Leprosy - Prosthetic implications

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Resident in Physical Medicine & Rehabilitation

"Leprosy work is not merely medical relief; it is transforming frustration of life into joy of dedication, personal ambition into selfless service"

Mahatma Gandhi
Objectives

- A couple of cases
- Infectious agent
- Presentation
- Impact on nerves, bones
- Look at Cases in Toronto
- Prosthetic devices
- Mention of the Foot
- Case quiz
- Encourage a field trip
Case 1. 38 M from Viet Nam.

- Left BKA – old prosthesis, choked, swollen.
- Note skin lesions and hand involvement

Case 2 – 40 M from Gambia

- Age 20 presented with ulceration over lateral malleolus. Subsequent foot drop due to peroneal nerve neuropathy. No other findings.
Why this subject in 2006

- We do have patients with leprosy.
- Multicultural society
- Long history for P & O

What is Leprosy?

- Chronic infectious granuloma forming disease caused by *Mycobacterium Leprae* (a bacillus similar to TB)
- A disease of peripheral nerves and skin, only bacillus to target nerves.
- Upper Respiratory Tract, eyes, testes, organs and bone.
History of Leprosy - Hansen’s Disease

- First written records in 600 B.C.
- Hansen - *M. leprae* 1st bacterium described - 1873
- Untreatable until 1940’s with sulpha antibiotics
- Epidemic in Europe in 12-13th century.
- Today 1.2 million mostly, Asia, Africa, S.America.
In North America

- 136-187 cases per year in U.S.
- Endemic in Texas and Arkansas in armadillos.
- Leper colony in Canada 1891-1957
- We will look at Toronto

M leprae – Can I catch it?

- Spread in aerosolized droplets, or direct skin.
- Slowest known reproduction - 2 weeks (most 2 minutes)
- Exposure - 2-4 years for effects.
- Incubation weeks--> 30 years!
- Never cultured in vitro
Presentation

- Infects skin and peripheral nerve fibres of dermis.
- Multiply best in cool regions, face, limbs. Superficial nerves
- Presents as a solitary macule, hypopigmented, alteration of sensation, due to bodies inflammatory reaction to the infection.
- **Indeterminate** - Africa 70% heal.

Wide spectrum of effect, no immunity to violent response.

- **Tuberculoid** – Very active immune response, few bacilli left (not detectable levels)
  - Affects a few peripheral nerves, adjacent skin, tuberculoid granuloma

- **Lepromatous** - host lacks resistance, all tissues affected, forms granulomas. $10^9$ bacilli/g tissue

- **Borderline** - between tuberculoid and lepromatous
**Tuberculoid** - Well developed cell mediated immunity.

- Usually a few areas of skin and Large Nerves often solitary and well defined
- N. thick from infiltrate, anesthesia,
- Wasting from motor n,
- Autonomic damage, cyanotic and impaired sweating.
- **May heal spontaneously**
Presentation

- Usually, skin lesion, may have for years with no change dry skin.
- Gradual numbness, don’t know until burn, cut
- Weakness, ie, ulner palsy, foot drop, facial palsy, wasting and weakness.
- Pain – Neuritis, single nerve first
- Eyes - iridocyclitis (uveitis)
- Nose – epistaxis
**Lepromatous – Host Overwhelmed**

- Chronic
- No cell mediated immunity
- Enormous bacilli growth.
- Not localized, blood to all areas, skin nerves, URI, nose, testes, organs.
- Starts as a small macule then symmetrical lesions all over body.

**Presentation of Lepromatous**

- Sensory loss to extensor surfaces, muscle weakness, intrinsics first.
- Waxy skin, folds of skin lion-like eyes (Leonine)
- Nasal stuffiness, epistaxis, perforation,
- Impaired sweating
- Feet and fingers, osteoporosis, #, edema
Bones & Nerves affected

- Phalanges, replaces marrow.
- Cortical - osteoporosis and #'s
- Lose pin prick, pain and temp. **Glove in stocking**
- later light touch-->deep p-->tot. anesth.
- Ulnar, median, radial, posterior tibial and facial
- Eventually motor is affected
Superficial sites, nerve trunks are cooler, traumatized, anatomically constricted

- ulnar nerve - medial epicondyle of the humerus,
- median nerve at the wrist,
- superficial peroneal nerve at the neck of the fibula,
- posterior tibial nerve behind and inferior to the medial maleolus, - claw toe
- radial nerve in the humeral groove posterior to the deltoid insertion - loss of extensors.

