Current Concepts in the Assessment and Treatment of Spatial Neglect

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Objectives

• The participant will:
  – Be able to understand current concepts regarding the neuroscience of neglect
  – Be able to compare the advantages and disadvantages of the tools to assess neglect
  – Be able to apply research based treatments of neglect into their clinical practice
Outline

• Neuroscience of neglect
• Assessment of neglect
• Treatment of neglect
Neuroscience of Neglect

• Attention
• Neglect
  – Neuroscience
  – Prognosis
  – Subtypes
    • Heterogeneous disorder (Barrett et al, 2006)
  – Neuroimaging
Attention

• Allocation of cognitive capacity to an object or task
  – Visual, somatosensory, auditory
  – Necessary for getting items into memory
  – Contributes to executive function
Orienting

• Brings attention to a specific location in space
• Generates perceptual awareness of the stimulus
• Considered to be involuntary & automatic
Orienting

- General alertness increases when there is a stimulus in the attentional field
- Attention is turned towards the point of interest
  - Head & eyes normally adjust
Visual Attention

• When we want to look at something, we need to shift our attention from one object to another
  – Other objects in our visual field are inhibited
Orienting

• Three phases
  – Disengagement from the present focus
  – Directional movement of attention
  – Re-engagement at a new focus of attention
Posterior Parietal Cortex

- Receives visual, auditory, somatosensory, limbic and motor output signals
- Evidence suggests strong links with frontal cortex, the cingulate gyrus, cerebellum, and basal ganglia
- Appears to be important for spatial processing and the control of eye movements
Selection

• Has a more executive role
  – Coordinates resources which are limited
  – You can only do so many tasks at one time

• “Supervisory attentional control”
  – Monitors and directs attention across tasks
  – Focus on a single relevant stimulus while ignoring irrelevant or distracting stimuli
Selective Attention

• Brain areas involved:
  – Prefrontal cortex
  – Anterior cingulate & supplementary motor areas
  – Basal ganglia
Sustained Attention

- Ability to maintain conscious attention over a period of time
- Ability to maintain consistent behavior response during continuous & repetitive activity
Vigilance

• Ability to maintain alertness
• May be controlled more by the right hemisphere
• Cognitive “fatigue” begins to show as vigilance decreases
  – Task performance begins to decline when vigilance decreases
Spatial Attention

- The internal representation of space by the CNS
- Must be able to know where we are in space & where objects are in space
- Controlled primarily by the right hemisphere of the brain
Spatial Representation

• Your CNS determines where you are in space from:
  – Retina
  – Eye position in head
  – Head on neck
  – Vestibular system
  – Trunk-shoulder-hand position
Core deficits

• Proposed framework
  – Spatial deficits
  – Non-spatial deficits
• Core spatial
  – A bias in spatial attention and salience
• Core nonspatial
  – Arousal, reorienting, and detection

Corbetta & Shulman, 2011
Neglect

• Failure to report, orient toward, or respond to stimuli on the contralesional side of space that cannot be attributed to sensory or motor dysfunction

Heilman et al, 1985
Neglect

• Lesion location is variable
  – Due to the complexity of the attentional system and spatial representation system

• Incidence varies widely according to different studies
  – 13% (Stone et al, 1992)
  – 81% (Sunderland et al, 1987)

  • Differences in sample acuity, assessments, etc
  • Rare with L CVA
Neglect

• Cortical
  – Parietal lobe
  – Parietal-temporal-occipital junction
  – Frontal lobe

Halligan at al, 2004
Neglect

- Subcortical lesions
  - Basal ganglia
  - Thalamus

Vallar, 2001
Neglect & Functional Outcome

• Patients with neglect have a much worse functional outcome than patients without neglect
  – Function measured by FIM, Barthel Index, etc
  – Variable degrees of acuity

• Independent predictor of poor outcome
  – Negative predictor along with another factor
    • Age, degree of hemiparesis, anosognosia, etc

Jehkonen et al, 2006 review
Neglect & Prognosis

• Prognosis for recovery is good for most patients
  – Significant improvements in spatial attention occur in acute patients with right sided CVA
    • Usually needed more than the acute stage to show a more complete recovery
  – Anosognosia did not improve in patients who demonstrated it

• But if recovery does not occur within first 6 months, prognosis is poor for further recovery
  – Motor recovery is also unlikely

