



The Role of Trauma in NeuroRehabilitation Outcomes

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| Affiliations

- Scientific Planning Committee Member
International Paediatric Brain Injury Society (IPBIS)
- Educational Planning Committee Member
North American Brain Injury Society (NABIS)
International Brain Injury Association (IBIA)
- Professional Advisory Board Member
PINK Concussions
- Independent Contractor
QTC Medical Group - A Leidos Company
- Founder and President
BrainPsych Medical
- Clinical Program Director, NeuroRestorative Florida

| Objectives

- 1) Identify at least 3 sources of common trauma and their neurobiological effects on the brain
- 2) Understand the role of trauma and personality
- 3) Understand the compounded impact of premorbid trauma in the context of Traumatic Brain Injury (TBI) rehabilitation
- 4) Identify at least 3 protective factors and trauma interventions to optimize neurorehabilitation outcomes

| History

Herodotus (Greek Historian in 5th Century BCE):

- Impact of trauma on individuals' level of functioning by recording observations of Athenian soldiers returning from combat

Freud & Burlingham (1943):

- Negatively affected children in nurseries due to bombings in WWII
- Need for assurance specific to safety and routines
- Role of caregivers' response was found to be equally critical

Kempe et. al (1962):

- First seminal paper to describe the medical manifestations of non-accidental trauma. The authors coined the phrase "battered child syndrome" to characterize the constellation of findings including childhood fractures, subdural hematoma, soft tissue swelling, skin bruising, failure to thrive, and sudden death. They highlighted the importance of injury that did not correlate to the described history.

| History

Terr (1970):

- One of the first clinicians to focus on the psychological impact of A&N on children
- Maltreated children: a) less willing to explore world and trust others; b) increased rate of cognitive impairment

Terr (1979):

- Studied kidnapped children in Chowchilla, California
- Common core reactions that traumatized children may display and distinguished between acute vs. pervasive/chronic developmental trauma
 - Cognitive coping
 - Trauma-related fears, memory and nightmares
 - Post-traumatic play and reenactment

Hysteria:

- Jean Martin Charcot (1887/1889) French neurologist; Sigmund Freud & Joseph Breuer (“Double consciousness”); Pierre Janet, 1889 (“dissociation”).
- Belief that altered states of consciousness led to hysterical symptoms
- Freud was ostracized in Victorian society

| History

DSM-III (1980):

- PTSD – First formal diagnostic recognition by psychiatric/mental health community
- PTSD – Expansion thereafter to include threatened, observed and actual events

DSM-V:

- PTSD: Most flexible
- Appreciates the individualized and varied manifestation of symptoms in victims/patients
- Proposal for developmental trauma disorder (DTD) was rejected (Schmid, 2013):
 - Emphasis on the etiology of the disorder might force current diagnostic systems to deviate from their purely descriptive nature.
 - Concern that comorbidities and biological aspects of the disorder may be underdiagnosed using the DTD criteria.

Neurobiological Effects of Trauma

Bessel van de Kolk (2005): “Complex Trauma”

- “multiple, chronic, and prolonged, developmentally adverse traumatic events, most often of an interpersonal nature (e.g., sexual or physical abuse, war, community violence)”
- 7 domains of impairment (cross domain impairment):
 - (1) Attachment – Secure vs. avoidant/ambivalent/disorganized
 - (2) Biology (The Limbic System → emotion, reactivity and reward responses for survival)
 - Amygdala
 - » Environmental threat response system via HPA → Fight, flight or freeze
 - » Memory → Decisions influenced by emotion rather than a rational basis
 - Hypothalamus
 - » Anger/Aggression
 - “Rage center” located in ventromedial hypothalamus
 - **Inhibited** by projections from the **dorsomedial** nucleus of the amygdala
 - **Facilitated** by projections from the **ventromedial** nucleus of the amygdala
 - » Regulating pleasure and sexual satisfaction
 - Continual activation changes brain structures → Hypervigilance vs. hypovigilance
 - Overproduction of stress hormones → over-pruning of neurons (Rinne-Albers et al., 2013)

