Novel, Neuroscience-Informed Approaches to Trauma Care in Community Clinical Settings

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Abstract

Trauma exposure, a highly prevalent condition in the United States, results in the development of chronic physical and mental health disabilities, such as diabetes, cardiovascular disease and posttraumatic stress disorder. Bench science advances in neurobiology and neuroscience have been translated into exciting clinical interventions, which have been shown to improve mental functioning and stress response. This article highlights three such interventions in hospital, primary care and community settings.

Introduction

Studies show that between 51 and 89 percent of Americans have experienced trauma at some point in their life.[1] Individuals have been trauma-exposed if they have an emotional response to a terrible event, such as an accident, rape, natural disaster, or combat. Fear, intrusive recall, pervasive avoidance, depression, hopelessness, and anxiety are all common forms of psychological distress that accompany the physical pain and discomfort of trauma.[2] These psychological stressors can lead to the development of chronic mental health issues, including posttraumatic stress disorder (PTSD). This negative feedback loop can also lead to poor overall health outcomes, such as diabetes and cardiovascular disease, and interfere with crucial components of recovery and posttraumatic growth, such as physical therapy, social reintegration and a return to a productive life.[3]

Post-traumatic growth (PTG) refers to the positive, transformative psychological adaptation a patient can experience after experiencing trauma, helping one gain an understanding of both the trauma and its negative psychosocial impacts. Experiencing high levels of PTG can lead to a reduction in many of the psychosocial stressors associated with trauma, allowing patients to focus energy on thriving and having greater chance at a successful recovery.[4]

The Neurobiology of Trauma

Individuals with PTSD have substantial limitations when it comes to distinguishing between what is safe and what is not.[5] The reason for this is that a set of chemical changes are set in motion in the brain and body when trauma occurs. These are normal processes that occur as a result of threat, but when the threat is very severe, the processes go haywire. For instance, when an individual is a victim of an assault, epinephrine (adrenalin) or norepinephrine floods his/her

brain and gives that person a rush of energy via the sympathetic nervous system (SNS). This can cause a startle response, queasiness (stomach), and heightened blood pressure so the person is able to survive by fighting or fleeing the offender.[6] In addition, there is a release of cortisol (referred to as the hypothalamic-pituitary-adrenal [HPA] response), a naturally occurring steroid that reduces the inflammatory response, which also encourages survival, and beta-endorphins to reduce whatever pain the individual may feel. The sheer amount of these chemicals has a negative effect after the trauma occurs, however, because it affects memory and the capacity to learn and focus attention. It also encourages defensive responses across different situations. This leads to an inability to interpret different sensory inputs, high levels of anxiety, irritability, and hypervigilance. In other words, trauma-exposed individuals can become chronically hyper-aroused because their bodies are giving them the wrong messages about threat.

Physical pain resulting from traumatic injuries and distress are also mutually maintaining, with the heightened arousal causing muscles to become more tense and pain more intense. Increased levels of pain then act as a reminder of the traumatic events, intensifying the brains' response and making pain even worse.[2] This Cascade Model of PTSD[6] results in chronic mental health and behavioral consequences, such as increased stress-related discomfort, prolonged poor quality of life, and substance abuse.[1,2,7,8]

Current advances in translational science have used many of these important neuroscience findings to develop clinical interventions that correspond with existing limitations in short term memory, sensory input, anxiety, and hyperarousal on the part of individuals with PTSD. The following section reviews some of the research being done by members of the Henry and Amelia Nasrallah Center for Neuroscience (NCfN) at Saint Louis University (SLU) with trauma survivors in clinical settings.

Treating Severely Traumatized Patients in Hospital Outpatient Settings

Gun violence was responsible for over 15,000 deaths and 30,000 injuries in 2019 in the U.S., with gun-related deaths in Missouri ranking fifth in the country per capita and homicide being the leading cause of death for young people between the ages of 15 and 44 in St. Louis (https://giffords.org/). When individuals have been shot, they are generally transported to and treated in the hospital emergency department, transferred to an acute trauma care floor, and then discharged to post-acute care (inpatient rehabilitation, skilled nursing facility, or home) based on need, and additional follow-up medical care in an outpatient trauma clinic. Trauma-focused cognitive behavioral therapy (CBT) can be implemented as a first-line intervention for individuals experiencing the negative mental and behavioral health effects of gun violence trauma in these settings, which do not normally provide mental health services. Narrative exposure therapy (NET) is one form of CBT that has been gaining evidence for efficacy in reducing anxiety symptoms and hyperarousal in trauma survivors.[9] The SLU Oberle Institute has developed a grant-funded pilot program to further test this approach as part of their outpatient trauma services.

