Enhanced Specialty Training for Physiotherapists in Neurological Specialty  
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Physiotherapy for Spasticity Management

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- Overview of Spasticity Management  
- Botulinum Toxin Injection  
- Assessment and Goal setting  
- Gait analysis and selection of muscles  
- RCP guideline  
- Physiotherapy Treatment for Spasticity  
- Service Model of NTWC  
- Case illustration

Spasticity Management for Paediatric and Adult

NDT / Bobath Approach  
http://www.ndta.org

Paediatric  
- NDT /Bobath Certificate Course in the Management and Treatment for Children with Cerebral Palsy  
- 8 weeks course  
- Emphasis on movement analysis

Adult Hemiplegia  
- NDT / Bobath Certificate Course in the Management and Treatment for Adults with Hemiplegia  
- 3 weeks course  
- Emphasis on movement analysis

Spasticity Management

Paediatric  
- Cerebral Palsy  
- Brain injury  
- Cervical dystonia  
- Torticollis

Adult  
- Stroke  
- Traumatic brain injury  
- Multiple Sclerosis  
- Spinal Cord injury  
- Neurogenic bladder  
- Cervical dystonia  
- Migraine
Spasticity Management for Movement Disorder

- Movement analysis
- Identify which muscles affect functions
- Identify goal based on ICF - better activity and participation
- Decide tailor made rehabilitation program
- Family support

International Classification of Functioning, Disability and Health (ICF) (2001)

Health Condition
(Stroke)

Body Function & Structure
Skeletal Alignment
ROM, Muscle Performance

Activities
Mobility, Self-Care
Communication

Participation
Family Routines
Work, leisure
Social relationship

Environmental Factors
Personal Factors

Problem of Spasticity in Neurological Patients

- Not everyone who has spasticity requires medical treatment;
- However, in many individuals, spasticity can interfere with function, mobility, self-care, or the ability of a caregiver to care for an individual.
- Left untreated, spasticity can often lead to muscle contractures, bony deformities, and mobility problems.

Problem of Spasticity in Neurological Patient

- Spasticity can also interfere with the fit and usefulness of orthoses or seating and mobility devices.
- Appropriate management and treatment can help reduce spasticity that interferes with day to day functioning and allow for greater independence and functioning.
- Spasticity is best managed by an interdisciplinary clinical team.
Goals of Spasticity Management:
- Improve Mobility
- Increase quality of gait/reduce risk for falls
- Increase independence with activities of daily living
- Improve range of motion/prevent contractures
- Postpone or avoid need for surgical intervention
- Improve fit of orthotic devices
- Improve seating & positioning
- Minimize/avoid deformities

Spectrum of Care for Management of Spasticity

How common is spasticity after stroke?
- Prevalence varies in the literature
  - 17% European study (Lundstrom et al, 2008)
  - 38% UK study (Watkins et al 2002)
- Spasticity mainly occurs in the first 3 months following stroke
  (Lundstrom et al, 2008)

What are the consequences of spasticity?
- Restricts normal movement
- Excessive/inappropriate movement
- Pain
- Interferes with function: active or passive
- Tissue damage
- Soft tissue/joint changes
Management of Spasticity After Stroke

Both components of hypertonia need to be addressed:

- Neurogenic component: overactive muscle contraction
- Biomechanical component: stiffening and shortening of the muscle and other soft tissues

The vicious circle of spasticity

Botulinum Toxin A

Botulinum Toxin A, injected into the muscles, where it binds to nerve endings and inhibits the release of the neurotransmitter acetylcholine (Ach). This leads to a decrease in muscular contractions for patients.

BOTOX®: Established Clinical Uses for Multiple Therapeutic Needs
**BOTOX in Adult Spasticity**

- Used in combination with:
  - Physiotherapy
  - Casting, splinting and orthotics
  - Orthopedic surgery
    - soft tissue
    - bone

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**BOTOX® in Adult Spasticity**

- Patient selection
- Treatment timing
- Dosage and administration
- Toxicity
- Clinical trials or experience
- Multidisciplinary approach with common goals

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**BOTOX® in Adult Spasticity**

- Dosage and Administration
  - How many units?
  - What volume?
  - How many sites?
  - Post-injection observation?

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**Botox Dosage – Upper Limbs**

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Dose/units</th>
<th>Injection site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pectoralis</td>
<td>50-200</td>
<td>2-4</td>
</tr>
<tr>
<td>Latissimus dorsi</td>
<td>50-200</td>
<td>2-4</td>
</tr>
<tr>
<td>Subscapularis</td>
<td>50-100</td>
<td>1-2</td>
</tr>
<tr>
<td>Brahioradialis</td>
<td>25-100</td>
<td>1-3</td>
</tr>
<tr>
<td>Biceps</td>
<td>75-200</td>
<td>2-4</td>
</tr>
<tr>
<td>Pronator teres</td>
<td>25-75</td>
<td>1-2</td>
</tr>
<tr>
<td>FCU/FCR</td>
<td>25-100</td>
<td>1-2</td>
</tr>
<tr>
<td>Add pollicis</td>
<td>5-30</td>
<td>1</td>
</tr>
<tr>
<td>FDS/FDP</td>
<td>20-50</td>
<td>1</td>
</tr>
</tbody>
</table>
### Botox Dosage – Lower Limbs

