Original Research Article

HIP International

Groin pain of neurological origin as a differential diagnosis of femoroacetabular impingement

HIP International
1–9

DOI: 10.1177/11207000221135067
journals.sagepub.com/home/hpi
SAGE

Bernardo Aguilera-Bohórquez[1], Omar Juárez[1], Daniela Calvache[1], Erika Cantor[2], Hernando Navarro[3], José Vélez[4] and Mauricio Pachón-Vásquez[1]

Abstract

Background: To describe the experience in the diagnostic process and treatment of patients with groin pain (GP) of neurological origin due to entrapment of the iliohypogastric (IH), ilioinguinal (IL) and genitofemoral (GF) nerves in a hip preservation clinic.

Methods: Retrospective study of patients with GP of neurological origin confirmed with ultrasound-guided nerve block. Clinical outcomes were reported in 21 cases (age, 53.3 ± 15.9 years) treated with conservative treatment from January to December 2019, and in 9 patients (age 43.7 ± 14.6 years) who underwent neurectomy from January 2015 to December 2019. Pain intensity was assessed with a numerical rating scale (NRS) before starting the diagnostic process (Day 0) and at the end of follow-up.

Results: All cases reported pain on groin palpation. Half of these cases also reported a positive FADIR test (flexion, adduction, internal rotation) (15/30). On day 0, the intensity of pain in cases treated with conservative treatment was severe in 19 patients (NRS 7–10) and moderate in 2 (NRS 4–6), with a median improvement of 7 points (interquartile range [IQR] 5.5–8.0) at the end of follow-up ($p < 0.001$). In neurectomy group, a similar improvement in pain severity was (Day 0: 9 points [IQR 8.0–9.0]; end of follow-up: 0 points [IQR: 0–2.0]; $p = 0.002$). At the end of the study, 17/21 patients with conservative treatment and 7/9 with neurectomy were pain free or with mild pain (NRS < 3).

Conclusions: In cases with PG of neurological origin, there is a high frequency of false positives in the FADIR test. Our findings suggest that neurectomy is a treatment option for patients in whom conservative treatment fails, providing significant pain relief.

Keywords

Femoroacetabular impingement, genitofemoral nerve, groin pain, iliohypogastric nerve, ilioinguinal nerve, neurectomy

Date received: 25 May 2021; accepted: 29 June 2022

Introduction

Groin pain (GP) is a common problem that can be attributed to a wide variety of intra- and extra-articular conditions. Among extra-articular causes, those of neurological origin related to iliohypogastric (IH), ilioinguinal (IL) and genitofemoral (GF) nerve entrapment are less common,[1] which makes them unlikely to be considered as the cause of pain.

Non-arthritic GP has been mainly attributed to femoroacetabular impingement (FAI), with an estimated prevalence that reaches 96.6% in specialised hip units, while in the general population it does not exceed 74%.[2,3] These

[1]Hip Preservation Unit, Clínica Imbanaco Grupo QuirónSalud, Cali, Colombia
[2]Institute of Statistics, Universidad de Valparaíso, Valparaíso, Chile
[3]Department of Gynaecology, Clínica Imbanaco Grupo QuirónSalud, Cali, Colombia
[4]Department of General Surgery, Clínica Imbanaco Grupo QuirónSalud, Cali, Colombia

Corresponding author:
Bernardo Aguilera Bohórquez, Hip Preservation Unit, Clínica Imbanaco Grupo QuirónSalud, Carrera 38A, No 5ª–100, Tower A Office 105, Cali 760042, Colombia.
Email: baguilera@imbanaco.com.co

data suggest that FAI as a cause of GP could be overestimated and therefore, other possible aetiologies are not explored and ruled out during the diagnostic process.[4,5] Since GP is a multifactorial condition, identifying and treating the exact cause of the pain can be a challenge for the orthopaedic surgeon, so a thorough history and physical examination is key to identifying the type and location of pain. Because GP is the main symptom of FAI, palpation of the groin area and deep knowledge of the dermatomes of the sensory nerves around the hip are essential to confirming this neurological aetiology.[6]

Most of the reports of GP cases of neurological origin have been reported as events secondary to surgical procedures such as appendectomy, hysterectomy, herniorrhaphy, and abdominoplasty, as well as T12/L1-L2 vertebral fractures. For this reason, their description has been made from the perspective of clinical specialties different from orthopedic surgery.[7–10] Therefore, it is necessary to have a more in-depth knowledge of how to properly differentiate cases of GP of neurological origin, especially from the perspective of hip surgeons.