Frane et al, 2004
Neglect & Prognosis

- Tracked 61 patients with neglect as tested by a battery of tests
  - Assessed 2 weeks and 35 weeks post stroke
- Results
  - Patients demonstrated significant improvements in perceptual deficits
  - Directional motor deficits did not improve
  - Most severe neglect was found in patients with frontal-parietal lesions

Rengachary et al, 2011
Types of Neglect

• Personal neglect
• Motor neglect
• Perceptual neglect
  – Near space/peripersonal
  – Far space neglect
  – Egocentric vs. allocentric
  ➢ Heterogenious disorder (Barret et al, 2006)
Personal Neglect

- Decreased attention to left side of body
- Typically seen in ADL’s, ambulation
- Frequently co-occurs with anosognosia
Anosognosia

• Unawareness of deficits
  – Common during the acute stage of recovery – 33%
  – Safety risk
  – Resistant to rehab

• Physiological, not psychological, in nature

• In extreme cases the patient may not recognize a body part as their own

Kortte et al, 2009
Motor Neglect

• Unable to act in/towards contralateral space
  – Example: patient is unable to move L hand when it is on their left leg but able to move it when it is placed on right leg
  • Motor system is relatively intact but unable to accessed
Perceptual Neglect

• Unable to perceive or attend to contralateral space
• Classical neglect “position”: patient rotated to right, unable to move eyes towards the left
Near vs. Far Space

- Subclasses of perceptual neglect
  - Near space/peripersonal space - within arms length
  - Far space - outside of reaching space
- May be disassociated and show one type and not the other rarely
Egocentric vs. Allocentric

• Egocentric neglect
  – Neglect is from the perspective of the patient
  – The patient misses the left side of space
Egocentric vs. Allocentric

- Allocentric
  - Neglect is from the perspective of the object which is neglected
  - The patient misses the left side of an object regardless of its position
Subtypes of Neglect

- Assessment of 166 inpatients/outpatients with R CVA
- Neglect found in 48% of right hemisphere stroke patients
  - Personal neglect = 1%
  - Peripersonal neglect = 27%
  - Motor neglect = 17%
  - Perceptual neglect = 21%

Buxbaum et al, 2004
Subtypes of Neglect

- Assessed 21 patients with neglect from acute stroke over a three week period
- Battery of tests given to try and distinguish neglect subtypes
  - Only 3/21 patients had a stable subtype over time
  - 5/21 patients demonstrated recovery
  - Remaining patients 13/21 patients switched neglect profile
    - Results suggest either the patient’s are inconsistent or the testing battery is not reliable/valid to distinguish subtypes

Hamilton et al, 2008
Neglect & Neuroimaging

- fMRI study of patient with acute neglect
  - fMRI is able to detect changes in the blood flow during a cognitive task
  - Patients had to detect visual objects in all fields
- Compared with control patients, neglect was characterized by reduced activation in the right parietal and lateral occipital cortex

Umarova et al, 2011
Neglect & Neuroimaging

• Diffusion tensor imaging (DTI) tractography is able to trace white matter pathways
• Completed in twelve patients with R CVA
  – Six of these patients showed signs of neglect

Schotten et al, 2011
Neglect & Neuroimaging

- Individual DTI tractography identified specific disconnections of the fronto-parietal and fronto-occipital pathways in the neglect group
  - Correlations found between patient performance on two visual search tasks and damage

Schotten et al, 2011
Neglect Recovery & Neuroimaging

- fMRI research shows that recovery pattern from neglect is variable
  - Some patients show increased activity of the right hemisphere
  - Other patients show increase activity of the left hemisphere

Cappa et al, 2011
Assessment of Neglect

• Functional Testing of Neglect
• Clinical Assessment Tools
Functional Testing of Neglect

• PT/OT examination of functional activities will grade independence with functional tasks

• Can describe performance and symptoms suggesting neglect
  – But won’t be very neglect specific
Catherine Bergego Scale

- Based on a direct observation of the patient’s functioning in ten real-life situations
  - Sometimes called the “BEN” (French abbreviation)
- Four-point scale is used, ranging from 0 (no neglect) to 3 (severe neglect)
- A total score is then calculated (range: 0–30)
  - Arbitrary cut-off points
    - Patients with a total score of 0 = no neglect
    - 1 to 10 mild
    - 11–20 moderate
    - 21–30 severe

Azouvi et al, 2003
Catherine Bergego Scale

- Good interrater reliability & validity
- Most sensitive items of the scale: neglect of left limbs, collisions while moving, and neglect in dressing
- Total CBS score correlates significantly with most paper-and-pencil tests

