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Review

MINIMALLY INVASIVE DIAGNOSTIC BLOCK AND PERCUTANEOUS RADIOFREQUENCY ABLATION IN THE TREATMENT OF CHRONIC HIP PAIN – REVIEW ARTICLE

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SUMMARY – The hyperactive "baby boom" generation is gradually aging, and chronic hip pain has become an increasingly common problem. Most patients with hip pain experience symptoms ranging from mild discomfort to severe pain. They can control the pain with conservative measures, but it inevitably progresses, causing a gradual decline in the quality of life. Conservative therapeutic approaches to hip pain include paracetamol, nonsteroidal anti-inflammatory drugs, narcotics and a variety of physical therapies. Total hip arthroplasty surgery is the only option for patients who experience a gradual decrease in mobility over time and whose pain is unaffected by a conservative approach. For most patients, surgical treatment is a good way to restore quality of life and reduce pain levels, However, this aggressive surgery is not possible in some patients. Many comorbidities in old age limit access to total arthroplasty, while the younger population is at an age where they want to delay surgical treatment. In both of these groups, it is desirable to consider other treatment options and techniques. Minimally invasive percutaneous partial sensory denervation of the hip joint has today become an option that can achieve significant success in providing the desired pain relief without the employment of a surgical knife. Today, there are different modalities for performing this procedure, ranging from diagnostic-pharmacological, radiofrequency (thermal, pulsating and cooled) and cryoablative modes. There is currently broad evidence that suggests that the use of fluoroscopically guided percutaneous radiofrequency ablation of the periarticular branches of the hip joint can provide pain relief for as long as 12-18 months.

Key words: *chronic hip pain; fluoroscopy; diagnostic block; radiofrequency denervation*

Introduction

The overall incidence of hip pain in the adult population (> 45 years of age) is about 7-10% (9.3% in women, 8.7% in men). It is often the primary cause of functional disability. Among adults who are active in sports, the incidence of chronic hip pain is 30-40%, while among the elderly over the age of 60, the incidence of pain averages about 12-15%. Unfortunately, it increases with age[1].

In most patients, the anamnesis is similar. Patients report that they have experienced constant and severe pain in the thigh and groin for several months. Initially, general analgesics are helpful, but gradually their pain intensifies and prevents them from walking, sitting and sleeping. The pain forces them to move with an orthopedic aid. Over time, the pain becomes constant, strong, sharp and deep in the groin and hip, radiating all the way to the knee (VAS 9-10). Typical clinical signs include pain in flexion, abduction and internal hip rotation. Synovitis and labral injuries of

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the hip joint are common causes of pain in younger people, while trochanteric pain syndromes and various osteoarthritis are more common in older age groups[2].

In the Pain Clinic of the Pula General Hospital, in cooperation with the Department of Orthopedics, selected patients with defined chronic hip pain have been able to resolve the algic syndrome through a program of interventional treatment, i.e., diagnostic blockade and radiofrequency denervation of the hip.

The aim of this review, based on our experience, was to describe the fluoroscopically-guided technique of diagnostic block and radiofrequency denervation of the hip, which avoids the neurovascular femoral bundle and reaches the target sites for hip capsule pain.

The basics of hip innervation

The hip joint is a spherical synovial joint that transfers weight between the upper and lower body and allows movement in all planes. Hyaline cartilage inside the joint, as well as the fibrocartilaginous sheath (labrum) around the edge of the acetabulum, enables its functionality. The hip joint is supported anteriorly by the iliofemoral and pubofemoral ligaments, and posteriorly by the ischiofemoral ligament. The hip joint is surrounded by a large number of muscle groups that allow a wide range of motion[3].

Hip innervation is complex and includes the gluteal, femoral, obturator and sciatic nerves. The majority of hip motor function is controlled by sciatic nerve activation. Sensory innervation of the articular capsule can be divided into anteromedial, anterior, posteromedial, posterior and posterolateral. The areas of the capsule that are most covered by sensory innervation are the upper, anterior and anteromedial portions. Therefore, it should be emphasized that the anterolateral aspect of this joint innervates the femoral nerve, the anteromedial part innervates the obturator nerve and its accessory branch, while the posterior part innervates the sciatic nerve and the upper gluteal nerve.

