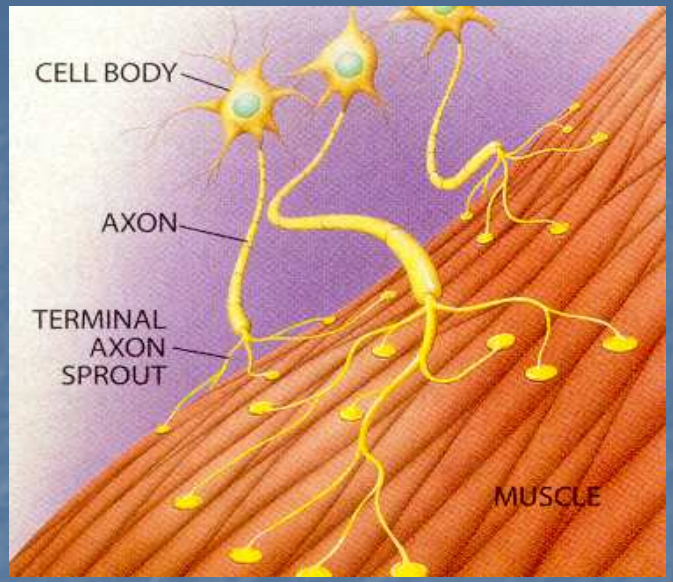
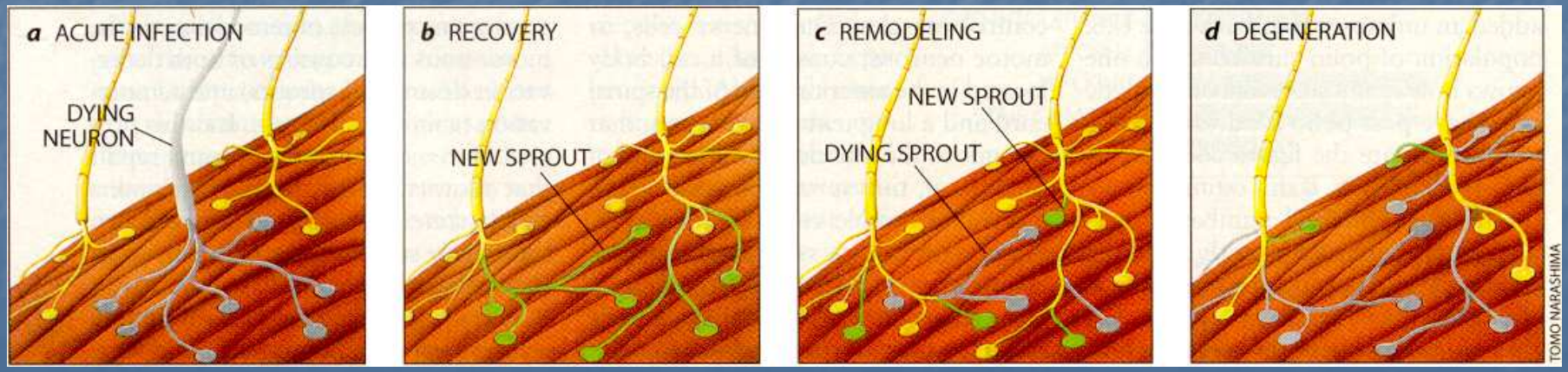


FIG. 1. Bodian's schematic view of the human brain which includes the upper portion of the spinal cord. The solid dots show the general distribution of lesions of poliomyelitis

Physiological Consequences of Polio Virus Infection

- A) Extensive neuronal involvement in the acute polio infection.
- B) Motor Unit Remodelling in post-recovery phase.
- C) Decompensation then produces Post Polio Syndrome.


CELL BODY
AXON
TERMINAL AXON SPROUT
MUSCLE


a ACUTE INFECTION
DYING NEURON
b RECOVERY
NEW SPROUT
c REMODELING
NEW SPROUT
DYING SPROUT
d DEGENERATION
TOMO NARASHIMA

Neurological Recovery Post-Polio Virus Infection

The extent of neurological and functional recovery is determined by three major factors:

(1) the number of motor neurones that recover and resume their normal function

(2) the number of motor neurones that develop terminal axon sprouts to reinnervate muscle fibres left orphaned by the death of their original motor neurones

(3) muscle fiber hypertrophy.

