HEMIPLEGIA IN CHILDHOOD

Leeds Hemihelp Meeting
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HEMIPLEGIC CEREBRAL PALSY (HCP)

Questions to be answered
What is meant by the term hemiplegia or HCP?
How will it affect my child?
What causes it?
How is it diagnosed?
Are there other hidden ways it may affect my child?
What treatments are available
What might the future hold as regards treatments
HEMIPLEGIC CP

HCP forms part of the spectrum of the group of conditions known as cerebral palsy.

It has a recognisable collection of signs.
HOW IS CEREBRAL PALSY DEFINED?

CP is a group of conditions in which the development of movement and posture is impaired.

It is permanent but not unchanging as child is growing and brain continues to develop.

Caused by a non-progressive disturbance to the developing foetal or infant brain (up to age of 2).

Often accompanied by other potential problems affecting learning, vision, sensation, behaviour, epilepsy.

It is a spectrum of disability.

No two affected children exactly alike.
CURRENT TERMINOLOGY

1. Define type of CP e.g. spastic, dyskinetic, ataxic
2. Part of body affected
e.g. Hemiplegia- one side of body affected due to damage to opposite side of brain
Doesn’t tell you about what caused the damage but other info helps
3. Back ground – prematurity; neonatal seizures
4. MRI findings
5. Functional classification : GMFCS, MACS
<table>
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<tr>
<th>A</th>
<th>B</th>
<th>C</th>
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</table>
| **Hemiplegia**  
Arm, body, leg affected on one side | **Diplegia**  
Legs affected more than arms | **Quadriplegia**  
Whole body affected |
| Arm turned in and bent  
Hand fisted  
Leg turned in and bent  
Tiptoe standing. | Arms slightly clumsy  
Legs pressed together and turned in  
Tiptoe standing | Poor head control  
Arms turned in & bent  
Legs pressed together  
Tiptoe standing |
Cerebral Palsy: Topographic

- Monoplegic
- Hemiplegic
- Quadraplegic
- Diplegic
EFFECTS ON DEVELOPMENT OF HCP

Motor development affected

- Gross motor function - big movements e.g. crawling, walking
- Balance and coordination is impaired
- Fine motor function - small movements with hands e.g. manipulation, release of objects

Communication (if dominant left hemisphere involved)

Learning ability (Cognition)
OTHER POSSIBLE EFFECTS ON HEALTH & DEVELOPMENT

**Epilepsy** - focal and generalised seizures

**Visual problems** - affecting visual fields - e.g. hemianopia (vision poorer on 1 side)

**Sensory problems** - ignoring affected side – inattention to limb can give rise to contracture

**Emotional and behavioural difficulties**
Visual pathway

Visual field defects

Example of lesion

1. Defect 1. Normal
   Unilateral field loss

2. 2. Normal
   Bitemporal hemianopia

3. 3. Normal
   Homonymous hemianopia

Left optic nerve compression
Chiasmal compression from pituitary tumour
Left cerebrovascular event
TYPES OF CEREBRAL PALSY

SPASTIC- tense, contracted muscles (most common type of CP).

ATHETOID- constant, uncontrolled motion of limbs, head, and eyes.

ATAXIC- poor sense of balance, often causing falls and stumbles

RIGIDITY- tight muscles that resist effort to make them move.

TREMOR- uncontrollable shaking, interfering with coordination.
UNILATERAL SPASTIC CP
(HEMIPLEGIC CP)

Commonest type of CP (25-40% of all cases)
Antenatal cause in 75% cases, 10% post natal
Involvement of arm and leg on one side
(arm > leg) Least motor disabling type of CP
Growth on affected side is poorer
Often a “silent” interval before symptoms noted at 4-9 months of age
67% are diagnosed by 18/12.
> 50% affected children walk at average age
PRESENTATION OF HCP