It is believed that inguinal pain is caused by sensory activation from the branches of the obturator nerve, while trochanteric (lateral) pain is transmitted through the articular branches of the femoral nerve. In a damaged hip joint, the greatest discomfort occurs during flexion (climbing stairs, wearing pants) and hip abduction (genital area hygiene). Painful perception for both movements originates from the articular innervation of the femoral and obturator nerves.

This simplified approach to hip innervation provides an opportunity to understand the goals of minimally invasive denervation and reduction of hip pain.

Whether using a fluoroscope or ultrasound, branches of the femoral and obturator nerves can be reached and denervated with relative ease and a limited risk of side effects, while branches originating from the sciatic nerve are too close to the main trunk to be denervated (Figure 1).

The articular branches of the femoral nerve slide along the periosteum between the lower anterior inferior spine (spina iliaca anterior inferior) and the ilio-pubic eminence, i.e., they lie below the ilio-psoas muscle tendon in the lateral aspect of the joint (ra-

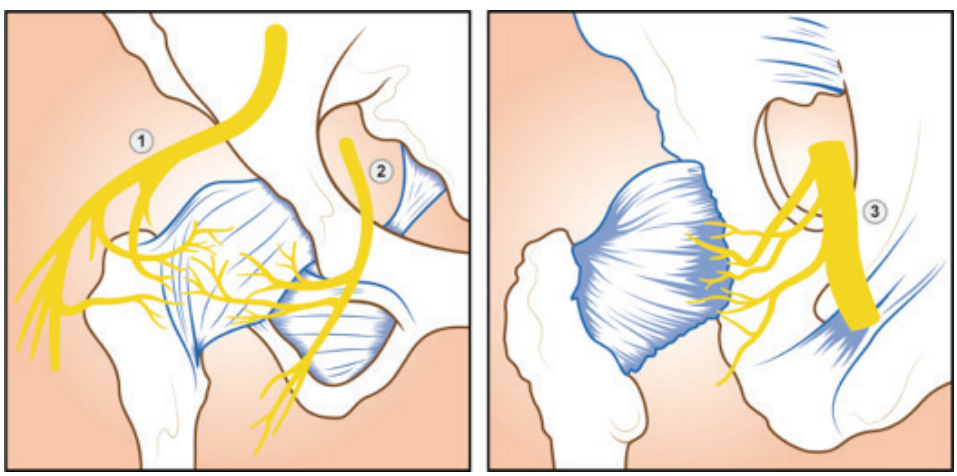

Figure 1. Knee innervation. 1. Anterior segment - femoral nerve branches (L1-L4). 2. Anteromedial segment – branches of the obturator nerve (L1-L4). 3. Posterior segment – branches of the sciatic nerve.

diological mark at 12 h). The articular branches of the obturator nerve travel between the pectineus and the external obturator muscle and enter the medial part of the articular capsule at the pubo-femoral ligament near the inferomedial acetabulum, in the area known as the pelvic teardrop. The accessory branch of the obturator nerve is located on the ilio-pubic eminence from which it provides branches for the medial part of the capsule[4].It is important to keep in mind that the obturator nerve divides into two main branches after it leaves its canal. The anterior branch, which runs in the interfascial plane between the pectineus and adductor brevis muscles, innervates the adductor longus, pectineus and gracillis muscles and provides sensory branches for the anteromedial hip capsule. The posterior branch innervates the muscles obturator externus, adductor magnus et brevis and provides a sensory branch for the knee joint, and this is the reason that hip pain is often accompanied by painful sensations in the knee[5].

Indications for minimally invasive access to the femoral and obturator nerves of the hip are: osteoarthritis of the hip, rheumatoid arthritis, osteonecrosis, avascular necrosis, persistent pain after total hip arthroplasty, pain after hip dislocation and metastasis[6].

Excluding criteria are: local infection, lumbar radiculopathy, Paget's disease, neurological diseases and hip fractures.

