BRIEF REVIEW

AN OVERVIEW OF INTERNET PORNOGRAPHY ADDICTION

Arabinda Brahma[1] & Mahuya Chattopadhyay Brahma[2]

[1]Consultant Psychiatrist, Kolkata Police Hospital
[2]Ex-M.O., Mental Health Unit, UNMC & RI, Salt Lake

ABSTRACT

Within this review, we provide an overview of the neurobiology of pornography addiction. The review focuses on the basic neurobiology of addiction and studies done on the neurobiology of the internet pornography addiction. This review also highlights the role of dopamine in pornography addiction, the role of certain brain structures as found on MRI studies and the effect of pornography addiction on higher cognitive functions. The review suggests that internet pornography addiction fits into the addiction framework and shares similar basic mechanisms with substance addiction. The review also stresses on the need of future research in this area.

Keywords : Neurobiology, Internet Pornography addiction, Pornography, Behavioral addictions, Online Sexual Behavior.

INTRODUCTION

A paradigm shift is occurring in the field of addiction especially in the context of assessment and treatment. While addiction has been associated with the problematic overconsumption of drugs and/or alcohol[1], recent research has changed the concept over the last few decades. Different neuroscientific research has revealed that various behaviors, which are repeatedly reinforcing the reward, motivation and memory circuitry are all part of the disease of addiction[2,3]. Based on neuroscientific evidences, the American Society of Addiction Medicine (ASAM) formally expanded their definition of addiction in 2011 and included both behaviors and substances:

Address for correspondence :
Arabinda Brahma
Email : drarabindabrahma04@yahoo.com

"Addiction is a primary, chronic disease of brain reward, motivation, memory and related circuitry. Dysfunction in these circuits leads to characteristic biological, psychological, social and spiritual manifestations. This is reflected in an individual pathologically pursuing reward and/or relief by substance use and other behaviors."[4]

The American Psychiatric Association (APA) also acknowledged the concept of behavioral addiction in the recent revision of the Diagnostic and Statistical Manual (DSM-5). The "Substance Related Disorders" chapter was renamed as "Substance Use and Addictive Disorders". Moreover, a "Non-Substance-Related Disorders" subchapter was created. Interestingly, a diagnosis of Internet Gaming Disorder (IGD) was placed withinSection 3 - Conditions for Further Study of the DSM-5[5].

Some authors believe that internet can deliver unending stimulation and in turn can activate the

brain reward system. So, a concept of supernormal stimuli was formulated, which may explain why users whose brains manifest addiction-related changes get caught in their pathological pursuit[6].

INTERNET PORNOGRAPHY ADDICTION

Pornography addiction is a relatively recent diagnostic term. It can be defined as patients with a propensity and tendency to view pornography images and videos frequently and regularly and experiencing distress when not allowed to do so[7]. However, it is debatable whether viewing pornography is actually an addiction or a sexual compulsivity or a subset of hypersexual behavior[8]. The DSM - 5 did not include pornography addiction as much research in this field was emergent when the classification was published[9]. Even current literature is not very clear on diagnostic criteria for the disorder though clinicians are seeing more patients with this problem over the past few years[10].

BASIC NEUROCIRCUIT OF ADDICTION

MESOLIMBIC DOPAMINE PATHWAY

All drugs of abuse affect the mesolimbic dopamine pathway, which originates from the ventral tegmental area (VTA) and projects into the nucleus accumbens (NAcc). NAcc (also known as reward center) is heavily connected with pleasure, reinforcement learning, reward seeking, and impulsivity. The mesolimbic dopamine pathway connects with three other key regions to form the reward system: The amygdala (positive and negative emotions, emotional memory), hippocampus (processing and retrieval of long term memories), and the frontal cortex (coordinates and determines behavior). On the whole, the reward system and its connecting regions modulate pleasure, reward, memory, attention, and motivation[11]. Similarly, naturally occurring behaviors viz. eating and sex, activate the reward system because of the fact that they reinforce behaviors necessary for survival[12].

MESOCORTICAL DOPAMINE PATHWAY

Another important component of the reward system is the mesocortical dopamine pathway. It starts in the VTA and terminates in the frontal cortex. Specific affected areas within the prefrontal cortex include the dorsolateral prefrontal cortex (DLPFC), responsible for key components of cognition and executive function, and the ventromedial prefrontal cortex (VMPFC) responsible for components of inhibition and emotional response. On the whole, the mesocortical dopamine pathway affects the cognitive component of reward processing[11,13].

