Cognitive Rehabilitation of Blast Traumatic Brain Injury

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Introduction

- **Blast-induced TBI (bTBI)** is the most common injury in the current War:
  - an estimated 60% of all blast injuries result in TBI
  - majority of blast survivors have mild TBI
    (Walter Reed Medical Center, Warden et al, 2005)

- **Mild TBI and bTBI:**
  - often unrecognized and left untreated
  - undiagnosed and improperly managed, can have a detrimental impact on veteran’s life
  - associated with substantial impairment in:
    - work productivity
    - social functioning
    - quality of life
  - present a costly public health issue
The most common impairments following non-blast TBI (nbTBI):

- Cognitive deficits:
  - executive functioning (planning, goal setting, cognitive flexibility and behavioral control)
  - learning and memory
- Functional & psychosocial disabilities closely related to these cognitive deficits

- It is still unclear whether the immediate and long-term neurocognitive consequences of bTBI are identical to those of nbTBI, but preliminary results suggest similar impairment profiles (Belanger et al., 2009).

- While there are no reports in the literature evaluating cognitive treatments specific for bTBI, there is evidence for the efficacy of cognitive rehabilitation in nbTBI.
Cognitive Rehabilitation of TBI

A Consensus Conference sponsored by the National Institute of Health defined the characteristics of effective cognitive interventions in TBI:

- Structured
- Systematic
- Goal-directed
- Individualized

They involve:

- learning
- practice
- social contact
- relevant context
Both randomized controlled studies and case reports have documented the success of cognitive interventions in improving:
- cognitive functions
- mood
- daily functioning
(Reviewed in Cicerone, et al, 2005)

Most of the research on cognitive rehabilitation has targeted adults with nbTBI

How does that apply to bTBI?

The applicability of these approaches to our patient population is not known although in both young individuals with TBI and elderly subjects with MCI, cognitive training has been shown to improve specific neuropsychological functions, predominantly executive skills and memory, which are also targets for the bTBI group.
Executive Function (EF) Rehabilitation

TBI is among the most common causes of executive dysfunction.

Several studies have documented goal management deficit in TBI due to impairments in strategic self-regulation (Robertson et al., 1997; Levine et al., 1998).

Goal management deficit =>
- disruption in everyday functioning
- often is the main cognitive complaint in patients with TBI
- associated with negative occupational outcomes (Mateer et al., 1987; Levine et al., 2000)
Executive Function (EF) Rehabilitation

TBI Patients with EF deficits are challenging to rehabilitate:
- poor insight into their problems
- lack of mental flexibility necessary to adapt to changes
- impoverished planning ability
- poor motivation

Improving executive abilities may help patients to make better recovery across many other functional domains

Thus, there is a real need for EF rehabilitation programs:
- to train and rebuild damaged executive skills and
- to use those skills more effectively in the service of other cognitive functions.
EF Rehabilitation

The Brain Injury Interdisciplinary Special Interest Group (BIISIG) of the American Congress of Rehabilitation Medicine for cognitive rehabilitation of people with TBI (2005) recommended:

For remediation of EF deficits => implementation of cognitive interventions that promote
- internalization of self-regulation strategies through
  - self-instruction and
  - self-monitoring

Several studies have demonstrated effectiveness of EF training and problem solving (Schlund, 1999; Levine et al. 2000; Medd & Tate, 2000; Ownsworth et al. 2000; Stabulum et al. 2000; Tham et al. 2001; Knight et al. 2002; Stuss et al. 2007; Novakovic-Agopian et al. 2010).
Goal Management Training (GMT)

- experimentally validated rehabilitation protocol
- adheres to the BIISIG recommendations
- theory-driven: based on theory of disorganization of behavior following frontal lobe lesions
- developed by Robertson (1996) and further expanded by Levine and colleagues (2000)

GMT:
- structured
- interactive
- manual-based rehabilitation program, which aims to:
  - increase participants’ awareness of EF problems
  - teach them to identify and describe these problems
  - teach patients to recognize their impact on the ability to achieve goals
  - train them with techniques to monitor and compensate for these problems
Executive Function Training

1. interactive exploration why people get “off track” and fail to complete tasks;
2. training with emphasis on:
   - specific strategies that help to establish a goal
   - determine the steps to reach it
   - while recognizing and inhibiting distractions
3. homework assignments relevant to each individual’s goals for reinforcement and facilitation of learned skills and concepts to real life.