The success of a minimally invasive procedure (diagnostic or therapeutic) is determined by achieving:

1. Reduced pain (desirable reduction of VAS scale by 50%)Improved functionality (improvement in walking and daily activities)
2. Reduced use of anti-inflammatory drugs (complete reduction of analgesics)If these goals are achieved after two diagnostic blocks, the patient is a candidate for longer anesthesia by radiofrequency ablation.If patients do not present the expected improvement in all three criteria after the diagnostic block, they are referred back to orthopedists or physiotherapists for further treatment[7].

Method

All procedures are performed under sterile conditions in the operating room using a fluoroscope (C-arch) after informed consent has been signed. Patients lie on their backs with a slightly abducted leg of the hip and with moderate intravenous sedation with midazolam or propofol.

To have a good view of the entire hip, the most important thing is to ensure good radiological visualization by placing the C-arch correctly. Initially, it is important to radiologically center and display the symphysis properly with symmetrical visualization of both obturator foramen. After that, it is desirable to gradually direct the fluoroscope tube caudally, at approximately 10 degrees, to "open" and maximize the visualization of the foramen space. When we achieve the largest view of the foramen, we stop and redirect the fluoroscope tube 5 degrees cephalic. Only then is the C-arch in the correct position for lateral displacement and visualization of the hip joint being treated.

This procedure is followed by surgical washing and coating of a wide area of the skin of the abdomen, groin, thighs and the entire hip (Figure 2).

Figure 2. Left hip and preparatory marking of the "critical zone" and vascular bundle for safer access to the femoral and obturator branches.

Proper demarcation of the three basic anatomical points, the upper anterior iliac crest, the pubic symphysis and the femoral sulcus, is important for successful performance of the blocks. A sterile marker is used to draw the line connecting the upper anterior iliac crest with the symphysis, i.e., the course of the femoral furrow is drawn (it becomes visible by bending the thigh). A "critical zone" is drawn between these two demarcation lines. It is the area above the femoral sulcus and just below the inguinal ligament and rep-

resents the central vascular zone that it is important to bypass when performing the procedure.

The percutaneous procedure begins with an anterolateral approach to the accessory branch of the femoral nerve, which is generally located at the 12 o'clock position of the upper acetabulum. The probe radiologically marks the target point and is gradually repositioned so that its direction is more perpendicular to the 12 o'clock target position. The probe tip is then retracted toward the femoral ridge line and the point of their intersection represents the point of needle entry (Figure 3). At the marked site, the skin is infiltrated with a local anesthetic and the spinal needle (25G / 10 cm) is directed toward the target under radiological visualization, between the filamentous ligament threads, just above the femoral head. Care should be taken not to injure the "labrum" of the joint capsule when directing the needle. This approach achieves the anteromedial trajectory of the needle, thus avoiding joint injury, and then the periosteum can be added. After placing the needle at the given target site, its position is confirmed by anteroposterior (AP), oblique and lateral examination (Figure 4). The diagnostic block can be accessed by infiltrating 3 mL of local anesthetic (1% lidocaine or 0.5% bupivacaine).

In the second step, after returning the fluoroscope to its initial inclination, the accessory branch of the obturator nerve is approached. The expected position

Figure 3. Marking the 12 o'clock position for the femoral branch and A-P projection.

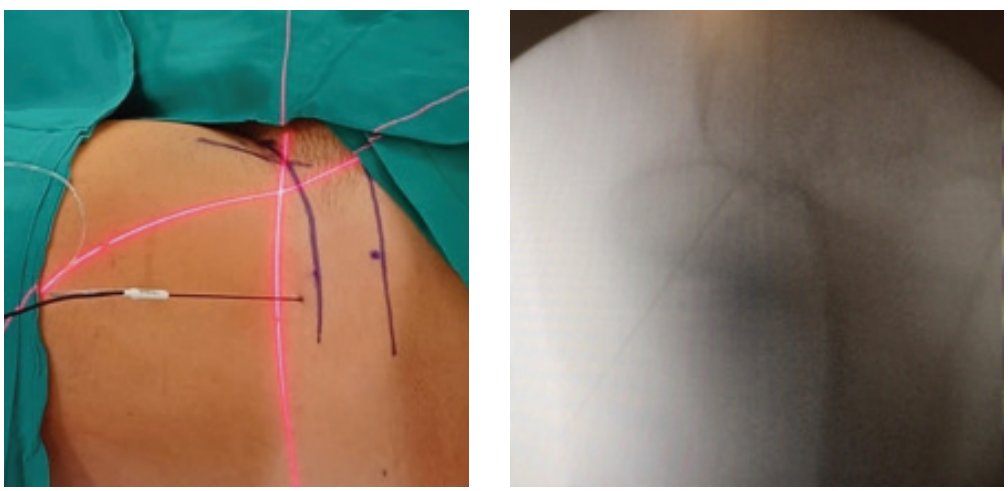

Figure 4. Depiction of the needle entry position for the femoral branch and L-L projection.

