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Mini-Review

Neuropsychologist's Role in Treatment of Traumatic Brain Injury – The 4 Cs-Caring, Compassion, and Continuity of Care

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Abstract

Neuropsychologist typically evaluate and treat people with traumatic brain injury (TBI), often as a first point of contact with a person outside the hospital, their primary care provider, and/or neurologist, who is a specialist in the brain and behavior, and will spend considerable time evaluating them (typically 8-12 hrs) and if warranted and appropriate, treating them. In this role, we need to be mindful that TBI can have lifelong consequences. As such, our diagnoses, findings and recommendations, serve to set the path of the individual on their course and trajectory. Traumatic brain injury is a significant global health issue with long-term consequences, including increased risk of neurodegenerative diseases.TBI affects nearly 70 million people annually worldwide and has a substantial impact on public health, with 22% of people in the United States experiencing at least one TBI with loss of consciousness in their lifetime. Traumatic brain injury involves primary injury from mechanical tissue deformation and secondary injury from chronic pathologic processes, such as ischemia, metabolic dysfunction, and neuroinflammation. Individuals with a history of TBI have an increased risk of developing dementia and other neurodegenerative diseases, such as Parkinson's and Alzheimer's disease.TBI leads to increased oxidative stress, protein aggregation, and chronic inflammation, contributing to the progression of neurodegenerative diseases. Some of the progression of these diseases can be forestalled by interventions by the neuropsychologist or their recommendations. We also have the capacity to serve as a partial gatekeeper, or buffer of who our patients get referred to, and what they get out of it. It is well known that people with TBI have experience reduced cognitive functioning that ranges in duration and severity. Cognitive rehabilitation interventions target problems in attention, memory, and executive function, which when not addressed, can interfere with the effectiveness of mental health services. Further, people with TBI have deficits in insight regarding evaluation of self and others, which can lead to disruption in daily functioning, poor ability to anticipate consequences, and other difficulties in daily functioning, such as pain management. As insight is gained into these deficits, reversals in behaviors can occur, as individuals with TBI begin to see the true challenges and consequences of the TBI now and into the future. Their neuropsychologist should be prepared and ready to deal with the non-linear process of recovery in TBI. Several evidence-based treatments have proven effective for individuals with TBI. These include cognitive-behavioral therapy for depression and hopelessness, mindfulness-based cognitive therapy, acceptance and commitment therapy, and emotion-regulation interventions. Providers must consider the unique interplay between neurological and psychological factors in TBI to optimize care and improve outcomes.

Introduction

Traumatic brain injury (TBI) is a unique disorder, that is associated with physical, cognitive, and emotional symptomatology. At its core, TBI is most problematic because an individual can go in a moment from having one life experience and in a matter of minutes that situation and that person can be completely changed. How the individual experiences that change depends upon several factors. These include but are not

limited to: the magnitude of the injury, the immediacy and quality of the care they receive, the social and financial supports available to them, and pre-existing health factors. In general, a person who is healthy, has good social supports, and has responded well or has been resilient to setbacks prior to a TBI, and gets good medical care in a timely fashion Is more likely to have a good prognosis than is the individual who has a TBI subsequent to being a fall risk from another condition. Traumatic brain injury is a public health issue with various long-term consequences, including an increased risk of neurodegenerative diseases.[1] TBI affects nearly 70 million people annually worldwide,[2] with 22% of the U.S. population having experienced at least one TBI with loss of consciousness, leading to significant disability and economic costs.[3] Traumatic brain injury can result from various causes, including direct contact injuries, acceleration/deceleration injuries, and blast-wave injuries. These injuries lead to primary damage, such as tissue deformation, and secondary damage, including ischemia, metabolic dysfunction, and neuroinflammation, which can ultimately cause chronic neurodegeneration.[1] Over the long term, TBI results in chronic and progressive axonal demyelination and degeneration, leading to neuronal loss and varying degrees of neuropsychiatric impairment.[4,5]

Various studies and meta-analyses found odds ratios ranging from 1.25–1.63, indicating that individuals with a history of TBI have a significantly increased risk of developing dementia.[6,7] Indeed, it is estimated that TBI accounts for 5–15% of the attributable risk for dementia.[8] Specifically, TBI is associated with amyotrophic lateral sclerosis (ALS), frontotemporaldementia (FTD), Parkinson's disease (PD), and Alzheimer's disease (AD). Among these, ALS and FTD are the least well established as being linked to TBI, while the evidence linking TBI to PD and AD is quite strong. While TBI accelerates cognitive decline by about three years in individuals with all forms of dementia, the exact cause of this effect remains undetermined.[9] It is increasingly recognized that TBI and other neurodegenerative diseases share many pathological mechanisms, with several forms of chronic neurodegeneration exhibiting mixed and overlapping pathologies.[10]

