Case Report

A CASE OF MERALGIA PARESTHETICA TREATED WITH OZONE THERAPY

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ABSTRACT

Meralgia paresthetica (MP) is a clinical condition of growing interest, mainly because it can affect a wide range of patients and is associated with abdominal and pelvic surgeries. This neuropathy occurs due to compression or irritation of the Lateral Femoral Cutaneous Nerve (LFCN), which is responsible for sensitivity in the outer part of the thigh. Local infiltration treatments typically use anesthetics and corticosteroids. In the presented case, a mixture of oxygen-ozone (O_2-O_3) at 20 µg/ml was injected locally, with a total of 8 cc and a single treatment.

KEYWORDS: *meralgia paresthetica, neuropathy, abdominal and pelvic surgery, oxygen, ozone*

INTRODUCTION

Meralgia paresthetica (MP) is a rare neuropathy caused by the compression of the Lateral Femoral Cutaneous Nerve (LFCN), which occurs in the region where the nerve passes through the inguinal ligament on its way from the pelvis to the thigh. The specific anatomy of this region explains the clinical presentation characterized by sensitivity alterations, burning pain, and dysesthesias in the anterior and lateral aspects of the thigh (1-5).

The term "meralgia" comes from the combination of the Greek words “meros” (thigh) and “algos” (pain), reflecting the main symptomatology of this condition; it was first described in 1885 by Hager and subsequently by Bernhardt and Roth in 1895, from which the condition is sometimes referred to as Bernhardt-Roth syndrome or Roth syndrome (6, 7). These early studies highlighted the association of MP with the use of "binds" or bands for the confinement of inguinal hernias before the era of modern surgical techniques. These devices, which exerted pressure on the pelvis and thigh, were a common cause of nerve compression and contributed to the development of this neuropathy (8-22).

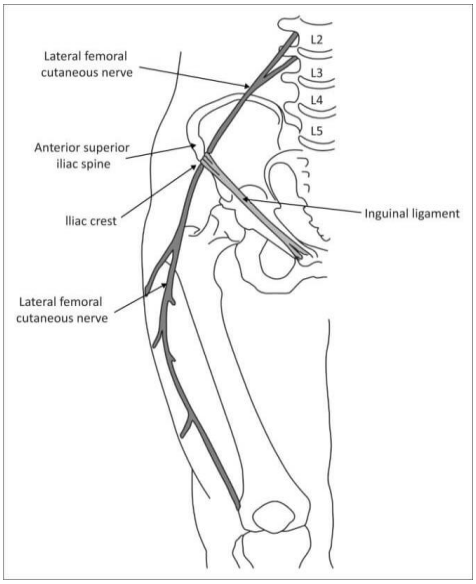
MP continues to be relevant primarily due to its association with abdominal and pelvic wall surgical procedures, as well as with medical conditions and risk factors such as obesity and diabetes. Therefore, understanding and managing MP is crucial to alleviating patient discomfort and improving postoperative and clinical outcomes.

Anatomy

The LFCN is a purely sensory nerve that provides innervation to the skin of the anterior and lateral aspects of the thigh. It originates from the anterior ramus of the second lumbar nerve (L2) of the lumbar plexus, with fibers also coming from the third lumbar nerve (L3). This nerve is characterized by its early autonomy, separating from other fibers of the lumbar plexus as it travels along the lateral margin of the psoas major muscle (Fig. 1).

Received: 8 June 2024
Accepted: 2 July 2024

Fig. 1. *Anatomy of the lateral femoral cutaneous nerve.*



After crossing the iliac fossa, the LFCN exits the pelvis by piercing the lower abdominal fascia, located just below the Anterior Superior Iliac Spine (ASIS) and the Inguinal Ligament (IL), with which the nerve is often closely associated. In this region, the nerve comes into direct contact with the fascia of the sartorius muscle and divides into two branches: an anterior branch and a posterior branch. These branches innervate the anterior and lateral portions of the thigh, respectively.

It is important to note the anatomical variability of the nerve's course, with up to five documented variations (10). In the majority of cases (about 80%), the nerve emerges below the inguinal ligament and medially to the ASIS. This position is crucial for understanding the etiology of nerve injury, as any compression or irritation in this area can significantly affect the function of the LFCN and lead to the symptoms of MP (3).

ETIOLOGY

MP can arise from a variety of factors, which can be divided into two main categories: idiopathic and iatrogenic.