of the nerve is in the midline of the lower edge of the lower anterior iliac crest and the middle part of the femoral head, in the incision of the acetabulum or the so-called pelvic teardrop. After radiological marking of the target, the tip of the probe slides on the skin of the groin/thigh until it intersects with the femoral furrow, and the place of needle entry is marked just below it, i.e., the skin is infiltrated at that position with local anesthetic (Figure 5). The target zone is deep along the pectineus muscle, along the pubo-femoral ligament at the junction of the pubic and ischia-iliac rami. This anteromedial approach allows the needle entry and trajectory to be more medial than the vascular structures and to position the needle by sliding along the anterior surface of the anterior sciatic bone. Radiologically guided cephalic direction of the needle takes place with its gradual change of inclination. It becomes more horizontal by tracking the position and maintaining contact with the sciatic bone. After placing the needle at the given target site in the acetabulum incision, its position is confirmed by anteroposterior (AP), oblique and lateral examination. The diagnostic block can be accessed by infiltrating 3 mL of local anesthetic (1% lidocaine or 0.5% bupivacaine) (Figure 6).

After the diagnostic blockade, the patient immediately feels that the pain in the groin and hip has disappeared (VAS scale is significantly lower), and immediately experiences improvement in gait. Depending

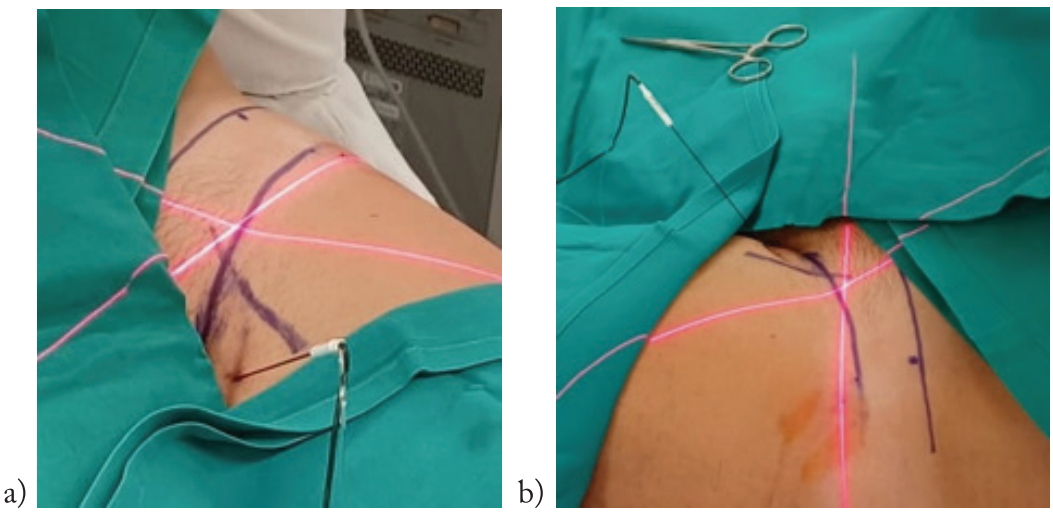

Figure 5. View of the needle entry position for the obturator branch (medially from the vascular bundle and below the femoral sulcus).

