Commentary

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Combining Clinical and Basic Neuroscience

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Description

For second-year medical students, brain and behavior module is a 13-week interdisciplinary course that covers both fundamental and clinical topics (anatomy, pharmacology, radiology, pathology, and behavioral science) that are relevant to the neurology and psychiatry Clerkships. As Head of the Module, my job is to coordinate fundamental and clinical neuroscience in an upward direction and on a level plane. Students, faculty, and the module director face inherent obstacles to the success of such intense modular courses. Our research has shown that the best way to achieve integration, which helps students avoid stress and neurophobia, is for all participating faculty to combine the basic and clinical sciences in a variety of settings, allowing for synergistic reinforcement of the information being learned. In the hope that some aspects of our model will be helpful to others involved in such multidisciplinary courses or modules, numerous examples of how basic science and clinical faculty collaborate in this endeavor will be discussed.

Clinical Neuroscience

The scientific study of fundamental mechanisms that underlie brain and central nervous system diseases and disorders is the primary focus of clinical neuroscience, which is a subfield of neuroscience. It aims to develop novel approaches to conceptualizing, diagnosing, and treating these conditions. A scientist with specialized expertise in the field is known as a clinical neuroscientist. Although neurology, neurosurgery, and psychiatry are the primary medical specialties that use neuroscientific information, other specialties such as neuroscience, neuroradiology, neuropathology, ophthalmology, otorhinolaryngology, anesthesiology, and rehabilitation medicine can contribute to the discipline. Integration of the neuroscience perspective alongside other traditions like psychotherapy, social psychiatry, or social psychology will become increasingly important in the future. Neurotechnologies, or devices that are capable of recording and stimulating electrical activity in the nervous system, have provided clinical neuroscience with a novel ally over the past few decades. These innovations worked on the capacity to analyze and treat brain problems. Through stimulation and recordings made during brain implants, neurotechnologies are simultaneously enabling a deeper comprehension of the healthy and pathological dynamics of the nervous system. In contrast, clinical neurosciences are not only directing neuroengineering toward the most pressing clinical issues, but they are also influencing neurotechnologies as a result of advancements in clinical medicine. For instance, knowing a disease's etiology informs not only where a therapeutic stimulation should be placed but also how stimulation patterns should be designed to be more effective or naturalistic. In order to show that this symbiosis between clinical neuroscience and neurotechnology is closer to a novel integrated framework than to a straightforward interdisciplinary interaction, we present examples of successful integration, such as deep brain stimulation and cortical interfaces.

Bioethics is a well-established field that is based on existing ethical principles like those found. Report and focuses on the ethics of biomedical research, including the protection of human research participants. Kindness toward others and justice neuroethics is a newer field that is based on the idea that studying the brain presents a unique set of ethical issues, and that developments in our knowledge of the brain and our capacity to record and alter brain function can challenge or alter our understanding of the human mind and identity. As a result, neuroethics includes considerations that go beyond the scope of conventional bioethics, such as neuroscience-based predictions of cognitive or behavioral patterns (which, for instance, could be used to assign opportunities in education or employment); utilizing evidence from brain data to draw conclusions about behavior and decision-making in the past or in the future; interventions in the brain that have the potential to have an impact on personal identity, memory, impulsivity, or cognitive control; interpretation of decision-making capacity (for instance, in a person who is psychotic, addicted, or has closed-loop brain stimulation); and how the development of better human brain models, like three-dimensional *in vitro* cell culture systems called brain organoids, raises the question of when and to what extent a model violates our existing ethical framework.

clinical studies

The clinical studies on the effects of DBS that contributed to our understanding of the neural circuits underlying motor dynamics and the associated pathologies were discussed in the preceding section. In this section, we will review a few studies on mood and cognition. Animal studies can also be used to investigate other basal ganglia functions, such as mood control in primates or rodents but in this instance, the complexity of human behavior necessitates even more in-depth human studies like clinical DBS studies. The boundaries of associative/limbic areas within the STN have been the focus of recent research. The need to avoid the collateral effects of DBS that are associated with the stimulation of functional areas that are not directly affected by the motor disorder being studied has once more fueled this research. Indeed, stimulation localization has been linked to non-motor outcomes in PD DBS. The question has been posed, and DBS clinical studies have provided practical solutions. The hypothesis that dorsal STN is responsible for motor functions and ventral STN is responsible for cognitive functions is based on the observation that motor and premotor cortices project to the latter, while prefrontal cortical areas project to the former. The effects of the target stimulation's location in the STN's dorsoventral/occipitorostral axis on DBS outcomes support this observation. Researchers have the unique opportunity to decipher the intricate brain mechanisms underlying human behavior and cognition thanks to the intrinsic characteristics of intracortical recordings. In addition, clinicians can use the information gleaned from intracortical recordings to plan the surgical resection so that patients' cognitive abilities do not decline after the procedure. In this section, some typical examples of how scientists can use intracortical recordings to study cognitive processes will be discussed. The cooperation between the various brain regions required to perform each cognitive function is a feature that is shared by all cognitive functions.