Bessel van de Kolk (2005): “Complex Trauma”

(3) Affect regulation

- Secure attachment and neurobiological integrity
- Reactive attachment disorder

(4) Behavioral control

- Impairment is complicated and exacerbated by ETOH/illicit use

Neurobiological Effects of Trauma



(5) Dissociation* & (6) Cognition+

- Dissociative Identity vs. Dissociative Amnesia⁺⁺
- Flood of stress hormone shrinks hippocampus (emotional and verbal memories)
- Smaller corpus callosum hinders processing and emotional regulation
 - » Poor integration capabilities
 - » Influences posttraumatic stress symptoms and negatively impacts academic skills
 - » Patient more likely to then to use behavior vs. words to problem solve

(7) Self-concept

- Impact of changes in sensory cortex
- Integrity of prefrontal cortex and executive functions → self monitoring, self awareness
- Impact on current and future relationship

*Painter & Scannapieco, 2013

+Rinne-Albers et al., 2013

++DSM-V, 2013

Differentiating Types of Trauma

1. Emotional Maltreatment

- Hard to assess at times because there are no physical indicators/signs
 - a) Acts of commission i.e., emotional abuse
 - Hostile, denigrating, rejecting comments/acts
 - b) Acts of omission i.e., emotional neglect
 - Emotional unavailability or unresponsiveness
 - Failure to provide attention, comfort, reassurance, encouragement and/or acceptance

2. Physical Abuse

3. Sexual Abuse

Differentiating Types of Trauma



4. Intimate Partner Violence / Domestic Abuse

- Dual victims: Vicarious vs. direct abuse
 - Children are 3x more likely to be abused and 4x higher risk of neglect if parents abuse substances*
 - Disrupts attachments, predictability, nurturance and stable foundation for academic success
 - Vicious cycle then repeats
- Culture
 - Fatalism: belief that one has little control over their own life
 - Culturally reinforced gender/sex roles
 - Cognitive dissonance in “Americanized” children

*National Council of Child Abuse and Family Violence, 2015

| Differentiating Types of Trauma

5. Situational Trauma

- Loss of loved one, life threatening medical illness, homelessness

6. Bullying and School Violence

- Evolution due to technology

7. Community Violence

- Families with good communication practices, strong interpersonal bonds, increased participation in school, outside activities, and religious groups all serve as protective factors*

8. World Events & Natural disasters

- 9/11; Hurricane Katrina; COVID-19; etc.