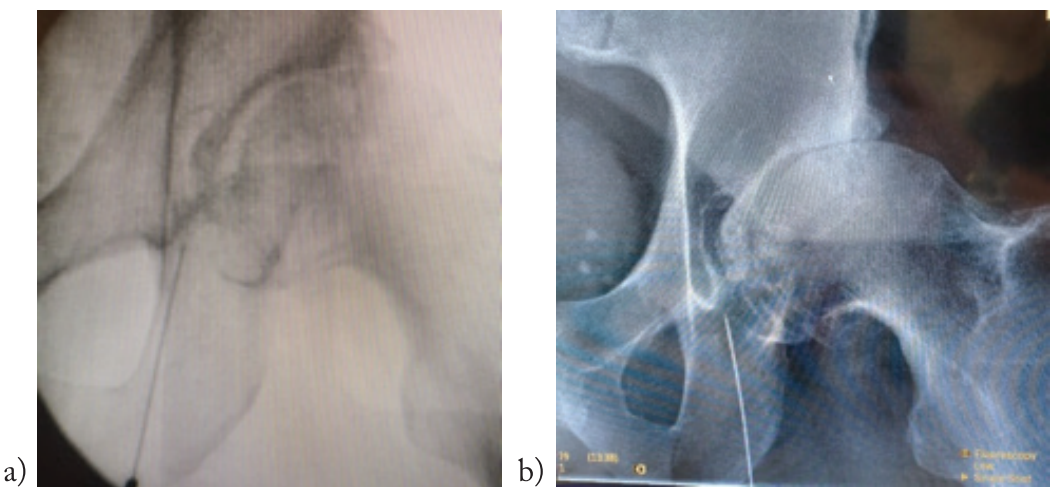

Figure 6. A-P projection of the obturator branch: a) first position, b) more distal position.

on the type of local anesthetic used, the relief can last several days or weeks.

After such a positive response, radiofrequency denervation of the articular branches can be planned.

The technique of fluoroscopically assisted placement of radio-frequency 22-gauge 100 mm electrodes/cannulas with a 10 mm active tip is identical to the previously described method. The same thing happens in two actions, each nerve separately. For radiofrequency ablation of the femoral branch, a lateral approach is also recommended in which the cannula is inserted from the lateral side of the thigh about 10 cm below the iliac spine near the antero-lateral border of the hip joint (Figure 4). In the second stage, the obturator nerve is accessed medially from the blood vessels in the same way, with the medial side of the thigh (Figure 5, Figure 6). The same cannula is used for both nerves. In addition to radiological control of the cannula position in several directions, the use of a radiocontrast agent (omnipaque) is also recommended.

After checking the position, sensory stimulation is performed at 50 Hz /0.6 V, 1 msec, for each individual nerve with a positive response, i.e., the appearance of moderate paresthesia in the groin and hip area. This is followed by a motor stimulation of 2 Hz / 2 V, 1 msec, which must not induce any muscle twitching, i.e., the proximity of the motor threads of the femoral or obturator nerve must be excluded[8].

Sensory and motor stimulation are extremely important steps performed prior to radiofrequency ablation, because sensory anesthesia (neuropathic pain of deafferentation) must be avoided, i.e., avoiding damage to motor branches that could cause weakness of adductor muscles and/or hip flexors. If any abnormal sensory or motor response is detected, the cannula tip must be repositioned and the electrical stimulation repeated. After confirming a good and safe cannula position, 1 mL of 2% lidocaine is injected and two consecutive thermal radiofrequency lesions are performed at 900/120 sec for individual femoral and obturator branches. It is acceptable to move the position of the needle tip in the second lesion, and place it for the femoral branch more cephalically, and more caudally for the obturator branch than the starting position. Sensory and motor stimulation should be repeated.

To achieve the maximum thermal effect, it is recommended that the active tip of the cannula be placed parallel and as close as possible to the branch of the nerve being treated. Therefore, when placing the cannula with a completely vertical approach, the contact with the thermal zone is reduced and a much smaller analgesic effect is achieved[9].

After thermal ablation through the cannula, a mixture based on a local anesthetic and 20 mg of methylprednisolone is injected around the nerve branches in order to reduce local edema and prevent possible neuritis of the treated nerve[10].

Side effects

After the percutaneous procedure, local hematomas may appear in the puncture zone. They are primarily associated with accidental puncture of the femoral vessel. To reduce this risk, the use of ultrasonic guidance is recommended[11].

According to the existing literature, this technique does not seem to be accompanied by major complications, except for the always possible allergic reaction to a contrast agent or local anesthetic[12].