The focus of this study was to describe the experience in the diagnostic process and treatment of patients with GP of neurological origin due to entrapment of IH, IL, and GF nerves in a hip preservation clinic. Additionally, a diagnostic algorithm is proposed to identify cases with GP of neurological origin as a differential cause of FAI.

Methods

This study was approved by the Institutional review board. A retrospective review of patients identified with GP of neurological aetiology due to IH, IL and GF nerve entrapment was carried out. All consecutive patients were treated in a hip-preservation centre.

Patients

Data from 2 independent groups of patients with neurological GP were identified and classified according to the type of treatment. First, cases who received only conservative treatment from January to December 2019 ("conservative group"), and second, cases that required neurectomy operated between December 2015 and December 2019 ("neurectomy group"). We retrospectively searched all patients who were treated only with ultrasound-guided block as a diagnostic-therapeutic tool for pain around the hip. A total of 177 procedures were found and in 22 nerve blocks, the IH, IL, and GF nerves were involved. Finally, the neurological aetiology of GP was confirmed in 21 cases that reported immediate or temporary improvement of the initial symptomatology, these cases were included in the first group. In consequence, the diagnosis was ruled out in only one of the 22 suspected cases of neurological aetiology.

The second group included 9 patients who underwent laparoscopic triple neurectomy of the IH, IL, and GF nerves. All surgical cases were initially treated with conservative management using pharmacotherapy and 2 nerve blocks, without a good clinical response.

Identification of neurological GP

All cases underwent an exhaustive clinical history to identify clinical antecedents such as previous surgeries and/or fractures that could explain the origin of pain. Palpation was performed from the flanks and hypochondriac region, passing through the iliac and hypogastric region to the inguinal region, having as landmarks the sensory innervation zones of the IH, IL, and GF nerves (Figure 1(a)). Measurement of ranges of motion and the FADIR test (flexion, adduction, internal rotation) were performed. In all cases, routine diagnostic imaging of the hip was indicated to rule out structural pathologies, including hip radiograph (anteroposterior pelvis, 45°and 90° Dunn projection and Lequesne's false profile) and magnetic resonance imaging (MRI).

In cases with pain upon groin palpation and positive FADIR test, a combined FADIR-groin palpation manoeuver was performed to identify whether the pain was of intra-articular or neurological origin due to possible entrapment of the IH, IL, and GF nerves. Therefore, the evaluation at this point was focused on discriminating whether the pain was produced by palpation or by movement. First, pain points in the sensory innervation zones of IH, IL, and GF nerves were identified (Figure 1(a) and (b)). Subsequently, the FADIR test was performed together with sustained palpation over the pain points, and the patient was asked if there was any change in the origin and area of pain while the FADIR test was being performed (Figure 1(c) and (d)). When the patient did not manifest any change in his pain, the neurological aetiology of GP was considered, and the protocol to confirm the diagnosis was initiated.

The presence of pain in the flank, hypochondrium, and/or inguinal region was an indicator to increase the suspicion of neurological aetiology. An ultrasound-guided nerve block of IH, IL and GF nerves was indicated as a diagnostic-therapeutic test in suspected cases. The absence of pain following the nerve block was considered a positive. Inguinal canal and gynaecologic pathologies were ruled out as differential diagnoses of GP. Evoked potentials were used to assess abnormalities in the nerve transmissions in uncertain cases but were not considered medically necessary for confirmation of neurological aetiology. Evoked

Figure 1. (a) Landmarks of the sensory innervation zones, (b) patient in supine position, palpation from the flank region, hypochondrium and inguinal region, (c) the examiner performs sustained palpation over the point of pain while performing flexion from 90° to 120°, and (d) the FADIR manoeuver is completed in conjunction with palpation at the point of pain.
The orange arrow indicates the point of pain in the groin area.

potentials were performed during the diagnostic or treatment process to make clinical decisions.

Ultrasound-guided nerve block

All nerve blocks were guided by ultrasound (General Electric GE; VENUE 40) with a high-frequency linear transducer (10–15 MHz), with the patient in supine decubitus. For the IL and IH nerves, the transducer was targeted over the anterior superior iliac spine (ASIS), aligning the axis between the ASIS and umbilicus. Slight movements were performed until the nerves were identified, keeping the ASIS on the external part of the image as a reference point. Subsequently, the oblique and transverse abdominal muscles were identified to recognise IL and IH nerves and then, a needle was introduced in-plane with respect to the transducer, until reaching the fascia that separates both muscles (Figure 2).

