



Brain Injury and Addiction: A Cognitive Rehabilitation Approach

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Learning Objectives

- Understand the various ways brain injury can occur as a result of addiction
- Identify the cognitive issues that can occur as a result of addiction
- Identify 3 cognitive rehabilitation approaches or strategies to use in the treatment of brain injury and addiction

Brain Injury Overview

- Acquired Brain Injury (ABI) vs. Traumatic Brain Injury (TBI)
 - ABI – occurs to the brain after birth; not congenital, hereditary, trauma from birth, or degenerative
 - TBI – insult to the brain as a result of an external force
- ABI causes: hypoxic, anoxic, stroke, infection, tumor, encephalopathy, disease, drugs, and alcohol
- TBI causes: falls, MVA, assaults, struck by/struck against
- Severity index: mild, moderate, severe

Brain Injury Overview

- Parts of the brain and functions:
 - Frontal Lobes – executive functions (attention, thought flexibility, etc.)
 - Temporal Lobes – memory, sequencing, language
 - Cerebellum – balance, coordination
 - Brain stem – arousal, breathing, heart rate
 - Thalamus – relay center for sensory information
 - Hypothalamus – body temperature, hormone regulation
 - Hippocampus – memory
 - Amygdala – fight or flight, emotions

Substance Use Disorder (SUD)

- Consists of cognitive, behavioral, and physiological symptoms
- Changes in the neural pathways that may persist beyond detoxification
- Diagnosis based on compulsive patterns of behaviors related use
 - Impaired control over use; social impairment; risky use; pharmacological criteria
- Different SUD categories (alcohol, cannabis, opioid, etc.)
- Severity and specifiers – mild, moderate, severe; “in early remission, in sustained remission”, etc.



Alcohol Use Disorder

1. Alcohol taken in larger amounts or over a longer period than planned
2. Persistent desire or unsuccessful attempts to cut down/control use
3. A great deal of time is spent in activities necessary to obtain/use
4. Craving, strong desire, or urge to use
5. Repeated use impacts one's ability to fulfill obligations
6. Continued use despite adverse consequences
7. Important activities are given up or reduced because of use
8. Recurrent use in situations where it is dangerous
9. Continued use even when it is known that alcohol is causing problems
10. Tolerance
11. Withdrawal



Opioid Use Disorder

1. Opioids are taken in larger amounts or over a longer period than planned
2. Persistent desire or unsuccessful attempts to cut down/control use
3. A great deal of time is spent in activities necessary to obtain/use
4. Craving, strong desire, or urge to use opioids
5. Repeated use impacts one's ability to fulfill obligations
6. Continued use despite adverse consequences
7. Important activities are given up or reduced because of use
8. Recurrent use in situations where it is dangerous
9. Continued use even when it is known that opioid use is causing problems
10. Tolerance
11. Withdrawal

Cannabis Use Disorder

1. Cannabis is taken in larger amounts or over a longer period than planned
2. Persistent desire or unsuccessful attempts to cut down/control use
3. A great deal of time is spent in activities necessary to obtain/use
4. Craving, strong desire, or urge to use cannabis
5. Repeated use impacts one's ability to fulfill obligations
6. Continued use despite adverse consequences
7. Important activities are given up or reduced because of use
8. Recurrent use in situations where it is dangerous
9. Continued use even when it is known that cannabis is causing problems
10. Tolerance
11. Withdrawal

Use, Abuse, Addiction

- Use – any substance consumption; having a beer socially; “I like it”
- Abuse – using substances inappropriately before changes in the brain take place; often causes some problems (DUI, trouble with work, etc.); “I love it”
- Addiction – when changes take place in the brain and individuals have compulsions to use; stopping use is very difficult; withdrawal symptoms; “I need it”
- Dependence – different than addiction; dependence can happen when medications are used appropriately; withdrawal symptoms



What Happens to the Brain

- Much like brain injuries cause changes in the brain, with prolonged use so can substance use disorders
- This can occur in different ways
 - Volume loss
 - Negatively impacting nutrients needed by the brain
 - Altering the reward pathway in the brain
 - Changing neurotransmitters/brain chemicals
 - Depriving oxygen to the brain
 - Damaging brain tissue and killing brain cells
 - Deterioration of health impacting brain damage
- Certain areas of the brain are at a higher risk for brain damage

How Drugs and Alcohol Work on the Brain

- Factors that impact drugs getting to the brain
 - How drugs enter the body
 - Drug distribution to the blood stream; blood-brain barrier
 - Rate of metabolism – body processing, using, and inactivating the substance
 - Affected by age, race, heredity, gender, health, emotional state, etc.
 - Elimination rate – body eliminating the substance and metabolites
- Peripheral Nervous System (PNS) & Central Nervous system (CNS) – primary target of psychoactive drugs is the CNS