Case reports

Example 1

A 72-year-old man had been suffering from chronic pain in his right hip for the past few years. The pain ws constant, often sharp, with discomfort in the hip and groin, worsened by walking. His stride was getting shorter, the average VAS was 7/10, and he had occasional soreness in the right knee. In previous years, he had received injections based on hyaluronic acid or based on local anesthetics and corticosteroids, but they were no longer effective. He was not a candidate for arthroplasty due to numerous comorbidities and a past stroke, chronic atrial fibrillation with dilated cardiomyopathy, gout and anticoagulant therapy. Due to pain, he used tramadol 75 mg + paracetamol 650 mg three times a day with antidepressants, with modest effect, and had difficulty emptying his bowels. At the clinical examination, he had severe hip pain when performing the Faber, Fadir and Quadrant test. Radiological findings showed severe degenerative changes and loss of joint space in the right hip. After bridging anticoagulant therapy with low-molecular-weight heparin, the patient underwent diagnostic blockade of the femoro-obturator branches with 0.5% bupivacaine. In the first week, the patient experienced satisfactory relief from the pain, after which the pain returned. He underwent another diagnostic block, but this time cortisone (triamcinolone) was added to bupivacaine. An-

esthesia and better motor activity were achieved over a longer time interval, as much as eight weeks. After confirmation of a good response, radiofrequency ablation of the femoral and obturator branches of the right hip was performed. There were no complications or side effects during the procedures. At the first check-up after week four, the patient reported that moderate pain was present in week two, but that he was quite satisfied (VAS 4/10), was not using pharmacotherapy and was taking better and longer walks. In the eighth and 12th week of radiofrequency ablation (RFA) he was still satisfied, and had discarded the cane while walking; the average VAS was 2-3/10 when taking an oral analgesic.

Example 2

The patient was a 52-year-old man who had played professional sports and had an arthroplasty of his right hip three years ago. He now suffered from severe pain in his left hip. Given the radiological findings (Tonnis grade I/II), the orthopedist did not decide on surgical treatment, but referred him to RFA of the hip. NSAID-based pharmacotherapy could not be used due to damage to the GI tract, and the use of other analgesic therapy was limited due to work and daily activities.

At the clinical examination, the patient experienced severe hip pain when performing the Faber, Fadir and Quadrant test.

The femoro-obturator diagnostic block was first performed with 3 mL of 0.5% bupivacaine at the target positions. In the first week, the patient showed enthusiasm regarding the effect, primarily because he achieved much better mobility in addition to analgesia. After week four, there was no longer any effect, and the patient underwent a second diagnostic block, this time performed with a mixture of 0.5% bupivacaine and 40 mg triamcinolone (Kenalog). Satisfactory performance for all criteria lasted for about 2.5 months.

After evaluation of the achieved effects with diagnostic blocks, radiofrequency ablation of the femoral and obturator branches of the left hip was performed. There were no complications or side effects during the procedures. At the first check-up after week four, the patient described the presence of moderate pain for the first few days, after which he was quite satisfied (VAS 3/10), without pharmacotherapy, better and longer walks and once again began exercising. In the eighth and 12th week of RF, the patient was still satisfied, with average VAS 2-3/10, occasional application of topical NSAIDs and leading an active life.

Discussion

Current knowledge on the perpetuation of low back pain suggests that the peripheral and central nociceptive systems act synergistically[13].

There is always a certain reluctance regarding methods that try to solve painful phenomena by treating only part of the nociceptive pathway. Clinical experience arising from other therapeutic procedures, such as rhizotomy of the zygopophyseal joints of the spine or other joints, such as the knee or shoulder, confirms that peripheral sensory branch denervation techniques can provide satisfactory control of long-term pain[14].

Numerous studies confirm that the correct approach in the treatment of chronic hip pain is based on a good response after the diagnostic block.

In a study by Edmonds-Seal et al., 18 patients with unilateral hip osteoarthritis underwent a diagnostic blockade based on Marcaine. All patients had a good response in the short term, for about two weeks, in terms of pain reduction and improved functional activity. Their pain levels gradually increased to the pre-injection level. The authors concluded that regional blockade of the hip nerve is not accompanied by complications and does not offer long-term beneficial pain relief in osteoarthritis of the hip[15].

