

General

Meralgia Paresthetica Review: Update on Presentation, Pathophysiology, and Treatment

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Purpose of Review

Meralgia paresthetica (MP) is a condition characterized by paresthesias, neuropathic pain, and alterations in sensorium of the anterolateral thigh secondary to impingement of the lateral femoral cutaneous nerve (LFCN). MP is generally diagnosed by clinical history and is often a diagnosis of exclusion. When diagnosis remains a challenge, diagnostic modalities such as ultrasound, MRI, electromyography, and nerve conduction studies have been utilized as an adjunct. This review summarizes the most recent medical literature regarding MP, its pathophysiology, presentation, and current treatment options.

Recent Findings

Treatment options for patients with MP range from lifestyle modifications and conservative management to surgical procedures. Initial management is often conservative with symptoms managed with medications. When conservative management fails, the next step is regional blocks followed by surgical management. The conflicting data for treatment options for MP highlight how the evidence available does not point to a single approach that's universally effective for treating all patients with MP.

Summary

Despite the apparent success at treating MP with regional blocks and surgical interventions, much remains to be known about the dosing, frequency, and optimal interventions due to the inconclusive results of current studies. Further research including randomized controlled trials are needed to better understand the most optimal treatment options for MP including studies with a larger number of participants.

INTRODUCTION

Meralgia paresthetica (MP) is a condition characterized by paresthesias, neuropathic pain, and alterations in the sensorium of the anterolateral thigh secondary to impinge-

ment of the lateral femoral cutaneous nerve (LFCN). It was first discovered in the late 1880s by Bernhardt and Roth who each independently published on the phenomenon.¹ While initially referred to as Bernhardt-Roth syndrome, the name "meralgia paresthetica" termed by Roth was adopted

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soon thereafter, derived from the Greek words “meros” and “algos,” meaning “thigh” and “pain,” respectively.^{1,2}

Although MP can present during any stage of life including childhood, it most often presents in the 5th decade of life and is more common in males.^{2,3} Patients with MP often present with subacute onset of pain of the anterolateral thigh which can be described as a burning, stinging or tingling sensation that is exacerbated even with light touch.^{4,5} Diagnosis often relies on clinically history alone but can be aided by imaging and nerve conduction studies.^{4,5} The majority of patients are managed conservatively with lifestyle modification, topical and oral analgesics, and injections with definitive surgical management reserved for refractory cases.^{4,5} In this review article, we explore MP with a focus on the clinical presentation, diagnosis, treatment, and prognosis.

PATHOPHYSIOLOGY

MP is attributed to the impingement of the lateral femoral cutaneous nerve (LFCN), a purely sensory nerve branch derived from the posterior divisions of the anterior rami of the L2 and L3 spinal nerves.⁶⁻⁸ As the nerve travels down the pelvis and lateral to the psoas muscle, it crosses the iliacus before passing beneath the inguinal ligament. The LFCN then traverses medial to the anterior superior iliac spine (ASIS), ultimately piercing the fascia lata before giving rise to its terminal cutaneous branches.^{6,7,9-11} Of note, the majority of cases are attributed to insults at the level of the inguinal ligament.¹⁰

Multiple diagnostic modalities have been investigated to evaluate pre- and post-evidence of pathologic changes secondary to MP; these pathological changes include polarized internodal swelling and endoneural vascular thickening, suggestive of a mechanistic injury pattern consistent with local demyelination and Wallerian degeneration.¹⁰ Ultrasound findings of MP include LFCN hypoechogenicity, anomalous perineurial borders, intraneural vascularity, enlarged neural cross sections, and diffuse focal thickening proximal to the anterior superior iliac spine (ASIS).^{12,13} Similar pathologic changes have been investigated with MRI neurography demonstrating persistent high signaling of the LFCN, nerve enlargement, and abnormal fat stranding all serving as indicators of potential injury.¹⁴