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Dose/units</th>
<th>Injection site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iliopsoas</td>
<td>50-200</td>
<td>2</td>
</tr>
<tr>
<td>Hamstring</td>
<td>50-200</td>
<td>2-3</td>
</tr>
<tr>
<td>Adductors</td>
<td>75-300</td>
<td>2-3</td>
</tr>
<tr>
<td>Quadriceps</td>
<td>50-300</td>
<td>6</td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>50-250</td>
<td>2-4</td>
</tr>
<tr>
<td>Soleus</td>
<td>50-200</td>
<td>2-4</td>
</tr>
<tr>
<td>Tib Post</td>
<td>50-150</td>
<td>1-3</td>
</tr>
</tbody>
</table>

#### Example:
A common situation is that of a adult hemiplegia with spastic gastrocnemius and soleus.  
Gastrocnemius: 100U  
Soleus: 50 – 80U  
Use: EMG guide  
Muscle stimulator  
US guide

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### Botox Injection with muscle stimulator

- Injection to tibialis posterior
- Injection to pronator teres

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### Side Effect

- **Pulmonary Effects of BOTOX® in Patients With Compromised Respiratory Status Treated for Spasticity With a Neurologic Condition**

- Patients with compromised respiratory status treated with BOTOX® for upper limb spasticity with a neurologic condition should be monitored closely.
Assessment and Goal Setting based on ICF framework

International Classification of Functioning, Disability and Health (ICF)(2001)

- Health Condition (Stroke)
  - Body Function & Structure
    - Skeletal Alignment
    - ROM, Muscle Performance
  - Activities
    - Mobility, Self Care, Communication
  - Participation
    - Active Roles, Work, Leisure, Social Relationships

- Environmental Factors
- Personal Factors

Body Function & Structure
- Skeletal Alignment
- ROM, Muscle Performance

Activities
- Mobility, Self Care, Communication

Participation
- Active Roles, Work, Leisure, Social Relationships

Environmental Factors

Personal Factors

Environment 

Personal

Body Function & Structure

Activities

Participation

Assessment based on ICF framework

- Body Function
  - Skeletal Alignment
  - ROM, Muscle Performance

- Activities
  - Mobility, Self Care, Communication

- Participation
  - Active Roles, Work, Leisure, Social Relationships

Environmental Factors
- Product & Technology
- Support & Relationships
- Accessibility for rehabilitation

Personal Factors
- Personality
- Self Acceptance & Motivation
- Age
- Family Support

Modified Ashworth scale of spasticity
(Bohannon and Smith 1987)

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No increase in muscle tone</td>
</tr>
<tr>
<td>1</td>
<td>Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion</td>
</tr>
<tr>
<td>1+</td>
<td>Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM</td>
</tr>
<tr>
<td>2</td>
<td>More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved</td>
</tr>
<tr>
<td>3</td>
<td>Considerable increase in muscle tone, passive movement difficult</td>
</tr>
<tr>
<td>4</td>
<td>Affected part(s) rigid in flexion or extension</td>
</tr>
</tbody>
</table>

Modified Tardieu Scale

- R1 Angle of muscle reaction to rapid passive stretching
- R2 Angle of muscle reaction to slow passive stretching

Goal Attainment Scale

- Directions: Write an “X” beside one of the following scores “-2,” “-1,” “0”, “+1,” “+2” for each action step listed across the top of the chart.
Goal of Spasticity Management

???

Participation

Gait Analysis

Full set of gait analysis (IGA)

- Physical examination
- Instrumented gait analysis including temporal-distance data, kinematics, kinetics and EMG data
- Energy expenditure assessment

Energy Expenditure
Role of Gait Analysis

Document an individual gait deviation
Evaluate the results of treatment
Treatment protocol development for patients suffering from:
- Cerebral palsy
- Muscular dystrophy
- Brain injuries
- Spinal cord injuries
- Stroke
- Spina bifida
- Lower-limb deformities
- Poliomyelitis

Typical CP gait patterns
- Jump gait: stance phase, knee flexed at IC and extended fast at LR
- Recurvatum gait: stance phase, knee over extended at MST and TST
- Crouch gait: stance phase, knee keeps flexed throughout stance phase
- Stiff knee gait: swing phase, knee flexion diminished, peak of knee flexion delayed

Typical gait patterns of Stroke patient
- Circumduction of hip
- Hip hitching
- Stiff knee pattern
- Decrease hip knee flexion
- Drop foot

OGA
Observation gait analysis

RCP (Royal College of Physician)
Guidelines on Spasticity Management for adult
BT injection must be part of a rehabilitation programme involving post-injection exercise, muscle stretch and/or splinting to achieve an optimal clinical effect.

1.4 Clinicians who have:
- appropriate understanding of functional anatomy
- experience in the assessment and management of spasticity,
- knowledge of appropriate clinical dosing regimes and the ability to manage any potential complications.

