Post-Traumatic Stress Disorder and Traumatic Brain Injury – Current Issues

Dewleen G. Baker MD
Associate Director – Clinical Affairs
VA Center of Excellence for Stress and Mental Health
Associate Professor
UCSD Department of Psychiatry

UCSD

VA Center of Excellence
CESAMH
Stress and Mental Health

Key Iraq wound: Brain trauma

By Gregg Zoroya, USA TODAY

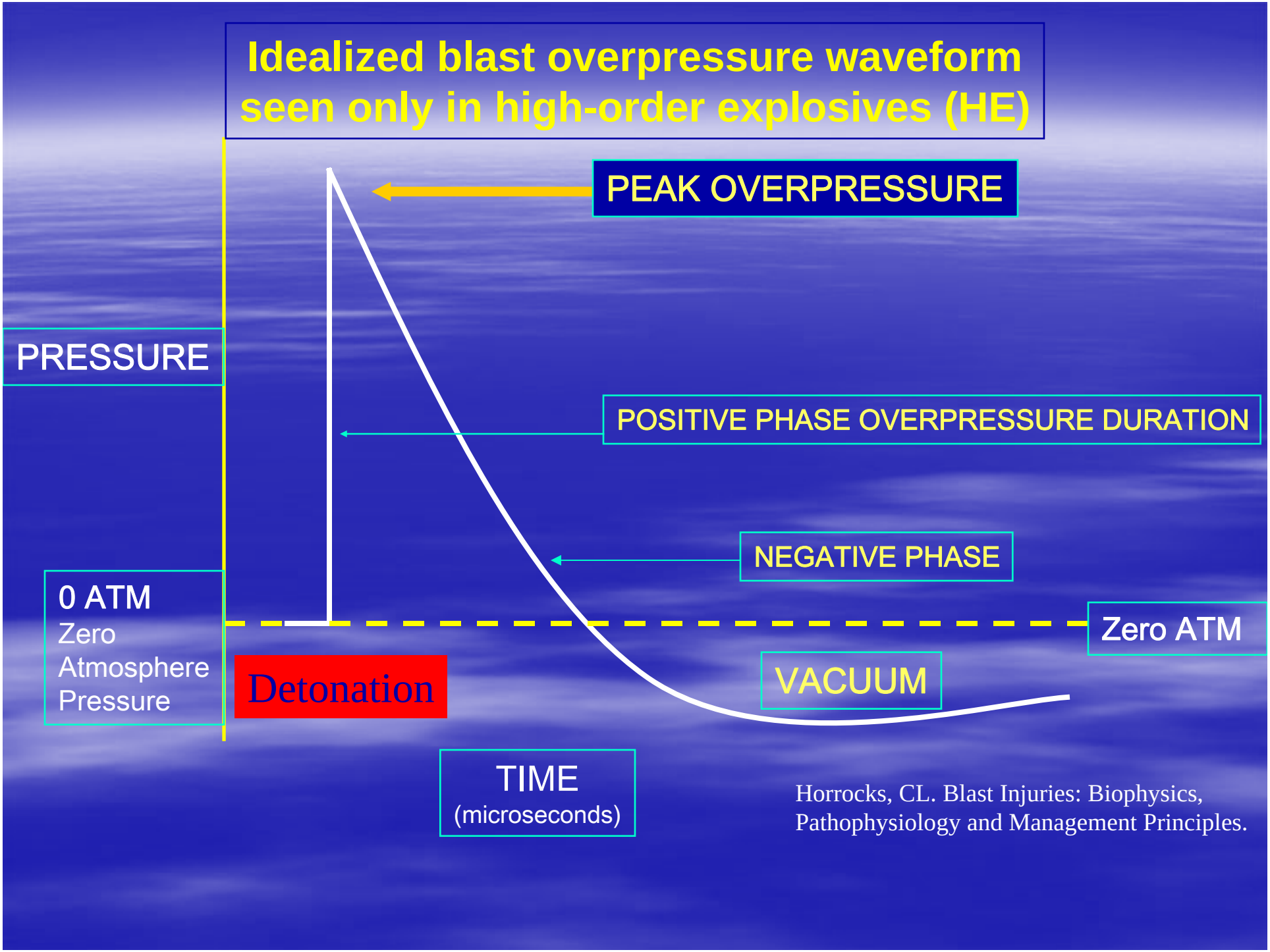
"A growing number of U.S. troops whose body armor helped them survive bomb and rocket attacks are suffering **brain damage** as a result of the blasts. It's a type of injury some military doctors say has become the **signature wound of the Iraq war**."