EPIDEMIOLOGY

Although cases of MP have been reported in all age groups, the condition primarily affects middle-aged adults in their fifth decade of life.¹⁵⁻¹⁹ Data are sparse and varied regarding the incidence of MP; for example, one study examined MP in a primary care cohort from 1990 to 1998 in the Netherlands found the incidence to be 4.3 per 10,000 person-years.²⁰ Additionally, another population based study in Minnesota from 1990 to 1999 reported an incidence of 32.6 per 100,000 patient years.²¹ Finally, population and hospital-based studies from 2004-2011 reported an incidence of MP between 32.6-43/100,000 people.^{18,22} Interestingly, in the United States military, incidence rates are al-

most twice the average rate with the incidence being 62/100,000 service members.²³ It is thought that this near doubling of incidence is due to prolonged load carriage, potentially leading to increased compression of the LFCN.²³

While MP can occur secondary to stretching of the LFCN alone, many patients have predisposing risk factors that make them more susceptible.⁷ Common risk factors include obesity, diabetes, pregnancy, tight fitting clothing, toxins (lead and alcohol), infectious diseases (acquired immunodeficiency syndrome and leprosy), trauma, iatrogenic (direct surgical injury, prolonged prone positioning, and inadequate padding), and mass effect causing direct impingement on the nerve.^{6-8,10,11} Furthermore, anatomical variations have been described in the literature, with certain patterns, including an anterior or posterior relation of the LFCN to the ASIS, conferring higher rates of developing MP with an estimated 25% of patients having an anatomical variant of the LFCN.^{10,11}

Patients with an elevated body mass index (BMI) show an increased odds ratio of developing MP ranging from 1.2-1.83 (OR 1.2, 95% CI 1.04-1.44, OR 1.83, 95% CI 1.02-3.29).^{18,19} The average BMI in patients diagnosed with MP is 28.0-33.8 kg/m², and in patients with a BMI \geq 30 kg/m², there is nearly a doubling of the risk of developing MP compared to age and sex-matched controls, likely due to increased compression along the LFCN.^{18,24} Additionally, obese individuals may be more vulnerable to occupational factors affecting the LFCN, such as jobs where patients wear a seatbelt, tight clothing, or are standing for long periods of time.^{17,23} The co-occurrence of diabetes mellitus (DM) has also been investigated as a risk factor. A population-based study in Olmsted County, Minnesota examined 262 patients diagnosed with MP and found that patients with DM have almost 7.5 times higher rates of MP than the general population.¹⁸ Other studies that have found no association between DM and MP, but it may be due to differences in study populations and sources of data.²² Moreover, age is a risk factor with the average age of diagnosis being 49.8 \pm 12.8 years.¹⁷ Peak incidences for each gender differ and are between 41-50 years old for men and 51-60 years old for women.^{17,25,26} Despite studies reporting an increased prevalence of MP among males, the literature surrounding sex as a risk factor is inconclusive.^{17,22,27-29} Unfortunately, there have only been a limited number of cases of adolescent MP that have been documented, and adolescents may have different risk factors than those in middle-aged adults. About 39% of adolescents being treated for osteoid osteoma lesions at the hip subsequently develop MP with BMI being an unrelated factor.^{30,31}

Iatrogenic MP can also be seen in patients who underwent prone positioning during surgery or during a stay in the intensive care unit (ICU), with the incidence ranging from 10.3-23.8%.^{15,19,28,32-36} Spinal surgeries such as thoracic and lumbar laminectomies have higher incidences of MP than other prone positioning surgeries, with risk factors including surgical times longer than 3.5 hours and an elevated BMI.^{19,28,32}

CLINICAL FEATURES

Patients with MP commonly present with persistent or intermittent dysesthesia or paresthesia. Common sensations include numbness, burning, aching or pain in the anterolateral aspect of the thigh.²⁷ Patients often describe a “shooting” pain or a “troublesome tingling and itch-like sensation” that is localized to one thigh.^{25,37} This pain typically worsens with prolonged sitting, standing, or extending the hips.^{27,38} Patients describe an increased sensitivity to clothing and are unable to tolerate tight clothing or carrying keys in the pockets on the side of dysesthesia.³⁹⁻⁴¹ A comparative study that examined 120 cases of MP found no difference in symptoms based on right or left thigh localization.⁴²

