

# Peripheral Neuropathy: Diverse Causes, Evolving Treatments

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## Introduction

Promising new strategies for peripheral neuropathy treatment extend beyond symptomatic relief, focusing on precision medicine approaches tailored to diverse etiologies. These advancements involve gene therapy, neurotrophic factors, immunomodulation, and small molecule drugs, aiming to promote nerve regeneration and protect existing fibers from damage[1].

For diabetic peripheral neuropathy, recent insights emphasize updated diagnostic criteria and a deeper understanding of its complex pathogenesis, driven by metabolic, vascular, and inflammatory factors. Early detection and multifactorial intervention, including strict glycemic control, lifestyle changes, and novel therapeutic targets, are critical to prevent progression and alleviate symptoms[2].

Chemotherapy-induced peripheral neuropathy is a common and debilitating side effect of many cancer treatments, characterized by neuronal damage from various chemotherapeutic agents. Current diagnostic approaches and emerging treatment strategies, including preventive measures and symptomatic management, are being developed, stressing the need for better tailored interventions to improve patients' quality of life[3].

Autoimmune neuropathies exhibit diverse clinical presentations and immunological underpinnings, including conditions like Guillain-Barré syndrome and chronic inflammatory demyelinating polyneuropathy. Recent advances in diagnostic criteria and therapeutic approaches emphasize that early recognition and prompt initiation of immunomodulatory treatments are crucial for improving patient outcomes and preventing long-term disability[4].

Peripheral neuropathies also stem from metabolic, nutritional deficiencies, and toxic exposures, with causes ranging from diabetes and vitamin defi-

ciencies to heavy metal poisoning and drug side effects. Understanding these diverse etiologies is key for accurate diagnosis and effective management, often requiring correction of the underlying cause or removal of the offending agent to prevent further nerve damage and promote recovery[5].

Small fiber neuropathy is increasingly recognized in the context of autoimmune diseases, with autoimmune processes damaging small nerve fibers. Diagnostic challenges and unique therapeutic considerations exist for this patient population. Screening and appropriate management are important to alleviate neuropathic pain and autonomic dysfunction associated with various autoimmune conditions[6].

Gene therapy offers exciting potential for inherited peripheral neuropathies, particularly Charcot-Marie-Tooth disease. Research outlines challenges and opportunities in developing genetic treatments, including gene replacement and gene editing strategies. Various viral and non-viral delivery methods are being explored in clinical trials and preclinical research, aiming to correct underlying genetic defects and provide disease-modifying therapies[7].

Managing neuropathic pain in peripheral neuropathy involves an updated overview of pharmacological and non-pharmacological approaches. A multimodal strategy tailored to individual patient needs is emphasized, discussing the efficacy and safety profiles of antidepressants, anticonvulsants, topical treatments, and interventional pain management. The goal is to optimize pain relief and improve patient functional status and quality of life[8].

The epidemiology, key risk factors, and preventative strategies for peripheral neuropathy highlight the global burden of the condition and common causes like diabetes, chemotherapy, and genetic predispositions. Identifying modifiable risk factors and implementing early interventions, such as lifestyle modifications, strict disease management, and careful monitoring, are essential to reduce disease incidence and progression[9].

Imaging of peripheral neuropathies, especially Magnetic Resonance Neurography, provides a clinical perspective on its indispensable role in diagnosis and guiding treatment. It helps localize nerve lesions, characterize pathology, and differentiate various forms of neuropathy including inflammatory, traumatic, and compressive types. Integrating imaging with clinical and electrophysiological findings significantly improves diagnostic accuracy and helps tailor therapeutic strategies[10].

## Description

Peripheral neuropathy treatment is undergoing a significant shift, moving beyond mere symptomatic relief towards targeted, precision medicine approaches. This involves exploring novel strategies like gene therapy, neurotrophic factors, immunomodulation, and small molecule drugs that aim to address specific disease mechanisms, fostering nerve regeneration and pro-

tecting existing nerve fibers[1]. Gene therapy, in particular, demonstrates exciting potential for inherited peripheral neuropathies such as Charcot-Marie-Tooth disease. Researchers are outlining both the challenges and opportunities in developing genetic treatments, including gene replacement and editing strategies, with various viral and non-viral delivery methods being explored in ongoing clinical trials and preclinical research. The goal is to correct the underlying genetic defects, offering hope for disease-modifying therapies in these currently untreatable conditions[7].