Parent usually first to suspect

• Non use of one hand (hand dominance before 2 years is usually abnormal)
• Hand is fisted. Goes up on toes on affected side
• Ignoring affected side
• Floppy or stiff limb
• Delay in acquiring motor milestone e.g. crawling, grasping a toy
ALTERNATIVE PRESENTATION OF HCP- AFTER PERI NEONATAL STROKE

Stroke is commonest cause of HCP

May be diagnosed after neonatal seizures (fits), often focal or encephalopathy (depressed conscious level)

Early neuroimaging – cerebral USS and/or MRI scan may reveal unilateral haemorrhage on side opposite to abnormal signs

Recognition enables therapy to start whilst on NICU

Follow up – may require repeat imaging and clinically reassess
DIAGNOSIS OF SPASTIC CP

Spastic CP must have 2 of following

1. Abnormal pattern of movement and/or posture
2. Increased tone - not necessarily all the time
3. Abnormally brisk reflexes (knee jerks)
4. Up going plantar responses

Spastic CP can be either unilateral or bilateral. **Unilateral is hemiplegia**
What is Spasticity?

Spasticity is a TRIAD of painful mass muscle spasms, rigid posturing of limbs, and increased reflexes.

Most common definition to be found in literature:
It is a motor disorder characterized by a velocity-Dependent increase in tonic stretch reflexes with exaggerated tendon jerks, resulting from hyper excitability of the stretch reflex, as one component of the upper motor neuron syndrome.

Lance, 1980

Muscle hypertonia as a result of Exaggerated reflexes
PLANTAR RESPONSES

Normal plantar response

Extensor plantar response (Babinski sign)
HISTORY FROM PARENT

Often nothing worrying about pregnancy or birth. Concerns come “out of the blue”

Or

Prematurity or term baby, stay on neonatal unit as unwell & had head scans

History, examination and scans – all put together to make diagnosis
COMPONENTS OF CLASSIFICATION

Assessment involves

Motor problems

- Tone (resistance to passive movement – hyper/hypo variable
- Type of movement problem – spasticity
- Parts of body affected

Associated problems e.g. epilepsy

Anatomical & Scan findings

- Neuro radiology scan findings- helps with timing causation & timing
- Identified cause- pre, peri or post natal
HEMIPLEGIC CP

No facial involvement (occurs in acquired hemiplegia, onset after 2 years)

Intelligence- in normal range to slightly low

Epilepsy occurs in ¼-1/3 of children with hemiplegia, often in those with learning and speech problems (often apparent by 3 yrs)

MRI scan findings: cystic cortical lesions

Visual field defects occur in 25%

Behavioural problems can be a concern
PHYSICAL EFFECTS OF HEMIPLEGIA ON ARM

• Arm turned in at shoulder (pronated)
• Elbow bent (flexed)
• Held against side of body (adducted)
• Wrist bent (flexed)
• Fingers bent (fisted)
• Thumb held tightly in palm (adducted)
• Arm may look slightly smaller
CONSEQUENCES OF ARM POSITION, WEAKNESS AND SPASTICITY

Difficulty with 2 handed tasks ADLs - washing; dressing; feeding; toileting

Play & School work - drawing; writing; computer work; cutting; using ruler; building; playing games

PE - running; jumping; throwing and catching;

Appearance & self confidence

Independence
PHYSICAL EFFECTS OF HEMIPLEGIA ON LEG

Mobility difficulties

• Toe walking (toe heel gait) - shortening of Achilles tendon (TA) and calf muscles
• Foot turned in (equinus) or out
• Knee bent and turned in (tight hamstrings)
• Hip flexed; a limp
• Leg shortening; feels cooler; slimmer calf muscles
FUNCTIONAL CONSEQUENCES OF LEG WEAKNESS AND SPASTICITY

Reduced stamina
- Tires more easily
- Complains of discomfort; spasms

Poor balance
- Needs hand rail on stairs
- Unsure on uneven surfaces
- Difficulty climbing; jumping; playing football
- Affects self confidence; inclusion by peers
- Physical appearance
GMFCS E & R Descriptors and Illustrations for Children between their 6th and 12th birthday

GMFCS Level I
Children walk at home, school, outdoors and in the community. They can climb stairs without the use of a railing. Children perform gross motor skills such as running and jumping, but speed, balance and coordination are limited.