The duration of MP can vary drastically, as symptoms can range from 0.5 months to 20 years.⁴² The mean duration of MP is 34 months with 36% of cases experiencing symptoms lasting from 12 months to 5 years.⁴² Of the cases evaluated, nearly 73% involved the lateral aspect of the thigh, and 26% of cases involved the anterior aspect of the thigh.⁴² The area of paresthesia typically does not extend past the medial line of the anterior thigh, and some patients may report lower lateral pain that is distinct from their thigh paresthesia.^{40,42} While most patients present with unilateral symptoms, bilateral presentation has been documented in about 10-18% of cases.^{33,42,43} Although patients with bilateral MP commonly present with the same clinical symptoms, there is the possibility of distinct etiology.^{33,36}

Patients with iatrogenic MP present similarly to those with spontaneous MP.^{15,42} These patients can have symptoms that emerge on the same day as the surgery or even several months later with 92% of patients reporting initial symptoms within the first 12 hours.^{15,33}

DIAGNOSIS

Diagnosis of MP is often clinical based on symptomatology with evidence of sensory nerve changes but preservation of motor nerve function. The neuropathy is typically unilateral in nature and more commonly observed in males as compared to females.⁴⁴ Patients commonly present with pain, paresthesias and burning in the affected region. They can also experience diminished sensation of pain, heat, and touch.⁴⁴ Symptoms can be exacerbated by light touch (e.g., from tight clothing) or sleeping on the affected side and alleviated with thigh flexion.⁴⁴ If severe enough, patients can experience limitations on their mobility and walk with a limp secondary to pain.⁴⁴

In the presence of symptoms, particularly atypical symptoms, diagnosis can be made using sensory nerve velocity studies. Testing will show evidence of nerve compression when compared against the unaffected side. However, even in patients of average body mass, performing such studies can be difficult.⁴⁵ Electromyographic studies can also be used to rule out other causes of neuropathy. Ultrasound imaging, as well as CT or MRI can also be utilized to visualize nerve compression. Clinical suspicion for the condi-

tion should be high in patients with chronic metabolic disease (e.g., obesity and diabetes) who present with chronic neuropathy that is unresponsive to conservative management.⁴⁶

DIFFERENTIAL DIAGNOSIS

MP can present similarly to other neuropathies or radiculopathies depending on its severity. For this reason, diagnosis can be delayed by several months to years. The differential diagnosis for MP includes neuropathies of the upper lumbar plexus, as well as femoral neuropathy, pelvic tumors and metastases, and chronic appendicitis.^{44,47} Like MP, radiculopathy of the lumbar plexus presents with nerve pain; however, it is typically associated with back pain of the affected region (e.g., secondary to disk herniation) with paresthesia radiating along the associated nerve fibers. Lumbar pathology can be cause both sensory and motor deficits depending on the nerve fibers affected, while MP causes only sensory deficits.

Femoral neuropathy presents similarly to MP with nerve pain. However, its etiology differs, as it can arise secondary to surgery of the abdomen, hip and pelvis from iatrogenic injury, lithotomy positioning, local ischemia, or trochar insertion.⁴⁵ Procedures requiring femoral catheterization can also increase the risk of hematoma formation and neuropathy development. Patients can present with unilateral knee pain, weakness, loss of knee extension, and loss of the patellar reflex.⁴⁵ Similar to the aforementioned conditions, pelvic tumors and metastases can also cause neuropathic pain, depending on their size and location. However, lesions can cause abdominal pain, pressure and distention, as well as nausea and vomiting. In the context of the associated malignancy, patients can develop weight loss, fatigue, and generalized weakness. Finally, chronic appendicitis is a rare condition and an uncommon cause of nerve pain. It occurs secondary to appendiceal obstruction (e.g., fecalith, lymphoid hyperplasia, foreign bodies, and tumors).⁴⁸ Patients may present with right lower quadrant abdominal pain.