Despite the human brain accounting for only 2% of total body weight, it consumes more than 20% of the body's oxygen.[11] This high metabolic rate generates significant levels of reactive oxygen species (ROS), making the brain particularly vulnerable to oxidative damage due to its high polyunsaturated fatty acid content and relatively poor oxidative stress response mechanisms. These factors collectively lead to various toxic events in key cellular processes. Omega-3 supplements and a diet high in other polyunsaturated fats can be important for TBI recovery.[12–15] In the brain, oxidative stress has also been linked to dysregulated iron homeostasis. Both TBI and aging-related neurodegenerative diseases induce changes in iron metabolism that increase iron deposition and elevate oxidative damage in the brain. Ferroptosis, an iron-mediated form of cell death, has also been observed in TBI1, and counteracting ferroptosis mitigates TBI symptoms.[16–18] In humans, TBI also exhausts the antioxidant reserve over the course of 7 days, as evidenced by reduced ascorbate (Vitamin C) and GSH. Overall, it is well-accepted that TBI increases ROS production and depletes antioxidant defense systems in the brain, leading to protein, lipid, and DNA damage that collectively impair neuronal function and eventually lead to neurodegeneration.[19] Thus, TBI-induced oxidative stress represents a link to increased risk of developing all forms of aging-related neurodegenerative disease. This underscores the need for a diet high in antioxidants and including Omega-3, vitamin C, and iron supplements.

All neurodegenerative diseases share the common pathological hallmark of abnormal protein aggregation. There is evidence that TBI disrupts key proteostatic processes, including the heat shock response, the unfolded protein response, the ubiquitin-proteasome system, and autophagy. Overall, there is substantial evidence for widespread dysregulation of proteostasis after TBI.[21–23] Given the commonality of impaired proteostasis across all forms of neurodegeneration, this is considered a general mechanistic link between TBI and aging-related neurodegenerative diseases.[24] One common factor in TBI is sudden decrements in hypothalamic-pituitary-adrenal-gonadal axis function. Many of these hormones bind to heat shock proteins and may enable their stability. This may be a reason to consider bioidentical hormone replacement or the use of therapies that increase neurosteroids and alleviate symptoms.[25]

Neuroinflammation is another prominent component

of aging-related neurodegenerative diseases.[26–28] Typically, this process is indicated by reactive morphology of astrocytes and microglia, which secrete inflammatory mediators into the brain parenchyma.[29] Acutely after TBI, the immune response is crucial for clearing debris. However, chronic inflammation, which is seen years after injury in patients, can perpetuate injury and contribute to aging-related neurodegenerative diseases.[30] Recently, TBI has also been linked to the development of a senescence-associated phenotype (SASP)-derived inflammation in the brain, which is a chronic low-grade inflammation previously established to contribute to brain aging.[31–32] In 2016, the popular press reported on research recommending that individuals with TBI should be placed on an anti-inflammatory medication, montelukast, as well as an allergy medication, such as cetirizine.[33] The only problem with this cocktail is that Montelukast is contraindicated among individuals with suicidal ideation, which is not uncommon among individuals with TBI. It is necessary to carefully screen individuals for suicidal ideation prior to being placed upon this regimen. The uptick in suicidal symptoms typically manifestwithin 24 to 48 hours.

Traumatic brain injury triggers multiple pathological processes that elevate the risk of neurodegenerative diseases. These processes include oxidative stress, disrupted protein homeostasis, and both acute and chronic neuroinflammation. These mechanisms are common to varying degrees across all forms of neurodegenerative diseases. Further research is needed to determine if targeting these common pathological changes therapeutically after TBI can reduce the increased risk of aging-related neurodegenerative diseases. This research could significantly advance our understanding of the problem and point towards potential neuroprotective therapies. The National Institutes of Health's 2022 triennial Alzheimer's Disease and Related Dementias (ADRD) Summit highlighted the importance of addressing TBI in the national research agenda.[34] As neuropsychologists, there are several steps we can take to assist and mitigate the effects of TBI. Firstly, recommending supplements and other interventions to alleviate patient symptoms can be beneficial. Secondly, for individuals with a history of TBI, using biomarkers such as S100B, which can be counteracted with supplements, can help determine the extent of their injury and manage it effectively.[35] Lastly, it is crucial to closely monitor and manage persons with TBI and ensure they are not lost to follow-up. This can be common in persons with TBI, particularly if they do not have a good support network. They often require reminders of their appointments. They need to be reinforced about tools that were introduced to them and material that was covered. What they do not need is to be patronized, doubted in their assertions, or believed to be exaggerating. In other words, if you have not had a brain injury, seen thousands of patients with them, and/or know various approaches that may be suitable to an individual, as you have come to know them, you might seem like that a really scary provider they have seen in the past, who was wearing a white coat, and they felt was dismissive of them.[36] All people, but particularly those with TBI, need an approach of caring, compassion, and continuity of care,that not only meets them where they are at but also looks at the short-term and long-term trajectories of this disorder and what they can handle today, this week, this month, this quartile, this year, next year, and the years after.