The GF was targeted with the transducer positioned over the groin and then, the femoral vein, artery and nerve were identified in the transverse plane. Superolateral to the femoral artery, the main branches of the GF nerve were identified. The needle was advanced in-plane with respect to the transducer, in a caudal-cephalad direction up to the spermatic cord or round ligament in proximity to the femoral artery (Figure 2). Under ultrasound guidance, an anaesthesiologist injected 10 mL of a mixture of saline, local anaesthetic, and corticosteroid around the target nerve. All ultrasound-guided blocks were performed by a trained anesthesiologist who completed a formal training course in the Focused Assessment with Sonography for Trauma (FAST) scan method.

Conservative treatment

Treatment with neuromodulatory drugs was indicated for an initial period of 3 months. Once the first ultrasound-guided nerve block was performed, pregabalin was started at 75 mg/day for 3 months. The dose was increased to 150 mg/day if the patient did not have a decrease in pain. In cases with recurrence of pain after this first line of treatment, a second ultrasound-guided nerve block and pharmacological therapy were indicated.

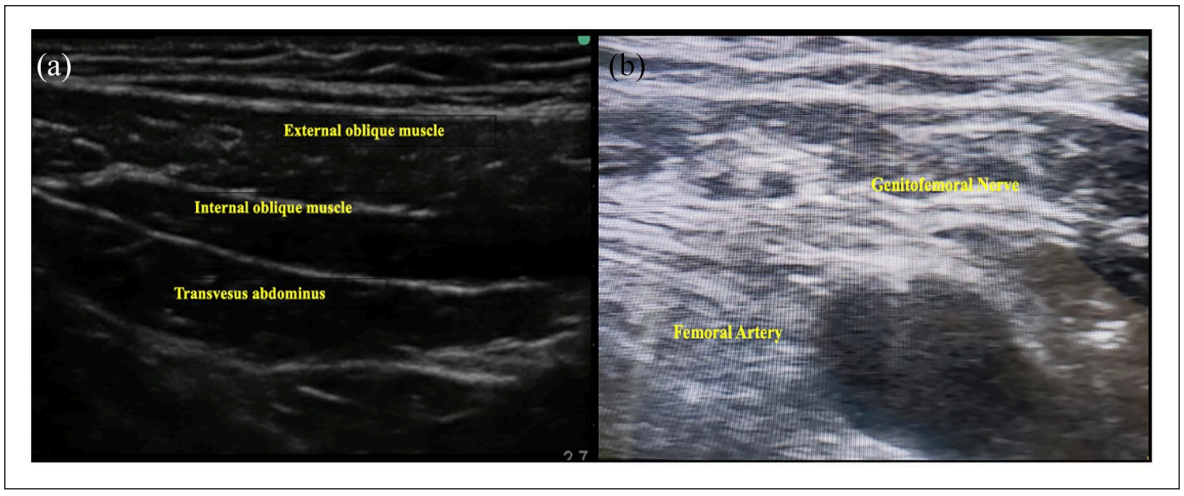

Figure 2. (a) Visualisation of the structures for the ilioinguinal and iliohypogastric nerve blocs and (b) visualisation of the structures for the genitofemoral nerve block.

Neurectomy

Patients were positioned in lateral decubitus under general anaesthesia. Laparoscopy was performed with a 30° lens between the ASIS and 12th rib. 2 12-mm portals were created, the first located 2 cm medial to the ASIS, and the second, 8 cm distal to the umbilicus. The peritoneum was dissected vertically until the quadratus lumborum muscle, and then, the psoas muscle, and their joint tendon were exposed. Subsequently, dissection of the aponeurosis of the quadratus lumborum was performed to proceed to the identification of the nerves.

IL and IH nerves were identified, 6 cm below 12th rib, following their course until before entering the transverse abdominis. Then, over the anteromedial border of the psoas and parallel to it, the GF was identified caudal to the inguinal canal. Triple neurectomy was performed cutting of a portion of at least 3 cm of each nerve. Finally, the extracted portion was sent to the pathology laboratory for histologic confirmation (Figure 3). Neurectomies were performed by a general surgeon and a gynaecological surgeon, both with experience in advanced laparoscopic surgery. Neurectomy of IL, IH, and GF nerves was indicated as the last treatment option after ruling out other possible etiologies in patients with severe symptoms who did not respond to conservative management after performing 2 ultrasound-guided blocks.

Data collection

All demographic and clinical information was extracted from institutional medical records. The primary outcome variable was pain intensity, which was assessed during routine clinical practice using an 11-point numerical rating scale (NRS), where 0 represented no pain and 10, the worst pain imaginable. The degree of pain was assessed on day 0 before starting the diagnostic process and at the end of follow-up (EOU).