TREATMENT

Treatment options for patients with MP range from lifestyle modifications and conservative management to surgical procedures (Table 1). Since most patients experience spontaneous recovery, conservative management is often the first-line treatment.^{49,50} Initial recommendations include lifestyle modifications such as avoidance of tight-fitting garments that compress the area around the waist and discussions about weight loss when appropriate.⁵¹ Symptoms are managed conservatively with medications including analgesics and nonsteroidal anti-inflammatory agents.^{51, 52} An observational study including 277 patients reported that 50% of patients experienced satisfactory relief with these lifestyle modifications and conservative measures alone.⁵² Tricyclic antidepressants and anticonvulsive agents have also been documented as pharmacologic treatments used for symptom relief although the efficacy of

these have not been systematically studied in MP.⁵³ Topical capsaicin has been used to treat surface hypersensitivity.⁵⁴ Transcutaneous electrical nerve stimulation (TENS) has been employed in patients with more disabling symptoms.⁵⁵

When conservative management fails, patients commonly transition to treatment with regional nerve blocks. Multimodal approaches combining corticosteroid injections of the LFCN with conservative pharmacologic treatments have been reported to have success rates between 85-91%.^{52,56} Ultrasound (US) technology is useful to correctly localize the LFCN and accurately guide the injection.⁵⁷ This is important because blind injection can have a failure rate of up to 60% due to the anatomic variability of the LFCN.⁵⁸

US-guided injections of the LFCN are most commonly a combination of a steroid and a local anesthetic.^{56,57,59,60} In a prospective study from 2020, 14 (82%) out of 17 patients treated with a single US-guided injection of the LFCN had significant decrease in pain symptoms.⁵⁹ Another study followed 20 patients treated with US-guided injections of the LFCN at three different levels for 12 months and found that 15 (75%) patients had complete resolution of symptoms and the remaining 5 (25%) had partial resolution of symptoms after a mean of 2.25 injections.⁵⁷ Other studies similarly report requiring multiple injections to achieve complete symptom resolution.^{56,60,61} Despite the apparent overall high success of local injections in treating patients with MP, there has yet to be a consensus in the literature on the frequency of injections and the dosage of the medications used.

The first case reporting the successful use of pulsed radiofrequency (PRF) neuromodulation of the LFCN in MP was in 2009.⁶² A single treatment with PRF resulted in complete pain relief that was sustained after 6 months without any evident side effects.⁶² A case report of a single patient who experienced complete resolution of symptoms after a second PRF procedure points to the possible benefit of repeating the procedure to achieve long-term relief.⁶³ A retrospective study reviewed clinical outcomes of PRF in 11 patients with intractable meralgia paresthetica and reported complete pain relief in 63.6% of patients, with the rest experiencing >50% pain reduction.⁶⁴

The available evidence in support of interventional pain procedures including peripheral nerve stimulation (PNS) and spinal cord stimulation (SCS) in the treatment of meralgia paresthetica is scarce. In a retrospective study of patients treated with implantable PNS systems over 30 years for the diagnosis of complex regional pain syndrome (CRPS), only one out of 165 patients had a PNS implant targeting the LFCN.⁶⁵ More recently, a case report described the novel use of a PNS implanted along the course of the LFCN in a patient with severe refractory MP.⁶⁶ The implanted device resulted in immediate pain relief that was sustained at a 3-month follow-up evaluation.⁶⁶ The use of an SCS for the treatment of meralgia paresthetica has only been reported once in the literature.^{67,68} After the implantation of the device, the patient reported nearly complete pain relief at 8 months with no reported adverse effects.⁶⁷

Although further studies are needed to firmly elucidate the long-term effectiveness and safety of these treatments, PNS and SCS are promising minimally invasive alternatives to surgery.

The main two surgical procedures performed in patients with MP are neurolysis and neurectomy. A retrospective cohort study of 16 patients reported complete pain relief in 75% of patients who underwent primary neurectomy compared to 60% of those who underwent primary neurolysis.⁶⁹ A higher success rate in patients undergoing neurectomy was also reported in a prospective cohort study on 22 patients.⁷⁰ In this study, complete or almost complete recovery was reported in 93.3% of neurectomy cases while only 37.5% of neurolysis cases achieved the same result.⁷⁰ In a study evaluating 14 patients after neurectomy or neurolysis, all patients treated with neurectomy had complete pain relief without recurrence while those who were treated with neurolysis had recurrence of symptoms within 9 months.⁷¹ Symptom recurrence was not observed 19 months postoperatively in patients treated with microsurgical deep decompression of the LFCN.⁷²

Neurolysis was highly favored by one retrospective study which reported complete or partial improvement in 78% of patients treated with neurolysis while only 35.7% of patients treated with neurectomy reported improvement.⁷³ This study reserved neurectomy for patients who had failed neurolysis in the past, had neuroma formation, or had extensive deformation of the nerve.⁷³ The higher complexity in these cases may have played a role in the lower success rate seen with neurectomy.⁷⁴ While the majority of available studies seem to favor neurectomy as a treatment, the evidence is still insufficient to firmly recommend one treatment over the other.

