Combat-related PTSD and the Developing Brain

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Objectives

• be aware of historical approaches to PTSD and how these beliefs influence care today
• understand why combat-related PTSD can affect mood, behavior, and life skills
• consider brain development as a factor in rehabilitation decisions for young adults
War of Independence 1775-83
Nostalgia

3 stages were noted:

• heightened "excitement and imagination"
• fever and prominent gastrointestinal symptoms
• frustration and depression
Civil War: 1861-1865
Soldier’s Heart or Irritable Heart

- “insane” soldiers were put onto trains unsupervised, the name of their state or home town pinned to their tunic
- others were left to wander the countryside and many died from exposure or starvation

Soldier’s Heart or Irritable Heart

- the number of “insane” soldiers found wandering about grew, until there was a public outcry
- in 1864 the War Department ordered that affected soldiers be kept in hospitals until families could come for them

World War I: 1917-1918
‘Shell Shock’

• symptoms were documented
  – staring eyes, unexplained blindness, deafness, paralysis, tremors, fear
  – defective control of temper, tendency to weep on slight provocation
  – lessened power of attention, defective memory and will power

• sometimes considered cowardice, malingering
Treatment of Shell Shock

• 1917: Army Surgeon General’s Office develops a treatment protocol: “PIE”
  – Proximity: treat in the field; psychiatrists in units
  – Immediacy: treatment began even as physical wounds were addressed
  – Expectation: quick return to battle

• 12.5% of WWI evacuations were for psychiatric reasons

Pols H and Oak S: The US Psychiatric Response in the 20th Century
World War II  (U.S. 1941-1945)
Combat Stress Reaction or Battle Fatigue

- Gen. George Patton was not sympathetic to the psychological effects of trauma.
- In August 1943 he slapped, cursed at, dragged, and kicked a presumed ‘Battle Fatigue’ patient out of a hospital tent.
  - The public reaction nearly ended his career.
  - The soldier turned out to have dysentery and malaria.
Combat Stress Reaction or Battle Fatigue

- Battle Fatigue was *defined* and studied
- *unit cohesion* was found to be a protective factor
- *intensity* and *duration* of combat exposure were associated with severity

Combat Stress Reaction or Battle Fatigue

• WWII service was generally “for the duration”
• by the end of the war, 50% of evacuations were for psychiatric reasons
• mental illnesses were classified in the ‘Medical 203’ in 1946
  – this was the foundation for the Diagnostic and Statistic Manual of Mental Disorders (DSM)

Vietnam: main combat 1964-1973

- nation was ambivalent about the war
- a college draft deferment (until September 1971) allowed affluent young men to avoid service
- the voting age in the US was 21 until the XXVI amendment was ratified on July 1, 1971
  - 18 to 20 year olds could be drafted, yet not vote
Vietnam: main combat 1964-1973

• troop rotation policy varied for officers and soldiers
  – officers: 6 months
  – soldiers: 1 year
• officers often had less battle experience than troops “FNG’s”, “90-day wonders”
  – this rotation made for rapid officer promotions
• very poor unit cohesion, even fragging
Post-Vietnam Syndrome

- psychiatric evacuations were 4.4% at start of conflict, rose to 60% by the end
- doctors referred to PTSD symptoms as “dysfunctional and bizarre”, proof of a pre-existing mental problem, or the result of drug abuse
- there are still lawsuits pending over whether PTSD disability is service-connected
Health care advances ➞ more PTSD

• advances in trauma care have led to better chances of surviving a battlefield injury
  – bodily injury is a major risk factor for PTSD*

• more powerful explosive ordnance has resulted in high prevalence of TBI
  – TBI may double the rate of PTSD**


key ideas

• they symptoms of PTSD have been observed for centuries, and are often considered signs of moral weakness even in modern times
• the US military began to try to decrease PTSD-related personnel loss in WWI
• disagreement continues about who has PTSD, and how real the disability is
PTSD: Lessons from brain imaging

- both functional and structural changes can be observed in the brains of patients who meet criteria for PTSD
- at present, these are only useful for research purposes, not diagnosis of individuals
“Are you reading my mind?”