Types of Explosive Blasts

Explosives Classification by Speed of Explosion

High-order (HE) versus Low-order (LE)

- High-order Explosives (HE) = detonated
  - Supersonic – Explosion is faster than the speed of sound
  - Characterized by blast over-pressurization impulse wave
  - HE does not mean “large” – **a hand grenade is a HE**
  - HE blast injuries are characterized as
    a) Primary, b) Secondary, c) Tertiary, d) Quaternary
  - E.g., all military bombs, TNT, Dynamite, Semtex, ANFO


Idealized blast overpressure waveform seen only in high-order explosives (HE)
PEAK OVERPRESSURE
PRESSURE
POSITIVE PHASE OVERPRESSURE DURATION
NEGATIVE PHASE
0 ATM
Zero Atmosphere Pressure
Zero ATM
Detonation
VACUUM
TIME
(microseconds)
Horrocks, CL. Blast Injuries: Biophysics, Pathophysiology and Management Principles.

Explosives Classification by Speed of Explosion

High-order (HE) versus Low-order (LE)

- Low-order Explosives (LE) = deflagration – not detonation
  - Subsonic – explosion occurs < the speed of sound
  - NO blast over-pressurization wave
  - LE does not mean "small" – **9-11 attacks involved LE**
  - LE injuries can be characterized as a) shrapnel, b) blunt, c) crush, d) burn
  - E.g., Napalm, gunpowder, Molotov cocktail, many petroleum-based

Blast-Injury Vocabulary

Specific for High-order Explosives (HE)

1. **Primary (1°) Blast Injury** (e.g. blast brain or blast lung)
   – over-pressurization impulse wave – often fatal
2. **Secondary (2°) Blast Injury** (e.g. glass shards)
   – penetrating shrapnel and debris
3. **Tertiary (3°) Blast Injury** (e.g. traumatic amputation)
   – blunt - blast wind throws the individual
4. **Quaternary (4°) Blast Injury** (miscellaneous)
   – burns, fume poisonings, suffocation, building collapse, crush injuries, chronic disease flare, mental health

Primary Blast Injury

associated exclusively with high-order (HE) explosives

- 1. Caused by the over-pressure blast wave
  - Invisible, supersonic
- 2. Lethal radius rapidly diminishes with distance
  - 1 / radius^3 . Lethal radius is 3x in water
- 3. Affects most air filled structures
  - Lungs, GI tract, Sinuses, Middle ear (TM rupture)
  - But also brain (blast brain)

Blast Brain – A Type of Traumatic Brain Injury

- Blast over-pressure wave – not always a straight path
  - Dampened, reflected, or amplified off solid surfaces
  - Helmets, Kevlar stop shrapnel, but magnify blast waves