Some of the progression of TBI can be forestalled by early intervention directed by the neuropsychologist or their recommendations. We also have the capacity to serve as a partial gatekeeper, or buffers of who our patients get referred to, and what they get out of it. It is well known that people with TBI have reduced cognitive functioning that ranges in duration and severity. Cognitive rehabilitation interventions target problems in attention, memory, and executive function, which when not addressed,can interfere with the effectiveness of mental health services.[37] Further, people with TBI have deficits in insight regarding evaluation of self and others, which can lead to disruption in daily functioning, poor ability to anticipate consequences, and other difficulties in daily functioning. As insight is gained into these deficits, reversals in behaviors can occur, as individuals become more cognizant. Hence, it is necessary to have an adept, caring, consistent and responsive provider, who follows evidence-based practice, and meets the clientele where they are at consistently.

Individuals with TBI frequently experience psychiatric disorders at higher rates than the general population. Common conditions include mood disorders (such as major depressive disorder, dysthymia, and

bipolar disorder), anxiety disorders (including PTSD, generalized anxiety, OCD, panic disorder, and phobias), psychotic disorders, and substance use disorders. Personality changes, such as apathy, emotional instability, aggression, and behavioral disinhibition, are also prevalent, along with suicidality and socially inappropriate behavior. Children and adolescents with TBI face similar challenges, often presenting with depression, anxiety, ADHD, PTSD, conduct disorders, and personality changes like aggression and affective instability.

Diagnosing psychiatric disorders in individuals with TBI can be complex, as cognitive deficits, such as memory and attention impairments, may hinder accurate reporting. Additionally, symptoms of TBI, such as emotional lability or behavioral dysregulation, often resemble other conditions like bipolar disorder, leading to frequent misdiagnoses. Accurate assessment requires integrating information about the TBI with psychiatric evaluations to ensure effective treatment and avoid inappropriate care. Psychiatric symptoms in TBI may stem from neurological damage, such as lesions, neurochemical disruptions, or cerebrovascular changes, or from psychogenic factors, including emotional responses to losses of autonomy, employment, or social connections. Effective treatment should address both neurological and psychological causes, as focusing solely on one aspect may limit treatment efficacy. Comprehensive diagnostic evaluations for TBI involve in-depth interviews, corroborative input from caregivers, and cognitive screenings (e.g., MoCA, MMSE). Standard mental health measures, such as the BDI-II and SCAT-5, can be helpful but must be used with an understanding of their limitations in TBI populations. Neuropsychological assessments may also be necessary to better understand the cognitive challenges that impact psychological functioning.

Mental health interventions for TBI should accommodate challenges such as memory deficits, impaired focus, emotional dysregulation, and physical fatigue. Strategies include shorter sessions, providing reminders and structured formats, summarizing session content, and encouraging journaling. Emotional regulation and mindfulness techniques are effective for managing stress and cognitive overwhelm. Several evidence-based treatments have proven effective for individuals with TBI. These include cognitive-behavioral therapy (CBT) for depression and hopelessness[38–40] mindfulness-based cognitive therapy,[41] acceptance and commitment therapy,[42] and emotion-regulation interventions.[43] Providers must consider the unique interplay between neurological and psychological factors in TBI to optimize care and improve outcomes.

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Conflicts of interest

Author declares that there is no conflict of interest.

Quotes from patients

"As a TBI survivor I have lived with anxiety and fear of social interaction due to how I was treated by doctors. These people that I speak of make the decisions that affect me for my entire life. They will affect me till I die and how doctors treat me for the rest of my life. It will leave me running away from doctors and suffering in silence. There is no depth to the endless suffering; I have faced due to TBI and PTSD from people handling my case. Even all these years later, I still am forced to deal with how badly I was treated by the so-called professional people that handled my case and my lack of care."

"I have spent my life in hiding due to doctors, calling me crazy instead of being sympathetic, understanding and helpful with my traumatic brain injury. I don't even dare try to open a discussion about traumatic brain injury to a doctor or someone because of the stigma of crazy. This has left me with a very, Lonely, Barron life. The medical system, the workers comp system, and everything else that someone with TBI has to deal with is broken. It is so broken. I'm ashamed of what has happened to me because I wasn't capable of stopping it. I wasn't capable of stopping the doctors in the cruelty and the white-collar people's cruelty. I have said so much, and yet so little. Does anybody ever think about how much money somebody with TBI is left to live on? Poverty level. In one of the law books, it said the people on workers comp were supposed

to get a cost-of-living increase, etc. somehow all the lawyers more white-collar people forgot it. What does that say about the system that I have had to deal with all my life?"

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