9. Immigration and Resettlement Trauma

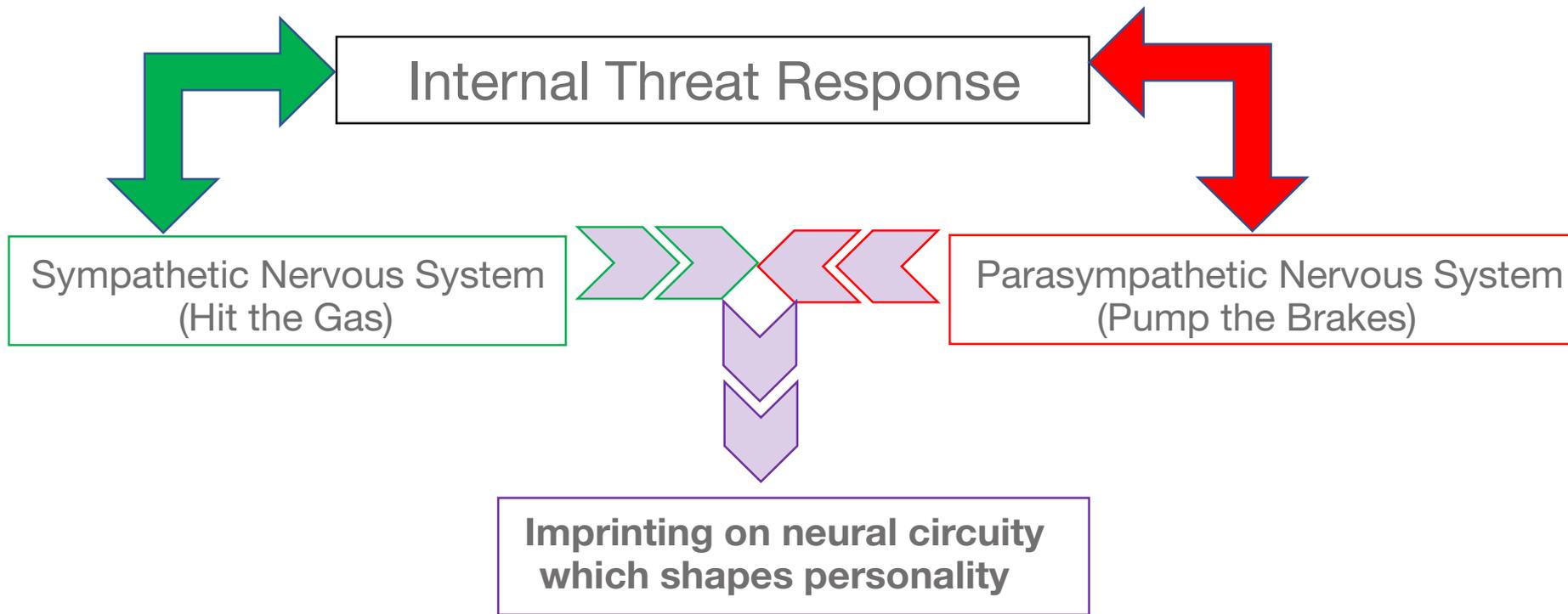
- Impact of legal vs. illegal migration
 - Risks from deportation, sexual victimization, gangs, drugs, etc.

*DeCarlo et al., 2014

Trauma and Personality

Extensive early childhood trauma likely to be one of the root causes for later development of personality disorders*

- Failure to appropriately progress across developmental milestones
 - Trauma interferes with one's ability to regulate arousal to internal and external stimuli



| Trauma & NeuroRehabilitation Outcomes



Allostatic Load (McEwen, 2012)

- The bodily “wear and tear” of chronic trauma

Co-morbidities due to trauma (Tyrka et al., 2013)

- Chronic trauma can overwork a patient’s physiology leading to comorbid and long-term health consequences such as obesity, CVD, diabetes, fibromyalgia, chronic fatigue.

Polyvagal theory (Porges, 2007)

- Role of vagus nerve in connecting multiple bodily systems for threat response efficiency
- Based on preferred response (call for help, fight back or freeze), vagus nerve adjusts system’s response
- Ingrained and automatic responding due to repeated and sustained traumas
- Talk therapy, neurobiofeedback, and breathing techniques to recalibrate polyvagal function

Trauma & NeuroRehabilitation Outcomes

Acute vs. Ingrained Trauma Reactions

- Hippocampus and prefrontal cortex: Impaired processing and over-inhibition → automatic responses driven by amygdala take over
 - L.Hippocampal functioning suppressed = impaired learning and memory retrieval
 - Larger, more active amygdala leads to delay in cause-effect, empathy, emotional language
- Orbito-frontal cortex
 - Housed in prefrontal cortex and important for learning from mistakes and guiding decisions
 - Smaller frontal lobes = less inhibitory control = increased impulsivity, poorer organization, and increased problems reading social cues
- Trauma neurocircuitry: state dependent memory
 - Shut down of higher cortical modes: rational thinking and introspection
 - Importance of healthy, predictable, safe rehab environments
 - Triggers can be both internal and external → once triggers, ingrained neurocircuitry sets off cascade response
 - Sounds, smells, non-verbal/visual cues, tasks, control dynamics, health symptoms