Statistical analysis

All analyses were performed in Stata version, 16.0 (StataCorp, College Station, TX, USA). The Wilcoxon signed-rank test for paired data was used to evaluate the change in the pain scale between day 0 and EOU. A p-value < 0.05 was considered statistically significant.

Results

Conservative treatment

21 patients (21 hips: 15 right and 6 left) with GP of neurological aetiology were treated with conservative management. The mean age was 53.3 ± 15.9 years; 20 cases were women, and the median follow-up was 16 months (Interquartile range [IQR] 12–17.5). 15 patients had at least 1 risk factor for the presence of neurological GP. 6 patients reported an antecedent of abdominal surgery: appendectomy ($n = 3$), cholecystectomy ($n = 2$), abdominoplasty ($n = 1$) and herniorrhaphy ($n = 1$). 9 women reported a history of gynaecologic surgery, caesarean section ($n = 3$), hysterectomy ($n = 5$) and salpingectomy ($n = 1$). 3 patients had undergone hip arthroscopy for FAI ($n = 3$), and 1 reported an antecedent of endoscopy in the subgluteal space ($n = 1$). Trauma around the hip was reported in 2 cases ($n = 2$). All patients manifested tenderness to palpation on the inguinal region; the FADIR test was positive in 12 patients.

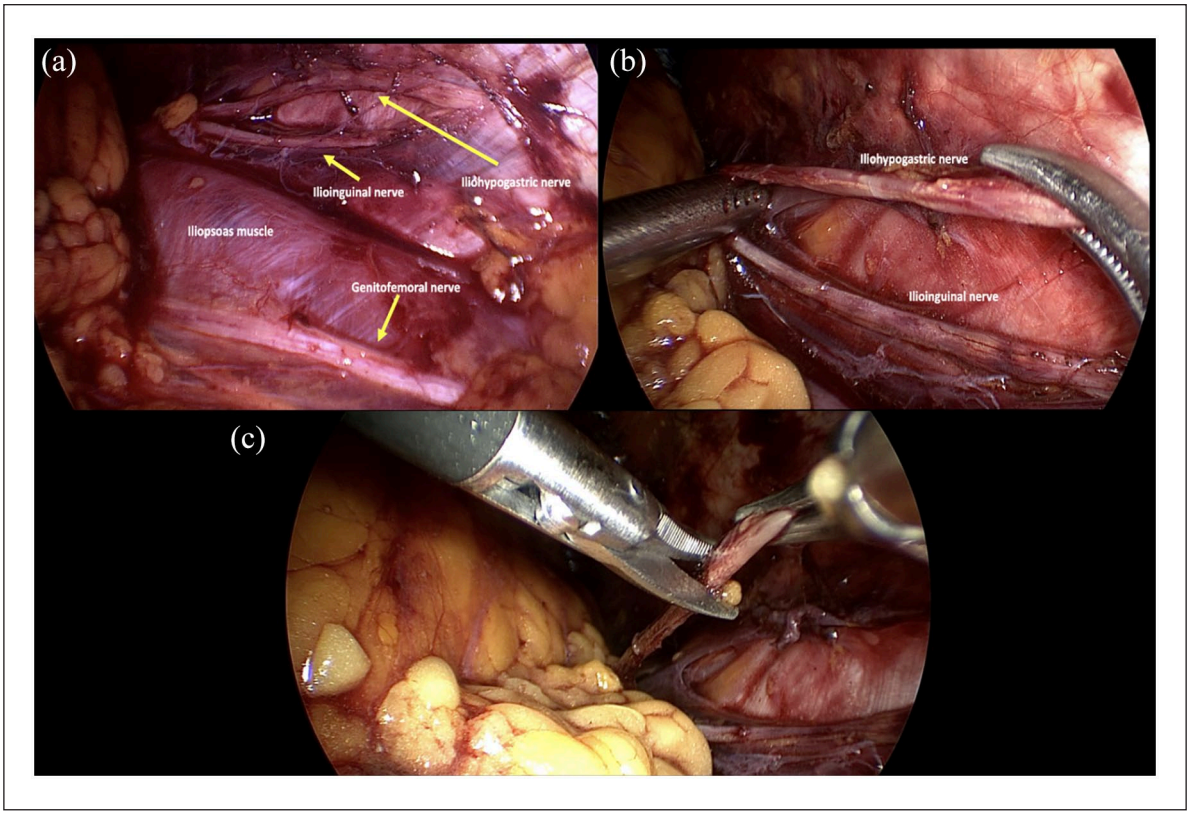

Figure 3. (a) Intraoperative identification of nerves, (b) location of the ilioinguinal and iliohypogastric nerve segment, and (c) neurectomy of the iliohypogastric nerve.