Understanding the diverse etiologies of peripheral neuropathy is crucial for effective management. For instance, diabetic peripheral neuropathy warrants a fresh look, with emphasis on updated diagnostic criteria and a deeper understanding of its complex pathogenesis, involving metabolic, vascular, and inflammatory factors. Early detection and multifactorial intervention, including strict glycemic control, lifestyle modifications, and novel therapeutic targets, are incredibly important to prevent progression and alleviate symptoms of this condition[2]. Another significant cause is chemotherapy-induced peripheral neuropathy, a common and debilitating side effect of many cancer treatments. The underlying pathophysiology involves neuronal damage from various chemotherapeutic agents. Current diagnostic approaches and available and emerging treatment strategies, including preventive measures and symptomatic management, are being discussed, stressing the need for better tailored interventions to improve patients' quality of life during and after cancer therapy[3].

Autoimmune neuropathies present with diverse clinical presentations and immunological underpinnings, covering conditions like Guillain-Barré syndrome and chronic inflammatory demyelinating polyneuropathy. Recent advances in diagnostic criteria and therapeutic approaches underscore that early recognition and prompt initiation of immunomodulatory treatments are crucial for improving patient outcomes and preventing long-term disability[4]. A related area explores small fiber neuropathy within the context of autoimmune diseases, shedding light on how autoimmune processes can damage these nerve fibers. This includes discussing diagnostic challenges and therapeutic considerations unique to this patient population. There's an increasing recognition of small fiber neuropathy as a common manifestation in various autoimmune conditions, emphasizing the importance of screening and appropriate management to alleviate neuropathic pain and autonomic dysfunction[6].

Beyond these, peripheral neuropathies also stem from metabolic, nutritional deficiencies, and toxic exposures. A current perspective details various causes, from diabetes and vitamin deficiencies to heavy metal poisoning and drug side effects. Accurately diagnosing and effectively managing these conditions relies on understanding these diverse etiologies, which often means correcting the underlying cause or removing the offending agent to prevent further nerve damage and promote recovery[5]. This highlights a broad spectrum of factors that can impact nerve health, necessitating comprehensive patient evaluation.

Effective clinical management extends to addressing neuropathic pain and optimizing diagnostic pathways. An updated overview of managing neuropathic pain in peripheral neuropathy covers pharmacological and non-pharmacological approaches, emphasizing a multimodal strategy tailored to individual patient needs. This includes discussing the efficacy and safety profiles of various agents like antidepressants, anticonvulsants, topical treatments, and interventional pain management and rehabilitative strategies, all aiming to optimize pain relief and improve functional status and quality of life[8]. Furthermore, the epidemiology, key risk factors, and

preventative strategies for peripheral neuropathy are critical. The global burden of the condition emphasizes common causes such as diabetes, chemotherapy, and genetic predispositions, underscoring the importance of identifying modifiable risk factors and implementing early interventions to reduce disease incidence and progression through lifestyle modifications and careful monitoring[9]. Finally, advanced imaging techniques, particularly Magnetic Resonance Neurography, are offering a clinical perspective, becoming indispensable for diagnosis and guiding treatment by localizing nerve lesions, characterizing pathology, and differentiating various forms of neuropathy, thus improving diagnostic accuracy when integrated with clinical and electrophysiological findings[10].

## Conclusion

Peripheral neuropathy represents a significant clinical challenge with diverse etiologies, encompassing metabolic, autoimmune, toxic, chemotherapy-induced, and inherited forms. Recent advancements highlight promising new strategies moving beyond just symptomatic relief towards precision medicine. These include gene therapy, neurotrophic factors, immunomodulation, and small molecule drugs that target specific disease mechanisms to promote nerve regeneration and protect existing fibers.

Key areas of focus in current research involve understanding the complex pathogenesis of conditions like diabetic peripheral neuropathy, emphasizing metabolic, vascular, and inflammatory factors. The importance of early detection and multifactorial intervention, including strict glycemic control and lifestyle modifications, is consistently underscored across various neuropathy types. Chemotherapy-induced peripheral neuropathy, a common side effect, is now being addressed with better-tailored interventions for prevention and symptomatic management. Autoimmune neuropathies, such as Guillain-Barré syndrome and chronic inflammatory demyelinating polyneuropathy, also demand early recognition and prompt immunomodulatory treatments to prevent long-term disability.

There's a growing recognition of small fiber neuropathy as a manifestation in autoimmune conditions, requiring specific diagnostic and therapeutic considerations. Gene therapy shows exciting potential for inherited forms like Charcot-Marie-Tooth disease, aiming to correct underlying genetic defects. Managing neuropathic pain involves a multimodal strategy combining pharmacological and non-pharmacological approaches. Furthermore, advanced imaging techniques like Magnetic Resonance Neurography are becoming indispensable for accurate diagnosis, localization of nerve lesions, and guiding treatment strategies for various neuropathy types. The global burden of peripheral neuropathy necessitates identifying modifiable risk factors and implementing early interventions for prevention.

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