Idiopathic origin

The idiopathic causes are directly attributable to mechanical and metabolic factors that cause compression of the LFCN, such as:

- obesity: excess body weight can exert additional pressure on the nerve region, contributing to compression and associated symptoms (22);
- pregnancy: physiological and structural changes during pregnancy may predispose to nerve compression;
- constrictive clothing: prolonged use of tight clothing or uniforms can apply direct pressure on the nerve region (19), causing symptoms;
- anatomical and mechanical alterations: conditions such as scoliosis, lower limb discrepancies, and other spinning-pelvic mechanical anomalies can alter the normal course of the nerve, predisposing it to compression;
- metabolic factors: diseases such as diabetes mellitus and alcoholism, along with conditions like lead poisoning, can affect nerve functionality through metabolic and toxic mechanisms.

Iatrogenic origin

Iatrogenic causes are related to surgical procedures and medical practices that can cause compression or irritation of the nerve, such as:

- open or endoscopic abdominal surgery: procedures such as hernioplasty, laparotomy, and other abdominal operations can lead to compression of the lateral cutaneous nerve of the thigh, especially if excessive pressure is applied during the operation.

- orthopedic surgery: during anterior approach hip arthroplasty, the nerve may become compressed or irritated (2, 5, 11).
- spinal surgery: prolonged prone positioning of the patient during spinal surgery can exert pressure on the nerve. Additionally, procedures involving the iliac crest, such as bone graft harvesting, can contribute to nerve compression.

CLINICAL

MP presents with a series of characteristic symptoms primarily affecting the anterior and lateral regions of the thigh (12, 16). Diagnosis can be complex due to symptoms that overlap with other conditions. The main symptoms include burning pain, the most common symptom affecting the anterior and lateral thighs. This pain can be continuous or intermittent and tends to worsen with physical activity. There may be accompanying sensations of tingling, numbness, or altered sensitivity in the same area (dysesthesias).

Differential diagnosis

Diagnosis can be challenging due to symptoms similar to those of other medical conditions. Conditions that may present with similar symptoms include:

- spinal and radicular disorders: lumbar disc diseases and spinal stenosis may cause symptoms similar to those of meralgia paresthetica, such as pain and sensory changes in the thigh region;
- chronic neurological disorders: polyneuropathy may present with symptoms of tingling and pain in the thigh, necessitating accurate differentiation;
- hip joint disorders: MP may complicate or be confused with hip joint disorders, such as femoroacetabular impingement, trochanteric bursitis, and coxofemoral osteoarthritis.

Diagnosis

Diagnosis requires a comprehensive clinical evaluation that includes the following:

- history and physical examination*:* a detailed history and physical examination to identify the pattern of pain and dysesthesias and to exclude other conditions;
- diagnostic tests*:* in some cases, diagnostic tests such as nerve conduction studies or electromyography may be necessary to confirm the diagnosis and exclude other neuropathies;
- imaging*:* imaging techniques, such as ultrasound or magnetic resonance imaging (MRI), may be useful to exclude other conditions and visualize nerve compression if present.

Clinical-diagnostic tests for MP

Diagnosis of MP can be confirmed and differentiated from other conditions through various clinical-diagnostic tests; the three main tests used are:

- Pelvic compression test: the patient is positioned on the healthy side, and the examiner positions themselves on the symptomatic side and applies downward compression on the pelvis for at least 30 seconds.
    - Interpretation:
        - if the patient reports a reduction in symptoms during or immediately after the compression, the test is considered positive;
        - this result suggests that compression reduces tension on the inguinal ligament and, consequently, compression of the lateral cutaneous nerve of the thigh;
        - the sensitivity of this test is generally considered very high, making it useful for confirming the presence of MP.
- Tinel sign or percussion of the nerve: an orthopedic hammer is used to gently strike the area of compression of the lateral cutaneous nerve of the thigh.
    - Interpretation:
        - if the nerve is particularly inflamed, percussion may provoke a sensation of electric shock or sharp pain.

These clinical-diagnostic tests offer a practical approach to identify MP and guide therapeutic management.

Diagnostic exams

To confirm the diagnosis, conducting neurophysiological and imaging exams is essential.