At day 0, pain intensity was classified as severe in 19 patients (numeric rating scale [NRS] 7–10 points) and moderate in 2 (NRS 4–6 points). At the EOU, 20 patients showed improvement in at least 2 points on the NRS scale. Of these, 17 patients were pain free or in mild pain (Figure 4). A statistically significant change in NRS scale scores was found between day 0 and EOU ($p < 0.001$), with a median improvement of 7 points (IQR 5.5–8.0). A second ultrasound-guided nerve block was required in 1 patient at 10 months of follow-up, with satisfactory results. 1 patient who persisted with severe pain was referred to a general surgeon due to a history of herniorrhaphy. 1 patient required additional treatment with arthroscopy due to morphological alterations compatible with FAI pincer, showing improvement in symptoms.

Triple neurectomy

Characteristics and clinical outcomes of patients (8 women, 1 man, mean age of 43.7 ± 14.6 years) who underwent triple neurectomy are summarised in Table 1. Risk factors for neurological GP were identified in 4 patients. In all cases, evoked potentials were performed showing alterations in IH, IL and GF nerve conduction. Ultrasonography of the inguinal canal ruled out the presence of hernias. 3 patients reported a positive FADIR test result.

The median follow-up time since neurectomy was 27.0 months (IQR 6–54 months). On day 0, all patients reported a severe level of pain (NRS 7–10 points), with an improvement on the NRS scale from 9.0 points (IQR 8.0–9.0) to 0 points (IQR 0–2.0) after neurectomy ($p = 0.002$). At EOU, 6 patients reported an NRS of 0 indicating an absence of pain; 1 patient reported mild pain (NRS of 2), and 2 patients had moderate pain (NRS 4–6) (Table 1). In all cases, histopathological analysis was positive for nerve tissue. No complications associated with the procedure were found.

Discussion

In this study, we described 30 patients who attended a centre specialised in hip pathologies, due to the presence of GP and in whom, during the diagnostic process, the neurological aetiology of GP was confirmed. Pain improvement was observed in most patients (conservative treatment: 17/21 (80.9%); neurectomy: 7/9 (77.8%) patients without pain or with mild pain), with no associated complications. These results are similar to those described by Poh et al.[11]

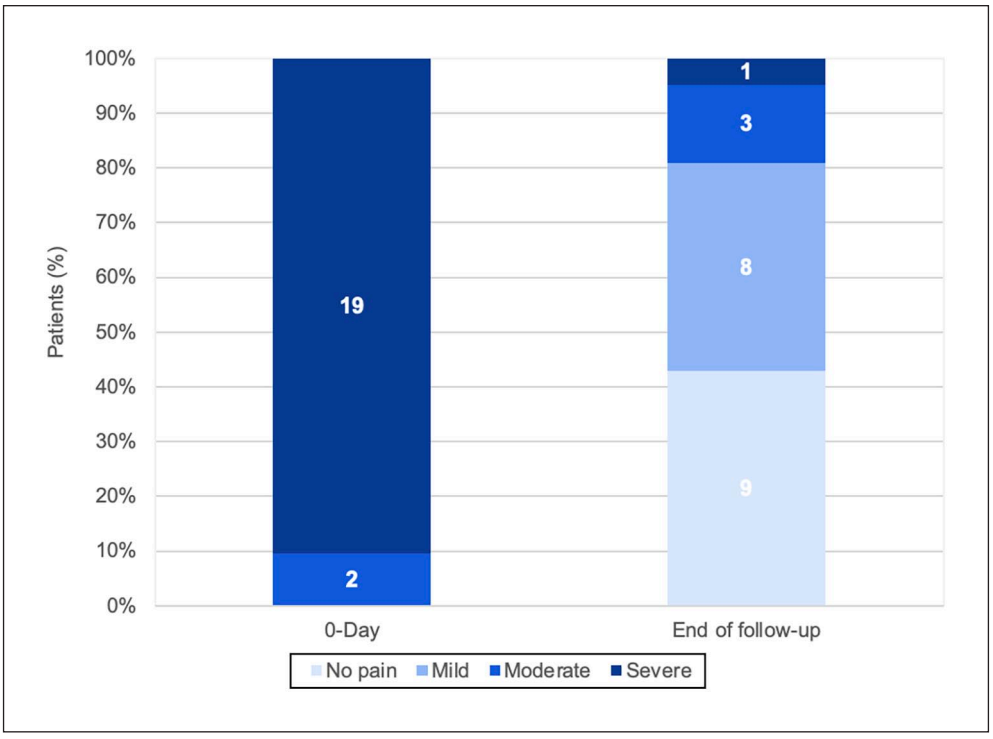

Figure 4. NRS pain scale before and after conservative management.