The Reward Pathway

- Officially called the Mesolimbic Dopaminergic Reward pathway; also known as the survival/reinforcement circuit; reward pathway; pleasure pathway
- Area of the brain that encourages beings to perform or repeat actions that promote survival (eating, drinking, etc.)
- The region of the brain most affected by psychoactive drugs
- Located in the CNS in the “old brain”
- Acts as a “go” or “more” switch
- There is a control circuit that acts as a “stop” switch; located primarily in the “new brain” and driven by the prefrontal cortex

The Reward Pathway

- When activated, the “go” switch sends 3 messages
 - Tells us what we are doing is necessary for survival
 - Tells us to remember what we did to survive
 - Tells us to **do more** of what we did to survive
- When the need is met, the “stop” switch sends chemical messages to shut down the “go” switch
- When a psychoactive drug enters this pathway, it activates the “go switch”
- With addiction, the “stop” switch breaks and the “do more of that” message takes over in the brain

The Reward Pathway

- When substance abuse progresses to addiction, these changes take place in the reward pathway and other areas of the brain that impact learning, emotion, and executive functioning
- Some brain structures impacted are: ventral tegmental area, nucleus accumbens, medial forebrain bundle, septum, amygdala, anterior cingulate cortex, dorsal striatum, hippocampus, prefrontal cortex, and portions of the thalamus and hypothalamus
- When the reward pathway takes over, the prefrontal cortex (which houses the frontal lobes) is cut out of the picture

The Reward Pathway

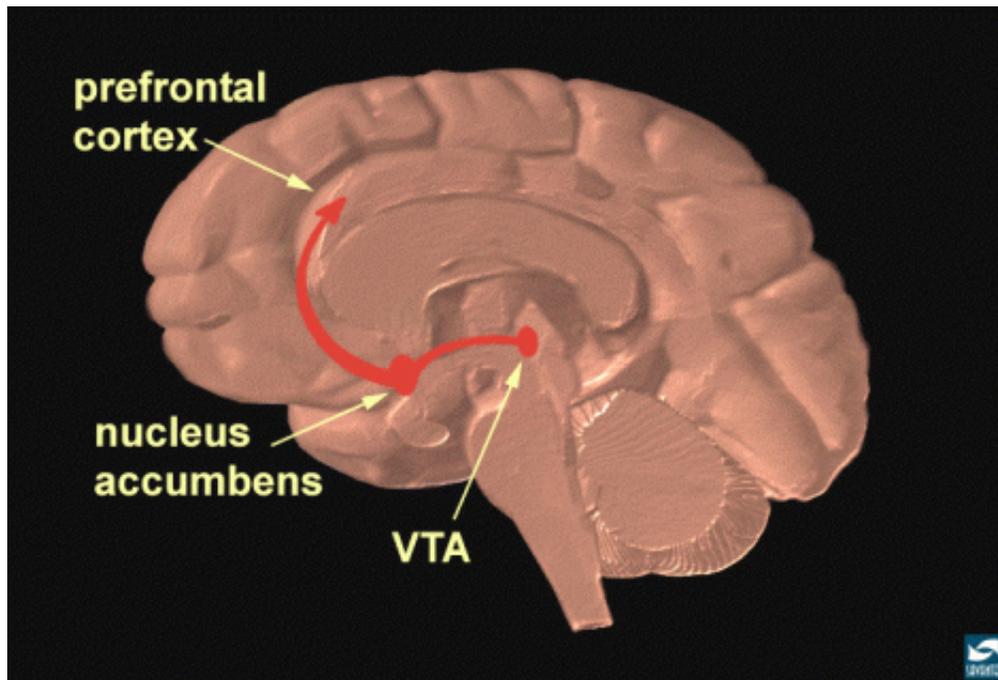


Image from www.drugabuse.gov

Statistics

- According to NIDA, 21-29% of individuals prescribed opioids for chronic pain misuse them, and 8-12% develop an opioid use disorder
- According to the CDC, on average, 130 Americans die daily from drug overdose
- 70,237 drug overdose deaths occurred in the United States in 2017
- Opioids were involved in 47,600 overdose deaths in 2017 (67.8% of all drug overdose deaths)
- From July 2016-September 2017 there were a total of 119,198 emergency room visits for suspected opioid overdose
- In 2017, Pennsylvania was the state with the 3rd highest rate of death due to overdose

Statistics

- Prevalence rates vary
- 37-66% of individuals with a history of preinjury alcohol abuse/addiction later sustain a TBI
- 45% of individuals hospitalized for brain injury are legally intoxicated at the time of injury
- 20% of individuals without a previous substance use disorder were more likely to use drugs or alcohol after their brain injury
- 38-63% of individuals in substance abuse treatment have at least one brain injury
- 67% of people in brain injury rehabilitation have a previous history of substance abuse
- 50% of individuals who have a pre-injury history of substance use disorder will return to using drugs/alcohol after their brain injury



