PTSD and the brain: What clinicians need to know

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Underexplored Territories in Trauma Education: Charting Frontiers for Clinicians and Researchers

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Learning Objectives

• Describe the neurocircuitry of posttraumatic stress disorder (PTSD)

• Explain two clinical implications of neuroimaging findings in PTSD

• Name one research area of future importance
What is fMRI?

- Nuclear magnetic resonance
  - Image biological tissue

- BOLD signal
  - Correlate of brain activity
Hippocampus

Amygdala

dmPFC, dACC

vmPFC, sgACC, rACC

dlPFC

BNST

Hypothalamus / PAG

Insula

Threat

Hypothalamus / PAG

ACSM-US

EVALUATION / MEANING

INTEGRATION / REGULATION (CONTEXTUAL)

REGISTRATION / EXPRESSION (PHASIC)

REGISTRATION / EXPRESSION (SUSTAINED)

SYMPATHETIC / ENDOCRINE RESPONSES

EVALUATION / MEANING

INTEGRATION / REGULATION (CONTEXTUAL)

Davies et al., 2010; Etkin, 2010; Hartley & Phelps, 2010
Amygdala

- ↑ amygdala responsitivity

Dannlowski et al., 2011; Hayes et al., 2012; Hughes & Shin, 2011
Hippocampus

- **Mixed findings**
  - ↓ during fear extinction
  - ↑ during encoding/learning

Hughes & Shin, 2011; Milad et al., 2009; Villarreal et al., 2002
Insula

• ↑ insula responsivity
Prefrontal cortex

- ↓ vmPFC activity

Hayes et al., 2012; Hughes & Shin, 2011; Milad et al., 2009
Threat

Hippocampus

Hypothalamus / PAG

Amygdala

Insula

dlPFC

dmPFC

vmPFC

REGULATION (COGNITIVE)

EVALUATION / MEANING

INTEGRATION / REGULATION (CONTEXTUAL)

REGISTRATION / EXPRESSION

INPUT CS-US

AUTONOMIC REGULATION

SYMPATHETIC / ENDOCRINE RESPONSES

CONTEXT

CONTEXT

MEANING
Neurocircuitry of PTSD: implications

- **Traditional model**
  - Emotional
    - Hyperactive
  - Regulatory
    - Hypoactive

- **Triple network model**
  - Salience (conflict monitoring, autonomic regulation, reward processing)
    - Hyperactive
  - Executive (working memory, attentional processes)
    - Hypoactive
  - Default (cognitive flexibility)
    - Hypoactive

Etkin & Wager, 2007; Patel et al., 2012
Implications for your practice

• Psychoeducation

Client: “Why am I constantly angry, looking over my shoulder, and “hitting the dirt” every time there was a loud bang?”

Therapist: “There is a logical explanation. A structure within the brain’s limbic system, the amygdala, is hyperactive in individuals with PTSD, thereby inappropriately and repeatedly overreacting to prepare the body to fight or flee. By engaging in cognitive-behavioral therapy, other brain areas with a regulatory effect on the amygdala may become more active, thereby helping you adjust to a more appropriate arousal level.”

• Intervention strategies
  – exposure
  – cognitive restructuring
  – emotion regulation
Treatment findings & further implications

- Psychological interventions modify brain function
  - Reversal of structural and functional abnormalities (i.e., normalization)
  - Compensatory changes in areas not altered before therapy

- Limited PTSD treatment results
  - Pharmacotherapy: ↑ hippocampus volume
  - Psychotherapy: ↓ amygdala activity
    - ↑ mPFC, hippocampus activity

- Use neuroimaging to predict
  - Risk
  - Prognosis
  - Response to treatment
  - Understand resilience and recovery

Linden, 2011; Thomas et al., 2014
References