Azouvi et al, 2006
Catherine Bergego Scale

- **Advantages**
  - Valid
  - Reliable
  - Functional test
  - Can be incorporated into regular PT/OT examination

- **Disadvantages**
  - Not well known
  - Not all items of the test are typically done by a single discipline

Azouvi et al, 2006
Clinical Neglect Assessment Tools

- Behavioral Inattention Test
- Cancellation tasks
- Drawing tasks
  - Figure copying
  - Clock drawing
- Line bisection
- Fluff Test
Neglect Assessment

• Not commonly formally done by PT
  – More common with OT/SP
• But…
  – Chart audit study in acute care
  – 248 subjects should have been assessed for neglect
    • 38% received some form of unilateral spatial neglect assessment
    • 13% were assessed with a standardized assessment

Korner-Bitensky, 2006
Behavioral Inattention Test

• Developed by Wilson et al (Rivermead BIT)
  – Available for purchase for around $300
    • Two parallel versions

• Six “conventional” subtests:
  – Line crossing
  – Letter cancellation
  – Star cancellation
  – Figure and shape copying
  – Line bisection
  – Representational drawing
Behavioral Inattention Test

• Nine behavioral subtests
  – Pre-scanning
  – Phone dialing
  – Menu reading
  – Article reading
  – Telling and setting the time
  – Coin sorting
  – Address and sentence copying
  – Map navigation
  – Card sorting
Behavioral Inattention Test

• No training required
• Interrater reliability, test retest reliability, and validity have been supported in the literature
• Equipment includes:
  – Photographs
  – Six different types of coins
  – Playing cards
BIT and CBS

• Assessed 17 patients with neglect using the CBS and subtests of the BIT
• Dissociations were found between mild neglect in visual screening tasks and moderate or severe neglect in behavior
• Only the line bisection subtest from the BIT correlated significantly with the CBS
  – Both tests showed good internal consistency

Luukkainen-Markkule et al, 2011
Behavioral Inattention Test

• Advantages
  – Valid
  – Reliable
  – Comprehensive
  – Functional component

• Disadvantages
  – Time for completion is approximately 40 minutes
  – Need for purchase
Cancellation Tasks

- Bells test
- Star cancellation
- Line cancellation (Albert’s test)
- Star cancellation
- Letter cancellation
Cancellation Tasks

• Goal is to mark the target
• Assessor measures the number of omissions/hits, time to completion, R vs. L differences
  – People without neglect may miss 4 or 5 targets

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2635542/figure/F1/
Line Bisection

• Patient is presented with multiple lines at various positions
  – Can vary in size, position, and orientation

• Patient is instructed to mark the midpoint of the line
  – Distance from midpoint is the measurement

Line Bisection

A. Normal line bisection  B. Highly impaired line bisection

http://www.medicine.mcgill.ca/strokengine-assess/images/lbt_figure.jpg
Cancellation & Line Bisection

• Advantages
  – Cheap
  – Fast
  – No equipment
  – Continuous measure of neglect

• Disadvantages
  – Will not distinguish neglect subtypes
  – Not well standardized
    • Paper position, start point, etc
Drawing Tasks

• Clock Drawing Test
  – Part of MMSE
  – No standard scoring
    • Normal/abnormal
  – Reliable test retest and interrater reliability for people with stroke
    • Not much evidence for its usefulness as a screen for neglect

Drawing Tasks

• Advantages
  – Cheap
  – Fast
  – No equipment

• Disadvantages
  – Will not distinguish neglect subtypes
  – Not well standardized
    • Paper position, start point, what to draw, scoring, etc
Fluff Test

• Test for personal neglect
• Attach targets to a person’s clothes
  – Stickers, cotton balls, etc
• The test required subjects to remove all the targets attached to the front of their clothes
  – Three on the right of the central body midline area
  – Three on the left of the central body midline area
  – Six along the subject’s left arm
  – Six along the right leg
  – Six along the left leg

Cocchini et al, 2001
Fluff Test

• N = 38 people with a history of subacute stroke (right lesion with or without neglect, left lesion without neglect)
• Tested and retested after 2 weeks along with other neglect testing
• Results
  – Patients with neglect did significantly worse
  – Correlation coefficient = .89
  – Low correlation with cancellation tests

Cocchini et al, 2001
Fluff Test

• Advantages
  – Cheap
  – Fast
  – May be reliable
  – Explicit test of personal neglect

• Disadvantages
  – Patients with left hemiparesis may not be able to reach all targets
    • Test can be modified to place targets that can be accessed by the right hand
  – Not well known
Comparison of Methods

