Managing the upper limb after stroke

NICK WARD, UCL INSTITUTE OF NEUROLOGY, QUEEN SQUARE

16th June 2014
Upper limb recovery after stroke

1. How do we treat people after stroke?
Upper limb recovery after stroke

I. How do we treat people after stroke?

1. Preservation of tissue
2. Avoid complications
3. Task specific or augmented training
4. Enhancement of plasticity
5. Compensation

Rehabilitation → Recovery
Upper limb recovery after stroke is *unacceptably poor*…. 

- **¾ of stroke survivors** will have upper limb symptoms after acute stroke (Lawrence et al, 2001)
- **Initial severity** is most significant predictor of long term outcome (Coupar et al, 2013), but also anatomical damage
- **60% of patients** with non-functional arms 1 week post-stroke didn’t recover function at 6 months (Wade et al, 1983)
- Those showing some synergistic movement in UL within 4 weeks after stroke have **90% chance of improving** (Kwakkel et al, 2003)

I. How do we treat people after stroke?
Upper limb recovery after stroke

I. How do we treat people after stroke?

The dose of UL treatment after stroke is *unacceptably low*...

- Patients engaged in ‘activity’ for **only 13%** of the day (Bernhardt et al, 2004)

- Patients were **alone for over 60%** of the day (Bernhardt et al, 2004)

- Practice of task-specific, functional UL movements in **only 51%** of ‘UL sessions’ (Lang et al, 2009)
Upper limb recovery after stroke

I. How do we treat people after stroke?

Is there evidence to support ‘increased dose’ - time on task?

• 2-3 hours of arm training a day for 6 weeks improved both FM and ARAT when started 1-2 months after stroke (Han et al, 2013)

• Other studies equivocal but high variability in design
  – extra = 2 hrs/week to 3 hrs/day
  – some initiated early, some late
Upper limb recovery after stroke

I. How do we treat people after stroke?

Is there evidence to support ‘increased dose’ – repetitions?

- In animals, changes in primary motor cortex synaptic density occur after 400 (but not 60) reaches (Remple et al, 2001)

- Most rodent studies involve hundreds of repetitions in a training session

- In human stroke patients, typical number of repetitions in a session is 30 (Lang et al, 2009)

- Ability to perform repetitions related to function – might be a ‘threshold’ above which UL use improves and below which it decreases (Schweighofer et al, 2009)
Is there evidence to support task-specific training?

- Is task-specific training enough?
- Cochrane review ‘says no’
- To be useful, task-specific training must be both retained and generalizable (Krakauer, 2006)
- Apply ‘principles of motor learning’
  1. Distributed practice - frequent and longer rest periods
  2. Variable practice - varying parameters of task
  3. Contextual interference - random ordering of related tasks

Upper limb recovery after stroke

I. How do we treat people after stroke?
Upper limb recovery after stroke

II. How do we increase dose?

Effect of Constraint-Induced Movement Therapy on Upper Extremity Function 3 to 9 Months After Stroke
The EXCITE Randomized Clinical Trial

Robot-Assisted Therapy for Long-Term Upper-Limb Impairment after Stroke

A Self-Administered Graded Repetitive Arm Supplementary Program (GRASP) Improves Arm Function During Inpatient Stroke Rehabilitation
A Multi-Site Randomized Controlled Trial

Dose is important

Motor – 1000’s of repetitions
Language – 100 hours
Upper limb recovery after stroke

II. How do we increase dose?

A Self-Administered Graded Repetitive Arm Supplementary Program (GRASP) Improves Arm Function During Inpatient Stroke Rehabilitation
A Multi-Site Randomized Controlled Trial
Jocelyn E. Harris, MSc; Janice J. Eng, PhD; William C. Miller, PhD; Andrew S. Dawson, MD
(Stroke. 2009;40:2123-2128.)

- multi-site single blind randomized controlled trial
- 4-week self-administered graded repetitive upper limb program in 103 stroke patients approx 3 weeks post stroke
- 3 grades (mild, moderate, severe)
- Provided with exercise book with instructions
- Repetitions, inexpensive equipment
- strength, range of motion, gross and fine motor skills
- GRASP group showed greater improvement in upper limb function
- GRASP group maintained this significant gain at 5 months post-stroke
Upper limb recovery after stroke

II. How do we increase dose?

Saebo ReJoyce

Robotic arm training

Biometrics

ImAble
Upper limb recovery after stroke

II. How do we increase dose?

Neurogripper (ARNI) – prototype in development
Upper limb recovery after stroke

II. How do we increase dose?

- Detailed upper limb assessment and report
- A thorough discussion of goals and prognosis
- Advice on symptom management
- When appropriate we will suggest further intensive in-patient treatment (involving at least 4 hours therapy per day) as part of a 3 week programme at Queen Square
- Where required, we will make referrals to other NHNN services (e.g. spasticity assessment clinic, upper limb Functional Electrical Stimulation clinic, specialist vocational rehabilitation clinic, orthotics clinic)
- We will liaise closely with local outpatient and community services where appropriate
- In all cases we will advise on how to achieve long term self-management where able

www.ucl.ac.uk/cnr/clinical/QS/nswmd

Referrals to:
Dr Nick Ward
n.ward@ucl.ac.uk
Upper limb recovery after stroke

II. How do we increase dose?
Upper limb recovery after stroke

III. Experience dependent plasticity after stroke

Plasticity takes place in the cortex

- changing strength of existing connections
- new connections
- getting rid of unused connections
Upper limb recovery after stroke

III. Experience dependent plasticity after stroke

Niell et al., Nat Neurosci 2004; 7: 254-260
Hua et al., Nature 2005; 434: 1022-1026
Upper limb recovery after stroke

III. Experience dependent plasticity after stroke

Enhancing post-stroke plasticity...

- Drugs
- NIBS
- BAT

...to maximise training effects

Upper limb recovery after stroke

III. Experience dependent plasticity after stroke
Upper limb recovery after stroke

Summary

• Upper limb recovery after stroke is *unacceptably poor*.

• The dose of UL treatment after stroke is *unacceptably low*.

• We need to increase the dose of therapy.

• Technology and new clinical services can help achieve this.

• Neuroscience will help to understand the mechanisms of recovery allowing us to target appropriate interventions to appropriate patients.
Upper limb recovery after stroke

Acknowledgements

FIL:
Richard Frackowiak
Rosalyn Moran
Karl Friston
Will Penny
Jennie Newton
Peter Aston
Eric Featherstone

ABIU/NRU:
Fran Brander
Kate Kelly
Diane Playford
Alan Thompson
All QS nurses, physios, OTs, SLTs

SOBELL DEPARTMENT:
Marie-Helen Boudrias
Holly Rossiter
Chang-hyun Park
Karine Gazarian
Ella Clark
John Rothwell
Penny Talelli

Some more slides at www.ucl.ac.uk/ion/departments/sobell/Research/NWard

Follow us on twitter Ward Lab at UCL or @WardLab

FUNDING:
wellcome trust MRC Medical Research Council Brain Research Trust

European Research Consortium Plasticise Helping the brain recover from damage