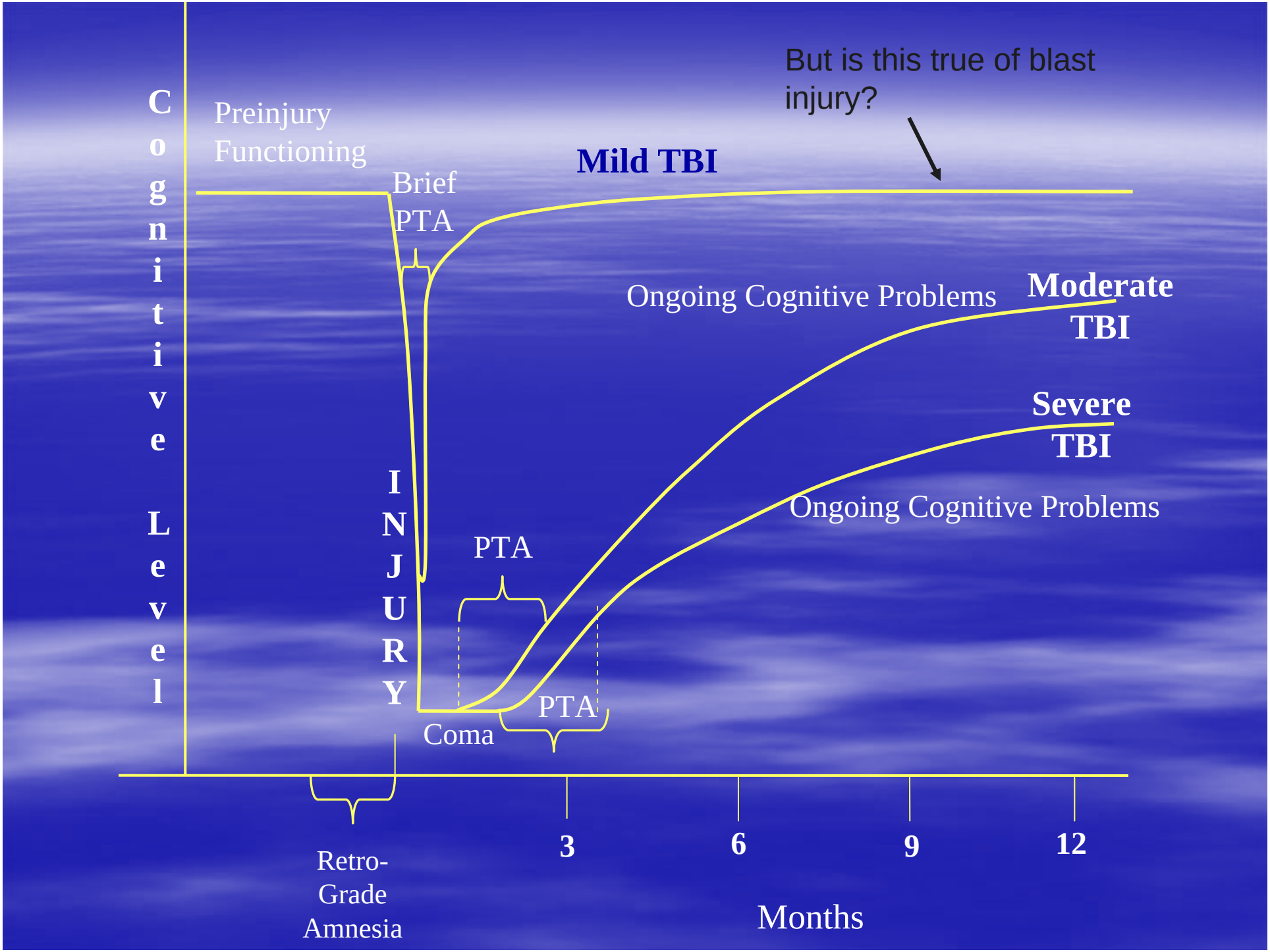
War Injuries: Explosive Blasts

- Most common cause of injury
- 64% of war injuries caused by blasts
- 41% of blast injured at Walter Reed had TBI (01/05 - 02/06)

Traumatic Brain Injury

Traumatic Brain Injury

- Insult to the brain caused by an external physical force
- Produces a diminished or altered state of consciousness
  - Dazed and confused for several minutes or
  - Knocked out / Rendered unconscious and/or
  - With memory gaps for some or all of the immediate period before or after the event
- Can result in impairments in physical, cognitive, behavioral, and/or emotional functioning