Kang and Bulstrode reported that the radiological condition worsened after repeated hip blockades based on local anesthetics and corticosteroids, most likely as a result of corticosteroid injections within the hip joint[16].

A study by Fernandes et al. showed the opposite, i.e., that there was no radiological deterioration in an interval of 5 to 14 months after the anesthetic block[17].

No significant complications of radiofrequency ablation have been described to date, although there is some concern that denervation of the hip joint may accelerate the progression of osteoarthritis of the hip or cause Charcot's arthropathy[18].

Available clinical research on various techniques of radiofrequency denervation of the hip does not indicate the possibility of worsening or accelerating the osteoarthritic process.

In a large study by Vanacloch et al. in which patients were monitored for eight years after radiofrequency ablation, no radiographic changes were observed that would indicate the acceleration of the natural degenerative process[19].

Conclusion

Changing the current paradigm on the treatment of chronic hip pain certainly requires further clinical research, but the positive results to date suggests a reasonable option in applying such minimally invasive percutaneous techniques to patients in whom surgery is not an option.

Since only nerve fibers are treated with radiofrequency denervation, not endoneural structures, it is to be expected that healing will occur after some time and that the pain will return. The simplicity and safety of the technique allows it to be repeated and thus repeatedly provide prolonged relief for patients who are often forced to use various orthopedic aids, be exposed to high doses of various groups of drugs and are without the prospect of surgical treatment.

In some cases, the analgesic effect of the blockade may be absent despite a properly performed procedure. This can be explained by the fact that hip innervation varies greatly from patient to patient. A large proportion of patients are also satisfied with a partial improvement in pain because they are aware of their poor overall condition.

Our experience, based on numerous existing clinical studies, confirms that this technique of minimally invasive treatment of chronic hip pain is a fairly safe, effective and rewarding method.

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Sažetak

MINIMALNO INVAZIVNI DIJAGNOSTIČKI BLOK I PERKUTANA RADIOFREKVENTNA ABLACIJA U LIJEČENJU KRONIČNIH BOLOVA U KUKOVIMA - PREGLEDNI ČLANAK

L. Kalagac Fabris, S. Zanghirella Maretić, M. Petrinović i *T. Tepšić*

Hiperaktivna "baby boom" generacija postupno stari i kronična bol u kuku postala je sve češći problem. Većina pacijenata s boli u kuku osjeća simptome u rasponu od blage nelagode do jake boli. Konzervativnim mjerama mogu kontrolirati bol, ali ona neminovno napreduje, uzrokujući postupni pad kvalitete života. Konzervativni terapijski pristupi boli u kuku uključuju paracetamol, nesteroidne protuupalne lijekove, narkotike i razne fizikalne terapije. Operacija totalne artroplastike kuka jedina je opcija za pacijente kod kojih se pokretljivost postupno smanjuje tijekom vremena i na čiju bol konzervativni pristup ne utječe. Za većinu pacijenata kirurško liječenje je dobar način za vraćanje kvalitete života i smanjenje razine boli, međutim, za neke druge pacijente ova agresivna operacija nije moguća. Često vidimo da mnogi komorbiditeti u starijoj životnoj dobi ograničavaju pristup totalnoj artroplastici, dok je mlađa populacija u dobi u kojoj želi odgoditi kirurško liječenje. U obje ove skupine poželjno je razmotriti druge mogućnosti i tehnike liječenja.

Minimalno invazivna perkutana parcijalna senzorna denervacija zgloba kuka danas je postala opcija kojom se bez kirurškog noža može značajno postići željeno ublažavanje boli. Danas postoje različiti modaliteti njezina izvođenja; od dijagnostičko-farmakoloških, radiofrekvencijskih (termalnih, pulsirajućih i rashlađenih) i krioablativnih načina.

Trenutačno postoje brojni dokazi koji upućuju na to da uporaba fluoroskopski vođene perkutane radiofrekventne ablacije periartikularnih grana zgloba kuka može pružiti olakšanje boli čak 12-18 mjeseci.

Ključne riječi: *Mastektomija, kronična bol u kuku, fluoroskopija, dijagnostički blok, radiofrekventna denervacija*