GMT-based EF training has been shown to improve organization and memory function:
- in patients with nbTBI (Levine et al., 2000)
- elderly with complaints of forgetfulness (Stuss et al., 2007)
- patients with mild anoxic brain injury (Bogdanova et al., 2009).
Cognitive Rehabilitation of bTBI

Rehabilitation Research & Development Clinical Trial
Boston VA Healthcare Systems

Cognitive Rehabilitation Treatment Goals:
- Improve cognitive functioning and
- Improve quality of life

With the long-term goals:
- to facilitate the veterans’ re-entry into the community and
- to optimize ultimate outcome of bTBI
Cognitive Rehabilitation of bTBI

Study aims:

- To examine the impact of a structured CRT on **cognitive function**
- To evaluate the effect of CRT on **daily functioning**
- To examine the effect of CRT on **psychiatric symptoms**
- To evaluate the long-term effects of CRT
- To evaluate which variables predict treatment-associated effects and retention of treatment effects
Study Design

- 120 participants are divided, using a blocked randomization procedure into:
  - cognitive intervention group (G1) and
  - educational intervention group (G2)

**Assessment:**
- baseline (T1)
- mid-intervention (T2)
- post-intervention - immediately following the intervention program (T3)
- follow up - three months later (T4)

**All assessments include:**
- neuropsychological tests battery
- mood and stress symptom measures
- functional outcome questionnaires
- health-related measures
Cognitive Training Intervention

- The study evaluates cognitive intervention using a modified version of a Goal Management Training (GMT) program with focus on executive function and a memory training (which emphasizes executive contributions to memory).

- Treatment program:
  - 1 session per week for 10 weeks
  - Each session lasts 2 hours (with a short break in the middle)

- Treatment administration:
  - a trained clinician with training and experience in cognitive rehabilitation group treatment administers Tx
Educational Intervention

- It is unknown whether the cognitive approach benefits exceed those of programs that focus only on education and support.

- Our study design aims to address this issue by comparison of a cognitive rehabilitation intervention and an active control group receiving educational support.

- Education about the nature and common symptoms of mTBI is a critical aspect of mTBI intervention (VA/DoD Clinical Practice Guideline for Management of Concussion/mTBI (CPGmTBI; 2009).

- The benefits of communication of health information by providers include:
  1) help in managing patient expectations,
  2) preventing the development of mTBI symptoms and/or
  3) reduction in their duration, number, and severity.
Educational Intervention (EI)

- The study EI follows VA/DoD recommendations for pts with mTBI experiencing persistent symptoms (CPGmTBI; 2009) and consists of several components:
  - provision of information about mTBI
  - education
  - awareness of limitations
  - strategies for prevention of further injury
  - self-monitoring of symptoms
  - eliciting and encouraging utilization of participant’s social support resources.

- The structure of EI is parallel to GMT:
  - interactive discussions to identify the problems that affect day-to-day functioning,
  - exploring and learning strategies for prevention of further injury,
  - self-monitoring of symptoms and using social support,
  - supplemented by homework tasks that will be reviewed at each session.
Treatment Standardization

Development of manualized treatment protocols is needed to ensure consistent treatment delivery across treatment settings.

Cognitive Treatment Manual was developed for this study. It is based on a modified GMT version, which was developed and utilized by our group for cognitive intervention in patients with mild anoxic brain injury (Bogdanova et al, 2009).

Development of the Educational Intervention Manual was guided by the VA/DoD recommendations and an existing educational manual used in a study of trauma survivors with acute stress disorder following mTBI (CPGmTBI; 2009).
Challenges

- Blast-related TBI is an emerging field
- The long-term outcome and recovery course are yet to be evaluated
- Complex nature of the traumatic event/s and extreme environmental factors
- Repetitive and cumulative traumatic events during tour/s of duty
- Lack of optimal post-injury care (rest) while on duty
- Neuropsychiatric co-morbidities (PTSD, sleep disturbance, depression, etc.)
- Little evidence for the effectiveness of cognitive rehabilitation for the mild TBI and bTBI
  (Tanielian & Jaycox, 2008; Belanger et al., 2009; Lew et al., 2009; Vanderploeg et al, 2009)
Future Directions

• Clinical Trials to compare Tx outcome for bTBI vs nbTBI patients
• Development of Combination Therapies to address multiple comorbidities (such as TBI & PTSD)
• Utilizing novel neuromodulation techniques (such as transcranial magnetic stimulation, transcranial LED)
• Interdisciplinary collaborations:
  ▪ to develop combination treatments
  ▪ to identify biomarkers/predictors of Tx outcome using neuroimaging (fMRI, Diffusion Tensor Imaging), physiological and electrophysiological measures, etc.
QuickTime™ and a decompressor are needed to see this picture.