“Why would you think that?”
Meet the pre-frontal cortex

• **impulse control**
  – predicting results of choices
• **focusing through distraction**
• **sustaining effort**
  – making mid-course corrections
• **prioritizing, planning**
• **not getting overwhelmed by emotions**
• **time sense**

...*executive functions*
Brain Regions Most Affected in PTSD

- Prefrontal Cortex
- Hippocampus
- Anterior Cingulate Cortex
- Amygdala
Pre-frontal cortex development

• the human PFC matures much later (27-30 yrs.) than that of all other animals
  – in chimpanzees, the PFC is mature when sexual maturity is reached
• until reliable executive functions mature, most of us need guidance and support to navigate life safely
Average age of US combatants

- Revolutionary War: 32 at Lexington, 26 at Valley Forge, 21 by the end
- Civil War: 26
- WWI: 25
- WWII: 24-26
- Vietnam War: 21-22 (some report 19)
- Iran and Iraq: 28 (active duty), 33 (National Guard)
Human Prefrontal Development

Grey-matter volume changes during normal development

- Proliferation
- Migration
- Arborization
- Myelination

% of maximum

Age (years)

Fertilization

Driving

Joining the military

Insel T. Perspectives: Nature, Nov 11, 2010
Possible benefits of later PFC maturation

• “learning vs. performance”
  – humans’ extended childhood allows for more learning under the protection of our parents before having to be able to perform on our own

• this may be an advantage for innovation
  – the Wright brothers first thought of their flying bicycle in childhood
  – Einstein first conceived of special relativity at 16
  – the trampoline was invented by a child in 1960

Thompson-Schill S et al. Cognition without Control: When a little frontal lobe goes a long way
Anterior Cingulate Cortex (ACC)

- integrates input from other brain regions
  - motivation
  - evaluation of error
- detects conflict between active, competing representations
  - signals the dl-PFC to increase cognitive control
- modulates cognitive, motor, endocrine, and visceral responses to emotionally loaded input
PTSD and the Anterior Cingulate

- In vets with PTSD, fMRI showed less activation in the presence of emotionally charged stimuli
  - Cognition did not ‘kick in’ to counteract a strong emotional and physical response to the upsetting pictures

BIOL PSYCHIATRY 933 2001;50:932–942
Ventromedial PFC

• evaluates probable outcome of behaviors
  – may ‘sum up’ pros and cons of the options, assign a unidimensional positive or negative valence to each

• emotionally loaded moral decision-making
  – trolley dilemma (flip a switch to kill one person vs. five people)

• input to motor, endocrine, visceral responses
  – fist-clenching, heart racing, stomach flips, shaking, sweating
PTSD and the Ventromedial PFC

- less vm-PFC activity
- impaired outcome predictions
- less ‘dampening’ of bodily responses
  - stronger startle, higher amplitude increases in heart rate, blood pressure, longer recovery time
  - this larger physical reaction can in turn increase the perception of danger
Dorsolateral Prefrontal Cortex

- very active in risky or moral decision-making
- anterior: more abstract modifiers
  - not grabbing a candy bar because of commitment to weight watchers
- posterior: less abstract modifiers
  - not grabbing a candy bar because someone present disapproves

Cieslik E et al: Is There "One" DLPFC in Cognitive Action Control? Evidence for Heterogeneity From Co-Activation-Based Parcellation. Cerebral Cortex 2012 Aug 23
Dorsolateral Prefrontal Cortex

• counterbalances strong affect to allow for optimal cognition
• crucial to impulse control
• does not reach adult dimensions until well into the 3rd decade of life

PTSD findings: Dorsolateral PFC

- In PTSD, dl-PFC is less active, actually becomes smaller in size
  - The same genes that when turned on cause brain cell death in degenerative brain diseases such as Parkinson’s or Huntington’s diseases have been found operating in PTSD patients.

