

Why Interventional Pain Procedures Fail: Role Of Central And Peripheral Sensitization In Pain Outcomes – A Narrative Review

Dr. Jayanta Pattanaik

M.D

Anesthesia

Fellow In DARADIA, The Pain Clinic, Kolkata

Dr. Gautam Das

MD, FIPP, CIPS

Department Of Pain Medicine

Daradia, The Pain Clinic, Kolkata

Dr. Suspa Das

MD, FIPP, CIPS

Department Of Pain Medicine

Daradia, The Pain Clinic, Kolkata

Dr. Shobha Yavagal

MD, Fellow In DARADIA The Pain Clinic

Department Of Pain Medicine, Daradia The Pain Clinic, Kolkata

Daradia, The Pain Clinic, Kolkata

Abstract

Interventional pain procedures are widely used for management of chronic pain conditions such as osteoarthritis, spinal pain, and neuropathic pain. However, clinical outcomes are variable and many patients experience incomplete or short-lived pain relief. Increasing evidence suggests that failure of interventional procedures is often related to neuroplastic mechanisms including peripheral and central sensitization rather than purely technical factors. This narrative review discusses mechanisms underlying failure of interventional pain procedures, emphasizing central sensitization pathways, clinical assessment tools, and strategies to improve patient selection and treatment outcomes.

Keywords: Interventional pain, central sensitization, peripheral sensitization, radiofrequency ablation, chronic pain mechanisms

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I. Introduction

Interventional pain medicine has become a major component of modern chronic pain management. Procedures such as epidural steroid injections, medial branch blocks, genicular nerve radiofrequency ablation, sympathetic blocks, and neuromodulation are commonly used.

Despite technical advances and imaging guidance, treatment success remains variable. Chronic pain is increasingly recognized as a complex biopsychosocial condition involving neuroplastic changes within the central nervous system.

II. Methods Of Literature Search

A structured literature search was performed using PubMed, Scopus, Web of Science, and Google Scholar.

Studies published between 2000 and 2025 were screened. Search keywords included 'interventional pain procedures', 'radiofrequency ablation', 'central sensitization', 'peripheral sensitization', and 'pain amplification'. Peer-reviewed articles and clinical studies were included.

Peripheral Sensitization

Peripheral sensitization occurs when inflammatory mediators reduce the activation threshold of nociceptors.

Prostaglandins, cytokines, bradykinin, and nerve growth factor enhance nociceptor excitability leading to primary hyperalgesia.

Central Sensitization Mechanisms

Central sensitization refers to amplification of neural signaling within the central nervous system. Persistent nociceptive input activates NMDA receptors in dorsal horn neurons, resulting in calcium influx and intracellular signaling cascades.

These mechanisms produce long-term potentiation of pain transmission.

Clinical Assessment of Sensitization

Recognition of central sensitization is essential before performing interventional pain procedures. Assessment tools include the Central Sensitization Inventory (CSI), quantitative sensory testing, and clinical examination for allodynia and hyperalgesia.

Strategies to Improve Outcomes

A mechanism-based approach is necessary for improving outcomes in interventional pain medicine. Pharmacologic treatments targeting central modulation include antidepressants and anticonvulsants. Rehabilitation strategies and cognitive behavioral therapy may also improve outcomes.

III. Conclusion

Failure of interventional pain procedures is often related to neuroplastic mechanisms rather than procedural errors. Understanding sensitization mechanisms can improve patient selection and clinical outcomes.

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