Lepromatous damage

- Invades the eye. Hazy cornea, keratitis.
- acute iridocyclitis
- severe glaucoma
- 5th N. anesthetic cornea, 7th lagopthalmos, and intrinsic m. weakness.
Nose and throat

- Muscle wasting and weakness.
- **Bones and Cartilage**
- Us. nasal bones and phalanges
- Collapse of nose, alveolar process, teeth (maggots)
- Invades larynx change in voice - feminization

**Table 2: Current World Health Organization’s recommendations for multidrug treatment of leprosy**

<table>
<thead>
<tr>
<th>Classification of disease</th>
<th>Drug</th>
<th>Dosage</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paucibacillary (I, TT, BTI)</td>
<td>Rifampin</td>
<td>600 mg once monthly, supervised</td>
<td>6 mo</td>
</tr>
<tr>
<td></td>
<td>Dapsone</td>
<td>100 mg daily, self-administered</td>
<td>6 mo</td>
</tr>
<tr>
<td>Single-lesion, paucibacillary</td>
<td>Rifampin</td>
<td>600 mg</td>
<td>Once</td>
</tr>
<tr>
<td></td>
<td>Ofloxacin</td>
<td>400 mg</td>
<td>Once</td>
</tr>
<tr>
<td></td>
<td>Minocycline</td>
<td>100 mg</td>
<td>Once</td>
</tr>
<tr>
<td>Multibacillary (BB, BL, LL)</td>
<td>Rifampin</td>
<td>600 mg once monthly, supervised</td>
<td>12 mo</td>
</tr>
<tr>
<td></td>
<td>Dapsone</td>
<td>100 mg daily, self-administered</td>
<td>12 mo</td>
</tr>
<tr>
<td></td>
<td>Clofazimine</td>
<td>300 mg once monthly, supervised</td>
<td>12 mo</td>
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<tr>
<td></td>
<td></td>
<td>or</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>50 mg daily, self-administered</td>
<td></td>
</tr>
</tbody>
</table>
184 Cases in Toronto

- TGH - 1979 - 2002, 80% of Canada
- Symptoms mean 4.8 years before presenting
- 1/3 had sensory nerve involvement
- ¼ had motor
- Origin, India, Philippines, Viet Nam
Motor involvement

Ulnar 15/80 8.3%
Median and Ulnar 12/180 6.7%
22% had lower extremity motor involvement
Common Peroneal 16.2%

<table>
<thead>
<tr>
<th>Nerve involvement</th>
<th>All patients</th>
<th>TT</th>
<th>BT</th>
<th>BL</th>
<th>LL</th>
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<tr>
<td>Upper extremity</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td>Motor</td>
<td>43 (23.4)</td>
<td>1 (0.5)</td>
<td>18 (9.8)</td>
<td>8 (4.3)</td>
<td>13 (7.1)</td>
</tr>
<tr>
<td>Sensory</td>
<td>59 (32.1)</td>
<td>2 (1.1)</td>
<td>18 (9.8)</td>
<td>16 (8.7)</td>
<td>12 (6.5)</td>
</tr>
<tr>
<td>Lower extremity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td>40 (21.7)</td>
<td>1 (0.5)</td>
<td>18 (9.8)</td>
<td>9 (4.9)</td>
<td>8 (4.3)</td>
</tr>
<tr>
<td>Sensory</td>
<td>60 (32.6)</td>
<td>2 (1.1)</td>
<td>21 (11.4)</td>
<td>17 (9.2)</td>
<td>14 (7.6)</td>
</tr>
</tbody>
</table>

Table 3: Delay to diagnosis according to nerve dysfunction

<table>
<thead>
<tr>
<th>Dysfunction</th>
<th>All patients</th>
<th>TT</th>
<th>BT</th>
<th>BL</th>
<th>LL</th>
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<tr>
<td>Motor</td>
<td>8.3 (43)</td>
<td>2.0 (1)</td>
<td>2.9 (18)</td>
<td>4.5 (8)</td>
<td>14.8 (13)</td>
</tr>
<tr>
<td>Sensory</td>
<td>7.9 (59)</td>
<td>3.0 (2)</td>
<td>2.9 (18)</td>
<td>4.6 (16)</td>
<td>12.9 (12)</td>
</tr>
<tr>
<td>Lower extremity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td>6.6 (40)</td>
<td>4.0 (1)</td>
<td>2.1 (18)</td>
<td>3.0 (9)</td>
<td>13.8 (8)</td>
</tr>
<tr>
<td>Sensory</td>
<td>6.9 (60)</td>
<td>0.5 (2)</td>
<td>2.5 (21)</td>
<td>4.0 (17)</td>
<td>16.4 (14)</td>
</tr>
</tbody>
</table>

*Mean number of years between onset of symptoms and diagnosis.
Finally to Prosthetics

- Usually in poorest places in the world.
- Using common, cheap material.
- Much of the diabetes technology is thankful.

