Introduction

Electrophysiology: Inexpensive Brain Probing

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Psychiatric disorders are complex and multifactorial. In order to fully understand and manage these complex disorders, all resources available to researchers should be maximally utilized. Electrophysiologic measurements of brain activity are characterized by their noninvasive nature and relative low cost, with the notable exception of magnetoencephalography (MEG).

Electrophysiologic testing of psychiatric patients, such as electroencephalography (EEG), evoked potentials, sleep, MEG, and eye-movement research, has yielded some of the most consistent and replicated biological findings in psychiatry—most notably, the P300 EP and sensory gating changes in thought disorders (eg, schizophrenia and schizoaffective disorders) and rapid-eye-movement (REM) sleep changes in depression. More than 50 publications over the last two decades have confirmed the decreased amplitude of the P300 EP in schizophrenia patients. While the P300 amplitude has also been reported to be decreased in depressed patients, it tends to normalize when the subjects are stable and in remission. REM sleep abnormalities (shortened latency and increased density) have similarly been described in depressed patients. Shortened REM latency has also been reported in schizophrenia patients but not nearly to the degree noted in depressed patients. Indeed, sleep abnormalities are pervasive in neuropsychiatric disorders. Due to size limitations, the contribution and future promise of sleep research were not included in this volume. More recently, sensory gating deficiency and saccadic eye-movement abnormalities seem to be emerging as trait factors characterizing vulnerability to psychotic disorders.

This issue of CNS Spectrums provides a roadmap for future research utilizing electrophysiology in probing psychiatric disorders. A recurring theme is the superior temporal resolution of these measures—being able to examine brain processes occurring within microseconds or milliseconds following stimulation. Another theme is the ability and usefulness of integrating electrophysiologic measures with other investigative tools like neuroimaging.

The paper by Winterer et al describes how EEG research can provide neural network models. Such models suggest that the brain is a dynamically shifting collection of interpenetrating, distributed, and transient networks. In the same paper, several examples are given demonstrating the capability of this research tool to generate pathophysiologic models, as well as disease classification and intermediate phenotyping for genetic investigations and pharmacodynamic modeling. Bruder and colleagues review the growing evidence that electrophysiologic and neurocognitive measures of brain function may be of value as predictors of therapeutic response to antidepressants. In their paper, they provide evidence from dichotic listening, quantitative EEG, and event-related potentials (ERPs) studies, that differences between treatment responsive and nonresponsive subgroups of depressed patients can be elucidated. Furthermore, the paper by Salisbury et al underscores how multimodal imaging has allowed the identification of distributed neural circuit abnormalities in structure and function that might give rise to the debilitating illness of schizophrenia. In their paper, Rojas et al provide a succinct account of how magnetoencephalography increased the depth of our understanding of the EEG as well as evoked potential phenomena in both health and in psychopathologic conditions. Finally, the paper by Somoza and Kim changes direction slightly. This paper highlights the difficulties inherent in attempting to translate clinical research findings to clinically useful procedure. This is one of the provinces of the newly developing field of translational research.

This volume of CNS Spectrums could not possibly cover the entire scope of neuropsychiatric electrophysiologic research. Much work is ongoing to unravel the electrophysiologic deviations associated with such complex disorders as addiction, and personality and anxiety disorders. The technological complexity of these ever-advancing electrophysiologic investigative tools is only paralleled by the immense promise this field of knowledge holds for the eventual understanding and conquering of mental disorders.