NEUROETHICS IN MEDICINE. PRESSING ISSUES

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The article focuses on some aspects of neuroethics in medicine. Due to the continuous growth of research, new advances in neuroscience, and use of neurotechnology, ethical issues related to personality, autonomy and confidentiality may arise. The article addresses neuroethical issues of management of patients with various neurological diseases and special psychological conditions. The issue of using neuroethical aspects to solve issues in the field of diagnosis and treatment of disorders of consciousness is also discussed. Another important area of research that uses neuroethics is treatment of drug addiction, namely the ethical aspects of using neurotechnology. The authors conclude that the prospects for using neuroethics in medicine are very diverse. It underlines the importance of its studying at all stages of medical education, including secondary, higher and postgraduate ones.

Keywords: neuroethics, patient management, disorders of consciousness, drug addiction treatment, transcarnial stimulation

Author contribution: Filatova YS and Zolotova IA made an equal contribution to preparation of the article.

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Received: 11.11.2024 **Accepted:** 03.12.2024 **Published online:** 31.12.2024

DOI: 10.24075/medet.2024.029

НЕЙРОЭТИКА В МЕДИЦИНЕ. АКТУАЛЬНЫЕ ПРОБЛЕМЫ

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В статье обсуждаются некоторые аспекты применения нейроэтики в медицине. Непрерывный рост исследований, активное применение новых достижений нейробиологии, а также использование нейротехнологий могут вызывать этические проблемы, связанные с личностью, автономией и конфиденциальностью. В статье затрагиваются нейроэтические вопросы о ведении пациентов с разнообразными неврологическими заболеваниями и особенными психологическими состояниями. Также обсуждается применение нейроэтических аспектов в решении вопросов, возникающих в области диагностики и лечения расстройств сознания. Другое важное направление исследований, в рамках которых используется нейроэтика, — лечение наркотической зависимости, а именно этические аспекты применения нейротехнологий. В заключение авторы приходят к выводам, что перспективы использования нейроэтики в медицине очень разнообразны, что подчеркивает важность ее изучения на всех этапах медицинского образования, включая среднее, высшее и постдипломное.

Ключевые слова: нейроэтика, ведение пациентов, расстройства сознания, лечение наркотической зависимости, транскарниальная стимуляция

Вклад авторов: Ю. С. Филатова и И. А. Золотова внесли равный вклад в подготовку статьи.

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Статья поступила: 11.11.2024 **Статья принята к печати:** 03.12.2024 **Опубликована онлайн:** 31.12.2024

DOI: 10.24075/medet.2024.029

Neuroscience and neurotechnology are developing rapidly. As a result, brain functions are being discovered in a new way. Neuroscience is an interdisciplinary field of science that studies the nervous system, its structure, functions, and development. It covers a wide range of disciplines, including neuroscience, psychology, molecular biology, medicine, and others. This area can be attributed to a scientific approach that seeks a systematic understanding of the structure and function of the nervous system in humans and animals [1]. Neurotechnologies are a set of methods, systems, and tools that provide direct access to the human brain. They allow to record and analyze brain activity through visualization of the nervous system of the brain, neuromodulation technology, “brain-machine” interface, and also collect, store and process neural or related information.

Such innovative advances in neuroscience and neurotechnology are expected to result in interventions that could not be used previously to treat a number of human diseases and promote health. Using the achievements of neuroscience will allow us to re-examine the relationship between human thoughts, emotions and behavior. Research and development in the field of neuroscience and neurotechnology bring significant benefits to society and individuals, and large-scale investments are being made at the national level for this purpose [2].

Over the past decade, there has been a sharply increased interest in ethical issues arising from the development of neuroscience. A new discipline called “neuroethics” appeared only in 2002. It was conceived as a new field of interdisciplinary discourse on moral dilemmas related to recent advances in neuroscience in a broad sense. Nearly twenty years after its emergence, neuroethics has a wealth of knowledge and an institutional base for further development. However, being a very young discipline, neuroethics is still in its infancy [3].

The discussion of neuroethics requires international cooperation. The most notable global neuroethics event is the Brain Neuroethics Consortium of the Global Neuroethics Working Group of the International Brain Initiative. Discussions in the working group include strengthening integration and collaboration between neuroscience and neuroethics, which is constantly being investigated by experts [4].

