RELATION BETWEEN THALAMIC VOLUME AND FUNCTIONAL OUTCOMES IN TBI

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Background

Limited number of studies have examined the relation between post acute rehabilitation and functional outcome. This is a retrospective assessment based upon data collected at various stages of recovery during post acute traumatic brain injury (TBI) rehabilitation. The current study focused on a variety of functional outcome measures including occupational status, living status, community integration, level of disability and ability. The purpose was to examine anatomical correlates of recovery and rehabilitation to assess factors that may play a role in mediating success or degree of recovery.

Method

Subjects

A sample of 38 patients of closed-head injury were included.

- Age
  - at injury (M=36.9, SD=13.7)
  - at MRI (M=37.6, SD=13.6)
  - upon admission (M=37.4, SD=13.7)
- Education (M=12.4, SD=3.6)
- Severity (Mild=5, Moderate/Severe=33)
  - Mild TBI was determined by a loss of consciousness (LOC) 0-30minutes AND/OR Post-traumatic Amnesia (PTA) less than 24 hours AND/OR a Glasgow Coma Scale (GCS) score of 13-15.
  - Moderate to Severe was determined by LOC greater than 30 minutes AND/OR PTA greater than 24 hours AND/OR a GCS score less than 13.
- Chronicity (M= 232.4 days, SD=271.9)

Outcome Measures

Six outcome measures were administered upon admission and discharge to a post-acute traumatic brain injury rehabilitation program.

- Disability Rating Scale (DRS)- assesses a person's general level of *disability* on a 30 point scale allowing for categorization of level of disability ranging from "none" to "extreme vegetative state". The DRS measures a person's status in areas of awareness, self-care, dependence on others, and employability. (Rapport et al., 1982).
- Centre for Neuro Skills Rating Scale (CNS)-assesses *ability* in the areas of cognition, withdrawal, agitation and aggression, physical therapy, occupational therapy, speech, language, education, and vocation on an 80-point scale. High scores on this scale indicate high levels of *ability* in each of the functional areas (Ashley & Persel, 1999).
- Mayo-Portland Adaptability Inventory (MPAI)-assesses physical, cognitive, emotional, social participation problems commonly experienced after TBI on a 34 item scale (Malec, 2005).
- Community Integration Questionnaire (CIQ)-assesses home integration, social integration, and productive activities after TBI on a 29 point scale (Willer et al., 1994).
- Living Status Scale (LSS)-assesses living situation on an ordinal scale that ranks the patient from 1-10. High numbers indicate living situations that require a high level of supervision (Ashley et al., 1990).
- Occupational Status Scale (OSS)-assesses *vocational involvement* on an ordinal scale that ranks the patient from 1-16. High numbers indicate vocational situations requiring a high level of supervision or no vocation (Ashley et al., 1990).

Admission, discharge and change scores were determined for DRS, CNS.
Only admission and discharge scores were determined for MPAI and CIQ.
Only change scores were determined for OSS and LSS.

Image Acquisition

- Imaging was conducted on a 1.5 T Siemens MRI
  - T2 Imaging: TR =5850 ms, TE = 86.24 ms, image matrix = 512x256, FOV = 24x24cm^2, number of slices = 25-40, slice thickness/separation = 3-5 mm

Imaging Analysis

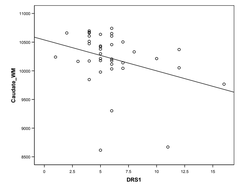
The structural data were reoriented, co-registered to the T1 template, segmented into gray matter (GM), white matter (WM), and cerebral spinal fluid (CSF), and then transformed into MNI space using SPM5. Individual data were examined for quality prior to inclusion for motion and other artifacts. Structures were traced in MNI space and volumes extracted.

Results

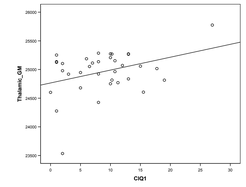
- One-way analysis of variance was used to examine the relation between severity of injury and anatomical factors
  - Severity Level (Mild vs. Moderate/Severe)
    - Moderate/Severe group had less Frontal GM (F=5.5, p=.024)
    - Moderate/Severe group had less Whole Brain WM (F=5.99, p=.019)
    - Moderate/Severe had more Anterior CSF (F=9.08, p=.005) and Caudate CSF (F=4.872, p=.034)
- Correlation analyses were performed to examine the relation between anatomical structures and outcome measures

Anatomical structures associated with baseline function

Caudate WM and DRS Admission r= -.326, p=.046

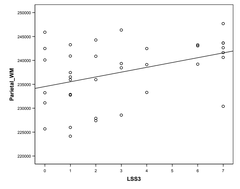


Thalamic GM and CIQ Admission r=.358, p=.035

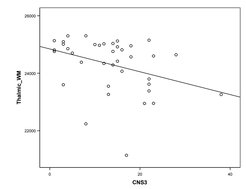


Anatomical structures associated with change in function and outcome

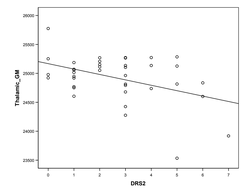
Parietal WM and LSS change r= .398, p=.015



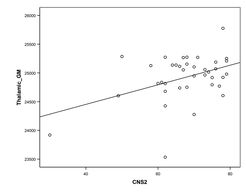
Thalamic WM and CNS change r=-.355, p=.029



Thalamic GM and DRS discharge r= -.429, p=.007



Thalamic GM and CNS discharge r=.422, p=.008



Discussion & Conclusions

This study extends previous human and animal findings by showing an association between thalamic volume and function. We extend these findings to suggest that thalamic volume has a role in mediating not only cognitive function but also functional outcomes. These preliminary findings provide additional support for the role of the thalamus in supporting functional status even within a severe TBI population. These data also support the role of structural MR Imaging in rehabilitation programs.

References

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