- Neurophysiological exams:
  - Sensory neurography: this test measures the conduction velocity and amplitude of the potential evoked by the lateral cutaneous nerve of the thigh. It is useful for assessing nerve function and identifying signs of damage or compression. Sensory neurography can help confirm the diagnosis of MP and differentiate the condition from other neuropathies.
- Imaging exams:
  - pelvic X-ray: used to exclude the presence of bone neoplasms, calcifications of the inguinal ligament, or other bone abnormalities that could contribute to nerve compression.
  - ultrasound: ultrasound of the lateral cutaneous nerve of the thigh can provide detailed images of the nerve structure and identify signs of compression, inflammation, or injury (13).
  - Magnetic Resonance Imaging (MRI): MRI provides an excellent view of soft tissues (1) and can reveal compressions or abnormalities not visible on X-ray. MRI can be used to exclude other conditions and confirm the presence of nerve compression.

TREATMENT

The choice of treatment depends on the severity of symptoms, the underlying cause, and the response to initial therapies.

Non-invasive treatment

1. Lifestyle modifications:
   - avoid compression: identify and modify habits that may contribute to nerve compression, such as wearing tight clothing, carrying heavy backpacks, or improper positioning.
   - weight management: weight loss can reduce pressure on the nerve and alleviate symptoms.
2. Pharmacological approach:
   - neurotropic drugs: used to improve nerve function and reduce pain. Analgesics and non-steroidal anti-inflammatory drugs (NSAIDs) can be useful for managing pain.
3. Physical therapy and osteopathy:
   - manipulations and stretching of the muscles and tendons can help reduce compression and improve mobility, techniques to improve flexibility and reduce tension in skeletal and musculo-tendinous segments.

Pain therapies

1. Pulsed radiofrequency ablation:
   - technique: uses radiofrequency energy to heat and deactivate nerve tissue, reducing pain (17). The procedure is guided by ultrasound for greater precision and safety (18).
2. Nerve anesthetic block:
   - anesthetic injections: provide temporary relief from symptoms and can aid in diagnosis and treatment planning.

Surgical treatment

1. Nerve neurolysis:
   - the procedure includes abdominal fasciotomy and partial detachment of the inguinal ligament until complete release of the nerve and its branches. It aims to remove compression and restore nerve function (15, 18, 20). The possibility of recurrence is approximately 20%.
2. Neurectomy:
   - the procedure involves isolation and resection of the nerve for a segment of at least 3 cm (21). It is a more invasive solution that eliminates nerve function in the affected area and leads to permanent loss of sensitivity in the nerve's area of competence (4).

CASE REPORT

A case is described of an obese patient treated for MP through an O_2-O_3 guided by an X-ray. In June 2024, a 43-year-old obese male patient came to our clinic, reporting a loss of sensation on the lateral side of the thigh and painful "shock-like" dysesthesias on the anterior side of the right thigh. The symptoms began shortly after undergoing bariatric surgery, which ended with the temporary placement of an abdominal-pelvic containment belt. This belt was maintained in place with moderate compression for over three hours.

In the following months, the patient underwent osteopathic treatment, non-steroidal anti-inflammatory drugs (NSAIDs), and had a lumbar MRI and electromyography performed (Table II). The latter reported a diagnosis of injury to the saphenous nerve and, thus, possible meralgia paresthetica.

Table II. *Results of electronuromyography and electromyography performed on the patient, accompanied by clinical interpretation of the findings.*

ELECTRONEUROGRAPHY

Sensory conduction velocity

Nerve and Site	Latency on Set ms	Peak latency ms	Width µV	Segment	Distance mnt	VDC ms
Lateral femoral cutaneus. S						
Above inguinal ligam	1.9	2.6	2	Above inguinal ligament - Thigh	120	63
Lateral femoral cutaneous.D						
Above inguinal ligam	NR	NR	NR	Above inguinal ligament - Thigh		

ELECTROMYOGRAPHY

Muscle	Inserz	Fibril	Fasciculations	Other	Width	Duration	Polifasic	Rccl
Right Iliopsoas	0	0	0		Norm	Norm	No	Norm
Right rectus femoris	0	0	0		Norm	Norm	No	Norm
Right adductor magnus	0	0	0		Norm	Norm	No	Norm

CONCLUSIONS

Examination limited by adipose tissue. As far as assessable, there is present SAP of the left lateral femoral cutaneous nerve, while a clear and reproducible response from the right lateral femoral cutaneous nerve is absent. The musculature dependent on L3 is normal. Findings overall suggestive of meralgia paresthetica.

An L3-L4 protrusive discopathy with right L3 foraminal conflict was also present on the MRI. After clinical evaluation, the performance of some clinical tests, and the collection of medical history, the therapeutic choice was to perform an X-ray guided injection (fluoroscopy) with O_2-O_3 (20 µg/ml) in the inferomedial region at the Anterior Superior Iliac Spine (ASIS) (Fig. 3).