Table 1. Characteristics and clinical outcomes of patients treated with neurectomy.

ID	Age (Yrs.)	Sex	History	Laterality	FADIR 0-day	Pain 0-day	Pain EOU
1	55	F	Lumbar instrumentation of L4–L5/S1.	L	(+)	9	6
2	22	F	Herniorraphy	L	(+)	9	0
3	62	F	Lateral compartment endoscopy	R	(+)	10	0
4	47	F	Arthroscopy FAI	R	(−)	8	0
5	37	M	THA	L	(−)	10	0
6	51	F	Perthes disease + THA	L	(−)	9	0
7	38	F	Hysterectomy	L	(−)	7	5
8	58	F	Saphenectomy, abdominoplasty	L	(−)	8	2
9	23	F	Arthroscopy FAI	R	(−)	8	0

Yrs, years; F, female; M, male; FADIR, L, left; R, right; flexion, adduction, and internal rotation; FAI, femoroacetabular impingement; THA, total hip arthroplasty; EOU, end of follow-up.

who reported an 84.2% improvement in pain (53/63) with the use of nerve blocks, and 80% (20/25) with neurectomy in patients who had groin or lower abdominal pain by entrapment of IL, IH and GF nerve.

The use of nerve block in the context of neurological GP is accepted as a diagnostic method, as well as the first line of treatment because it can produce hydro-dissection of the affected nerve, offering pain relief.[12] Effectiveness rates of nerve block for the treatment of neurological pain are different, with improvement percentages ranging from 22.0% to 84.2%.[9–11,13] These results have justified the use of neurectomy despite being a radical procedure when conservative management fails.[9,11] The results of neurectomy in pain management are heterogeneous, with effectiveness rates ranging from 52% to 91%.[13–16]

Statistically significant differences in favour of surgical treatment have been reported in controlled clinical trials.[9,10] Verhagen et al.[10] reported that in patients with neurological GP following herniorrhaphy, neurectomy is 3 times more effective than conservative management (71% vs. 22%). However, laparoscopic neurectomy may have associated complications, such as: (1) vascular lesions,

mainly in those performed on the right side due to the proximity of the vena cava and internal iliac vein; (2) partial functional impairment of the external and internal oblique and transversus abdominis muscles; and (3) infection and intra-abdominal adhesions.

2 of 9 patients treated with neurectomy reported no improvement of symptoms, suggesting that the neurological aetiology may not be the exact cause of GP. However, before surgery, inguinal, thoracolumbar, and gynecological pathologies were ruled out in all cases. The identification of the aetiology of GP in these patients has been complex due to the diffuse presentation of symptoms over time, so they are currently being followed up by the chronic pain clinic, and the use of neurostimulators is being considered in order to block pain signals of central origin.

Among 30 GP cases, 19 had a history of surgical procedures considered risk factors for neurological GP. Herniorrhaphy and mesh placement are considered the most frequent cause of chronic GP due to entrapment of the IL and GF nerves, because these 2 procedures are performed directly in the inguinal canal.[7] Surgical procedures in the lower abdomen are also recognised as risk factors for chronic GP. For example, in an abdominoplasty, an extensive segment of abdominal skin is usually resected, which, together with the closure of the rectus abdominis muscles, can distort tension and anatomy of abdomen. Another risk factor recognised in the literature is gynecological procedures, due to the manipulation of the round ligament through which the GF nerve runs.[6]

Since neurological GP is not a frequent event, there is no consensus on the most appropriate diagnostic process and treatment. It is essential to conduct a comprehensive clinical history by asking specific questions to know all the patient antecedents that can support the suspicion of the exact cause of pain. During physical examination, it is possible to find findings that may confuse the diagnosis. For example, half of our cases reported a positive FADIR test result, suggesting FAI as a possible aetiology. Because of this, it is important to implement palpation of the groin region as part of the routine physical examination before performing the FADIR test; this in order that the patient can focus on the pain and help us to correctly isolate the true origin. For patients with pain upon groin palpation and positive FADIR test, the senior author proposes the performance of a combined FADIR-groin palpation maneuver (Figure 1), which, although not validated, has helped us in our clinical practice to guide the patient on the correct discrimination of pain to differentiate between intra-articular and neurological aetiology. In cases of high suspicion, the infiltration of IL, IH and GF nerves or in the intra-articular region of the hip is key to confirming the diagnosis and defining an adequate treatment.