1.4 BT injection must be part of a rehabilitation programme involving post-injection exercise, muscle stretch and/or splinting to achieve an optimal clinical effect.

RCP ( Royal College of Physician) Guidelines on Spasticity Management for adult (2009)

1. Principle of coordinated spasticity management
1.1 The management of spasticity should be undertaken by a coordinated multidisciplinary team (MDT), rather than by clinicians working in isolation.
1.2 An appropriate physical management programme is in place.
1.3 Clinicians who have:
- appropriate understanding of functional anatomy
- experience in the assessment and management of spasticity,
- knowledge of appropriate clinical dosing regimes and the ability to manage any potential complications.

RCP ( Royal College of Physician) Guidelines on Spasticity Management for adult (2009)

2. Botulinum toxin Injection
2.1 Patient should have focal or multifocal, dynamic spasticity
2.2 Clearly identified an achievable, realistic and measurable goals
2.3 Carer understand the treatment goal
2.4 Obtain verbal/ written consent
2.5 Clinician understand different dose of the products:
   - Dysport: 1000unit, Botox:360units maximum

RCP ( Royal College of Physician) Guidelines on Spasticity Management for adult (2009)

3. Follow up, documentation, outcome evaluation
3.1 Injection should follow with:
   - Therapy review for assessment, treatment and casting
   - MDT review for effect and future management
3.2 Injection should be followed with formal assessment of outcomes
3.3 Evaluation should include:
   - achievement of goal, change in impairment and functions
3.4 Documentation for all injections should include:
   - patient and carer expectations for outcome
   - a clear statement of agreed treatment goals
   - baseline outcome measures appropriate to those goals
   - BT product, dose, dilution and muscles injected
   - follow-up treatment plan
   - evaluation of outcome and repeat measures
   - plans for future management.

RCP ( Royal College of Physician) Guidelines on Spasticity Management for adult (2009)

4. Service
4.1 Service should have access to staff with relevant expertise and facilities including space for casting/splintage
4.2 Clinician should have access to facilities for assessment, selection and treatment planning e.g. EMG, muscle stimulators

5. Training
5.1 Clinician should be able to demonstrate competent
5.2 Training program should be in place

Any patient with motor weakness should be assessed for spasticity.

Exercises and stretches should be used for anyone with spasticity and at risk of losing ROM.

Botulinum Toxin should be considered in patients with spasticity of 1 or 2 joints but should be carried out within the context of an expert service and accompanied by rehabilitation over the following 2 to 8 weeks.
What else do the RCP guidelines recommend?

- Any patient whose range of movement at a joint is reduced or at risk of becoming reduced should have a programme of passive stretching of all affected joints on a daily basis and the programme should be taught to the patient and/or carers.
- If stretching alone does not control contractures, serial casting around a joint should be considered as a treatment for reducing contractures.

Summary

- Multidisciplinary approach to spasticity management.
- Essential to consider both neural and non-neural (biomechanical) components of hypertonia.
- Need to consider long term management.

Physiotherapy Modalities for Management of Spasticity

- Positioning (lying/sitting)
- Stretching
- Myofascial release
- Casting
- Splints
- Weight bearing
- Electrical Stimulation

Positioning

- Lying – No prolong prop up during hospitalisation
- Anti-rotational device on AFO- prevent tight ITB (ilio-tibial band)
- Mattress – too soft prohibit the mobility on bed
- Sit out is important ≠ sit on bed

Position on bed

- No hyper-extended neck
- No Prolonged prop up posture
- No side flexion of neck
- No Internal rotation/protraction of shoulder

Limb positioning on bed

- Lateral rotation of leg cause tight ITB
- Extension spasticity cause quadriceps tightness
- Wedge to break on spasticity
- Possibility to prevent the formation of Heterotopic Ossification
- Anti-rotational device on AFO

Mattress – too soft prohibit the mobility on bed
**Heterotopic Ossification**

**Stretching**
- Stretching is definitely essential
  - Systematic review on stretching with bias:
    - Stretching time (20-30 mins)
    - Stretching force (not mentioned)
    - Heterogenic group (CP cannot be compared with stroke)
- Stretch in tissue level
- Massage

**Myofascial Release (MFR)**
- MFR: hands-on stretching upon the body's tissue
- Allowing the tissues to once again properly align
- As the muscles return "home" to their original positions, ease of movement and exercise will be welcome.

**Resting splints**
- Aim to maintain muscle length and prevent soft tissue shortening

**Electrical stimulation**
- FES (Functional Electric Stimulation)
- TES (Therapeutic ES)
- NMES to agonist
- NMES to antagonist
- ES to injection site

**Casting**
- Resting splints
**Principles of rehabilitation**

- Early intervention and mobilization to prevent irreversible complications
- Involvement of every carer into rehabilitation process including nurses, health care assistance and family members
- Regular education and training for staffs
- Provide family support and education on rehabilitation information
- Identify meaningful outcomes and carry out research for evidence-based practice