Recent Findings and Newer Paradigms of Neuroimaging Research in Geriatric Psychiatry

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Over the past several decades, there has been a significant increase in the population of older adults and associated mental health problems throughout the world. For older adults, mental health problems such as dementia, depression, psychosis, and anxiety disorders can be debilitating and reduce the overall health and quality of life. Moreover, as most of the geriatric psychiatric disorders are not easily diagnosed and treated, it is important to understand the neurobiological mechanisms of these disorders, as this understanding promises to improve clinical care. In this regard, a large number of neuroimaging techniques are being developed and are used for research, with some ultimately entering clinical practice. In 1999, the special issue of the Journal of Geriatric Psychiatry and Neurology reviewed a broad spectrum of neuroimaging and related modalities such as magnetic resonance imaging (MRI), magnetic resonance spectroscopy, positron emission tomography (PET), quantitative electroencephalogram, and computed tomography with comprehensive articles describing methods and observations in normal aging and related psychopathologic states. Since 1999, there has been even further significant progress in neuroimaging research. Molecular imaging using PET can detect detrimental effects occurring in the brain on a molecular basis. The recent advances in structural and functional MRI methodologies open the ways to application of neuroimaging techniques to common clinical situations such as diagnosis and personalized treatment. Moreover, advances in network theory may enable us to understand the pathophysiological mechanisms in the brain as a disruption to a network. This special issue of the Journal of Geriatric Psychiatry and Neurology brings together internationally recognized experts in the imaging field to address these key issues. Reza Tadayonnejad and Olusola Ajilore discuss brain network dysfunction in late-life depression. To date, several studies have highlighted structural and functional abnormalities of frontal, striatal, temporal, and parietal areas in late-life depression. These abnormalities might result in a broad range of negative impacts on mood, cognition, and global functioning in patients with late-life depression. Although the widespread nature of structural damage in late-life depression is suggestive of a system disorder resulting in disrupted networks, studies based on the univariate statistical approaches for analyzing functional and structural imaging have a limited ability to test such hypotheses. In this regard, multivariate and patternwise perspectives using network theory provide a new paradigm for understanding the complex neurobiological mechanisms of late-life depression. In this review, a network dysfunction model is used as a conceptual framework for reviewing recent neuroimaging findings in late-life depression. Kentaro Hirao and Gwen Smith discuss recent developments in the molecular imaging using PET in late-life depression. With the development of sensitive and accurate instrumentation and radiotracer chemistry, molecular PET imaging can detect in vivo the precise neurobiological process of various geriatric neuropsychiatric disorders including Alzheimer disease, Parkinson disease, and late-life depression. They review the recent advances and literature in molecular imaging in geriatric psychiatric disease, with a focus on late-life depression. Interestingly, they provide the future directions of the molecular imaging studies integrating molecular imaging with genetic, neuropsychiatric, and cognitive outcomes, multimodality neuroimaging. Howard Aizenstein and colleagues discuss the clinical application of the neuroimaging methods to predict the treatment response to antidepressant medications. A number of imaging studies have demonstrated that pretreatment structural and functional MRI markers are predictive of an individual’s response to standard antidepressant pharmacotherapy. This article reviews the literature on MRI prediction of treatment response and discusses how these findings can be relevant to personalizing treatment of late-life depression. Chris Abbott discusses the several reports of neuroimaging studies on longitudinal electroconvulsive therapy (ECT). The ECT is known to be one of the most effective treatments for refractory depression and other psychiatric disorders; however, the precise neurobiological mechanism of action and neural correlates of treatment response are poorly understood.

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In this review, they summarize several previous structural and functional neuroimaging studies on longitudinal ECT and suggest a comprehensive conceptual framework integrating these prior works. John Ryan and colleagues discuss the impact of type 2 diabetes mellitus on the functional and structural changes in the brain. Type 2 diabetes mellitus is very common and one of the major health problems throughout the world. Although type 2 diabetes mellitus is the one of the risk factors for the cognitive impairment including the Alzheimer disease, we do not yet fully understand the neurobiological mechanisms of these associations. Hence, they review studies that have utilized structural and functional neuroimaging to identify neural pathways that link the type 2 diabetes mellitus to impaired cognitive performance and potentially Alzheimer disease. Changtae Hahn and colleagues discuss neuroimaging findings in late-onset schizophrenia and bipolar disorder. As compared to early-onset schizophrenia and bipolar disorder, there were fewer published neuroimaging studies on late-onset schizophrenia and bipolar disorder. In this regard, we cannot know whether late-onset schizophrenia and bipolar disorder are subtypes of the early-onset variants or distinctive disease entities. Hence, they summarized the previous functional and structural neuroimaging studies and provide the integrative perspectives of late-onset schizophrenia and bipolar disorder.

Overall, advances in neuroimaging methods, among other areas of neuroscience, have contributed to the development of novel theories of etiology of various geriatric psychiatric disorders. In addition, it is important to note that neuroimaging research needs to be integrated with other cognitive and neuroscience methods as well as theories drawn from animal models in constructing integrative model of geriatric psychiatric disorders.