Neurological Recovery (continued)

- Motor unit size can increase 7 to 8 fold
- A single motor neuron for quadriceps that originally innervated 5000 muscle fibers may eventually support 35,000 to 40,000 fibers.
- a muscle can retain normal strength even after 50% of the original motor neurones have been lost

Polio Vaccines

- Salk (1955) Inactivated poliovirus vaccines (IPV); injection
- Sabin (1962) Attenuated poliovirus vaccine (OPV); Oral
  - 1 case of polio (VAPP) per 2.5 million doses
- CDC recommendation in USA:
  - IPV at 2 months & 4 months age
  - IPV at age 12 – 18 months & 4 – 6 years
- Australia generally uses IPV for all doses

Post Polio Syndrome

Criteria for Post-polio Syndrome

(March of Dimes 2000)

1. Prior Paralytic Poliomyelitis (evidence)
2. Period of partial/complete recovery
3. Gradual or sudden onset of progressive & persistent signs or symptoms
4. Symptoms persist for at least a year
5. Exclusion of other causes

Post Polio Syndrome

Definition

An otherwise unexplained constellation of symptoms in a patient who had paralytic polio & may include:

- new muscle weakness (previously affected or so-called non-affected muscles)
- muscle & joint pain
- fatigue
- new muscle wasting
- heat or cold intolerance
- swallowing, breathing or sleep disturbance.

Post Polio Syndrome

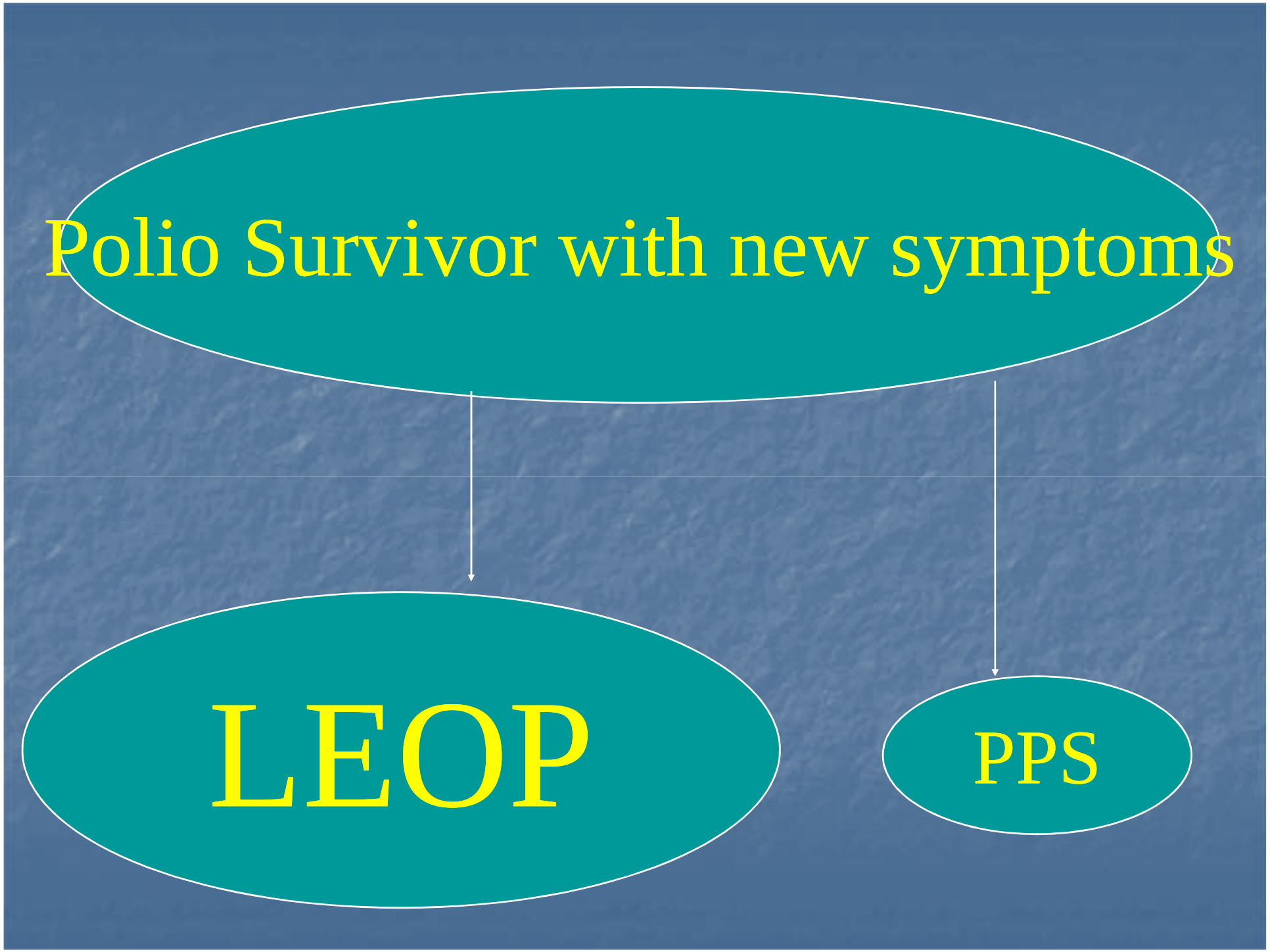
Scope of Problem.

