

**EXPLORING THE ROLE OF THE NERVOUS SYSTEM FOR
UNDERSTANDING DEPRESSION IN SPINAL CORD INJURY**

**SHAMBHOVI MITRA
Ph.D**



**Department of Humanities & Social Sciences
Indian Institute of Technology Delhi**

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**EXPLORING THE ROLE OF THE NERVOUS SYSTEM FOR UNDERSTANDING
DEPRESSION IN SPINAL CORD INJURY**

by

SHAMBHOVI MITRA

Department of Humanities & Social Sciences

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DEDICATION

This work is dedicated to Master. Adhiraj Mitra (my Son) for bearing with me and keeping me in good humor throughout my journey.

CERTIFICATE

This is to certify that the thesis titled, "**Exploring The Role of The Nervous System for Understanding Depression in Spinal Cord Injury**," submitted by **Ms. Shambhovi Mitra** for the award of the degree of **Doctor of Philosophy**, to the Indian Institute of Technology, Delhi, is a record of original bonafide research carried out by her under my guidance and supervision. I am satisfied that the thesis presented by **Ms. Shambhovi Mitra** is worthy of consideration for the degree of **Doctor of Philosophy**. The results of this thesis have not been submitted to any other University or Institute for the award of degree.

I certify that she has pursued the prescribed course of research.

Dr. Varsha Singh

Associate Professor

Department of Humanities and Social Sciences,

Indian Institute of Technology Delhi, India

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Shambhovi Mitra

Abstract

According to the Neurovisceral Integration theory (NVI), inhibition and flexibility regulate goal-oriented behavior. The central and autonomic nervous systems (CNS-ANS) interact for inhibition and flexibility. The spinal cord acts as a conduit between the brain and the body to execute goal-oriented behavior. Thus spinal cord injury disrupts this conduit resulting in physical, autonomic, and psychological consequences. Depression is an important sequel to spinal cord injury with somatic and cognitive-affective manifestations. The NVI theory postulates that impaired autonomic nervous system function results in impaired inhibition and flexibility, thereby predisposing an individual to be at risk of developing depression. Literature shows variability in the prevalence of depression in spinal cord injury. On the other hand, literature shows that depression is associated with impairment of the autonomic nervous system. Thus, this thesis aims to understand how the nervous system impairment caused by the injury contributes to depression in spinal cord injury.

The thesis has three studies to study the nervous system's role in depression. Chapter 3 showed the first study results indicating an impaired autonomic nervous system function in spinal cord injury participants with the probable major depressive disorder than non-depressed participants. Coping with injury is the psychological adjustment to dealing with the injury, thereby influencing depression. Thus, coping autonomic nervous system function and depression were also studied. There was a significant relation observed. A low depression score was associated with better coping and high autonomic nervous system function. The "Disability Paradox" phenomenon was associated with high autonomic nervous system function when depression was studied longitudinally.

Depression in spinal cord injury has somatic and cognitive manifestations. According to the NVI theory, the autonomic nervous system regulates the affect and processes. As described in chapter 4, the subsequent study compared spinal cord injury participants' affect and cognitive process with age-matched healthy participants. The spinal cord participants had an impaired affect process than healthy controls. The cognitive process did not show any difference. The results indicated that the autonomic nervous system function is impaired more in the affect process than in the cognitive process.

As described in chapter 5, the study evaluated the autonomic nervous system during the affect and cognitive process. The results showed low autonomic nervous system function in spinal cord participants than healthy controls.

Chapter 6 analyzed the participants' affect state and autonomic regulation included in studies described in chapter 4 and 5. The study results showed a negative affect state in spinal cord participants with low autonomic regulation.

The spinal cord is a part of the central nervous system. Thus an injury to the spinal cord results in impaired affect and cognitive processes. Literature shows depression to have cognitive-affective manifestations in spinal cord injury. This thesis tried to understand the role of the impaired nervous system in developing depression in spinal cord injury.

