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INTERVENTIONAL

Meralgia paraesthetica: Ultrasound-guided injection at multiple levels with 12-month follow-up

Andrea S. Klauser[1] · Mohamed M. H. Abd Ellah[1,2] · Ethan J. Halpern[3] · Isabella Sporer[1] · Carlo Martinoli[4] · Alberto Tagliafico[5] · Martin Sojer[6] · Mihra S. Taljanovic[7] · Werner R. Jaschke[1]

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Abstract
Objectives To evaluate the efficacy of ultrasound (US)-guided injections around the lateral femoral cutaneous nerve (LFCN) at different levels in meralgia paraesthetica (MP) patients.
Methods The study was approved by the university ethics committee and informed oral and written consent were obtained from all patients. Between June 2008 and August 2013, 20 patients with symptoms of MP, including nine men (mean age, 61.33 years) and 11 women (mean age 61.18 years), were treated with US-guided injection of steroids along the LFCN at three different levels in a mean of 2.25 sessions. A visual analogue scale (VAS) was used to measure symptoms before, immediately after and 12 months after treatment.
Results Complete resolution of symptoms was documented in 15/20 patients (mean VAS decreased from 82 to 0), and partial resolution in the remaining five (mean VAS decreased from 92 to 42), which was confirmed at 12-month follow-up. By using the different levels of injection approach overall significantly better symptom relief was obtained ($p<0.05$).
Conclusion The outcome of US-guided injection along the LFCN can be further improved by injections at different levels ($p<0.05$), which was confirmed at 12-month long-term follow-up.
Key Points
- *Meralgia paraesthetica is an entrapment neuropathy of the lateral femoral cutaneous nerve.*
- *Ultrasound proved effective in diagnosis and in guiding injection therapy.*
- *Injection at the anterior superior iliac spine has been used previously.*
- *Multiple injections along the nerve course were used in this study.*
- *Long-term follow-up (12 months) confirmed the results.*

Keywords Meralgia paraesthetica · Ultrasound · Ultrasound-guided injection · Lateral femoral cutaneous nerve · Entrapment neuropathy

✉ Mohamed M. H. Abd Ellah
dr_m_hamdy2006@hotmail.com

1 Diagnostic Radiology Department, Medical University Innsbruck, Anichstrasse 35, A-6020 Innsbruck, Austria

2 Diagnostic Radiology Department, South Egypt Cancer Institute, Assiut University, Assiut, Egypt

3 Departments of Radiology and Urology, Jefferson Prostate Diagnostic Center and Kimmel Cancer Center, Thomas Jefferson University, Philadelphia, PA, USA

4 Cattedra "R" di Radiologia-DIMI, Università di Genova, Largo Rosanna Benzi 8, 16132 Genoa, Italy

5 Dipartimento di Medicina Sperimentale (DIMES), Università degli Studi di Genova, Genoa, Italy

6 Neurology Department, Medical University Innsbruck, Anichstrasse 35, 6020 Innsbruck, Austria

7 Department of Radiology, The University of Arizona Health Network, 1501 N. Campbell Ave., Tucson, AZ 85724, USA

Abbreviations

ASIS	Anterior superior iliac spine
LFCN	Lateral femoral cutaneous nerve
MP	Meralgia paraesthetica
US	Ultrasound
VAS	Visual analogue scale

Introduction

Meralgia paraesthetica (MP) is a painful mononeuropathy of the lateral femoral cutaneous nerve (LFCN), characterized by

pain and/or sensory disturbances along the region of nerve distribution. This condition may be caused by entrapment of the LFCN in proximity to the anterior superior iliac spine, when the nerve courses close to the inguinal ligament [1–3], as well as by nerve entrapment due to fibrosis, trauma and operation.

In patients not responding to oral medications or conservative treatment, regional nerve block of the LFCN is often recommended as an effective treatment of MP. Unfortunately, wide anatomical diversity in the course of the LFCN reduces the efficacy of blind anaesthetic blocks [4]. Anatomical variability leads to reported failure rates for regional nerve blocks as high as 60 % [5]. Ultrasound (US) has been demonstrated to be useful for visualization of peripheral nerves, especially very small nerves such as the ramus palmaris, the saphenous nerve and the LFCN [6–8].