Neuroscientific research that focuses on physiological responses to memory informed the development of NET by incorporating an autobiographical-memory theoretical framework for understanding how intrusive symptoms and fear networks are activated in the brain.[10] Over the course of several NET sessions, participants are guided through a therapeutic process that encourages them to share a testimony of their traumatic experiences within a more general lifespan narrative that includes both positive and negative memories and thoughts on the future.

From a neurobiological perspective, NET provides a safe environment to recall the contextual information of traumatic "cold memories" associated with an event and the linked "hot memories" or fear structures, which consist of the sensory, cognitive and emotional perceptual information and physiological and motor responses associated with that same traumatic event. Flashbacks, a prime symptom of PTSD, are the result of all the cold and hot memories of the traumatic event being activated when the survivor encounters just one internal or external stimulus associated with the fear structure surrounding that event. PTSD causes the same SNS and HPA responses that become active when experiencing a traumatic event to become active and re-experienced during flashbacks, ultimately hindering the functioning of HPA. This increases the number and strength of associations between triggering cues, making it easier for traumatic memory to be activated. The negative effect of PTSD on the HPA response

also restricts memories from incorporating contextual spatio-temporal information, which makes recall of the event less coherent and more prone to activating the fear structure. The autobiographical nature of NET helps one reduce the sense of threat associated with hot memories by anchoring them to the spatio-temporal information of that individual's life. Continually sharing traumatic memories within the larger context of a life narrative with another individual helps one create a coherent lifeline that provides meaning to the recollection of traumatic events. It also allows new, non-traumatic information to become part of memory recall. This can enhance emotional processing of the traumatic event by helping to reduce the negative reinforcement of avoidance thoughts and behaviors. It can also improve emotional processing, reducing fear and anxiety associated with the SNS response and structuring traumatic memories in a way that changes the pathological associations surrounding them. This helps survivors understand that traumatic memories are distinct from the traumatic event itself, allowing recall to occur more safely and in a controlled manner.[9] Studies of NET and its effect on PTSD have focused almost exclusively on populations facing violence in or from developing countries. This pilot represents a novel approach to treating victims of violence in the U.S.

Treating Trauma Exposed Patients in Primary Care Settings

Studies show that higher lifetime trauma leads to impulsivity,[11] and a combination of the trauma and impulsivity are likely associated with a number of different behaviors such as fiscal imprudence,[12] substance use disorders (SUDs)[8,13,14] and other health impairing habits of behavior and lifestyle like reckless driving,[15] physical inactivity, poor diet,[16] risky sexual behavior,[17] medical non-adherence,[1] self-mutilation,[11] suicidality,[18] etc. Studies of delayed reward discounting (DRD), a category of impulsivity that is implicated in these behaviors, usually focus on SUDs and rarely consider trauma as a predictor of discounting. This is a particular concern among physicians in primary care settings where there is a need to negotiate with patients about decision-making related to health behaviors that contribute to chronic disease outcomes.

Meanwhile, neuroscience research has shown that trauma exposure may be an important predictor of discounting behavior. When high chronic stress occurs, such as traumatic stress, the amygdala's circuitry reacts by promoting defensive responding,[19]and there is increasing monoaninergic release that engages low affinity NA alpha1, dopaminergic (DA1), and serotonergic (5-HT2A) receptors, thereby interfereing with working memory.[20] Working memory acts as a temporary store for mental representations that are relevant to any decision or task that is currently taking place. It also sustains relevant information that can be retrieved from other areas of the brain during active processing. Several studies show a relationship between working memory and a measure of discounting.[21]

A behavioral economic framework called the Competing Neurobehavioral Decision System[22] is now being increasingly used to explain health-behavior decisions. These decisions are thought to be influenced by an impulsive decision-making system that leads individuals to choose immediate reinforcements, i.e., they "discount," and an executive decision system (i.e. working memory and other relevant areas of the brain) that leads individuals to inhibit impulses in favor of long-term rewards, i.e., they delay gratification.[22] Trauma-exposed patients' existing chronic stress and impaired cognitive functioning weakens these systems, causing them to discount (select smaller, short-term rewards over larger, long-term rewards).[23-25] This novel framework could have broad implications for how the medical community deals with trauma-exposed patients. Researchers affiliated with the SLUCare Physician Group, ARCHNet and SLU have already begun much of this important research.[23-29]

Also, important translational work prompted by researchers at Virginia Tech's Addiction Recovery Research Center has resulted in a number of interventions that can be used in primary care settings.[22] These interventions include modified behavioral economic approaches to motivational interviewing and mindful attention, choice bundling/bracketing (patient asked to make a series of decisions rather than one discrete decision), episodic future thinking (projecting self into plausible future scenarios), working memory training, contingency management and contracting, which seek to alter how people structure choices.[30]

