Brachial Plexus Birth Palsy

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BPBP

Traction or compression injury during birth

~ 1 : 1000 live births
R > L (LAO presentation)

Risk factors: macrosomia, difficult delivery, multiparity

Spontaneous recovery in most
~ 30% incomplete recovery

Foad et al, JBJS 2008
Foad et al, J Child Orthop 2009
Evans-Jones et al, ADCFNE 2003
Hoeksma et al, Dev Med Child Neurol 2004
Lagerkvist et al, Dev Med Child Neurol 2010

Microsurgery for persistent neurologic deficits & weakness

Assessment challenging
Indications controversial
Evolving techniques
Goals

Make correct diagnosis
• Characterize pattern
• NOT etiology

Predict recovery

Appropriate surgical intervention

Maximize UE function, outcomes

Waters & Bae, Pediatric Hand and Upper Limb Surgery, 2012 © COSF 2015

Preferred age of first evaluation

~1 – 2 months of age

Differential diagnosis:
• Fracture
• Infection
• CNS
• Syndromic

Prognosticate

What to assess?

Face: Horner’s

Back: Winging

Chest: Hemidiaphragm paralysis

What to assess?

Active motion
• Spontaneous
• Stimulated
• Infantile reflexes

Passive motion
• ER in adduction

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What to assess?
Serial (monthly) visits until 6 – 12 months of age

- Evaluate recovery
- Risk stratification
- Multiple examiners

Waters, JBJS, 1999

Predictors of recovery?

**Toronto Test Score**

- Michelow et al, PRS 1994

Biceps alone incorrectly predicts recovery in 12.8%.

Addition of elbow, wrist, thumb, & finger extension reduced to 5.2%.

TTS < 3.5 at 3 months of age indicates poor recovery.

Elbow extension 0 – 2

Wrist extension 0 – 2

Digital extension 0 – 2

Thumb extension 0 – 2

Total score 0 – 10

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Predictors of recovery?

**Anti-gravity biceps**

Gilbert: 3 months

Waters: 2 - 5 months

Waters, JAAOS 1997

Predictors of recovery?

**“Cookie test”**

- Borschel & Clarke, PRS 2009
- Curtis et al, JHS 2002

9 months of age

Arm adducted

Success is cookie to mouth with <45° neck flexion

Cafemom.com

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Diagnostic testing

Radiographic
• Myelography
• CT
• MRI

Electrodiagnostic
• EMG/NCV

Not utilized at our center

van Ouerkerk et al, Child Nerv Syst, 2000

CT & CT myelography

CT Myelography
• 84-94% true positive
• 12% false negative
• 4% false positive
• 60% root avulsions accurately diagnosed

Kawai et al, Neuro Ortho 1989
Clarke & Curtis, Hand Clin 1995

MRI

Avulsion vs. extraforaminal lesions
Level(s) of involvement
• Inaccurate in up to 15%
• Advantage over PE for surgical indication?
• Utility over intraop assessment?


Clarke & Curtis, Hand Clin 1995

Electrodiagnostics

Underestimate severity
Overestimate recovery
• Do not match intraop findings
• Need for sedation, anesthesia
• Operator dependent

Sloof, Microsurgery, 1995.
**Microsurgical indications**

- Horner’s + flail limb
  - 3 months

- Upper trunk lesions
  - Absent biceps at 5 mo
  - TTS < 3.5 at 3-6 mo
  - Cookie test at 9 mo

**Microsurgery**

- “Gold standard”
  - Exploration
  - Neuroma excision
  - Autologous nerve grafting

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Nerve transfers
Alternative to nerve grafting and secondary tendon transfers

Neuroma excision + graft
• long time to reinnervation

Transfer axons for adjacent nerve

Transfer from adjacent nerve
• Closer to motor end plate
Nerve transfers

Advantages
- Technically easier
- Time to reinnervation

Evolving indications

<table>
<thead>
<tr>
<th>Indication</th>
<th>Rationale</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global plexus</td>
<td>Provide axons</td>
<td>CN XI to SSN</td>
</tr>
<tr>
<td>Root avulsion</td>
<td>Provide axons</td>
<td>IC to MCN</td>
</tr>
<tr>
<td>Late presentation</td>
<td>Faster reinnervation</td>
<td>Ulnar to MCN</td>
</tr>
<tr>
<td>Mixed recovery</td>
<td>Preserve function</td>
<td>Radial to axillary</td>
</tr>
</tbody>
</table>

Nerve transfers


Results of treatment

80-100% anti-gravity elbow flexion
60-80% good shoulder recovery

Kawabata et al, CORR 1987
Waters, JBJS 1999
Hentz & Meyer, Microsurgery 2001
Gilbert et al, Microsurgery 2006
El-Gammal et al, Microsurgery 2010

Results of treatment

Haerle & Gilbert, JPO 2004

Haerle & Gilbert, JPO 2004

Results of treatment

Malessy & Pondaag, JBJS 2014

- 34 patients
- C5 neurotmesis, C6 avulsion
- All have MRC grade IV biceps
- 66% Mallet IV abduction
- 32% Mallet IV ER

Malessy & Pondaag, JBJS 2014
Results of treatment

Why?

• Too late
• Too few axons
• Suboptimal reconstructions

Results of treatment

Why?

• Too late
• Too few axons
• Suboptimal reconstructions

# Nerve Fibers

<table>
<thead>
<tr>
<th>Nerve</th>
<th># of Fibers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal Accessory</td>
<td>1,600</td>
</tr>
<tr>
<td>Suprascapular</td>
<td>3,500</td>
</tr>
<tr>
<td>Intercostal</td>
<td>1,200</td>
</tr>
<tr>
<td>Musculocutaneous</td>
<td>6,000</td>
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</tbody>
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Summary

BPBP: 1:1000 live births
• 30% persistent deficits

Microsurgery
• 3-6 months of age based upon physical exam
• Grafting vs. nerve transfers

Improvements in active motion
• Secondary procedures for function & dysplasia