Trauma & NeuroRehabilitation Outcomes

- The entire spectrum of TBI severity, from mild to severe, is associated with an increase in psychiatric conditions*
- Acquired/Traumatic Neurological Injury and MH can significantly change the way a person perceives (sees, hears, smells, etc.), understands, thinks, moves and feels, as well as manages one's general health. (Jacobs, H. 1993, 2012) BUT so can trauma...so which has a bigger effect?
- This affects how the patient will respond to his/her environment and his/her related behavior(s).
- Psychotic syndromes occur more frequently in those with TBI vs. general population**
 - More focal frontal and temporal abnormalities on neuroimaging (MRI/CT) +
 - Lower rate of negative symptoms+
- Higher prevalence in moderate to severe TBI
- Can occur during PT-Epilepsy and more traditionally as part of a mood disorder

*Vasihnavi et al., 2009

**McAllister, 1998

+ Fujji & Fujji, 2012

Trauma & NeuroRehabilitation Outcomes

Neuroplasticity

- The brain remains “plastic” or malleable throughout life**
- With some exceptions, the brain generally retains the ability to repair/remap itself
 - Pros and cons
- Brain-derived neurotrophic factor
 - Protein that stimulates neuronal production
 - Trauma can reduce brain volume by limiting production of BDNF*+
- Autophagy and other trophic factors (helper proteins that allow neuron to develop and maintain connections)
 - Role of neuroinflammation due to trauma, other factors (food/medications/chronic pain, etc.) and related impact on rehab outcomes

*Vasihnavi et al., 2009

**Gray et al., 2013

+Cicchetti et al., 2015

Trauma Treatment & Variables that Influence NeuroRehabilitation Outcomes

Psychopharmacology

- “I have to have my medications,” “I don’t need any meds!”
- Pros and cons
- Neuroscience/PGT

Primary Care

- Proactive vs. reactive mindset
- “Well, you’re an MD., right?” – Pick the correct providers
- The role of sex/gender

Milieu Therapy

- Healing environment, practices and behaviors to build self-efficacy
- Learned helplessness (Seligman & Maier, 1967)
 - Work Comp: Fertile ground for LH when checks don’t arrive on time, health practitioners don’t explain diagnoses and treatment → claimants begin to feel insecure and believe they have little control over the care necessary to get well

Personality

- Premorbid strengths/deficits

Age

- Child vs. adult treatment
- Male vs. female treatment

Resources

Retraumatization

Trauma Treatment & Variables that Influence NeuroRehabilitation Outcomes



- Low-grade “silent” inflammation contributes to nearly every major sign of aging
- Inflammation is helpful in the setting of any acute injury or infection BUT chronic inflammation is harmful and may play a significant if not primary role in comorbid illness
- Increased neuroinflammation decreased BDNF

WHEN DAMAGE OVERWHELMS REPAIR → NEURONS DIE

Trauma Treatment & Variables that Influence NeuroRehabilitation Outcomes

The 7 Signs of Silent Inflammation

1. Aches and Pains
2. Brain Fog
3. Memory Impairment/Diminished Brain Function (TBI vs. Trauma vs. NI vs. ALL)
4. Digestive Distress: Inflammatory signals that linger in the gut can irritate your intestinal lining causing stomach upset
5. Cardiovascular Problems: Low-grade inflammation lingers in blood vessels and makes them vulnerable to “bad” LDL cholesterol infiltrating the vessel walls
6. Low energy and fatigue: the constant attempt to put out the “internal inflammatory fire” often causes fatigue and weakens the immune system

Trauma Treatment & Variables that Influence NeuroRehabilitation Outcomes



CASE STUDY 1

CASE STUDY 2

Trauma Treatment & Variables that Influence NeuroRehabilitation Outcomes



TRAUMA IS PREVENTABLE

| Questions?