Among hip specialists, the first presumptive diagnosis in GP cases is FAI. GP is a multifactorial condition, resulting in the coexistence of several potential causes that increase the possibility of making a diagnostic error. In this study, the coexistence of neurological and intra-articular aetiology was identified in one patient who had a positive result after the infiltration for both causes. Initially, the neurological aetiology was treated with conservative management, showing pain relief for a while. Later, during the follow-up, the patient consulted for recurrence of pain that was attributed to FAI; hip arthroscopy was performed, and the symptomatology improved completely. Based on our experience, a diagnostic algorithm for neurological GP is proposed in Figure 5.

This study has limitations. First, the number of cases included may be considered limited in determining the clinical outcomes of a specified treatment. Even so, given that GP due to the entrapment of the sensory nerves of the hip is a rare event, this study provides information that serves as a basis for complementing the knowledge about the neurological aetiology from the orthopedics field. Second, we did not discriminate by affected nerve because we blocked IL, IH, and GF nerves simultaneously. Since these nerves share roots and areas of skin innervation, their discrimination is difficult.

To conclude, in cases with GP of neurological origin, there is a high frequency of false positives in the FADIR test. Our findings suggest that neurectomy is a treatment option for patients in whom conservative treatment fails, providing significant pain relief.

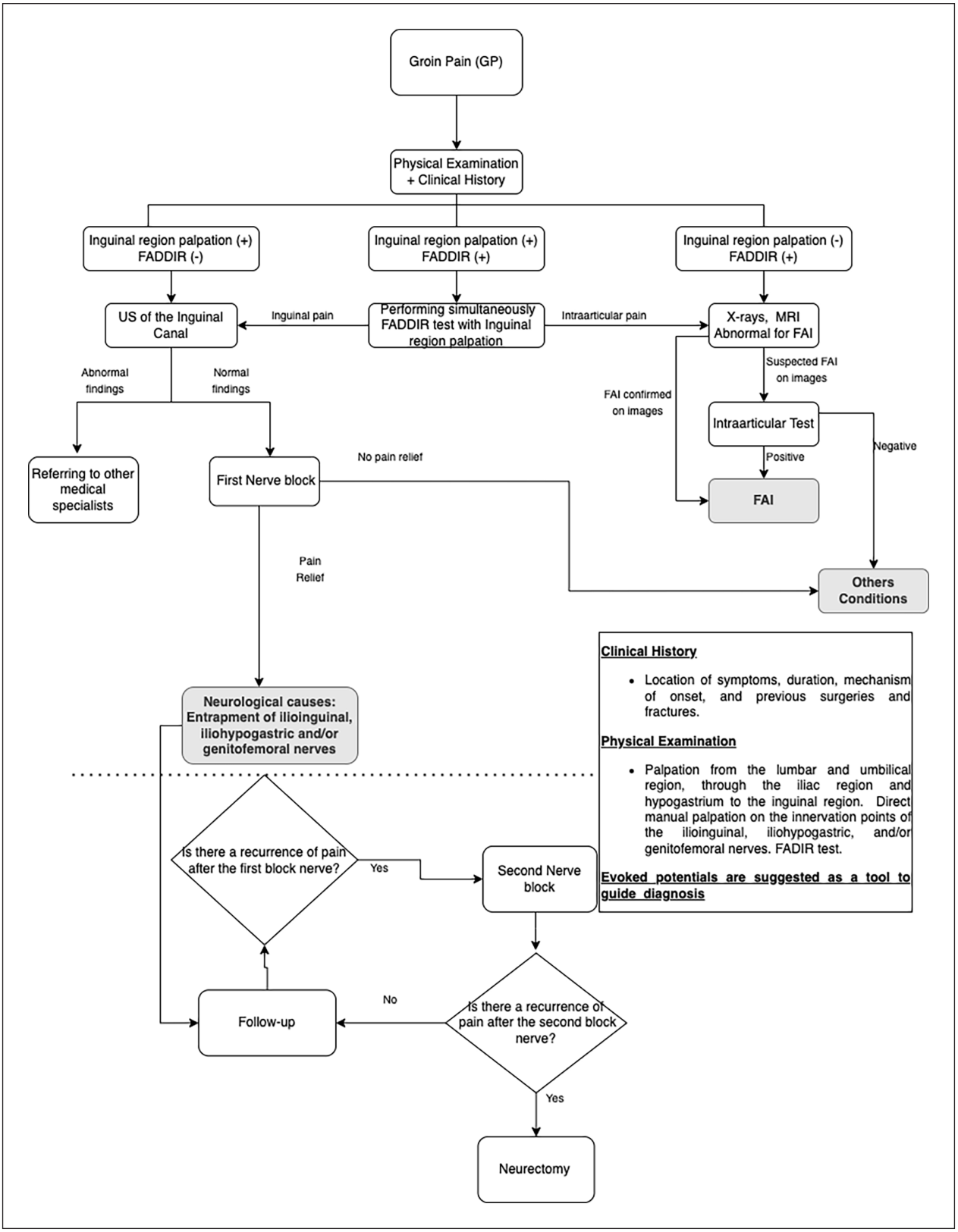

Figure 5. Algorithm of the diagnostic process and treatment for neurological groin pain.

Acknowledgements

The authors thank Biopublest for their help with technical editing.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

1. Rassner L. Lumbar plexus nerve entrapment syndromes as a cause of groin pain in athletes. *Curr Sports Med Rep* 2011; 10: 115–120.
2. Röling MA, Mathijssen NM and Bloem RM. Incidence of symptomatic femoroacetabular impingement in the general population: a prospective registration study. *J Hip Preserv Surg* 2016; 3: 203–207.