Due to the continuous research and use of advances in neuroscience, new challenges may arise related to personality,

autonomy, and protection of confidential information. Existing ethical principles are applicable in solving these problems, but in some situations new ethical, legal and social standards may be required. The above-mentioned problems should be solved in interdisciplinary cooperation with participation of neuroscientists, practicing physicians, ethicists, philosophers, sociologists and lawyers [5].

The use of neurotechnology can lead to significant changes in various fields, from healthcare to human rights. These technologies can help people with paralysis move, improve mental health measures, and boost economic growth. But at the same time, they can also create new threats to security and privacy, challenge human autonomy, and exacerbate inequality. While novel technologies that promise widespread social changes are not new, the connection of neurotechnology to the brain poses unique challenges, whereas scientists and policy makers have identified significant ethical and political issues related to neurotechnology [6,7]

AREAS OF APPLICATION OF NEUROETHICS IN MEDICINE

Neuroethics issues may relate to clinical practice, namely ethical aspects such as a doctor–patient relationship, differences between clinical practice and research, important decision-making issues in treatment of certain diseases, and much more.

Doctors are responsible for following the traditional principles of clinical practice and medical ethics in their field. Clinically oriented documents often provide doctors with a wide degree of opinion independence, but on the other hand limit their actions to algorithms and standards. Thus, there is a number of diseases and conditions in neurology that require intervention of neuroethics.

The case of Phineas Gage, which is probably the first published one, was described by Harlow JM [8]. As a result of an accident at work, the patient suffered a severe traumatic brain injury affecting the medial and orbital areas of the frontal lobe, and became impulsive, violent and rude. Damasio A [8] suggested that damage to the ventromedial prefrontal cortex leads to a loss of ethical and emotional assessments regarding moral consequences of actions, resulting in blurred boundaries between good and evil. Moreover, patients who had damaged the ventromedial prefrontal nucleus were unable to correct or control aggressive behavior and/or unusual reactions, facing negative consequences of their actions. It was morally harmful for the patients and other people [9]. According to Damasio A, the patients are able to speculate, but have impaired emotions that serve as somatic markers and can be used by the brain to quickly and unconsciously filter out options with important positive or negative emotional consequences.

Thus, the Phineas Gage case highlights the importance of the frontal lobe for moral behavior, whereas subsequent studies involving healthy people using neurophysiological techniques such as functional magnetic resonance imaging and non-invasive brain stimulation techniques have revealed a broader and more complex neural network. Among these areas, it is necessary to mention the callosal gyrus of the cerebral cortex, a neural structure that is considered important for resolving the conflict between the emotional and rational components of moral reasoning [10]. Insula, a neural structure, which is essential for development of interoceptive states, appears to be involved in the development of an affective component of a sense of lawlessness (an emotional component associated with perception and experience of the absence of legality, that includes emotions such as fear, anger, anxiety, helplessness and frustration arising in response to a sense of injustice, lack of law and order, or threat to personal rights and freedoms) [11]. And the area of the brain that plays an important role in development of the emotional component of a sense of lawlessness is represented by basal ganglia, as well as the subthalamic nucleus, which is involved in assessing conflict situations related to human behavior, which is determined by a system of norms and values [12].

Returning to the relevance of clinical models in the field of neuroethics, motor disorders such as Parkinson's syndrome, Huntington chorea, and Tourette's syndrome should be mentioned. These diseases are characterized by a low sensitivity to ethical violations when patients do not respond to moral or ethical problems, are not aware of their seriousness, or do not take due care of the consequences of their actions. This is evident in the manifestation of symptoms such as impulsivity in the form of sudden mood swings, outbursts of aggression with shouting, threating others [13–15]. In addition, an important role is played by the study of mental syndromes such as obsessive-compulsive disorder [16] and depression [17], which in turn are characterized by a high sensitivity to ethical violations, when patients are concerned about the consequences of their actions. Although their main manifestations and mechanisms are different, it is interesting to note that all the above-mentioned syndromes are accompanied by similar anatomical and functional changes in neural structures (insular lobe, callosal gyrus, basal ganglia). Thus, the insular part is responsible for integration of sensory information and emotional phenomena, which makes it possible to assess moral dilemmas from the point of view of personal experience and social norms; the cingulate gyrus is associated with processing of emotions and decision-making, which makes it important to assess moral consequences; the basal ganglia are involved in changing habits and automating behavior, which can also affect moral standards, especially in periodic interaction and decision-making. These neural structures interact with each other, creating a complex network that allows people to make ethically informed decisions and respond to moral challenges in a social environment [18].