GMFCS Level II
Children walk in most settings and climb stairs holding onto a railing. They may experience difficulty walking long distances and balancing on uneven terrain, inclines, in crowded areas or confined spaces. Children may walk with physical assistance, a hand-held mobility device or used wheeled mobility over long distances. Children have only minimal ability to perform gross motor skills such as running and jumping.

GMFCS Level III
Children walk using a hand-held mobility device in most indoor settings. They may climb stairs holding onto a railing with supervision or assistance. Children use wheeled mobility when traveling long distances and may self-propel for shorter distances.

GMFCS Level IV
Children use methods of mobility that require physical assistance or powered mobility in most settings. They may walk for short distances at home with physical assistance or use powered mobility or a body support walker when positioned. At school, outdoors and in the community children are transported in a manual wheelchair or use powered mobility.

GMFCS Level V
Children are transported in a manual wheelchair in all settings. Children are limited in their ability to maintain antigravity head and trunk postures and control leg and arm movements.
### MACS Manual Ability Classification Score

**TABLE 2:** Manual ability function classification system.

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
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<tbody>
<tr>
<td>Level I</td>
<td>Handles objects easily and successfully</td>
</tr>
<tr>
<td>Level II</td>
<td>Handles most objects but with somewhat reduced quality and/or speed of achievement</td>
</tr>
<tr>
<td>Level III</td>
<td>Handles objects with difficulty; needs help to prepare and/or modify activities</td>
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<tr>
<td>Level IV</td>
<td>Handles a limited selection of easily managed objects in adapted situations</td>
</tr>
<tr>
<td>Level V</td>
<td>Does not handle objects and has severely limited ability to perform even simple actions</td>
</tr>
</tbody>
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OTHER “HIDDEN” PROBLEMS

Learning and attention problems may not be apparent until child starts nursery/school.

Awareness and recognition precede intervention.

Shouldn’t be attributed to other causes e.g. “naughty boy/ boys are slower”

Educational support may be needed.

May be exacerbated by other difficulties – communication difficulties, epilepsy or visual problems.
OTHER CONCERNS

Behaviour problems

Often most prominent problem (occurs in 50%)
Sudden unexplained outbursts, may be associated with
• Aggressiveness
• Hyperactivity
More likely or worse if child has
• Epilepsy
• Delayed language development
• Learning problems
INVESTIGATIONS/EVALUATION OF CHILD WITH SUSPECTED CP

MRI scan- abnormal in 80-90% of all those scanned

Helps with finding cause and in some cases prognosis but doesn’t alter management

Clinical examination detailed history & MRI brain scan should determine cause in most cases

Done at different times depending on age child presents but usually before 2 years
PREVALENCE OF CP

2/1000 live births for all CP

Half of all those affected were born pre term (<32 weeks or <1.5 kg)

5% acquire CP after birth

Hemiplegia is largest group within CP

Prevalence approx 1/1000

All CP more common in boys

M:F ratio = 1.33:1
CAUSES OF HEMIPLEGIA-
PERINATAL STROKE

Classified according to

1. Ischaemic (insufficient blood gets to area due to blockage of vessel or haemorrhagic due to breakage of vessel)

2. Blood vessel affected- either artery or vein

3. Timing of injury- before or around time of birth ( >2/3 cases in utero)

4. Timing of symptoms- at birth with seizures or later in infancy with early hand preference after silent period
LEFT CEREBRAL HEMISPHERE SHOWING SPECIALISED AREAS OF CORTEX
Blood supply of important cortical areas
How do muscles receive messages from brain

Message travels from cortex in cortico-spinal tracts (anterior and lateral)