3. Jauregui JJ, Salmons HI, Meredith SJ, et al. Prevalence of femoro-acetabular impingement in non-arthritic patients with hip pain: a meta-analysis. *Int Orthop* 2020; 44: 2559–2566.
4. Kanezaki S, Sakai A, Nakamura E, et al. Surgical management of obturator neuropathy with a concomitant acetabular labral tear — a case report. *Acta Orthop* 2018; 89: 591–593.
5. Gerhardt M, Christiansen J, Sherman B, et al. Outcomes following surgical management of inguinal-related groin pain in athletes: a case series. *J Hip Preserv Surg* 2020; 7: 103–108.
6. Suarez JC, Ely EE, Mutnal AB, et al. Comprehensive approach to the evaluation of groin pain. *J Am Acad Orthop Surg* 2013; 21: 558–570.
7. Madura JA, Madura JA 2nd, Copper CM, et al. Inguinal neurectomy for inguinal nerve entrapment: an experience with 100 patients. *Am J Surg* 2005; 189: 283–287.
8. Shadhu K, Ramlagun D, Chen S, et al. Neuralgia due to ilioohypogastric nerve injury after inguinal hernioplasty: a case report. *BMC Surg* 2018; 18: 59.
9. Hahn L. Treatment of ilioinguinal nerve entrapment – a randomized controlled trial. *Acta Obstet Gynecol Scand* 2011; 90: 955–960.
10. Verhagen T, Loos MJA, Scheltinga MRM, et al. The groin-pain trial: a randomized controlled trial of injection therapy versus neurectomy for postherniorraphy inguinal neuralgia. *Ann Surg* 2018; 267: 841–845.
11. Poh F, Xi Y, Rozen SM, et al. Role of MR neurography in groin and genital pain: ilioinguinal, iliohypogastric, and genitofemoral neuralgia. *AJR Am J Roentgenol* 2019; 212: 632–643.
12. Eichenberger U, Greher M, Kirchmair L, et al. Ultrasound-guided blocks of the ilioinguinal and iliohypogastric nerve: accuracy of a selective new technique confirmed by anatomical dissection. *Br J Anaesth* 2006; 97: 238–243.
13. Zacest AC, Magill ST, Anderson VC, et al. Long-term outcome following ilioinguinal neurectomy for chronic pain. *J Neurosurg* 2010; 112: 784–789.
14. Kim DH, Murovic JA, Tiel RL, et al. Surgical management of 33 ilioinguinal and iliohypogastric neuralgias at Louisiana State University Health Sciences Center. *Neurosurgery* 2005; 56: 1013–1020.
15. Loos MJ, Scheltinga MR and Roumen RM. Tailored neurectomy for treatment of postherniorrhaphy inguinal neuralgia. *Surgery* 2010; 147:275–281.
16. Moore AM, Bjurstrom MF, Hiatt JR, et al. Efficacy of retroperitoneal triple neurectomy for refractory neuropathic inguinodynia. *Am J Surg* 2016; 212: 1126–1132.