Cognitive Level
Preinjury Functioning
Brief PTA
INJURY
Coma
PTA
PTA
Retro-Grade Amnesia
But is this true of blast injury?
Mild TBI
Ongoing Cognitive Problems
Moderate TBI
Severe TBI
Ongoing Cognitive Problems
3
6
9
12
Months

Associated Symptoms of TBI

- Cognitive

  Memory deficits, poor concentration, thinking problems

- Emotional-Behavioral

  Depression, anxiety, irritability, mood swings

  Impulsivity, apathy, agitation, aggression

- Physical

  Headache, dizziness, fatigue, noise/light intolerance, insomnia/sleep disturbance

Mild TBI

- 80% of TBI
- There is **no symptom** that is **unique** to or **diagnostic** of mild TBI
- Many postconcussion symptoms occur in normal healthy individuals
- All symptoms/problems overlap with one or more other conditions
  - (PTSD, depression, anxiety, chronic pain, somatoform disorder, chronic health conditions)

What about Traumatic Brain Injury and Posttraumatic Stress Disorder?

Diagnostic Criteria for PTSD

- A. Exposed to traumatic event
  - The person experienced, witnessed, or was confronted with an event involving actual or threatened death, serious injury or a threat to physical integrity of self or others
  - The person's response involved intense fear, helplessness or horror

Diagnostic Criteria for PTSD

- B. The traumatic event is reexperienced in one or more of the following ways
  - Recurrent images, thoughts or perceptions
  - Recurrent distressing dreams of the event
  - Acting or feeling as if the event was recurring
  - Intense psychological distress OR physiologic reactivity at exposure to cues that symbolize or resemble an aspect of the event

Diagnostic Criteria for PTSD

- C. Persistent avoidance of stimuli associated with trauma and numbing as indicated by 3 or more:
  - Avoiding thoughts, feelings, or discussion, activities, places or people that bring back recollections; sense of foreshortened future
  - Inability to recall; restricted affect
  - Diminished interest or participation
  - Feeling detached or estranged

Diagnostic Criteria for PTSD

- D. Persistent symptoms of increased arousal by 2 or more:
  - Difficulty falling or staying asleep
  - Irritability or outbursts of anger
  - Difficulty concentrating
  - Hypervigilance
  - Exaggerated startle response
- E. Duration for more than 1 month

PTSD: Associated Features

- Feelings of depression
- Feelings of guilt related to the trauma
- Feelings of shame
- Thoughts of suicide
  - Rate of suicide 6 times greater than individuals without PTSD
  - Highest rates of suicide attempts of all the anxiety disorders
- Co-Morbidities: Depression, Substance Abuse, Mood cycling, Panic and anxiety symptoms

PTSD and TBI symptom Comparison

- PTSD
  - Insomnia
  - Memory Problems
  - Poor concentration
  - Depression
  - Anxiety
  - Irritability
  - Stress symptoms
  - Emotional numbing
  - Avoidance
  - Intrusive symptoms
- Mild TBI
  - Insomnia
  - Impaired Memory
  - Poor concentration
  - Depression
  - Anxiety
  - Irritability
  - Headache
  - Dizziness
  - Fatigue
  - Noise/Light intolerance

TBI and PTSD: Literature

- Development of PTSD symptoms after a blast injury may be related to the severity of the injury, although research findings about this are mixed [Bryant 2001, Bontke 1996, Glaesser 2004, Williams 2002, Bryant 2000]
- Some researchers have argued that impaired consciousness precludes experiencing the trauma event [Bryant 2001, Mayou 1993, Price 1994, Sbordone 1995]

TBI and PTSD: Literature

- In general research supports the occurrence of PTSD following mild TBI
  - Incidence 13%-27%
  - Prevalence 3%-59%

  [Bryant 2000 & 1999, Hickling 1998, Read 2004, Mather 2003, Creamer 2005]
- There is evidence for association of TBI with other MH disorders: depression, anxiety disorders and bipolar disorder [Van Reekum 2000]

TBI and PTSD: Literature

- Risk factors for PTSD after a head injury [Review: Kim et al 2007]
  - Early post injury depression and anxiety
  - Female
  - Avoidant coping
  - Left temporal lesion [Vasa 2004]
- These studies have methodologic limitations

TBI and PTSD

- Cognitive symptoms after TBI are usually transient
- Risk factors for persistent cognitive symptoms after a mild TBI
  - History of depression and anxiety
  - Expectations
- Data are preliminary and studies are limited in number

Case Examples

Case 1:TBI, PTSD or both?