• N = 206 people with right subacute stroke
• Assessed with multiple paper and pencil measures (Bells, reading, writing, line bisection, clock, figure copying) and the CBS
• Most sensitive paper and pencil measure was the starting point in the cancellation task
• Whole battery was more sensitive than any single test alone
• Behavioral assessment was more sensitive than any other single test

Azouvi et al, 2002
Comparison of Methods

- N = 34 people with right acute stroke vs. control subjects
- Tested using a test battery of cancellation tests, complex line bisection, copying a figure/sentence, reading, etc
- Determined that star/shape cancellation and line bisection tasks were most sensitive measures
  - Detected 88% of neglect patients as a battery
  - Most sensitive single test was line bisection

Lindellit et al, 2007
Summary of Clinical Neglect Assessment Tools

• A battery of tests is usually recommended
  – Determining the cut off score for neglect depends on the test
  – Scoring is a bit variable so you need to be internally consistent
Interventions

- Medications
- Attention training
- Scanning
- Activation therapy
- CIMT

- Trunk rotation
- Eye patches & hemispatial glasses
- Prisms
- Neck vibration/TENS
Interventions Not Covered

• Caloric stimulation
• Optokinetic stimulation
• Transcranial magnetic stimulation
• Transcranial direct current stimulation

Not practical or available in clinical practice
Why so little evidence?

• Cochrane Review 2009: found no evidence for effectiveness for any interventions!
• Difficult to study patients in acute care
  – Lots of spontaneous recovery
  – LOS constraints
  – Priority is not research
• Lack of national registry for patients with stroke for research

Wilkinson et al, 2011
Medications

• Data from studies with animals indicate that ascending dopamine systems projecting to the neostriatum, frontal cortex, and cingulate gyrus are involved in sensory orienting, arousal, and motor intention

• Neglect can be induced by injections of the dopaminergic neurotoxin MPTP into the caudate nucleus of monkeys
Bromocriptine

• Dopamine agonist
  – Parlodel is trade name

• One side effect to look for is dizziness & orthostatic hypotension
Methylphenidate

- Ritalin
- General CNS stimulant
- More commonly used for patients with a general decrease in attention
Medications

• Case studies:
  – Bromocriptine and methylphenidate may improve motor and perceptual tasks
  – Other studies suggest DA agonist treatment worsens neglect symptoms
    • May be related to subcortical lesions
    • DA uptake system damaged and the DA goes to the unaffected hemisphere

Advantages/disadvantages?
Attention Training

• Subjects with neglect can be taught to cue themselves
  – Verbal and tactile cues to attend to left side of a task
  – Verbal cues
  – Patient taught to self cue aloud
  – Patient taught to self cue

Robertson et al
Attention Training

• Small studies & case studies (Robertson et al, 1995; 1998) have supported its effectiveness
  – Patients significantly improved on several neglect and attention measures immediately after training, and these improvements were maintained for 2 weeks.
  – An auditory tone sounded before a left visual stimulus improved awareness of the left visual field in 8 neglect patients.

• Effect on functional activities is unknown

Advantages/disadvantages?
Scanning

- Commonly used treatment for neglect
- Teach patient to scan or look to the left using visual cues
  - “Anchors” on left side of space
  - Colored lines, rulers, own fingers, other objects
Scanning

• Some older large randomized controlled trials found improvements in neglect
  – Weinberg et al, 1977;1979
• Effect on functional activities is unknown

Advantages/disadvantages?
Activation Therapy

- Idea is to increase “activation” of the damaged hemisphere
- Make small movements of the hand/UE while completing tasks
Activation Therapy

- Small movements of the left hand on the left side of space reduce neglect symptoms
  - Improvements found in walking trajectory, reading, and paper & pencil testing
- Meta-analysis of the activation literature (Lin 1996) found large effect sizes for both group and single-subject studies of contralesional limb activation

Advantages/disadvantages?
What is CIT?