Once the dopamine flood finishes its course, there is activation of the extended amygdala, an area associated with pain processing and fear conditioning. This leads to activation of brain stress systems and dysregulation of anti-stress systems with a decreased sensitivity to rewards and an increase in the reward threshold, which is known as tolerance[14]. Thus, there is a repetition and reinforcement of the addictive behaviors.

GENETICS

Research has identified the genetic connection between the A1 allele of the Dopamine D2 receptor gene and a susceptibility to develop alcoholism[15]. Later, it was suggested that individuals with this genetic predisposition are likely to have disruptions in the mesolimbic reward system[16]. These interruptions result in a hypodopaminergic state that yields a predisposition to addictive, compulsive, and impulsive behaviors, as well as several personality disorders. Blum and colleagues coined the term "Reward Deficiency Syndrome" to represent the inborn chemical imbalance that presents as one or more behavioral disorders[16].

MOLECULAR UNDERPINNING OF ADDICTION

A large number of research on the molecular explanation for addiction has evolved, focusing

mainly on the roles of CREB, DeltaFosB and glutamate[17-19]. The sum of this research indicates that the flooding of dopamine in the reward system triggers an increase in the production of cyclic AMP (cAMP), which then signals the release of cAMP response element-binding protein (CREB). In turn, it causes release of dynorphin, which slows the release of dopamine and inhibits the VTA, thereby dampening the reward system. This is probably the molecular basis of tolerance. This process may be involved with dependence too, as the inhibited reward system leaves the subject in an anhedonic state when abstinent from the source of problematic dopamine release. When the addict becomes abstinent, CREB levels quickly drop, tolerance fades, and sensitization begins. At this point, DeltaFosB becomes the predominant factor.

DeltaFosB is a transcription factor, which operates partially in an opposite manner to CREB, in that it suppresses dynorphin and increases sensitivity in the reward pathway. Unlike the elevated CREB levels that dissipate quickly, the elevated DeltaFosB level remain for extended periods - weeks or months. This enhances response to rewards and reward related cues, leaving the subject sensitive to addiction related cues and vulnerable to compulsive behaviors and relapse[18].

Another important component is the neurotransmitter glutamate. Various research has revealed that glutamate is intimately involved with the learning component of addiction, and the increased amount of dopamine in the mesocorticolimbic pathway leads to an increased sensitivity to glutamate. This may strengthens and fuels the learning/memory pathways related to the addiction and its surrounding behaviors[20].

DOPAMINE & NEUROPLASTIC CHANGES

Research has also revealed that if a person compulsively and chronically views Internet pornography, there will be continued release of dopamine into the reward system which stimulates neuroplastic changes that reinforce the experience[21]. These neuroplastic changes build new brain maps for sexual excitement. The already established brain maps for natural sexuality cannot compare to the newly developed and continuously reinforced maps generated by continued viewing of Internet pornography. Therefore, the addicted person progresses to more explicit and graphic Internet pornography for maintaining the higher level of excitement.

FINDINGS ON STRUCTURAL MRI

AnMRI study by Kühn & Gallinatin volving 64 healthy male subjects and correlated hours of viewing of explicit material on internet per week and years of use with dorsal striatal structure and connectivity[22]. The important findings were :

- longer duration and more hours per week of use correlated with lower grey matter volume in the right caudate.
- more years and more hours per week of use correlated with lower left putaminal activity in response to brief, still sexual images. fMRI studies confirmed that the putamen is activated during sexual arousal[23].
- subjects who consumed more pornographic material had less connectivity between the right caudate and left DLPFC. DLPFC is associated with executive functions as well as with cue reactivity to drugs and internet gaming. Disruptions in this circuit are implicated in drug and behavioral addictions.

EFFECT ON HIGHER COGNITIVE FUNCTIONS

A study using an Iowa Gambling Task modified with pornographic pictures revealed that the sexual arousal in a decision making situation can interfere with feedback processing and advantageous decision making[24]. Moreover, sexual arousal induced

by sexual images impaired working memory performance in a pictorial 4- back paradigm[25]. The findings suggest that executive functions may be affected in individuals who are addicted to watching online pornography.

CONCLUSION

This review investigated the recent scientific researches regarding neural processes of addiction in relation to both substance abuse and behavior addictions. The results support the view that the same addiction model may be applicable to the addictive Internet-related behaviors including online pornography viewing[26]. However, there is a need for further research to formulate an integrated neurobiological model of pornography addiction.

