IRCM

MONTREAL CLINICAL RESEARCH INSTITUTE

Addiction Neuroethics: An exploration of the social and ethical issues of using stimulation based neurotechnology to treat drug addiction

Claudia Barned, PhD – Institut de Recherches Cliniques de Montréal and McGill University

OUTLINE

- Addiction & Treatment Approaches
- Neuroscience Developments
- Addiction Neuroethics
- DBS & tDCS - Ethical & Social Issues
- Conclusions & Implications

Addiction & Treatment Approaches

- Pharmacological Approaches
- Behavioural Therapy
- Neurotechnology

OUTLINE

Addiction & Treatment Approaches

Neuroscience Developments

Addiction Neuroethics

DBS & tDCS - Ethical & Social Issues

Conclusions & Implications

Neuroscience Developments

- Modern neuroscience has given rise to a range of possible treatments for addiction. Recent developments promise to improve the lived experience of those with an addiction by helping in abstinence and treatment efforts.

- Over the years we have seen a drastic development in the types of neurotechnology marketed for the treatment of addiction. DBS and tDCS have been proposed as emerging neurotechnology to treat addiction.

- Risks and benefits?
    - Potential misuse or harm that might arise in particular situations?

OUTLINE

Addiction & Treatment Approaches

Neuroscience Developments

Addiction Neuroethics

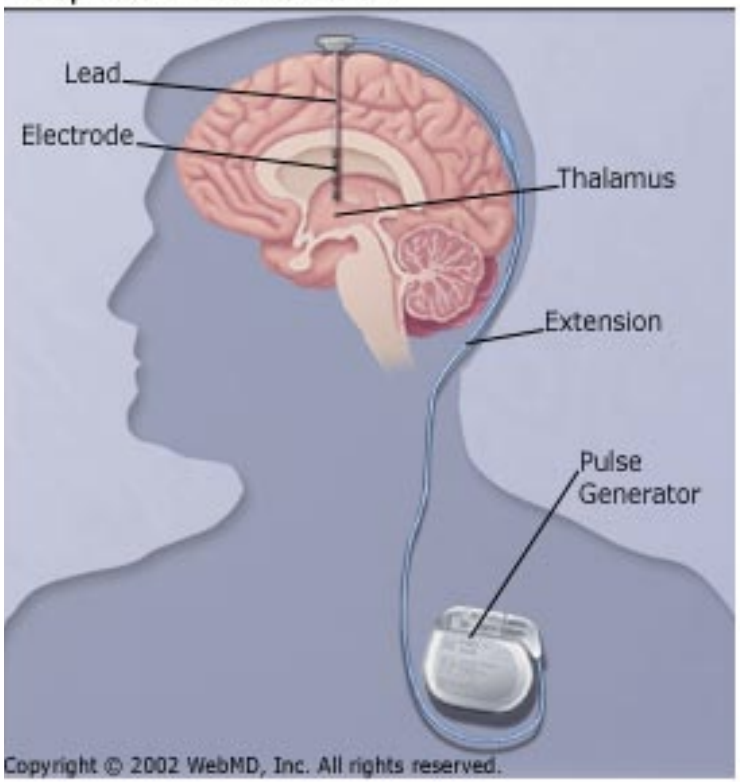
DBS & tDCS - Ethical & Social Issues

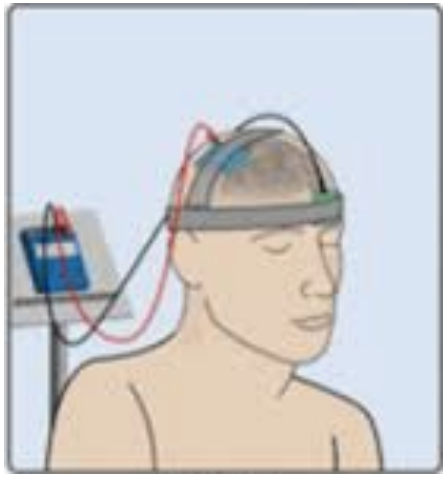
Conclusions & Implications

Addiction Neuroethics

- An emerging field that "examines the neuroethical challenges raised by neuroscience research on addiction, its potential applications in the treatment and prevention of addiction and the formulation of social policies toward drug use."

(Carter, Hall & Illes, 2012)





Transcranial direct current stimulation

Neurotechnology targeting addiction

Deep Brain Stimulation

- Neurosurgical intervention originally developed to treat intractable cases of neurological movement disorders (such as Parkinson's disease)
    - Persons with PD who have failed to respond or who no longer respond to pharmacological treatments.
    - OCD, depression and Tourette's syndrome
    - Trialed as a treatment for addiction

[Krack et al., 2010]

- Involves the insertion of microelectrodes into specific regions of the brain in order to modulate neural activity via electrical current

[Carter et al, 2009].

- The premise is that DBS resolves an electrical imbalance at the level of the cortico-basal ganglia-thalamocortical loop by inactivating the target area

[Stelten et al 2008]

In what context has DBS been proposed to treat addiction?