A recent meta-analysis compared outcomes in patients treated with injection, neurolysis, or neurectomy.⁷⁵ The study found the incidence of complete pain relief was significantly higher after neurectomy, followed by neurolysis and then injection.⁷⁵ Importantly, no statistically significant differences were found regarding incidence of complications between the three modalities.⁷⁵ Although this study suggests neurectomy is the most effective procedure, a different meta-analysis compared the outcomes of US-guided injections and surgery and found no statistically significant difference between the two modalities.⁷⁶ The conflicting results in these studies highlight how the evidence available does not point to a single approach that's universally effective for all patients with MP. Given the lack of consensus over the most effective treatment modality, patient preference should be a key consideration when selecting a treatment.

PROGNOSIS

Complications of MP can include permanent, debilitating anterolateral thigh nerve damage that can limit functional capacity and mobility due to pain. In many cases, MP can be improved with conservative management. For patients with severe refractory symptoms that are not improved with the aforementioned treatments, conditions can be improved

Table 1. Clinical Efficacy and Safety of Treatments for Meralgia Paresthetica

Author and Year	Groups Studied and Intervention	Results and Findings	Conclusions
Williams et al. 1991	277 patients were treated with a combination of conservative treatments, steroid injections, and surgical procedures.	Conservative treatments combined with injections successfully relieved symptoms in 91% of 277 patients, while the remaining 24 patients required surgical treatment.	Most patients with MP will not require surgical intervention.
Puig et al. 1995	One patient was treated with topical 0.025% capsaicin cream 5 times daily.	Symptoms were markedly relieved after five days but returned after medication was stopped.	Topical capsaicin can provide symptomatic relief; however larger trials would be beneficial to confirm effect.
Fisher et al. 1987	Three pregnant patients were treated by TENS.	All three patients had complete resolution of symptoms postpartum.	TENS may be an effective treatment for MP; however, in this study the cessation of pregnancy may have also helped with symptom resolution.
Dureja et al. 1995	40 patients were treated with a minimum of 5 LFCN blocks and diphenhydantoin 100 -300 mg daily for 10-12 weeks.	85% of patients experienced complete relief within 10 weeks, 5% had partial relief, and 10% showed no relief with up to six months of treatment.	Most patients with MP were successfully treated with a combination of conservative management and local injections.
Klauser et al. 2016	20 patients were treated with US-guided injection of steroids along the LFCN at three different levels in a mean of 2.25 sessions.	75% of patients had complete resolution of symptoms and the remaining 25% had partial resolution of symptoms.	US-guided injection of corticosteroids at multiple levels of the LFCN can lead to sustained symptom resolution.
Kiliç et al. 2020	Three groups were compared: single-dose US-guided LFCN injection (n=17) vs. TENS (n=16) vs. sham TENS (n=21).	Patients treated with US-guided LFCN injection experienced more pain relief compared to the other groups.	Both US-guided injections and TENS of the LFCN can have a therapeutic effect; however, US-guided injections show greater benefits.
Tagliafico et al. 2011	20 patients were treated with one or two US-guided injections of the LFCN.	80% of patients experienced diminishing symptoms after a single injection while 20% of patients required a second injection for symptom relief.	Some patients may experience sustained symptom relief after a single nerve block while other require successive nerve blocks for sustained relief.
Haim et al. 2006	79 patients were treated with conservative management, nerve blocks, or surgery.	21 out of 79 patients responded to conservative management. Out of the 58 treated with nerve blocks, 48 had complete symptom resolution after up to three injections.	Patients may require repeated nerve blocks for symptom relief.
Su et al. 2020	One patient was treated with US-guided nerve hydrodissection of the LFCN using D5W during seven sessions of injections for two months.	Patient successfully recovered after treatment.	US-guided nerve hydrodissection is an emerging treatment; however, larger studies to confirm its efficacy are needed.
Philip et al. 2009	One patient was treated with pulsed radiofrequency (PRF) of the LFCN at 42°C for 120 seconds.	The patient experienced complete and sustained cessation of pain without evident side effects.	PRF of the LFCN may be an effective and safe treatment in refractory cases.
Dalmau-Carolà 2009	Two patients were treated with PRF of the LFCN.	One patient received two PRF treatments which resulted in total relief sustained at two years' follow-up. The second patient was pain free after one PRF treatment.	PRF of the LFCN can result in sustained pain relief in patients.
Lee et al. 2016	11 patients underwent PRF of the LFCN.	63.6% of the patient reported complete pain relief while the remaining patients experienced >50% pain reduction. No complications were observed.	PRF of the LFCN can result in immediate and sustained pain relief without complications.