- 0.625% of population are Polio Survivors.
- 50% of this group have Post Polio Syndrome symptoms.
- Likelihood increases with Polio infection at age greater than 5 years and more severe initial symptoms eg: respiratory compromise
- Between 25-75% of Polio Survivors will experience the symptoms of PPS (but this does not necessarily mean they have PPS)

Late Effects of Polio (LEOP)

symptoms which would normally be expected to occur with time, due to biomechanical disadvantage from long-standing weakness or bodily asymmetry caused by polio, e.g.

- **pain**
- **fatigue**
- **weight gain**
- **age related weakness**


Polio Survivor with new symptoms
LEOP
PPS

PPS vs LEOP

<u>Important to make the distinction because:</u>

1. **advice on management of symptoms may be different based on the diagnosis**
2. **facilitate research studies on the use of pharmacological agents and therapies in PPS patients presenting with new progressive weakness.**

Aetiology of PPS

- 1. Motor Unit Dysfunction √
- 2. Muscle Overuse √
- 3. Muscle Disuse √
- 4. Loss of Motor Units with Ageing √
- 5. Predisposition to Motor Neuron Degeneration
- 6. An Immune Mediated Syndrome
- 7. The Effect of Growth Hormone
- 8. Chronic Poliomyelitis Infection or Reactivation
- 9. Combined Effects- disuse, overuse, pain, weight gain, other illnesses √

PATIENT PRESENTATION

A) **Prime Symptoms**

- Fatigue (89%)
- Pain (86%)
- Weakness (83%)

B) **New Atrophy** (28%)

C) **Activities of Daily Living Decline** (78%)

PATIENT PRESENTATION

A) **Prime Symptoms**

- Fatigue (89%)

- Primary Fatigue including muscular and neural fatigue
- Secondary Fatigue due to persistent pain, respiratory disorders, sleep disorders, joint problems, depression and coping stressors

PATIENT PRESENTATION

A) **Prime Symptoms**

- Pain (86%)

- Myalgia (Muscle Pain)
- Neuralgia (Nerve Pain)
- Biomechanical and Overuse Pain

PATIENT PRESENTATION

A) **Prime Symptoms**

- New Weakness (83%)

- Previously affected muscles (60-87%)
- Not previously affected muscles (37-77%)
- Muscle twitching and cramps (up to 50%)

PATIENT PRESENTATION

D) **Additional Presenting Problems**

- 1. Pulmonary Dysfunction
- 2. Sleep Disorders.
- 3. Dysphagia.
- 4. Cold/Heat Intolerance.
- 5. Degenerative Arthritis/MSK Problems
- 6. Social & Psychological Problems.

EVALUATION PROCESS

Identify Areas of Dysfunction

- History.
- Neurological Examination.
- General Physical & Biomechanical Examination.
- E.M.G.
- C.K. Elevation.

PATIENT PRESENTATION

E) **Past History**

- age at onset.
- variables associated with shorter interval to PPS.
- initial symptoms- most often lower limb in acute illness.
- Onset usually insidious (after precipitating event)