Case studies of DBS use for addiction

Woman successfully treated for agoraphobia by bilaterial DBS of the Nacc (which also ameliorated her comorbid alcohol dependence) (Kuhn et al., 2007).

3 of 10 people were treated for Tourette's syndrome, OCD or anxiety by means of DBS of the Nacc- these three reported smoking cessation (Kuhn et al., 2009).

Treatment –refractory OCD quit smoking after receiving DBS of the Nacc [however these changes took place 10 months after her DBS treatment]

DBS Leading to Smoking Cessation

Research Report

Observations on Unaided Smoking Cessation after Deep Brain Stimulation of the Nucleus Accumbens

Kuhn J.[a] · Bauer R.[c] · Pohl S.[c] · Lenartz D.[b] · Huff W.[a] · Kim E.H.[a] · Klosterkoetter J.[a] · Sturm V.[b]

Aims: We explore whether clinical research on deep brain stimulation (DBS) of the nucleus accumbens (NAc) to treat addiction is justified besides theoretical speculation. *Methods:* Since 2004, 10 patients who were also smokers were treated at the University of Cologne for Tourette's syndrome (TS), obsessive-compulsive disorders (OCD) or anxiety disorders (AD) by DBS of the NAc. We assessed their smoking behavior after DBS and (in retrospection) before by the Fagerström Test for Nicotine Dependence (FTND) and additional items. *Results:* Three male patients were able to quit smoking after DBS. They were less dependent and higher motivated compared to the rest of the sample. They are stimulated with a higher voltage. During 1-year, 2-year, and 30-month follow-ups, we found a higher rate of successful smoking cessation (20, 30 and 30%) compared to unaided smoking cessation in the general population (13, 19 and 8.7%). *Conclusions:* Albeit the results of the study are severely limited by the method of retrospective self-assessment of psychiatric patients, further research of DBS of the NAc to treat addiction seems justified. In addition to biological mediators, psychosocial factors should be assessed in further prospective studies.

Improvement in craving for alcohol after DBS

Special Supplement Peer-Review Report

Deep Brain Stimulation Surgery for Alcohol Addiction

Juergen Voges, Ulf Müller, Bernhard Bogerts, Thomas Münte, Hans-Jochen Heinze

Results

Five patients were treated off-label with bilateral NAc DBS for severe alcohol addiction (average follow-up 38 months). All patients experienced significant and ongoing improvement of craving. Two patients remained completely abstinent for more than 4 years. NAc stimulation was tolerated without permanent side effects. Simultaneous recording of local field potentials from the target area and surface electroencephalography while patients performed neuropsychological tasks gave a hint on the pivotal role of the NAc in processing alcohol-related cues.

Remission of alcohol dependency following deep brain stimulation of the nucleus accumbens: valuable therapeutic implications?

Jens Kuhn[1], Doris Lenartz[2], Wolfgang Huff[1], SunHee Lee[1], Athanasios Koulousakis[2], Joachim Klosterkoetter[1], Volker Sturm[2]

Abstract

Chronic consumption of alcohol represents one of the greatest health and socioeconomic problems worldwide. We report on a 54-year-old patient with a severe anxiety disorder and secondary depressive disorder in whom bilateral deep brain stimulation (DBS) of the nucleus accumbens was carried out. Despite the absence of desired improvement in his primary disorder, we observed a remarkable although not primarily intended alleviation of the patient's comorbid alcohol dependency. Our case report demonstrates the extremely effective treatment of alcohol dependency by means of DBS of the nucleus accumbens and may reveal new prospects in overcoming therapy resistance in dependencies in general.

Lesioning of nucleus accumbens reduces opioid addiction

Nucleus Accumbens Surgery for Addiction

Nan Li, Jing Wang, Xue-lian Wang, Chong-wang Chang, Shun-nan Ge, Li Gao, He-ming Wu, Hai-kang Zhao, Ning Geng, Guo-dong Gao

Results

The short-term outcomes were encouraging and triggered rapid application of this treatment in China from 2003 to 2004. However, lack of long-term outcomes and controversy eventually led to halting the surgery for addiction by the Ministry of Health of China in November 2004 and a nationwide survey about it later. Our institute had performed this surgery in 272 patients with severe heroin addiction. The follow-up study showed that the 5-year nonrelapse rate was 58% and the quality of life was significantly improved. Patients had several kinds of side effects, but the incidence rate was relatively low. The patients gradually recovered more than 5 years after the surgery. The side effects did not severely influence an individual's life or work. Nationwide surgery showed that the nonrelapse rate was 50% in the sample of 150 cases, from 1167 patients overall who underwent stereotactic surgery in China.

Smoking Cessation and Weight Loss After Chronic Deep Brain Stimulation of the Nucleus Accumbens: Therapeutic and Research Implications: Case Report

Mariska Mantione, MSc, Wim van de Brink, MD, PhD, P. Richard Schuurman, MD, PhD, Damiaan Denys, MD, PhD

CLINICAL PRESENTATION

A 47-year-old woman presented with chronic treatment-refractory obsessive-compulsive disorder, nicotine dependence, and obesity.