This study aimed to evaluate the efficacy of US-guided LFCN injections at different levels in the treatment of MP patients and to confirm the resulting long-term symptomatic relief at 12-month follow-up.

Materials and methods

The university ethics committee approved the HIPPA-compliant study protocol and informed written and oral consent was obtained from all patients.

Twenty patients with typical clinical symptoms of MP including pain, burning sensation, numbness, tingling or paraesthesias along the anterolateral aspect of the thigh (the course of the LFCN) were included in the study. A referring neurologist with 10 years of neurology experience made the diagnosis. He examined the patients carefully, including a thorough history taking, to exclude other possibilities. No further studies including electromyography (EMG) were performed for the patients prior to the procedure. Magnetic resonance imaging (MRI) of the lumbar spine was performed in patients only before repeating the injection to exclude the possibility of lumbar spine causes.

The study population included nine men (age range 47–70 years, mean±SD 61.33±8.57 years) and 11 women (age range 46–75 years, mean±SD 61.18±8.77 years) (Table 1).

A sonographic follow-up after 6 weeks was performed. If patients did not have complete symptom relief, they were scheduled for a further injection. Patient symptoms at baseline, at follow-up and at 12 months were graded with a visual analogue scale (VAS).

In addition, we compared the level and extent of patient-reported pain and paraesthesias at the follow-up examinations by dividing them into paraesthesias/pain located at the level of the anterior superior iliac spine (ASIS), extending to the mid thigh or to the knee. The VAS was compared at follow-up to the initial VAS before treatment.

Ultrasound (US) technique

US examinations were performed by a musculoskeletal radiologist with 15 years of experience in musculoskeletal US. Each examination was performed with an 18-6 MHz linear array transducer (LA435; MyLab90; Esaote, Genoa/Firenze, Italy).

The pure sensory LFCN is the largest proximal nerve that emerges from the spinal nerves of segments L2 and L3. It courses inferiorly on the iliac muscle to the medial side of the anterior superior iliac spine, approaches the femoral region through the inguinal ligament, and supplies the skin of the anterolateral aspect of the upper and middle thigh. The anterior superior iliac spine is a reference landmark, which is easily palpated and visualized by US as a prominent hyperechoic structure with posterior acoustic shadowing. It passes above, below or between the inguinal ligament, above the sartorius muscle and below the tensor fasciae latae.

The sartorius muscle lies medially, at its curved lateral border one or more fascial sockets can be seen in which the LFCN lies, where each dividing branch can lie in a separate socket. It then pierces the fascia and runs superficial to the sartorius muscle in the subcutaneous region of the thigh and ends by dividing into anterior and posterior divisions.

According to a study by Tagliafico et al. [9], the US transducer was positioned parallel to the inguinal ligament. Therefore the lateral aspect of the probe was placed on the ASIS, and the medial aspect of the probe was angled in a slightly caudal direction, so the transducer was parallel with the inguinal ligament. Then the transducer was moved down in a mediocaudal direction, where the LFCN was detected as a typical oval structure containing several small rounded hypoechoic fascicles, which can show hypoechoic swelling, cross-sectional area enlargement and perineural fibrosis in entrapment conditions. In the longitudinal scanning plane attention was paid to alteration of normal fascicular echotexture, and nerve calibre swelling.

After 6 weeks a follow-up scan was performed to determine resolution of patient symptoms. In patients with persistent pain or non-complete pain relief the LFCN was carefully scanned from the first level along its course more distally into the thigh, where it divides into anterior and posterior branches. The skin was marked by the patient regarding extent of pain and paraesthesias. If a swollen segment was identified in the course of the LFCN the injection was performed at these levels. A swollen segment was defined as an increased thickness in the longitudinal and axial plane of the nerve, visualized as a difference in nerve calibre by showing an increased cross-sectional area compared to the more proximal level.