Upper Extremity

- Loss of hand function is more common
- Very gradual compared to other neuropathy
- Digit absorption is slow – very adaptable

1. Direct injuries
2. Ischemia,
3. Repetitive stress and
4. Mechanical force on open wound (Douglas)
Breakdown

- Most common grip is a lateral pinch.
- Skin breaks down at maximal stress point.
- Clawed Stump calluses will worsen.
- Infected wounds.

Approach to hand

- Arora et al Indian J. Occupational Therapy
- N=10
- >50% absorption of thumb, and >2 fingers.
- Compared 3 grasps and 3 pinches.
- Fitted - partial hand prosthesis
- Used GPAS Scale.
- Easy fit thermoplastic
- Thumb - post & base
- Base over thumb base and thenar muscles.
- Anchored with Velcro.
Results

- Before Prosthesis
- All ten, side pinch & hook, 2 – cylindrical.
- Post
- 7 pulp pinch, 9 tripod, all cylindrical, 5 spherical

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Activities</th>
<th>Pre intervention</th>
<th>Post intervention</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dressing</td>
<td>9±1.25</td>
<td>8.5±1.5</td>
<td>5.6%</td>
</tr>
<tr>
<td>2.</td>
<td>Eating</td>
<td>8.6±0.52</td>
<td>6.1±2.1</td>
<td>29.1%</td>
</tr>
<tr>
<td>3.</td>
<td>Caring for yourself</td>
<td>2.5±0.53</td>
<td>2.4±0.6</td>
<td>4%</td>
</tr>
<tr>
<td>4.</td>
<td>Preparing meals</td>
<td>8.9±0.57</td>
<td>8.7±1.02</td>
<td>23%</td>
</tr>
</tbody>
</table>

Modulan Grip Aid by Ciba Geigy

- Epoxy two resins – rapid, cheap individual
- Patient present, molded to handle or tool
- Grasps device to shape – 12 hours.
Care of the foot in Leprosy

- Too broad for this talk.
- Anesthesia.
- Motor paralysis foot drop, claw toe
- Charcot foot
- Auto-amputation
- Absorption, bony changes and fractures.
- Impaired sweating – dry cracked.
A few castings.....

Lower Extremity Amputation

- Leg and foot spared at all costs.
- Do not believe it will be better without it.
- Anesthetic patient with poor hand function.
- Compared to traumatic amputees, much more difficult, often discarded.
- Goal is to preserve stump with foot wear, orthoses as long as possible.
Indications for amputation

- Flail Leg
- Fixed deformity
- Cancerous conversion
- Non-healing ulcers

- Majority are BKA


The $28 Foot - Jaipur

- World’s poorest countries cannot afford imports
- 1971 by Sethi and Chandra.
- Light weight, for multiple usage in bare footed or sandaled individual.
- Climb trees, ride bikes, squat.
- Made of local materials, quick.
- Multi-axial.
The Jaipur Limb.

- Most similar to a SAFE (stationary ankle flexible endoskeleton)
- 12–15 cm high
- Very flexible keel
- Multi-axial foot ankle system allows for ankle, mid-foot, and forefoot motion.
- Made from a wood supramalleolar block attached to a prosthetic shank
- “Microcellular rubber calcaneal, midfoot, and phalangeal "bones" secured with adhesive cord or tape…encased in rubber vulcanized in premade foot molds.”

Prosthetic feet for low-income countries. Craig. JPO 2005

Microcellular Rubber – Or a Car Tire
The Jaipur foot manual.

- Ankle block. Short wooden keel allows for dorsiflexion and plantarflexion.
- MCR heel block allows torsion and deflection for squatting and uneven ground. Absorbs shock.
- Forefoot block stiff MCR to allow natural toe movements. Toes each separate MCR
- External cover, vulcanized rubber, natural look, durable water proof.
Jaipur Limb

- Made of high density polyethylene and pipes (often PVC)
- Once open to contain different size stumps
- Now total contact thermoplastics.
- Endoskeletal with nylon knee joint.

Case Number 1

- West Africa, presented with infected malleolus.
- Skin changes
- One large nerve and numbness
- Treated quickly.
- Diagnosis? Tuberculoid
Case 2

- Male from Viet Nam
- Skin lesions, shortened phalanges.
- Waxy skin
- BKA
- Diagnosis: lepromatous

Summary

- Not so rare
- Wide spectrum of disease
- You are not at risk for infection
- Prosthetist is a great friend
- $60 BKA prosthesis!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
- Volunteer at a leprosy hospital.