Lateral tract crosses over in pyramids (lower part of brain)

Continues as upper motor neuron (nerve) down into spinal cord

Emerges in biceps nerve in neck area

Passes to biceps muscle attached to upper arm
CROSS SECTION OF BRAIN TO SHOW MOTOR TRACTS
neurons in the cerebral cortex control movements of the contralateral limbs

medulla: lateral corticospinal tract fibers cross over

lateral corticospinal tract: neurons project to somatic efferents that innervate limb muscles

anterior corticospinal tract: neurons project bilaterally to somatic efferents that innervate proximal muscles

to limb muscles

to proximal muscles
MANAGEMENT OF MOVEMENT PROBLEMS

Physical therapy is the mainstay:
Postural care, aiding development, stretching, hydrotherapy etc.
Orthotics
Oral baclofen and other drugs
Surgery- much less frequently done
+others
STROKE INVOLVING ARTERY (AT BIRTH AND ANTENATALLY)

This MRI picture of the brain arteries (MRA) shows an occlusion of the middle cerebral artery (MCA, arrow).

In NAIS, seizures in the newborn would lead to this MRI picture that shows an acute or “fresh” stroke.

In APPIS, an infant with weakness noted at 6 months would lead to this MRI which shows a loss of brain tissue in the same area.
STROKE INVOLVING VEINS OCCURRING BEFORE BIRTH

Premature brain
Veins (blue) drain the periventricular white matter

Germinal matrix bleeds
Blocks draining veins
Venous infarct (stroke)

PVI damages motor pathways = weakness on opposite side
ORTHOSES (SPLINTS)

Muscle doubles length by 4
Stretching is stimulus for growth of muscle

AFOs
- Restore heel toe gait
- Stabilising joint

Cumbersome

Stretch gastrocnemius

Little evidence from research
BOTULINUM TOXIN A

Inhibits acetylcholine release at nerve ending by temporarily blocking receptors at junction between nerve and muscle

Muscles are relaxed as messages from nerve to contract muscle can’t pass across

Botox or Dysport used

Decreases spasticity, increases weakness

Botox also helps to reduce the appearance of wrinkles!
Mechanism of Action of Botulinum Toxin

C. botulinum

ACH-containing vesicles

Motor end plate

Muscle fiber

Toxin blocks release of ACH from vesicles

Stimulation blocked
BOTULINUM TOXIN A

Useful in hemiplegia to reduce spasticity in Lower limb, to reduce

- Equinus- abnormal foot down and turned in posture
- Crouch gait due to knee flexion
  In upper limb, to reduce
- Elbow flexion (improve reach)
- Wrist/finger flexion (improve grasp)
- Thumb in palm position (grasp & hygiene)
BOTULINUM TOXIN A

How to give injection: use sedation

- Midazolam orally
- EMLA topically
- Gas and air to breathe in
- Give injection under ultrasound guidance or by feel/site

Review 1-2 months later

Temporary improvement maybe beneficial as can achieve goal in that time. Need to repeat 6 months later if still needed as effect wears off

Query long-term outcome
BOTULINUM TOXIN A THERAPY

Set functional goals before starting.

Helps in lower limb with

• Standing
• Gait
• Tolerating splints

Upper limb

• Pain/spasms
• Hand function- open hand, thumb out, wrist neutral position.
At around 7 – 9 years consider
TA lengthening – after Botox finished
Multi-level soft tissue release at
  • Hips- not usually required in hemiplegia
  • Knees
  • Ankles
i.e. lots of small operations
Rehabilitation so important
Not common procedure nowadays
OTHER TREATMENTS
HIPPOTHERAPY & LYCRA SPLINTS

A little evidence from research to support case that lycra splints are beneficial
KINESIO OR FUNCTIONAL TAPING

More popular seen at 2012 Olympics

Child more aware of taped hand so uses it more

Child removes tape or picks at it
Fun ‘n’ Games
Lots of fun ways to get the two hands busy working together!

www.research.ncl.ac.uk/hemiplegiaresearch-fungames

A new website for children with hemiplegia and their families!