REFERENCES

1. White WL. Slaying the Dragon : The History of Addiction Treatment and Recovery in America. 1st ed. Chestnut Health Systems; Bloomington, IL, USA : 1998.
2. Karim R, Chaudhri P. Behavioral addictions: An overview. J Psychoactive Drugs 2012; 44 : 5–17.
3. Leeman RF, Potenza MN. A targeted review of the neurobiology and genetics of behavioural addictions : An emerging area of research. Can J Psychiat Rev Can Psychiat 2013; 58 : 260–273.
4. American Society of Addiction Medicine (ASAM) Public Policy Statement: Definition of Addiction. Available online : http://www.asam.org/for-the-public/definition-of-addiction
5. American Psychiatric Association (APA) Diagnostic and Statistical Manual of Mental Disorders. 5th ed. American Psychiatric Publishing; Arlington, VA, USA : 2013.
6. Hilton DL. Pornography addiction — A supranormal stimulus considered in the context of neuroplasticity. Socioaffective Neurosci Psychol 2013; 3 : 20767.
7. Ley D, Prause N, Finn P. The emperor has no clothes : A review of the 'pornography addiction' model. Current Sexual Health Reports 2014; 6(2) : 94-105.
8. Bancroft J, Vukadinovic Z. Sexual addiction, sexual compulsivity, sexual impulsivity, or what? Toward a theoretical model. J Sex Res 2004; 41(3) : 225-234.
9. Wilson G. Your brain on porn: Internet pornography and the emerging science of addiction. Richmond VA : Commonwealth Publishing : 2014.
10. Maltz W, Maltz L. The porn trap : The essential guide to overcoming problems caused by pornography. Harper Collins : 2009.
11. Volkow ND, Wang G-J, Fowler JS, et al. Addiction : Beyond dopamine reward circuitry. ProcNatlAcadSci 2011; 108 : 15037–15042.
12. Potenza MN. Non-substance addictive behaviors in the context of DSM-5. Addict Behav 2014; 39 : 1–2.
13. Koob GF, Volkow ND. Neurocircuitry of Addiction. Neuropsychopharmacol 2010; 35 : 217–238.
14. Robinson TE, Berridge KC.The psychology and neurobiology of addiction : an incentive–sensitization view. Addiction 2000; 95 (8s2) : 91-117.
15. Blum K, Noble EP, Sheridan PJ, et al. Allelic association of human dopamine D2 receptor gene in alcoholism. JAMA 1990; 263 : 2055–2060.
16. Blum K, Cull JG, Braverman ER, et al. Reward Deficiency Syndrome. Am Sci 1996; 84 : 132–145.
17. Madsen HB, Brown RM, Lawrence AJ. Neuroplasticity in addiction : Cellular and transcriptional perspectives. Front Mol Neurosci 2012; 5 : 99.
18. Nestler EJ. Transcriptional Mechanisms of Drug Addiction. Clin Psychopharmacol Neurosci 2012; 10 : 136–143.
19. Robison AJ, Nestler EJ. Transcriptional and epigenetic mechanisms of addiction. Nat Rev Neurosci 2011; 12 : 623–637.
20. Kalivas PW, O'Brien C. Drug Addiction as a Pathology of Staged Neuroplasticity. Neuropsychopharmacolo 2007; 33 : 166–180.
21. Doidge N. The Brain That Changes Itself: Stories of Personal Triumph from the Frontiers of Brain Science. Penguin Books; New York, NY, USA : 2007.
22. KühnS, Gallinat J. Brain structure and functional connectivity associated with pornography consumption : The brain on porn. JAMA Psychiat 2014; 71 : 827–834.
23. Arnow BA, Desmond JE, Banner LL, et al. Brain activation and sexual arousal in healthy, heterosexual males. Brain. 2002; 125 : 1014–1023.
24. Laier C, Pawlikowski M, Brand M. Sexual picture processing interferes with decision making under ambiguity. Arch Sex Behav 2014; 43 : 473–482.
25. Laier C, Schulte FP, Brand M. Pornographic picture processing interferes with working memory performance. J Sex Res 2013; 50 : 642–652.
26. Love T, Laier C, Brand M, et al. Neuroscience of Internet Pornography Addiction : A Review & Update. Behav Sci 2015; 5(3) : 388-433.