Injection technique

Injections were performed by using a 27G needle (40 mm, Braun, Germany) with strict adherence to sterile conditions

Table 1 Visual analogue scale (VAS) scores before and 12 months after treatment

Sex	Age, y	Level of first infiltration	Level of second and further infiltration	Number of injections	VAS before treatment	VAS 12 months after treatment	Reduction VAS
M	68	A	-	1	70	0	70
F	75	A	-	1	70	0	70
F	68	A	-	1	100	0	100
M	47	A	-	1	90	0	90
F	62	A	A	3	40	0	40
M	50	A	A	5	100	20	80
M	70	A	B	2	70	0	70
F	46	A	B	2	70	0	70
M	69	A	B	2	90	50	40
F	54	A	B	2	100	50	50
F	55	A	B	2	80	0	80
F	59	A	B	2	100	0	100
M	56	A	C	2	70	0	70
M	68	A	C	2	90	0	90
M	63	A	C	5	100	0	100
F	52	A	C	2	80	0	80
F	69	A	C	2	100	0	100
F	68	A	C	2	70	40	30
F	65	A	C	4	100	50	50
M	61	A	C	2	100	0	100
			Mean	2.25	84.5	10.5	74
			SD	1.16	16.69	19.59	22.34
			Median	2.0	90	0	75

A at anterior superior iliac spine, *B* distal of inguinal ligament, *C* lower thigh, *M* male, *F* female

(appropriate skin preparation and disinfection, sterile ultrasound gel and transducer, and patient sterile covering) [10]. A mixture of 1 ml triamcinolone acetonide (a long-acting corticosteroid) 10 mg/ml, and 5 ml of 0.5 % bupivacaine (Marcaine) was injected around the nerve at the level where US showed pathological alterations of the nerve calibre.

In the first session the nerve was injected at the level of the inguinal ligament (first level) exactly at the point where the nerve thickening was detected [6]. The needle was inserted from the medial or lateral side depending on best access towards the thickened nerve by using an axial scan plane complemented by a longitudinal scan plane in order to visualize the exact needle positioning and careful observation of the injection procedure.

Care was taken to visualize the spread of medication, which distended the perineurium around the LFCN, and to avoid needle penetration of the nerve itself. If the nerve was not floating in the medication, a redirection of the needle under axial plane scan around the nerve towards a more lateral position was gently performed in order to obtain the best loosening of the perineural tissue during injection.

Analysis

Patient self-assessment of pain and extent of skin mark was documented prior to each US procedure on a 0–100 VAS. A 12-month follow-up after the last treatment session was obtained for each patient. Patients' symptoms were also evaluated immediately after the injection to evaluate the efficacy of injection.

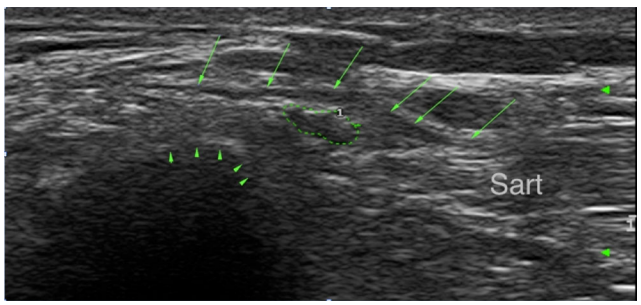

Fig. 1 Axial ultrasound scan of the right thigh, showing a slightly thickened lateral femoral cutaneous nerve (LFCN; encircled) close to the distal aspect of the anterior superior iliac spine (arrowheads) with partial depiction of the inguinal ligament (arrows), showing a hypoechoic thickening of the ligament close to the LFCN. (*Sart*) sartorius muscle

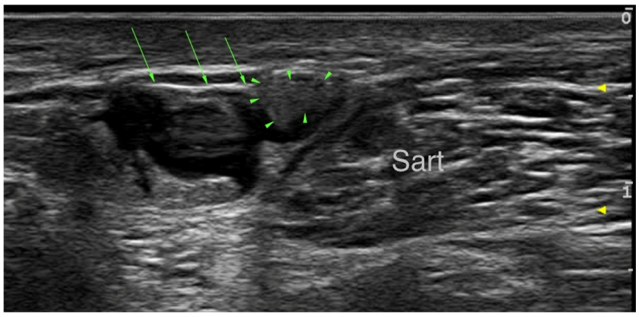

Fig. 2 Ultrasound-guided injection showing spreading of the medication (hypoechoic fluid) around the lateral femoral cutaneous nerve (LFCN). In-plane needle placement (arrows) from lateral was close to the LFCN (between arrowheads). The inguinal ligament is depicted ventrally as a transverse linear hypoechoic stripe. (*Sart*) sartorius muscle

Patient demographics and VAS scores were tabulated and the proportion of patients with complete resolution of symptoms was calculated with a 95 % confidence interval (CI) using the binomial exact method because of the small size of the patient population.