Amygdala

- not just a ‘fear center’
  - more of a ‘WTF’ center
  - coordinates threat assessments in ambiguous or novel situations
- receives sensory and visceral activation as well as inhibition from “above”
- affects stress hormone release, sympathetic tone, reflex potentiation, and memory storage
PTSD findings: the Amygdala

- those with PTSD have higher amygdala activation with fearful face exposure, which does not fade on repetition
  - less counterbalancing input from the PFC
  - overreaction, less dampening, and poor extinction

PTSD and the Amygdala

- enhanced memory of events under stress
- impaired working memory for neutral daily events

Hippocampus

- the brain’s librarian
  - search engine (finds your book)
  - helps integrate newly acquired memories into long-term storage (re-shelves books so they can be found readily, discards duplicates)
  - serves a similar role in navigating physical space, storing a map of the route so it can be retrieved
  - these tasks generate your brain’s largest coordinated bursts of activity, causing STRUCTURAL changes
PTSD and the hippocampus

- impaired contextualization of memory
- inefficient working memory
- in PTSD, core affect (emotional tone) is over-determined by remembered events instead of the here-and-now
Key ideas

- PTSD causes injury or abnormal function of the brain areas that continue to develop well into the 3rd decade of life.
- These control emotional regulation, planning, reactions to stress, impulse control, memory.
- There is solid physical evidence which correlates with these findings.
Aggression in combat-related (CR)-PTSD

• study: cross-sectional self-report data on impulsive aggression
  – not just anger, hostility
  – not premeditated aggression

• impulsive aggression much higher in veterans with PTSD (70%) than without PTSD (29%)

Teten A et al. Military Medicine, Vol 175 No 6, June 2010
Intimate aggression and CR-PTSD

• in 1995, 63% of male Vietnam veterans with PTSD reported at least one act of intimate aggression in the last year (1995)
• Vietnam veterans without PTSD have shown the same intimate aggression rate as the general population in different studies

Different paths

• environment shapes brain development

• pathways important for survival become stronger
Human Prefrontal Development

Civilian young adults

- use crucial years to rehearse:
  - **self care skills**
    - trial and error mastery of sleep and food needs
    - capacity for substance intake
  - **financial independence**
    - budgeting and prioritizing
    - time management, social norms of work (language, dress, etc.)
Civilian young adults

- parents/guardians provide ‘backup’ support to young adults who on average reach full financial independence at about 28 years old (US)
  - this safety net is important for rehearsing skills, surviving mistakes
Young adults in combat

• in those same years, a combat situation selects for:
  – ‘cold’ decision making in ‘hot’ emotional states
  – hypervigilance
  – ‘zero-to sixty’ aggression
  – no opportunity to rehearse life management skills

• not playing “with a net”: an error can mean death
Are young returning soldiers at a disadvantage?

- May 2012 Gulf War II era Veterans’ unemployment rates (national comparison)
  - ages 18-24, **23.5%** (vs. 12.9%)
  - ages 25-34, **14.7%** (vs. 8.2%)
  - ages 35-44, 6.4% (vs. 6.8%)
  - ages 45-54, 7.5% (vs. 6.4%)

*Bureau of Labor Statistics*
Veterans: Alcohol Abuse

- PTSD is associated with a 2 fold increase in alcohol misuse among Iraq and Afghanistan veterans over all, even more in:
  - younger males
  - emotional numbing
  - hyperarousal
  - depression

Summary

• veterans with PTSD suffer from physical changes in brain structure and function
  – more emotionally reactive
  – stronger physical reactions to emotion
  – less able to foresee outcomes of their choices
  – more intimate aggression
  – more depression
Summary

- combat veterans with impulsive, aggressive, and/or substance-related offenses need:
  - assessment for PTSD as part of a thorough mental health and substance abuse assessment
  - treatment if needed
  - rehabilitation for TBI if present
- ask if younger veterans have worked and lived independently- they may benefit from occupational/vocational therapy to acquire independent living skills
Finding help for veterans with PTSD

• Veterans’ Administration
  – assessment and treatment of PTSD (medication, therapies)

• National Center for PTSD (part of VA)
  – on-line coaching
  – mobile apps for self-help and education

• DoD Outreach Center for Psychological Health and Traumatic Brain Injury
Finding help for veterans with PTSD

- Arizona Department of Veterans’ Services
  - educational assistance, appeal of VA decisions, family relief fund
- US Vets
  - housing, family services, job assistance, counseling
- Arizona Coalition for Military Families
  - “roadmap to veteran employment”
  - workshops for veterans, families
  - advocacy