Recent research tells us that lots of frequent practice improves children’s ability to use both arms and hands. Spending some time every day doing two-handed activities is ideal.

Play and leisure time provides a good opportunity to do this and it helps if what you do is fun!

We have made this website to share lots of ideas to practise difficult hand and arm movements using a selection of toys and games.

You can view/download/print lots of illustrated instruction sheets – just visit:

www.research.ncl.ac.uk/hemiplegiaresearch-fungames

Dr Anna Bassa, NIHR Career Development Fellow & Honorary Consultant Paediatric Neurologist; Janice Pearse, Senior Research Occupational Therapist; Emma Kirkpatrick, Research Trial Manager
Positive effect of play-therapy

- Performance, capacity, function
- Improvements maintained 3 months later
- Short, frequent, parent-led practice
- Using games with adapted instructions
- Instructions available online – see our website

https://research.ncl.ac.uk/hemiplegiaresearch-fungames/
Strategic Impact
Funding
Newcastle University
Web design: Brittany Coxon
Hand-Arm Intensive Bimanual Therapy
What is CIMT for children?

Constraint Induced Movement Therapy (“CIMT” or “CI Therapy”) is a rehabilitation program for the upper limb. CIMT involves rehabilitation of the weaker arm while restraining the stronger arm in a light-weight cast. CIMT is supported by research - positively affect not only the hand and arm, but the brain itself through use of alternative neural pathways.

A CIMT programme is short but intensive. Treatment is provided daily over a period of 3 to 4 weeks.

Risks of over intensive treatment: weakness; Falls.
VR and Robotics
tDCS to enhance therapy outcomes?
Early Therapy In Perinatal Stroke

- Home-delivered
  - Parent-led
  - 1st 6m
  - Fits into daily life
- Parents/carers
- Play
- "Environment"
TREATMENTS FOR HCP

Botulinum injections help if combined with therapy and specific goals set.

Very little known about orthotics and taping.

Evidence for CIMT and bimanual therapy & parent led therapy Fun Games/eTIPs.

Intensive therapy ‘works’

Early identification & early intervention could improve outcomes. How to achieve?
PARTICIPATION – FROM EARLY YEARS TO ACHIEVE GOALS
THE 5 F WORDS IN DISABILITY!

- Function
- Fun
- Family factors
- Friends
- Fitness

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

Emphasis on functional independence not correction of deformity

Holistic approach & support for families

Newer treatments/therapies- CIMT/Bimanual/tDCS/VR/stem cells - experimental

Identify early – Neonatal MRIs & treat

Prevention of brain injury in neonates with neuro protective agents and cooling
SUMMARY

Hemiplegia is a type of cerebral palsy affecting one side of body. It accounts for 35% of all cases of CP. Caused by vascular damage to white matter areas in brain on opposite side. Occurs most frequently in antenatal period due to blockage/ leakage from blood vessels. Asymmetry of movements noted in 1st year. Often after “silent” period. Management mainly physio, baclofen, botulinum toxin and orthotics. Newer approaches include bimanual therapy and CIMT. Parent led therapies. Future – Earlier identification of perinatal strokes would allow earlier intervention and improved outcome due to neuroplasticity.
HEMIPLEGIA – THE FACTS

Half the body is affected with varying degrees of weakness.

Effects are similar to those of a stroke.

May occur before, during or soon after birth.

It is caused by damage to some part of the brain.

Physically affects either the left or right hand side of the body.

Limited control in the affected side.

Epilepsy, visual impairment or speech can be “hidden” problems.

Get the full facts from HemiHelp.*

Information at www.hemihelp.org.uk

Affects one child in 1000.

* HemiHelp is a membership organisation offering information and support to children and adults affected by hemiplegia and their families.

HemiHelp is a registered Charity – No 1065349
Questions ?