One such intervention, episodic future thinking, has shown to be the most effective in reducing discounting in laboratory research.[31] Because sessions of episodic future thinking are very brief, they have great potential for primary care because they involve prompting individuals to develop goals and generate

positive cues about the future over pre-determined periods of time, which can be used by primary care providers and care teams to revisit during check-ups. In addition, episodic future thinking interventions also aid what can become negative thinking about the future, which is common among trauma-exposed patients.[32] Like NET, which was introduced in the previous section, episodic future thinking interventions also are used to improve patients' ability to establish narratives – and these narratives help with coping and behaviors that require decisions between short and long term rewards. This has led to the development of a research protocol to test an episodic future thinking intervention at SLUCare. This intervention would essentially focus on whether episodic future thinking reduces not just discounting, but also chronic disease outcomes (in this case chronic disease outcomes related to diabetes).[33]

University-Community Partnership To Address Trauma-Related Cognitive-Communicative Decline

Traumatic Brain Injuries (TBIs) are prevalent in older African Americans of low socio-economic status, most commonly caused by falls.[34] The presence of a TBI increases risk for dementia.[35-37] Given the overwhelming evidence that minority elders experience greater risk but inadequate and frequently delayed detection of dementia, this group experiences increased numbers of preventable hospitalizations, and higher healthcare cost burden.[38,39] Therefore, culturally competent strategies are necessary for reducing health disparities that systematically and disproportionately affect underserved elderly African Americans with signs and symptoms of cognitive-communicative decline. The following paragraphs describe one such strategy.

In 2017, the SLU School of Medicine's Geriatric Workforce Enhancement Program partnered with CareSTL Health and Northside Youth and Senior Service Center, Inc., two community health centers serving minority and economically disadvantaged residents of North St. Louis, to establish the Senior Social Group For Brain Health As We Age. The NCfN provided substantial support for the group, which was operational until the onset of the COVID-19 pandemic. As indicated by the group name, sessions focused upon aging brain health issues, including trauma-related topics such as prevention and management of TBIs. The group of 10 to 12 community-dwelling African American elders was led by a cognitive neuroscientist from SLU with clinical credentials in speech-language pathology (WP), in collaboration with the medical, nursing, and behavioral health staff of CareSTL Health and Northside.

Weekly gatherings were conducted in the North St. Louis neighborhood of The Ville, on the hallowed grounds of the former Homer G. Phillips Hospital (HGPH). Opened in 1937, HGPH welcomed African American patients and was the premiere medical training center for African American healthcare professionals before its forcible closing in 1979.[40] Later. CareSTL Health transformed a corner of the HGPH building complex into a day health center; group participants gathered at this historic site for weekly sessions. As a familiar and cherished symbol of this African American community's response to racial health disparities, it was conducive to candid conversations about health that inspired participants' revelations of personal experiences of trauma.

Culturally responsive activities were led with input and approval from participants and community health center staff to sensitively address the subject of TBIs resulting from falls, vehicular accidents, gun-shot wounds and domestic violence, among other causes experienced by group participants.[40-42] Their learning of trauma-related concepts was promoted by introducing functional phrases and terms such as "chronic traumatic encephalopathy" (and the acronym "CTE"), "cognitive reserve" and "concussion" in guided group discussions based on collective readings of lay-friendly materials by the National Institute on Aging, the Alzheimer's Association and the Centers for Disease Control and Prevention, among other authoritative sources. These take-home materials in the forms of handouts, brochures and booklets were distributed to participants as accessible and appealing external memory aids that could be shared with family and professional caregivers.

Because falls are a leading cause of trauma-related hospitalizations among the elderly and are especially common among low-income African American elders, we dedicated multiple sessions to falls prevention (i.e., http://www.cdc/gov/homeandrecreationalsafety/falls). Participants' learning about dementia risk associated with TBI from falls and other causes was assessed and consolidated through group games which tested pre-training knowledge, such as Brain Health Jeopardy, Brain Health Trivia Tournament, and word-

search contests. Participants reported that their newly acquired actionable knowledge about trauma enhanced their interactions with health professionals, family caregivers and peers, and contributed to their sense of control over their health and quality of life as they age.

Conclusion

The commitment to improving the lives of individuals by translating groundbreaking bench science to novel approaches to health care is paramount as the NCFN continues to gain prominence in academia and academic medicine as a leading Center of Excellence. The three examples of trauma care in community clinical settings described in this article represent how members of the NCfN are fulfilling this imperative and working to improve care across the continuum using a neuroscience-informed approach.

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Disclosure

None reported.

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