• Used to be called “Forced Use” training
• Some prefer “CIMT”
  • Constraint induced movement therapy
• Program to improve function use of the more affected UE using a program of:
  – Forced use
  – Shaping
  – Massed practice
Neglect & CIT

- Randomized controlled trial (Van der Lee, 1999) with 66 subjects
  - Compared CIT program with NDT control group
- Significant improvements found in CIT group post training and with long term follow up
  - Subgroup with neglect had large significant improvements
  - Neglect status was not explicitly measured as an outcome

Advantages/disadvantages?
Trunk Rotation

- Goal is to practice rotating trunk towards contralesional (left) space
- Often combined with scanning

Wiart et al, 1997
Trunk Rotation

• Some research evidence suggests improved FIM and neglect scores with rotation training (Wiart et al, 1997)
  – May be due to increased standing time
• But, more recent larger study found no difference between trunk rotation, rotation plus half eye patching, and control groups in FIM and neglect measures (Fong et al, 2007)

Advantages/disadvantages?
Eye Patching & Hemispatial Glasses

- Each superior colliculus of the midbrain receives input from the contralateral hemifield of each eye, but predominantly from the contralateral eye.
- Reduces input to the left superior colliculus, which then releases its inhibition over the right superior colliculus.
- This improves visual functioning in the left hemifield.
Eye Patching & Hemispatial Glasses

- Hemispatial glasses consist of a standard eyeglass frame with the ipsilesional (right) hemifields of both lenses blocked out by a light-deflecting lens or an opaque patch.
- Full-eye patches completely eliminate visual input into the covered, ipsilesional (right) eye.
Eye Patching & Hemispatial Glasses

• Evidence is mixed for monocular patching
  – Improvements in neglect measures reported but not in all studies

• Improvement in neglect measures have been found with hemispatial glasses/half patches
  – Some studies report carryover into improved function but functional effects are still uncertain

Advantages/disadvantages?
Prisms

• The prisms cause an optical deviation of the visual field to the right
  – Objects appear farther to the subjects’ right than is actually the case
  – While wearing the lenses, subjects initially misreach to the right
Prisms

• After repeated exposure, subjects correct the reach trajectory to accurately grasp target objects
  – Visual input is overridden
• Effect has been observed in both controls and patients with neglect
Prisms

• Immediate use of prism improves measures of neglect in both acute and chronic patients
  – Multiple small randomized controlled trials
  – Effects last after the prisms are removed which suggests remapping of the brain

• Conflicting evidence on the effect of prisms on ADLs but most studies have reported no functional effects

Advantages/disadvantages?
TENS/Neck Vibration

• Muscle vibration activates muscle spindles that provide afferent information to the central nervous system.
• The stimulation is interpreted as a change in muscle length.
  – Changes in perceived body orientation may result.
TENS/Neck Vibration

- Research studies exploring the use of left posterior neck vibration (5-20 minutes) with/without scanning have found improvements in neglect and function
  - Gains were maintained at follow up also so effects were not just temporary

- Less research available with TENS (during a treatment session) + scanning
  - Improvements with neglect reported

Advantages/disadvantages?
Treatment Suggestions for Clinical Environments

• Family education
• Incorporation of neglect treatment strategies into mobility training
Family Education

- Clear explanation of neglect and patient’s behavior
- Set-up of environment

Osawa, 2010: Family participation reduced neglect!
Neglect Education

• Explanation of what the symptoms are
• Prognosis
• What they can do to help
• Safety education
  – Falls risk
  – UE protection
  – Driving
Communication

• Approach from right for communication
• Approach from center/left for therapy purposes
• Can use auditory cue to redirect patient to the left side of space
  • Finger snap, etc
Patient Environment

• Avoidance of left sided obstacles
  • Can become therapeutic activity

• Proper seating in wheelchair
  • Make sure patient is vertical in chair

• Protection of left side in wheelchair
  • Use of arm tray with Velcro
  • LE straps for leg rests
Mobility Training + Neglect Strategies

• Early standing with trunk rotation to the left
• Use of standing frame with left sided environmental interactions
• Combine with reading activities for scanning
• Use of balloon or ball toss for scanning with rotation
• Can use PWB device for safety purpose
  – Also get benefits of standing for preparation for gait training
Mobility Training + Neglect Strategies

• Functional training
  – Incorporate self cueing/attention training
  – Can force activity to the left side of space - remapping effects
  – Use of scanning in ADL training - eating, reading, grooming
Mobility Training + Neglect Strategies

• Emphasis of left side active exercise
  • Activation and exercise effect
  • CIT if appropriate to patient’s level
• Can have patient look towards body part moving
  • Help to remap left side of space
Mobility Training + Neglect Strategies

• Prisms may be expensive to trial so make some hemispatial glasses or half patches

• Incorporate TENS into sessions if units are available
  – Time for set up should be minimal
High Level Activities

• Scanning while ambulating
  • Route finding
  • Community mobility
  • Obstacle courses
  • Playing catch while walking