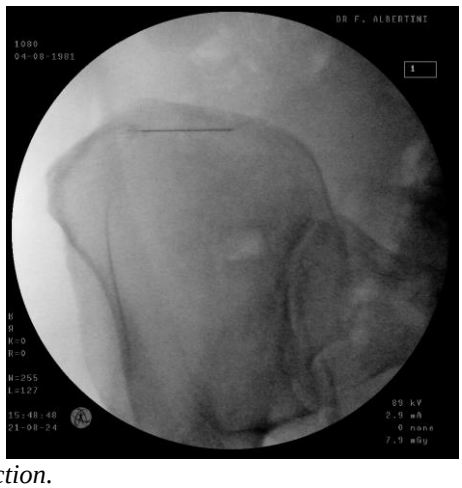


Fig. 3. *Scopic control of the O_2-O_3 injection.*

The patient experienced gradual improvement one week after the treatment, culminating in the complete disappearance of pain. By the twentieth day, there was also a partial reduction in the sensory deficit. The results were reassessed at 30, 60, and 90 days following the injection, consistently confirming the benefit.

DISCUSSION

Much of the therapeutic potential of O_2-O_3 therapy in pain management is attributed to its multimodal mechanism of action. The most fundamental mechanism involves the oxygenation of the treated tissue and the restoration of cellular redox balance. In addition, ozone regulates the local antioxidant system, thereby reducing the inflammatory response and improving the management of ischemia/reperfusion processes. Several studies have confirmed its anti-inflammatory properties, as well as its anti-edematous, regenerative effects on nerves, and analgesic effects (9, 22-25).

CONCLUSIONS

MP is a complex and multifactorial condition that requires particular attention both in the diagnostic and therapeutic phases. Local infiltrative therapy with O_2-O_3 should always be considered in cases that can avoid surgical treatment.

REFERENCES

1. Ally RM, Velleman MD, Suleman FE. Meralgia paresthetica: Now showing on 3T magnetic resonance neurography. *SA journal of radiology*. 2019;23(1). doi:https://doi.org/10.4102/sajr.v23i1.1745
2. Dellon AL, Mont M, Ducic I. Involvement of the Lateral Femoral Cutaneous Nerve as Source of Persistent Pain After Total Hip Arthroplasty. *The Journal of Arthroplasty*. 2008;23(3):480-485. doi:https://doi.org/10.1016/j.arth.2007.04.027
3. Aszmann OC, Dellon ES, A. Lee Dellon. Anatomical Course of the Lateral Femoral Cutaneous Nerve and Its Susceptibility to Compression and Injury. *Plastic and reconstructive surgery*. 1997;100(3):600-604. doi:https://doi.org/10.1097/00006534-199709000-00008
4. Ataizi ZS, Ertilav K, Ercan S. Surgical options for meralgia paresthetica: long-term outcomes in 13 cases. *British Journal of Neurosurgery*. 2018;33(2):188-191. doi:https://doi.org/10.1080/02688697.2018.1538480
5. Barton C, Kim PR. Complications of the Direct Anterior Approach for Total Hip Arthroplasty. *Orthopedic Clinics of North America*. 2009;40(3):371-375. doi:https://doi.org/10.1016/j.ocl.2009.04.004
6. Bernhardt M. Neuropathologische Beobachtungen. *Archiv für Psychiatrie und Nervenkrankheiten*. 1876;6(2):549-564. doi:https://doi.org/10.1007/BF02230825
7. Bernhardt M. Isoliert Ueber im Gebiete des N. cutaneus femoris externus vorkommende Paräesthesien. *Neurol Cent*. 1876;14:242-244.
8. Coert JH, Dellon AL. Documenting Neuropathy of the Lateral Femoral Cutaneous Nerve Using the Pressure-Specified Sensory Testing Device. *Annals of Plastic Surgery*. 2003;50(4):373-377. doi:https://doi.org/10.1097/01.sap.0000041483.93122.58
9. Dall'Olio M, Princiotta C, Cirillo L, et al. Oxygen-Ozone Therapy for Herniated Lumbar Disc in Patients with Subacute Partial Motor Weakness Due to Nerve Root Compression. *Interventional Neuroradiology*. 2014;20(5):547-554. doi:https://doi.org/10.15274/inr-2014-10078
10. Dimitropoulos G, Riempst van, P. Schertenleib. Anatomical variation of the lateral femoral cutaneous nerve: A case report and review of the literature. *Journal of plastic, reconstructive & aesthetic surgery*. 2011;64(7):961-962. doi:https://doi.org/10.1016/j.bjps.2010.11.020
11. Homma Y, Baba T, Sano K, et al. Lateral femoral cutaneous nerve injury with the direct anterior approach for total hip arthroplasty. *International Orthopaedics*. 2015;40(8):1587-1593. doi:https://doi.org/10.1007/s00264-015-2942-0
12. Pearce J. Meralgia paraesthetica (Bernhardt-Roth syndrome). *Journal of Neurology, Neurosurgery and Psychiatry*. 2006;77(1):84-84. doi:https://doi.org/10.1136/jnnp.2005.072363
13. Pardal Fernández JM, Grande Martín A, Godes Medrano B, Segura Martín T, García García J. Estudio morfológico con ecografía en la meralgia parestésica: en busca de la eficiencia terapéutica. *Revista de Neurología*. 2018;66(01):34. doi:https://doi.org/10.33588/rn.6601.2017281
14. Cho KT, Lee HJ. Prone Position-Related Meralgia Paresthetica after Lumbar Spinal Surgery : A Case Report and Review of the Literature. *Journal of Korean Neurosurgical Society*. 2008;44(6):392. doi:https://doi.org/10.3340/jkns.2008.44.6.392
15. Schwaiger K, Panzenbeck P, Purschke M, et al. Surgical decompression of the lateral femoral cutaneous nerve (LFCN)