Results

A swollen LFCN was identified in all patients at the level of the ASIS. Corticosteroid injection was administered in all 20 patients at this level. Four patients were pain-free at follow-up, whereas 16 of 20 patients presented with residual pain after the first injection; however, they did report an overall improvement of 74/100 on the VAS. The US follow-up examination showed in 14 out of 16 patients a further swollen portion of the LFCN and injection was performed at these levels (Figs. 1, 2, 3a, b and 4). Only two out of 16 patients required re-injection at the first level by showing on-going nerve swelling at this level.

Paraesthesias and pain persisted at the level of ASIS after the first injection in two out of six patients; complete resolution of symptoms was documented in five out of these six patients at 12-month follow-up. Paraesthesias and pain distal to the region of the inguinal ligament were present in six patients; complete resolution of symptoms was found in four of these six patients. Paraesthesias and pain extending distally to the mid thigh were present in eight patients; complete resolution of symptoms was documented in six of those eight patients (Table 1).

Overall, complete resolution of symptoms was documented in 15/20 patients (75 %; 95 % CI 0.44–0.90) and partial resolution in the remaining five patients. Among patients with complete resolution of symptoms, the mean VAS decreased from 82 to 0 ($p<0.0001$). Among the remaining five patients, the mean VAS decreased from 92 to 42 ($p<0.01$). Those patients remained symptom free or with persistent on-going improvement at the 12-month follow-up (Table 2), overall resulting in a statistically significant long-term improvement ($p<0.05$).

There were no post-procedural complications, and no reported pain during, immediately after the injection or at 12-month long-term follow-up.

Discussion

The LFCN exits the pelvis with a relatively superficial course where it can be injured by entrapment or compression between the ileum and the inguinal ligament, near the ASIS. The nerve may be irritated by adjacent anatomical structures, by conditions that increase intra-abdominal pressure such as obesity or pregnancy, by diabetes and other neuropathies, and after hip replacement, trauma and from tight-fitting clothes or belts [11].

Typical symptoms related to the LFCN include burning sensations, tingling, numbness or pain on the lateral side of the thigh, extending to the lateral side of the knee. Primary methods of treatment include medical therapy for pain and amelioration of the local cause for nerve irritation or compression. When these therapies fail, regional nerve block of the LFCN is commonly employed. Traditionally, the LFCN injection is performed by inserting a needle medial and caudal to the ASIS and injecting local anaesthetic in a field block