INTERVENTION

The patient was treated with deep brain stimulation of the nucleus accumbens for obsessive-compulsive disorder. Unintended, effortless, and simultaneous smoking cessation and weight loss were observed.

OUTLINE

Addiction & Treatment Approaches

Neuroscience Developments

Addiction Neuroethics

DBS & tDCS - Ethical & Social Issues

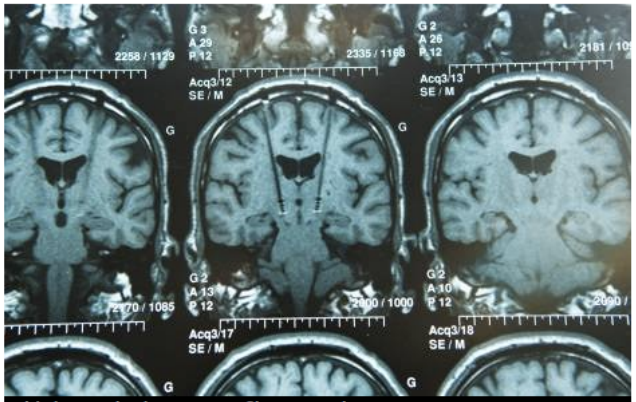
Conclusions & Implications

Over-simplistic & optimistic media portrayals

Can Deep Brain Stimulation Cure Addiction?

By Jeanene Swanson 08/19/14

This relatively simple neurosurgical procedure can be used to treat a variety of disorders originating from abnormal brain activity such as Parkinson's, OCD, Tourette's, and more. So why does nobody know about it?



this is your brain on . . . - Shutterstock

Deep brain stimulation sounds a bit intimidating, if not downright scary. And, unless you're a neuroscientist or science news junkie, you've probably never heard of it.

In reality, deep brain stimulation—DBS—is a relatively simple neurosurgical procedure that can be used to treat a variety of disorders originating from abnormal brain activity. Since the 1960s, deep brain stimulation at low frequency has been used to treat chronic pain. In 1987, scientists discovered that high-frequency stimulation of the thalamus could be used to treat the tremors found in movement disorders, such as Parkinson's disease (PD). Approved by the FDA to treat PD in 2002, DBS is also approved to treat other movement

DBS Concerns

- Application of DBS to addiction not obvious
  - Still identifying the neural circuitry
  - Not certain of its neural and neurochemical effects
- Safety concerns
  - Infections
  - Could cause psychological, emotional & behavioural disturbances
- Not enough justification for use of DBS in addiction
  - Pharmacological and psychotherapeutic remedies exist that are not as invasive and have been proven effective
  - Doesn't warrant such procedures when benefits are unknown and might not outweigh the harms.
  - Extremely expensive procedure ($50,000 US) with ($10,000 – ongoing maintenance every few years.

(Bell et al., 2009; Carter & Hall, 2011; Carter et al., 2011)

Transcranial Direct Current Stimulation (tDCS)

- tDCS is a non-invasive form of neurostimulation that delivers a low electric current via an anode and cathode placed on the scalp.

(Salling & Martinez, 2016)

- Electrical current penetrates the skull and modulates brain activity by:
    i. Changing the resting membrane potential of the neurons (altering the baseline level of targeted neurons).
    ii. Modulating synaptic activity in a manner similar to long-term potentiation (at the anode) and long-term depression (at the cathode)

tDCS and Addiction

- Studies have investigated the effects of tDCS on nicotine dependence, specifically on craving and nicotine cues.
    - Results suggest that tDCS may reduce craving for nicotine (though not consistent)

(Salling & Martinez, 2016)

- Studies show a less consistent effect on alcohol craving
    - Mixed results – for some, tDCS was found to reduce cravings, but for others, there was no difference

(Boggio et al, 2008; Klauss, et al, 2014)

Ethical & Social Concerns

- Safety and efficacy aspects
  - Compared to DBS, tDCS is reported to be extremely safe.
  - Safety risks described are mild headaches and mid burning or itching sensation under the electrodes.
  - Given the relative newness of these technologies, not much is known about the chronic long-term effects.
  - Future studies may reveal unsuspected side effects that are more serious than those associated with traditional methods of addiction treatment.

Questions to Consider

Can these technologies be accessed by the population they are designed to help?

How cost effective are they?

OUTLINE

Addiction & Treatment Approaches

Neuroscience Developments

Addiction Neuroethics

DBS & tDCS - Ethical & Social Issues

Conclusions & Implications

Conclusions

Neuroscience has the potential to provide novel methods for reducing addictive behaviour and the resulting harms.

It is important that these methods be developed and used in ways that take account of the social context in which addiction treatment is provided.

Safety and efficacy concerns need to be validated before such technology can be released or made available on the market.