- OIF, two tour veteran, early 20's, 100% service connected for PTSD; discharged from the military after hospitalization for PTSD, depression
- His unit was in Al Anbar province just before and during the siege of Fallujah
- TBI event and multiple trauma events

Case 1:TBI, PTSD or both?

- TBI event
  - Providing security near a tank which fired a round
  - He was hit by a shock wave, blown off his feet, hit the wall
  - Lost consciousness for about 5 minutes, rejoined firefight when he regained consciousness, was nauseated, vomited for two hours

Case 1:TBI, PTSD or both?

- TBI event
  - Did not seek medical attention
  - Current complaints: Memory problems, problems with balance and speech, blacks out if he if physically active

Case 1:TBI, PTSD or both?

- Primary Emotional Trauma Event
  - Clearing city of insurgents/house to house
  - Insurgents began to lob grenades when they entered the house
  - Close fighting, nearly hand to hand
  - Half of platoon wiped out – nine died, 10 injured
  - Emotionally numb; extreme helplessness

Case 1:TBI, PTSD or both?

- Other Emotional Trauma Events
  - On convoy, roadside bomb went off
  - Three injured, two killed, body parts scattered everywhere
  - He had shrapnel injuries
  - Extreme fear helplessness, horror

Case 1:TBI, PTSD or both?

- Clinical Presentation
  - Separated from wife, in marital counseling, domestic violence charge which was dropped, concerned about being a good father to his one year old daughter
  - Medically healthy, no current use alcohol or drugs; experimented in high school, up to 20 beers/night on weekends in military
  - Background: Middle class, intact, loving, caring family

Case 1:TBI, PTSD or both?

- Clinical Presentation
  - "C" student in school, some truancy, low ASVAB scores
  - Neuropsychological Testing: Average IQ, substantial deficits in verbal memory and intact non-verbal memory; good executive functioning, perceptual reasoning and visual attention; considerable discrepancy between right and left hemispheric functions
  - Normal neurological exam and brain imaging, including Magnetoencephalogram (MEG)

Case 1:TBI, PTSD or both?

- Treatment
  - Vocational rehabilitation counselor; organizational aids (Palm Pilot); Supportive psychoeducation (Brain Injury program), School assistance, such as audiotaping of classes
  - Treatment for PTSD and depression including verbal modalities and medication (SSRI)

Case 1:TBI, PTSD or both?

- Follow-up (6-9 months later)
  - Sporadic attendance with vocational and unclear success in college
  - Active attempts to return to active duty: verbalized that he felt a structure, a purpose and camaraderie
  - Second team meeting: Verbalization of his desires and needs and reformulation of plan

Major Issues

- Diagnosis is complex; Need detailed history from childhood forward
- Comprehensive assessment reveals PTSD, but no clear evidence for blast-related injury
- The assessment gives clear indications of emotional and cognitive strengths and weakness
- Treatment must be appropriate to developmental stage
- Expectations for recovery

Case 2:Moderate/severeTBI and Depression

- OIF veteran, late 30's, mechanical head injury with loss of consciousness greater than 30 minutes, unable to continue military job
- Living situation: Divorced from wife, attempted to work at civilian job, but was unable
- Depressive symptoms, intrusive imagery, suicidal ideation

Case 2:TBI, Depression, PTSD

- Clinical Presentation
  - Neuropsychological testing unequivocal
  - Significant depressive symptoms
  - PTSD symptoms
  - Suicidal thoughts, no plan