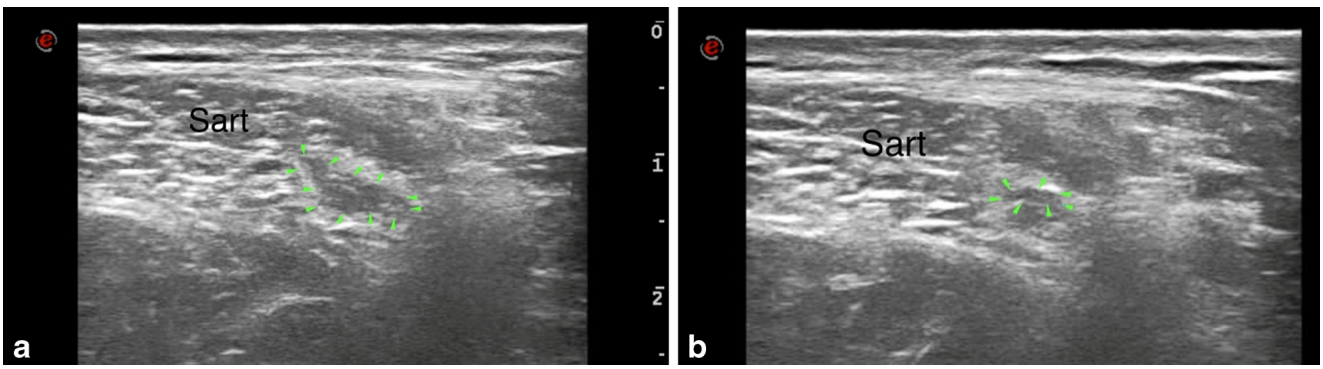

Fig. 3 A thickened lateral femoral cutaneous nerve (LFCN) (**a** between arrowheads) can be seen in comparison to the smaller cross-sectional area immediately more distally (**b**). (*Sart*) sartorius muscle

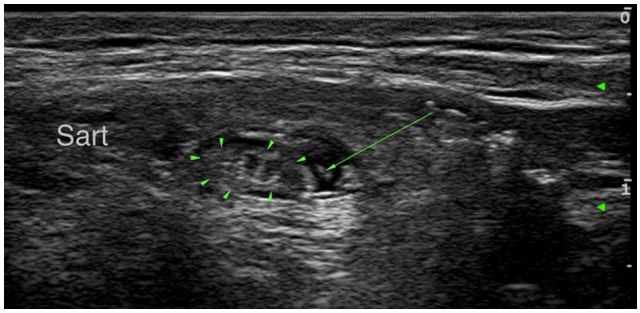

Fig. 4 Targeted ultrasound-guided injection around the thickened lateral femoral cutaneous nerve (LFCN). The long arrow shows the echogenic needle tip (out-plane) just adjacent to the nerve coming from lateral aspect in order to spread the medication around and to loosen the perineural tissue by gently advancing the needle more distally. (*Sart*) sartorius muscle

technique [12–14]. Unfortunately, there is considerable anatomical variability of the LFCN in about 30 % of patients [15], and the distance between the LFCN and the ASIS can vary from 0.3 to 6.5 cm [16]. A recent study evaluated the anatomical variation in patients with idiopathic MP showing that the distance between the LFCN and the ASIS was significantly different between idiopathic MP patients and healthy volunteers of the corresponding age group [8]. A cadaver study of the LFCN reported that the anatomical course of the LFCN can be classified into one of three different patterns [4]. The importance of our study is not only evaluating the ASIS level, but extending the sonographic investigation of the LFCN in order to allow for injections of different sites when symptoms persist after the first injection.

A study by Lee et al. [17] using a blind injection technique in patients with MP required multiple repeated injections for successful results in two of three cases. The lack of a predictable relationship of the LFCN to a palpable anatomical landmark may explain the greater than 60 % failure rate of blind regional nerve blocks [5]. The accuracy of US in localizing the LFCN was investigated by Ng et al. [18] in 20 cadavers and by using the transdermal nerve stimulators in ten volunteers. Using anatomical landmarks the accuracy was 5.3 % in cadavers and 0 % in volunteers, while accuracy when using US was 84.2 % in cadavers and 80 % in volunteers [11].

US provides accurate identification of swollen segments of the LFCN, and can be used to accurately guide corticosteroid or local anaesthetic agent injections to these precise locations. Interestingly, in our follow-up investigation multiple level involvement of the LFCN was found and therefore different levels were injected in 14 patients presenting initially without complete symptom relief. Our findings suggest that involvement of multiple different levels of LFCN may be the case in the severely diseased patients, which should be investigated at follow-up examinations and included in any further treatment plans. A potential explanation might be the presence of extended adhesions and perineural fibrosis inhibiting nerve gliding and contributing to pain and paraesthesias.

Another published series of US-guided LFCN injections prior to the current study included ten patients with successful nerve block; however, long-term follow-up results and pain score assessment were not evaluated [10].

Recently Tagliafico et al. [7] showed the value of US-guided injections performed at the level of the ASIS in 20 patients. We used a similar technique to that demonstrated by Tagliafico et al. [7], but included in addition the treatment of swollen nerve segments more distally in cases where symptoms did not completely resolve after the first injection. With injection of the first level only complete resolution of symptoms would have been achieved in five out of 20 patients. Overall by using this new extended approach a significant improvement of symptoms was obtained ($p<0.05$).

