Birth Related Brachial Plexus Injuries

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Learning Outcomes:
To provide an overview of:
- Brachial Plexus anatomy
- Consequences of a BRPI
- Assessment
- Interventions
  - Surgical
  - Therapy

www.rnoh.nhs.uk/services/peripheral-nerve-injury-unit

Patient and Family Education leaflet, Seattle Children's Hospital, Washington.

https://en.m.wikipedia.org/wiki/Brachial_plexus#C5

C5
C6
C7
C8
T1

Cords
Divisions
Ribs
Nerve roots
Roots of the brachial plexus

What is BRPI

0.42 to 2.6 per 1000 Births (average - 1 in 2300)

Evans-Jones et al. (2003)

The RNOH is one of the largest tertiary centres in the UK for BRPI.

Patient and Family Education leaflet, Seattle Children's Hospital, Washington.

Narakas Classification

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<tr>
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Traction Injury

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Brachial Plexus Birth Injuries

Signs of BRPI

- Clavicle fracture
- Shoulder and arm deformity
- Axillary nerve palsy
- Wrist drop

Krumlinde-Sundholm et al. (2007); Ho et al. (2012)

Clinician Reported Outcomes (CROs):
- AHA (performance)
- BPOM (capacity)
- Krumlinde-Sundholm et al. (2007); Ho et al. (2012)

Patient Reported Outcomes (PROs):
- FPS/VAS/BPI (Pain)
- Peds QL (HR-QoL)
- BPOM SE (Function)

Brown, Van der Looven, Ho, and Pondaag (under review)

Clinician Reported Outcomes (CROs):
- Mallet sub-score
- Narakas at 1 month
- Record of elbow flex recovery
- Serial evaluation key movements

Pondaag and Malassey (2018)

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- Narakas at 1 month
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Pondaag and Malassey (2018)

RNOH-Traumatic Neuropathy

www.rnoh.nhs.uk/services/peripheral-nerve-injury-unit

BIOMECHANICAL

FUNCTIONAL

Activity Limitations

Participation Restrictions

Impairment
Development of the GHJ

Normal development of the HOH

Kwong et al. (2014)

Normal development of the glenoid

Zember et al. (2015)

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Branches affecting the shoulder
Dorsal Scapular Nerve (C5)

Supplies:

Suprascapular Nerve (C5, 6)

Supplies:

Axillary Nerve (C5, 6)

Supplies:

Soft tissue imbalances

Consequences of shoulder contracture

- Imbalance between internal and external rotators.
- Arm held in internally rotated position.
- Shortening of subscapularis and pectoral muscles.
  - Secondary shortening of anterior joint capsule, coracohumeral ligament, and rotator interval.
  - HOH pulled into IR and faces in posterior direction.
  - HOH subluxes posteriorly (especially with flexion of the arm).

Fairbank (1913)
70% of children who present with an internal rotation contracture will have concomitant glenohumeral deformity.

(Pearl and Edgerton, 1998)

**Consequences of shoulder contracture**

**Humeral Head Defects**
- Flattening
- Altered size
- Changes in retroversion

**Glenoid dysplasia**
- Concave-flat
- Convex
- Biconcave (Pseudoglenoid)

**Glenoid version**

6-month-old boy with Right BPI

L  R
Initial Management

Conservative Approach

- Observation/Review (monthly)
- Neurophysiology
- Stretches
- Parental education

Therapists: Assessment and Treatment

Assessment - Observation

Assessment - ROM

Inferior Scapulo-humeral angle in Abduction
Assessment

Posterior Scapulo-humeral angle in horizontal flexion

Basic Exercises/Stretches

Normal Development

Surgical Options

Decision making

Early Interventions 0-24 months

- Observation/Review (monthly)
- Neuropathology (Koch and Kravetz, 2003)
- Patient and parental compliance and understanding
- Social factors surrounding care

- Supraclavicular Exploration
- Neurology
- Nerve Transfer
- Nerve Graft
- Anterior Release
- Botox
Supraclavicular Exploration and Neurolysis

- Visualise the injury
- Neurona
- Neurophysiology
- Non-degenerative injury
- Removal of constrictive scar tissue

Nerve Graft

Nerve Transfer

- Nerve dissected.
- Identification of sacrificial fascicles.
- Division of those fascicles.
- Redirection of those neurones into a denervated nerve.
- Muscle activation within months.