Other important neuroethical issues relate to recent advances in diagnosis and treatment of disorders of consciousness. This area is rapidly expanding and becoming more relevant. However, it is still insufficiently studied. Modern debates on the boundaries of consciousness are interdisciplinary in nature and affect achievements of such sciences as neurology, ethics, and philosophy [19].

Approaches to determining the level of consciousness have been developed in clinical neurology. Neurologists, especially as consultants, regularly assess patients' level of consciousness, predict the results of loss or decrease in consciousness, identify opportunities for nervous system recovery, and advise families on what to expect and how best to prepare for possible outcomes. In turn, these assessments and recommendations form the dominant axis around which important decisions are made regarding the intensity and duration of care that should be provided to the patient. Assessment of the consciousness level and ability to recover are important in making decisions about limiting or continuing life-sustaining treatment, which strongly indicates that consciousness is a central element of the concept of personality [20].

Prolonged use of limited intensive or supportive care resources for patients who are considered incapable of additional neurological recovery may also raise difficult ethical questions among medical professionals [21]. From this point of view, the ethical importance of a clear understanding of how

to approach decision-making about supportive care becomes obvious.

Treatment of drug addiction is another important clinical area in which achievements of neuroethics can be used. Though some medical treatment methods exist, there is an urgent need in more effective new treatment methods. A promising approach involves electrical neurostimulation as a means of combating addiction or so-called electrotherapeutic methods as an alternative or complement to behavioral and pharmacological interventions [22].

Recently, electrical neurostimulation has been studied as a method of treating addiction. The FDA has approved two non-invasive electrical nerve stimulators for additional treatment of acute opioid withdrawal symptoms. These devices, placed behind the ear, stimulate certain cranial nerves. This nerve stimulation is reported to produce a rapid effect in terms of relieving withdrawal symptoms resulting from abrupt cessation of opioid use. Current experimental evidence indicates that this type of non-invasive neurostimulation can perfectly complement opioid detoxification medications with lower side effects and increased treatment commitment. However, the potential of this method and its possible long-term side effects have not yet been studied [23].

But what areas of the brain, if they are affected, will provide the best result in the treatment of addiction? In this regard, some clues can be found in a number of case reports in humans, which describe complete, permanent, and virtually painless elimination of psychoactive substance use disorders. This elimination was caused by direct effects on certain areas of the brain and neural connections that are known to be involved in the process of addiction formation, such as the insula, nucleus accumbens, dorsolateral prefrontal cortex, and amygdala [24]. For example, smokers spontaneously lost all interest in cigarettes after a stroke that damaged the bilateral anterior insular lobe. More recent studies show that damage to any of the vast areas of the brain that have a functional connection with the anterior insular lobe can also lead to loss of dependence [25].

The possibility of non-invasive stimulation of these brain areas would be of great help, but these types of effects are mainly limited to rather superficial than deep areas of the brain. Existing methods of non-invasive neurostimulation include transcranial direct current stimulation, transcranial alternating current stimulation, transcranial magnetic stimulation, and transcranial focused ultrasound stimulation. These methods have been widely used for decades and involve applying voltage through 2 or more electrodes placed on the scalp, so that the current is usually up to 2 mA. These methods, and especially transcranial direct current stimulation, were used specifically to treat addiction [26]. There are still many unresolved issues regarding potential treatment of addictions using transcranial stimulation. The first question is which area to target and which pulse frequency to use. There are also ethical issues such as interventions that reduce drug cravings, possible side effects that alter the will and ability to make decisions [27]. Side effects can also be worrisome, as invasive deep brain stimulation can lead to mania, disinhibition, and psychosis.

CONCLUSION

Thus, the prospects for using neuroethics in medicine are very diverse. Most of them relate to neurotechnologies, which are important to use for the benefit of the patient. The examples described in the article are only a part of the possible perspectives for condemning ethical aspects in achieving neurobiology, and in most cases, they relate to issues of diagnosis and treatment of a number of neurological diseases and behavioral disorders. This highlights the importance of studying neuroethics at all levels of medical education, including secondary, higher, and postgraduate education.

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