To our knowledge our study is the first in the literature to consider such a long therapeutic follow-up with proof of ongoing complete symptom decrease over a 12-month period. The study by Tagliafico et al. [7] investigated the therapeutic effect over a 2-month follow-up.

As compared to prior reports using a standard dosage of 40 mg/ml methylprednisolone acetate, we used only 10 mg/ml triamcinolone, which represents an equivalent dosage of one-quarter [6, 7]. In four patients, a complete resolution of symptoms after one injection was achieved, whereas in 16 out of 20 patients more than a single injection was necessary to improve symptoms. Out of these patients, nine showed a complete resolution. Our results suggest that an exact delineation of the level of nerve alteration and precise placement of the medication under US guidance can allow for reduction of corticosteroid dosage.

Table 2 Visual analogue scale (VAS) scores in patients with complete and partial symptomatic relief

Complete symptomatic relief (15 patients)	Number of injections	VAS-A (before treatment)	VAS-E (12 month after treatment)	Reduction VAS
Mean	2	82	0.00	82
SD	1	17.40	0.00	17.40
Median	2	80	0	80
Partial symptomatic relief (5 patients)	Number of injections	VAS-A (before treatment)	VAS-E (12 month after treatment)	Reduction VAS
Mean	3	92.00	42.00	50.00
SD	1.41	13.04	13.04	18.71
Median	2	100	50	50

Interestingly in a previously published case report, Mulvaney [19] showed immediate and long-term relief of pain associated with chronic MP using only percutaneous fluid injection around the nerve. He attributed this result to the blunt dissection (hydrodissection) that might be caused by the injected fluid, which might also result in improvement of the perineural circulation. He also suggested that this procedure might potentially represent an alternate treatment to surgical neurolysis or corticosteroid injection in MP patients. We agree to some extent with his opinion especially in that we injected a lower dose of corticosteroids, as discussed before, compared to the previously described doses in the literatures. There was a clear notable complete response immediately after the injection in all of our patients. However, evaluating the patients 6 weeks later in order to avoid the possible misleading effect of local anaesthetic, not all patients showed complete resolution of symptoms.

Inflammation of the nerve and its surrounding area has not been established as the cause of pain in MP; however, nerve entrapment seems the most likely aetiology. This may also favour the previously described supposition of hydrodissection by the injected fluid and the subsequent improvement of the perineural circulation.

There were no complications such as blockade of nearby nerves like the femoral nerve, needle trauma of the target neural structure, bleeding or skin de-pigmentation registered, which may be due to the use of lower doses of corticosteroids compared to other studies. However, a randomized controlled trial is needed to prove our results and to explain more precisely the reason for improvement and pain relief and if local anaesthetic alone and normal saline (as placebo) might be useful.

Our study had some limitations; first we did not perform an EMG study in patients before treatment, but we depended mainly on the thorough clinical examination and history taking by a neurologist with 10 years experience. Furthermore, we performed lumbar spine MRI in all patients before the second injection to exclude L2-L3 pathology.

Secondly we depended on the visual evaluation of the LFCN to define pathological segments by determining the site of abrupt change of the nerve cross-sectional area (CSA) or fascicular swelling and detection of perineural fibrosis by US. Sonopalpation and induction of pain at pathological segments by compression using the US probe were carried out as well. We attributed this to the lack of information about normal and abnormal values of CSA of LFCN in the literature. We found only one study [20] that tried to specify some normal and pathological values of the CSA of LFCN; however, most of the studies described the anatomical variations in the nerve and the distance from ASIS.

Thirdly, nothing in the literature supports the supposition of multiple-level involvement of the LFCN; however, we think that postoperative haematomas for example may dissect in the facial layers and cause adhesions around the nerve. Multiple-level involvement was a significant finding in our study with significant long-term improvement at 12-month follow-up.

Fourthly, as we discussed, a major limitation of this study was the lack of a control group, so a randomized placebo-controlled trail should be included in future study designs.

In conclusion, the present study demonstrates for the first time that US-guided injection of corticosteroids at multiple levels of the LFCN in MP patients may lead to a significantly better outcome ($p<0.05$), with consistent improvement or complete relief of symptoms persisting at 12-month long-term follow-up.

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