सार

न्यूरोविसरल इंटीग्रेशन थ्योरी (एनवीआई) के अनुसार, लक्ष्य उन्मुख व्यवहार के लिए अवरोध और नम्यता की की आवश्यकता होती है। अवरोध और नम्यता की भूमिका के लिए केंद्रीय तंत्रिका प्रणाली और स्वायत्त तंत्रिका प्रणाली (CNS-ANS) के परस्पर क्रिया आवश्यक है। लक्ष्योन्मुख व्यवहार के निष्पादन के लिए रीढ़ की हड्डी मस्तिष्क और शरीर के बीच एक नली के रूप में कार्य करती है। इस प्रकार रीढ़ की हड्डी की चोट इस नली के विघटन का कारण बनती है जिसके परिणामस्वरूप शारीरिक, स्वायत्त और मनोवैज्ञानिक परिणाम होते हैं। दैहिक और संज्ञानात्मक – प्रभावी अभिव्यक्तियों के साथ रीढ़ की हड्डी की चोट के लिए अवसाद एक महत्वपूर्ण अगली कड़ी है। एनवीआई सिद्धांत बताता है कि बिगड़ी हुई स्वायत्त तंत्रिका प्रणाली के कार्य के परिणामस्वरूप अवरोध और नम्यता भी बिगड़ी होती है जिससे व्यक्ति के अवसाद विकसित होने का खतरा होता है। साहित्य, रीढ़ की हड्डी की चोट में अवसाद की व्यापकता में परिवर्तनशीलता, दिखाता है। दूसरी ओर साहित्य, अवसाद को स्वायत्त तंत्रिका प्रणाली की हानि से जुड़ा हुआ दिखाता है। इस प्रकार इस थीसिस का उद्देश्य यह समझना है कि, चोट के कारण तंत्रिका प्रणाली में हानी, रीढ़ की हड्डी की चोट में कैसे योगदान करती है। निम्नलिखित अध्यायों में प्रस्तुत तीन अध्ययनों में अनुसंधान समस्या का अध्ययन किया गया है। अध्याय 3 में चर्चा किए गए पहले अध्ययन में रीढ़ की हड्डी की चोट के प्रतिभागियों में स्वायत्त तंत्रिका तंत्र की हानि का अध्ययन किया है। अध्ययन के परिणाम में रीढ़ की हड्डी की चोट वाले प्रतिभागियों में हानी हुआ स्वायत्त तंत्रिका प्रणाली दिखाया है जो गैर-अवसादग्रस्त की तुलना में संभावित प्रमुख अवसादग्रस्त विकार के साथ था। चोट से निपटना मनोवैज्ञानिक समायोजन है, जिससे अवसाद

प्रभावित होता है। इस प्रकार स्वायत्त तंत्रिका प्रणाली के कार्य और अवसाद का मुकाबला करने के संबंध का भी अध्ययन किया गया है और एक महत्वपूर्ण संबंध देखा गया है। कम अवसाद बेहतर मुकाबला और उच्च स्वायत्त तंत्रिका प्रणाली के साथ जुड़ा हुआ पाया गया। जब अवसाद का लंबे समय तक अध्ययन किया गया था, तब विकलांगता विरोधाभास की घटना को उच्च स्वायत्त तंत्रिका प्रणाली से जुड़ा हुआ देखा गया था।

रीढ़ की हड्डी की चोट में अवसाद में दैहिक और संज्ञानात्मक अभिव्यक्ति होती है। एनवीआई सिद्धांत के अनुसार, स्वायत्त तंत्रिका प्रणालीभाव और प्रक्रियाओं को नियंत्रित करता है। अध्याय 3 में वर्णित अगले अध्ययन कार्य प्रभाव और प्रक्रियाओं को नियंत्रित करता है। अध्याय 3 में वर्णित अगले अध्ययन ने रीढ़ की हड्डी की चोट के प्रतिभागियों के प्रभाव और संज्ञानात्मक प्रक्रिया की तुलना स्वस्थ प्रतिभागियों से मेल खाने वाले उम्र के साथ की है। स्वस्थ नियंत्रण की तुलना में रीढ़ की हड्डी के प्रतिभागियों में प्रभावित प्रक्रिया को खराब देखा गया। संज्ञानात्मक प्रक्रिया में कोई अंतर नहीं दिखा। परिणाम ने संकेत दिया कि स्वायत्त तंत्रिका प्रणाली का कार्य संज्ञानात्मक प्रक्रिया की तुलना में प्रभावित प्रक्रिया में अधिकहानी ग्रस्त है। अध्याय 5 में वर्णित अगले अध्ययन में प्रभाव और संज्ञानात्मक प्रक्रिया के दौरान स्वायत्त तंत्रिका प्रणाली का मूल्यांकन किया है। परिणाम में स्वस्थ नियंत्रण की तुलना में रीढ़ की हड्डी के प्रतिभागियों में कम स्वायत्त तंत्रिका प्रणाली कार्य दिखाया है। अध्याय 6 ने अध्ययन 2 और 3 में शामिल प्रतिभागियों की भावात्मक स्थिति और स्वायत्त विनियमन का विश्लेषण किया है। अध्ययन के परिणाम में कम स्वायत्त विनियमन वाले रीढ़ की हड्डी प्रतिभागियों में नकारात्मक भावात्मक स्थिति की उपस्थिति को दिखाया है। रीढ़ की हड्डी केंद्रीय तंत्रिका प्रणाली का एक हिस्सा है। इस प्रकार रीढ़ की हड्डी में चोट के परिणामस्वरूप हानी ग्रस्त हुआ प्रभाव और

संज्ञानात्मक प्रक्रियाएं होती हैं।रीढ़ की हड्डी की चोट में संज्ञानात्मक भावात्मक अभिव्यक्तियाँ होने के लिए,साहित्य अवसाद को दर्शाता है।इस थीसिस के माध्यम से हमने तंत्रिका तंत्र की भूमिका को समझने की कोशिश की, जो रीढ़ की हड्डी की चोट में अवसाद में,चोट के कारण हानिग्रस्त हुआ है।

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