Author and Year	Groups Studied and Intervention	Results and Findings	Conclusions
Perryman et al. 2018	A patient underwent placement of a wireless peripheral nerve stimulator along the LFCN.	The patient reported immediate pain relief that was sustained at a three month follow-up evaluation.	Wireless PNS may be an effective intervention; however, larger studies are required to better understand its efficacy and safety.
Barna et al. 2005	A patient is treated with an implantable spinal cord stimulator.	Patient reported 100% pain relief and improved functional status.	An implantable spinal cord stimulator led to complete symptom resolution.
Ruiter et al. 2012	16 patients were treated with neurolysis or neurectomy.	60% of patients who underwent neurolysis had complete pain relief while 75% of patients who underwent neurectomy had complete pain relief.	Neurectomy was slightly more effective than neurolysis in the treatment of MP.
Ruiter et al. 2015	22 patients were followed prospectively and assessed six weeks after neurolysis or neurectomy.	Complete recovery or almost complete recovery was seen in 37.5% of neurolysis cases and in 93.3% of neurectomy cases.	Neurectomy was more effective in treating MP than neurolysis.
Emamhadi 2012	14 patients were treated with neurolysis (5) or neurectomy (9).	All patients who underwent neurectomy had complete pain relief without recurrence while those who underwent neurolysis had recurrence of symptoms within nine months.	Patients treated with neurectomy have a lower incidence of symptom recurrence than patients treated with neurolysis.
Benezis et al. 2007	167 cases were treated with either neurolysis (153) or neurectomy (14).	78% of patients treated with neurolysis reported complete or partial improvement while only 35.7% of patients treated with neurectomy reported improvement.	Neurolysis was more effective in treating MP than neurectomy; however, differences between the two treatment groups make the comparison difficult.
Morimoto et al. 2018	12 patients were treated with microsurgical deep decompression of the LFCN.	All patients reported symptom improvement with complete relief in nine (75%) patients and partial relief in three (25%) patients.	Microsurgical deep decompression can effectively treat MP.

with surgical nerve decompression, although success rates can vary. Cases caused by pregnancy typically resolve after delivery.

CONCLUSION

MP is a sensory mononeuropathy of the anterolateral thigh, that is characterized by paresthesias, numbness, altered sensorium and burning pain. MP has been associated with numerous risk factors and inciting triggers, many of which are modifiable, that can contribute to the development of these debilitating symptoms. MP is generally diagnosed by clinical history and is often a diagnosis of exclusion. When diagnosis remains a challenge, diagnostic modalities such as ultrasound, MRI, electromyography, and nerve conduction studies have been utilized as an adjunct. MP can sometimes be misdiagnosed with other pathologic processes such femoral and lumbar neuropathies, trochanteric bursitis, herpes zoster, and osteoarthritis of the hip.

The prognosis of MP is generally good as most cases resolve spontaneously or respond to conservative management (lifestyle modification, medications, physical therapy, and injections). When surgical intervention is warranted,

outcomes are generally favorable with most patients experiencing complete resolution of their symptoms. Despite the inherent risks associated with undergoing LFCN neurolysis and decompression, complications are low, making this a favorable option for those who have failed conventional treatment. While there are currently several effective means for management of MP, further efforts should be aimed at identifying individuals at high risk of developing MP and addressing any modifiable risk factors. Further studies are required to better evaluate the optimal treatment and dosing for the management of MP.

AUTHOR CONTRIBUTIONS

All authors were involved in the writing and editing of the manuscript.

DISCLOSURES

There are no conflict of interests with the authors.

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