Impact on the Brain and Functioning

- Alcohol/drugs lower seizure threshold and may trigger seizures
- Alcohol/drugs slow down/stop brain injury recovery
- Alcohol/drugs can impact balance, putting individuals at increased risk for falls and additional brain injuries
- Alcohol/drugs can negatively impact mood and behavior
- Alcohol/drugs can impact prescribed medications (dangerous/lethal risks, increase/decrease effectiveness, etc.)
- Alcohol/drugs can increase cognitive deficits
- Damage from alcohol/drug use itself (changes to the brain, loss in volume, Wernicke-Korsakoff Syndrome, etc.)



Addiction and Brain Injury

- Scenario 1. An individual sustains a brain injury then later develops an addiction
- A brain injury can cause someone to be vulnerable to developing a SUD post-injury due to damage caused in the brain, isolation, coping, mental health diagnoses, use of prescribed narcotics, etc.
- Example: Someone with a TBI drinks alcohol in excess to manage feelings of sadness and loneliness after their injury and later develops an alcohol use disorder
- Implications: drug and alcohol concerns may be overlooked while focusing on brain injury recovery

Addiction and Brain Injury

- Scenario 2a. An individual has an addiction and then sustains a brain injury that is diagnosed
- Individuals with SUD are more at risk for sustaining a TBI
- Use of alcohol at time of injury is associated with a more severe brain injury
- Example 1: An individual with a history of drug and alcohol addiction is in a car accident while intoxicated and sustains a brain injury
- Example 2: An individual with a heroin addiction overdoses and sustains an ABI due to hypoxia or anoxia
- Implications: long-term drug and alcohol use may cause changes in the brain that are now compounded by a brain injury; normal SUD treatment centers may not understand brain injury

Addiction and Brain Injury

- Scenario 2b. An individual has an addiction and then sustains a brain injury that is not diagnosed
- Alcohol/drug use may hide the initial symptoms of a brain injury, making it difficult to recognize that one occurred
- Example: An individual loses their balance and falls while intoxicated, hitting their head. They were already disoriented due to the alcohol. Two days later some symptoms still persist, but they never seeks treatment. No diagnosis is listed in medical records and no treatment is received
- Implications: questions regarding brain injury are often not screened for when entering SUD treatment; individual may have difficulties related to the brain injury that are perceived as resistance

Addiction and Brain Injury

How brain injury impacts addiction recovery

- Individuals with brain injuries have unique cognitive, physical, emotional, behavioral, and/or social needs that can influence recovery
- Implications for treatment: difficulty remembering feedback, trouble paying attention in session, processing delays impacting ability to receive feedback, difficulty planning activities to support recovery, difficulty accessing supports/resources, difficulty with initiation and follow through, increased difficulty with impulsivity, etc.
- May be labeled as “resistant”

Addiction and Brain Injury

How substance use disorder impacts brain injury recovery

- If needing to choose between two treatment programs, may need to treat the brain injury first (medical stability needs, competing program schedules, etc.)
- Individuals may be preoccupied with thoughts/cravings
- Compounding effects of brain changes from addiction and now brain changes as a result of injury
- Relapses may impact treatment in brain injury programs and progress on brain injury goals
- Substance use slowing down brain injury recovery



Addiction and Brain Injury

- Scenario 3. Addiction as a Brain Injury
- Example 1: An individual who has reached the level of addiction, now has a change to the reward pathway of their brain and frontal lobes
- Example 2: An individual who has chronically used drugs and alcohol used these substances to the point that there is damage to brain cells and the brain

Addiction as a Brain Injury

- An individual with an addiction has impaired abilities to stop using due to deficits in the prefrontal cortex (frontal lobes) and other areas
- “Stop” switch is not working
- When deprived of the substance, the brain reacts to stress differently, and often negatively
- Learned environmental triggers elicit a response
- Alcohol and drugs can cause direct damage to the brain/brain cells (ex: Wernicke-Korsakoff Syndrome)

Addiction as a Brain Injury

What the research says

- Topiwala, et al. found that hippocampus shrinkage was related to the amount people drank
- Ersche, et al. found evidence that chronic drug users experienced significant cognitive impairments (executive function, memory) that persisted several years after stopping use
- Darke, et al. identified that individuals in the opioid maintenance group demonstrated a poorer performance to other groups in executive functioning, information processing speed, and verbal and nonverbal learning