Spinal Accessory to Suprascapular Nerve Transfer

Anterior Release

Aims:
- Restore balance.
- Improve function.
- Improve ER.
- Normalise the development of the shoulder.

Important Shoulder Exercises
2 – 5 years

Assessment

- Observation
- Functional assessment - Play
  - Developmental milestones
  - Gross motor skills
  - Weight bearing
  - Fine motor skills
- Joint ROM
- Sensation?
- Pain?

Assessment - ROM

<table>
<thead>
<tr>
<th>Shoulder</th>
<th>Elbow</th>
<th>Wrist</th>
<th>Forearm</th>
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<tr>
<td>Flexion</td>
<td>9.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abduction</td>
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<td>(90° Ab)</td>
<td>11.</td>
<td></td>
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<td>External Rotation</td>
<td>(90° Ab)</td>
<td>12.</td>
<td></td>
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<tr>
<td>Inferior Scapulo-humeral angle (in Ab)</td>
<td>13.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posterior Scapulo-humeral angle (in HF)</td>
<td>14.</td>
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Assisting Hand Assessment (AHA)

- Semi-structured recorded play session
- 15-30 minutes duration

Assesses bi-manual function and how the child usually uses their affected hand (performance)

Assessment – Modified Mallet

Important Shoulder Exercises
When to worry?

The rapid loss of passive external rotation between monthly examinations is indicative of progressive capsular and muscular contracture, and thus the onset of subluxation or dislocation.

Surgical Options

Late Interventions
2 - 5 years

Anterior Release → true tightness?

Botox → co-contraction?

Co-contraction

"Muscle patterning problem where imbalances have occurred between antagonist pairs of muscles"

"One or more muscles become overactive and impede the ability of their counterpart to carry out their prime mover role"

Botox

The Older Child and Adolescent

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<tr>
<th>Phase 1: Anterior Release</th>
<th>Phase 2: Co-contraction</th>
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<td>Anterior muscle release</td>
<td>Co-contraction</td>
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<tr>
<td>Reduces tightness</td>
<td>Muscle patterning</td>
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<tr>
<td>Increases motion</td>
<td>Impedes ability</td>
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<td>Maintains function</td>
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"Muscle patterning problem where imbalances have occurred between antagonist pairs of muscles"

"One or more muscles become overactive and impede the ability of their counterpart to carry out their prime mover role"
Challenges

- Growth spurts
- Body image-problems

Compliance!!!

- Shift of responsibility

Assessment - ROM

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Assessment – Modified Mallet

- Structured recorded session
- 5-10 minutes duration

Asks the child to specifically use their affected arm (capacity)

Brachial Plexus Outcome Measure (BPOM)

Self Management

Treatment

Independence in Everyday activities/ School
The Older Child and Adolescent

**Elbow contracture**
- Bony Block?
- Extension and Supination Stretches
- Serial Casting (6/52)
- Night splint

**Surgical Options**

The Older Child and Adolescent

**Interventions**
- Botox
- Anterior Release
- Tendon Transfer
- Osteotomy (Humeral and forearm)
- Glenoplasty

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**Latissimus Dorsi Tendon Transfer**

**Pronator/Flexor to Extensor Tendon Transfer**
Bony Deformity Reconstructions:

- Rotational Osteotomy of the Humerus
- Rotational Osteotomy of Forearm
- Glenoplasty

Summary

Treatment Goals:

- Maintain PROM/prevent contracture.
- Facilitate bone growth, shape and development.
- Maintenance of a concentric, stable GHI.
- Strengthen weak muscles.
- Promote normal function.
If no signs of recovery or only limited signs at 6 weeks REFER TO TERTIARY CENTRE!!

Encourage DAILY SHOULDER STRETCHES no matter what age the child is!

References

Abedigawad et al. (2014). Humeral rotational osteotomy for shoulder deformity in OBPP. The Open Orthopaedics Journal, 8, 130-134.


Resources

Erbs Palsy Group
http://www.erbspalsygroup.co.uk

hazel.brown5@nhs.net


Knezev et al. (2011). Severe Obstetric Brachial Plexus Palsy Can Be Identified at One Month of Age. PLoS ONE 6(10): e26193.