Case 2:TBI, Depression, PTSD

- Clinical Presentation
  - Neuropsychological testing unequivocal
  - Significant depressive symptoms
  - PTSD symptoms
  - Suicidal thoughts, no plan

Case 2:TBI, Depression and PTSD

- Progression of Events
  - Preceded head injury – PTSD symptoms prior to head injury
  - His career trajectory changed following the head injury
  - The patient was grappling with his losses: cognitive, career, interpersonal
  - He met diagnostic criteria for major depression (SCID)

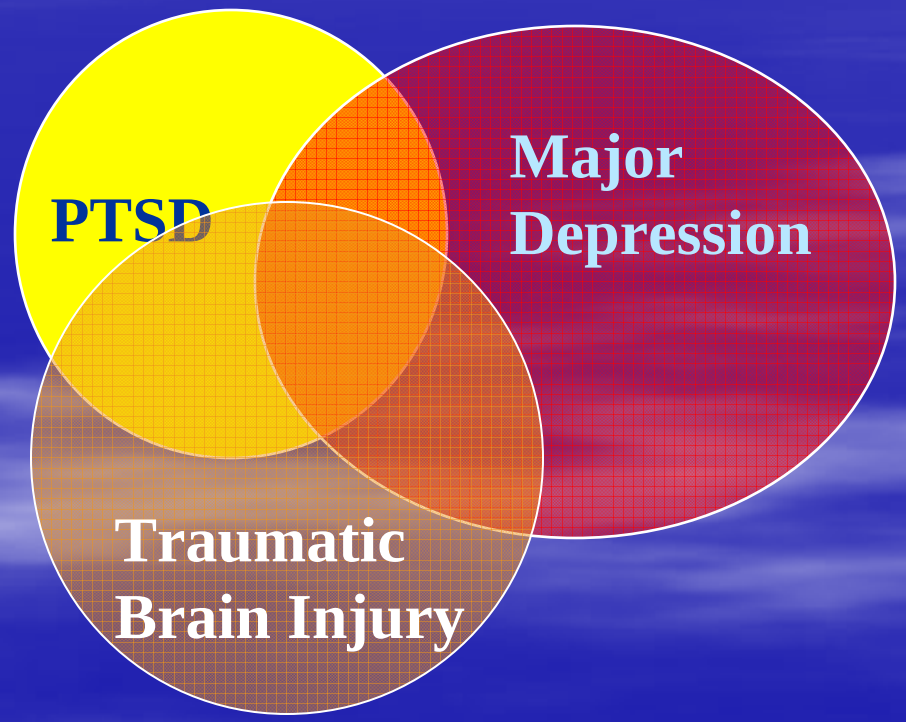
Case 2:TBI, Depression and PTSD

- Treatment
  - Physical therapy (help with balance) and cognitive retraining
  - Career counseling
  - Antidepressant (SSRI) for major depressive episode
  - Verbal treatments

Major Issues

- Diagnosis is complex; Need detailed history (timeline) is important
- Moderate TBI can be associated with significant cognitive changes and feelings of loss
- The assessment gives clear indications of mental health diagnoses and cognitive strengths and weakness
- Recovery and adaptation are possible

PTSD Comorbidity in OEF/OIF



Treatment of PTSD

- Growing evidence base for PTSD treatments
  - Exposure-based psychotherapies √√
    - Additional benefits of cognitive restructuring?
  - Pharmacotherapies
    - Selective serotonin reuptake inhibitors √√
    - MAOIS √
    - Other antidepressants √
    - Anticonvulsants
    - Adjuncts
      - Prazosin √
      - Atypical antipsychotics √
- Pharmacotherapy alone usually inadequate to obtain optimal outcomes
  - Combined Rx + exposure-based therapy
    - Studies ongoing

Questions for Further Research

- What are the consequences of blast injuries to the brain?
- What is the relative comorbidity of PTSD and blast TBI?
- Can they be differentiated?
- What are optimal treatments?