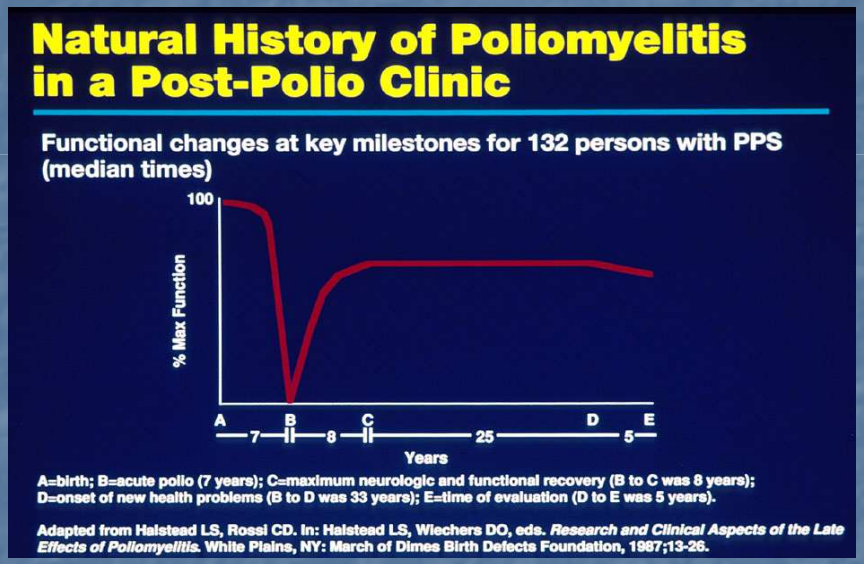
EMG: Motor unit potential recorded 5 times

- High amplitude Motor Units
- Long duration
- Polyphasic(denervation+reinnervation)
- Unstable/ some spontaneous activity
- Contains small late potentials that are variably linked
- Late potentials probably represent reinnervated muscle fibers

EVALUATION PROCESS

Prognosis

- must clarify difference between deterioration in function & deterioration from disease process.
- rare for progression of disease.



PPS Diagnostic Issues

- **The term PPS has been used loosely by many consumers and even physicians to describe all new problems noted by polio survivors.**
- **Thus PPS is over-diagnosed.**

Management

Minimise deterioration in function over time by:

1. Optimising balance between muscle, strength & endurance Vs burden.
2. Pacing.
3. Gradually decreasing daily energy expenditure.

Management

Formalise Treatment Goals

- 1. Lifestyle modifications- pacing, ergonomics, rest.
- 2. Increase muscle capacity & treat fatigue: strength, endurance, orthotics.
- 3. Pharmacological: Antidepressants, NSAIDs, Mestinon, Amantidine, Deprenyl, Coenzyme Q10, Carnitine, other.
- 4. Decrease muscle load to less than muscle capacity.
- 5. Treat specific complications.

Management

Problem/Challenges

- Fatigue
- Weakness
- Pain
- Functional Loss
- Dysphagia
- Respiratory Issues/OSA
- Cold/Heat Intolerance
- Psychosocial Issues

Strategies

- Exercise Prescription
- Ergonomic Advice
- Orthotics Prescription
- Medications
- Speech Pathologist
- Respiratory Physician
- Environmental Adjustment
- Social Work/ Psychologist
  Community Supports
  PSV/ Polio Network

RESOURCES IN PATIENT MANAGEMENT

Polio Survivor, Carer/Family +

1. Neurology Consultant (Diagnosis, Investigations, Medications).

2. Rehabilitation Physician (Team & Functional Management).

3. Physiotherapist (exercise prescription, fitness, strength, endurance, posture, stretch and stabilise).

4. Occupational Therapist (ergonomics, pacing, ADL, cognition, equipment needs).

5. Speech Pathologist (respiratory, swallowing, voice and communication issues).

6. Social Worker (financial, community, accommodation supports.

RESOURCES IN PATIENT MANAGEMENT

7. Respiratory Physician (breathing disorders, sleep apnoea).
8. Orthotist (footwear, braces, trunk supports, technological equipment).
9. Psychologist (mood, coping strategies, CBT).
10. Dietician (Nutritional advice, weight loss or gain advice).
11. Support Groups/ Networks
12. Other- Acupuncture, yoga, meditation practitioners, personal trainers, other medical and like

Resources in Patient Management

Medication Trials & Usage

1.	Pyridostigmine	+/-
2.	Carnitine	-
3.	Amantidine	-
4.	Selegiline	+ mildly
5.	Human Growth Factors	+mildly
6.	Human Growth Hormone	-
7.	Mestinon	-
8.	Bromocryptine	+mildly
9.	High Dose Steroids	-

Medications Potentially to be avoided in PPS

- Beta-blockers
- calcium channel blockers
- diuretics
- certain antibiotics
  - tetracycline
  - aminoglycosides
- Phenytoin
- lithium
- phenothiazines
- barbiturates
- statins
- benzodiazepines
- certain anaesthetics