for Meralgia paresthetica treatment. *Medicine*. 2018;97(33):e11914. doi:https://doi.org/10.1097/MD.0000000000011914

16. Patijn J, Mekhail N, Hayek S, Lataster A, van Kleef M, Zundert JV. Meralgia paresthetica. Evidence-Based Interventional Pain Medicine: According to Clinical Diagnose. *Meralgia Paresthetica*. Published online November 1, 2011:155-159. doi:https://doi.org/10.1002/9781119968375.ch20
17. Lee JJ, Sohn JH, Choi HJ, et al. Clinical Efficacy of Pulsed Radiofrequency Neuromodulation for Intractable Meralgia Paresthetica. *Pain Physician*. 2016;19(3):173-179.
18. Nahabedian MY, Dellon AL. Meralgia paresthetica: etiology, diagnosis, and outcome of surgical decompression. *Annals of plastic surgery*. 1995;35(6):590-594.
19. Orr RM, Johnston V, Coyle J, Pope R. Reported Load Carriage Injuries of the Australian Army Soldier. *Journal of Occupational Rehabilitation*. 2014;25(2):316-322. doi:https://doi.org/10.1007/s10926-014-9540-7
20. Payne R, Seaman S, Sieg E, Langan S, Harbaugh K, Rizk E. Evaluating the evidence: is neurolysis or neurectomy a better treatment for meralgia paresthetica? *Acta Neurochirurgica*. 2017;159(5):931-936. doi:https://doi.org/10.1007/s00701-017-3136-x
21. Siu TLT, Chandran KN. Neurolysis for meralgia paresthetica: an operative series of 45 cases. *Surgical Neurology*. 2005;63(1):19-23. doi:https://doi.org/10.1016/j.surneu.2004.07.035
22. Parisi TJ, Mandrekar J, Dyck PJB, Klein CJ. Meralgia paresthetica: Relation to obesity, advanced age, and diabetes mellitus. *Neurology*. 2011;77(16):1538-1542. doi:https://doi.org/10.1212/wnl.0b013e318233b356
23. Tagliafico A, Serafini G, Lacelli F, Perrone N, Valsania V, Martinoli C. Ultrasound-Guided Treatment of Meralgia Paresthetica (Lateral Femoral Cutaneous Neuropathy). *Journal of Ultrasound in Medicine*. 2011;30(10):1341-1346. doi:https://doi.org/10.7863/jum.2011.30.10.1341
24. Szklener K, Rudzińska A, Juchaniuk P, Kabała Z, Mańdziuk S. Ozone in Chemotherapy-Induced Peripheral Neuropathy—Current State of Art, Possibilities, and Perspectives. *International Journal of Molecular Sciences*. 2023;24(6):5279. doi:https://doi.org/10.3390/ijms24065279
25. Karlsson JOG, Andersson RG, Jynge P. Mangafodipir a Selective Cytoprotectant — with Special Reference to Oxaliplatin and Its Association to Chemotherapy-Induced Peripheral Neuropathy (CIPN). *Translational Oncology*. 2017;10(4):641-649. doi:https://doi.org/10.1016/j.tranon.2017.04.012