Addiction as a Brain Injury

What the research says

- Tolomeo, et al. identified that methadone maintenance treatment was connected to increased impulsivity and structural brain abnormalities
- McDonald, et al. found that individuals in the opioid maintenance group had trouble recognizing emotions in others and understanding inferences in conversation/social situations
- Tolomeo, et al. found the formerly opioid dependent/currently abstinent and current opioid dependent/daily heroin users had reductions in white matter of the brain



Addiction as a Brain Injury

What the research says

- Arias, et al. found that opioid dependence was associated with global and domain-specific neurocognitive impairments (learning and memory); long-term alcohol and cocaine dependence was associated with neurocognitive impairment (executive functioning)
- Terrett, et al. found that prospective memory is disrupted in chronic opiate users

Deficits Associated with Brain Injury and Addiction

Deficit	Brain Injury	Substance Use, Abuse, Addiction
Memory	x	x
Judgment	x	x
Reasoning	x	x
Impulsivity	x	x
Attention	x	x
Emotional regulation	x	x
Balance/coordination	x	x
Decision making	x	x
Processing	x	x



Treatment Considerations

- Better screening for brain injury and addictions at all treatment providers
- Taking a team approach
- Various levels – continuum of care
- Time considerations (length of treatment; length of sessions)
- Increased training for providers
- Using an integrative, whole-person approach (health/wellness, quality of life, mindfulness, cognition, etc.)
- Do not isolate the individual or label them as resistant
- Individualize treatment and modify/specialize groups (when possible)
- Specialized programming for individuals with BI and addictions
- Alternative pain management techniques
- Include Cognitive Rehabilitation Therapy



Cognitive Rehabilitation Therapy

- “Relearning cognitive skills that have been lost or altered as a result of damage to brain cells/chemistry” The Society for Cognitive Rehabilitation, 2013
- If prolonged substance use and addictions impact cognitive functions, cognitive rehab can help by working on relearning cognitive skill areas and promoting neuroplasticity
- Can improve outcomes – if cognitive issues that impact addiction recovery can be addressed, individuals may have more success in addiction recovery

Cognitive Rehabilitation Therapy Included with Addiction Treatment

- Include education routinely in individual and group sessions
- Help connect implications of the brain injury to addiction recovery
 - How cognitive deficits (memory, attention, processing) impact recovery
 - Cue and provide feedback during sessions
 - Educate on compensatory strategies
 - Address areas happening inside and outside of sessions
 - How psychosocial changes impact recovery
 - Review interpersonal communication skills
 - Ensure mental health diagnoses are addressed (depression, anxiety, adjustment)
 - Increase quality of life activities
 - How physiological changes impact recovery
 - Pain – does pain need to be managed by opiates? Are there safer, more effective options?
 - Mobility and access

Cognitive Rehabilitation Therapy Included with Addiction Treatment

- Assist with developing and implementing strategies
 - Weekly schedules to plan out activities to support recovery
 - Alarms to assist with follow through/reminders
 - Memory logs during sessions
 - Checklists
 - Mindfulness exercises
 - Planning out scripts for conversations
 - Practice stop/think strategies
 - Thought flexibility strategies
 - Decision making trees and problem solving skills
- Practice strategies during sessions

Cognitive Rehabilitation Therapy Included with Addiction Treatment

- Use worksheets and develop material personalized to needs
- Tailor approach to individual strengths/deficits, personal goals, and learning styles – visuals, modify materials
- Clearly identify and list with the individual who their supports are and how/when they can help
- Allowing extra time for processing and to reduce cognitive/sensory overload
- Structure and routine
- Repetition
- Assign homework and review homework
- Work on emotional recognition, emotional regulation, and coping skills
- List triggers and how to manage triggers – role play during sessions
- Introduce positive activities and experiences

Treating Addiction as a Brain Injury

- Whole-person, integrative approach
 - Mind, body, spirit connection
- Aim to re-introduce the “stop” switch and break the unregulated reward cycle; address deficits in the frontal lobes and other areas of the brain
 - Work the brain – including “drill and practice” activities to retrain the brain and promote neuroplasticity (worksheets, “cognitive playground”, “brain games”)
 - Introduce strategies – stop/think, planners, mantras and mnemonics, alarms, etc.
 - Practice – use the strategies and skills developed – help connect how these can be used at home and in the community
 - Education – help individuals to understand addiction as a brain injury, the purpose of this approach, how it connects to the big picture, and how it can be applied



Conclusion

- Brain injury and substance use disorder can be connected to each other in various ways
- Addiction is associated with changes to different areas of the brain and this can result in functional changes for an individual
- It is important to treat both the substance use disorder and the brain injury
- Providers should address treatment from an integrative perspective that includes Cognitive Rehabilitation Therapy to support brain injury and addiction recovery



Comments & Questions?

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