

ORIGINAL PAPERS

The Role of Psoas Compartment Block in the Management of Pain During and After Total Hip Arthroplasty

Bianca Basgan¹, Nicolae Iordache^{2,3}, Dragos Cocos⁴

Abstract

Objectives: Evaluation of the efficiency of the lumbar plexus block in patients subjected to surgical interventions of total arthroplasty of the hip, regarding the intra- and postoperative analgesia. **Materials and methods:** Between January 2014 – July 2016, 30 patients subjected to the total hip prosthesis intervention were included in a prospective study. The cases were selected based on an initial diagnosis of coxarthrosis, and the patients were hemodynamically monitored, both during the surgery, and in the wake-up room, then they were visited after the surgery, twice a day, as long as they had the pain catheter. Protocols have been filled in, to track the evolution of the pains, the mobilization, as well as the need for opioids. **Results:** By using the lumbar plexus block, an important percentage of patients was obtained (63.33%), for which the postoperative administering of opioids (in the wake-up room and/or in the ward) has not been necessary. After measuring the values of the minimum blood pressure during the surgery and after setting an average of these values, it has been found that most patients remained stable from the hemodynamic point of view. Likewise, a consistent number of patients (86.65%) were registered to be suffering from a minimum postoperative pain at rest, between 0 and 2 (NRS). In 83.33% of the patients, an early mobilization was noticed, even on the first day after the surgery. **Conclusions:** The lumbar plexus block, combined with general anesthesia, constitutes an efficient method in pain therapy management, by decreasing the consumption of opioids during and after the surgery, as well as by facilitating early mobilization of patients immediately after the surgery, without unwanted accidents during medical gymnastics.

Keywords: lumbar plexus block, psoas muscles, total hip replacement surgery, analgesia

Rezumat

Obiective: Evaluarea eficienței blocadei plexului lombar la pacienții supuși intervențiilor chirurgicale de artroplastie totală a șoldului, privitor la analgezia intra- și postoperatorie. **Materiale și metode:** În perioada ianuarie 2014 - iulie 2016, un număr de 30 de pacienți supuși intervenției de proteză totală de șold au fost incluși într-un studiu prospectiv. Cazurile au fost selectate pe baza unui diagnostic inițial de coxartroză, pacienții fiind monitorizați din punct de vedere hemodinamic, atât intraoperator, cât și în sala de trezire, apoi vizitați postoperator, de două ori pe zi, atâta timp cât beneficiau de cateterul pentru durere. Au fost completate protocoale pentru a se urmări evoluția durerilor, mobilizarea, precum și necesarul de opioide. **Rezultate:** Prin utilizarea blocadei plexului lombar a rezultat un procentaj important de pacienți (63,33%) pentru care administrarea postoperatorie de opioide (în sala de trezire și/sau pe secție) nu a fost necesară. După măsurarea valorilor tensiunii arteriale minime din timpul operației și stabilirea unei medii a acestor valori, s-a constatat că majoritatea pacienților au rămas stabili din punct de vedere hemodinamic. De asemenea, la un număr consistent de pacienți (86,65%) s-a înregistrat un nivel al durerii minime postoperatorie.

¹ Department of Anesthesiology and Intensive Care Medicine, „Saint Elisabeth Hospital”, Gütersloh, Germany

² Department of Surgery, „Saint John” Emergency Clinical Hospital, Bucharest, Romania

³ Clinical Department no. 10, „Carol Davila” University of Medicine and Pharmacy Bucharest, Romania

⁴ Department of Anesthesiology and Intensive Care Medicine, „Marienhospital”, Oelde, Germany

Corresponding author:

Bianca Basgan

Department of Anesthesiology and Intensive Care Medicine, „Saint Elisabeth Hospital”, Stadtring Kattenstroth 130, 33332 Gütersloh, Germany.

E-mail: bianca.basgan@sankt-elisabeth-hospital.de

operatorii în repaus, situat între 0 și 2 (NRS). La 83,33% dintre pacienți s-a observat o inițiere a mobilizării precoce, chiar din ziua întâi postoperator. **Concluzii:** Blocada plexului lombar, combinată cu anestezia generală constituie o metodă eficientă în managementul terapiei durerii, prin scăderea consumului de opioide intra- și postoperator, precum și prin facilitarea unei mobilizări precoce a pacienților imediat după operație, fără accidente nedorite în timpul gimnasticii medicale.

Cuvinte cheie: blocada plexului lombar, mușchii psoas, operația de proteză totală de șold, analgezie.

INTRODUCTION

The „Psoas Compartment Block” technique was described for the first time in 1974 by the American doctor Alon P. Winnie, in a revolutionary article for that time¹, that was detailing both the anterior approach of the lumbar plexus (3 in 1 Block or femoral nerve block), and the posterior approach.

Subsequently, doctors Chayen D., Nathan H. and Chayen M. are making a series of additions and practical indications, in an article about the posterior approach, entitled ”The Psoas Compartment Block”², and the technique presented in this article also constitutes the basis for this study.

From an ideal point of view, pain management should incorporate techniques with minimum adverse reactions for the patients, and, equally important, with immediate local effects or that occur in a short interval of time. The painless mobilization or with minimum pain of the patients, in order to facilitate rehabilitation as early as possible, constitutes a first rank objective during pain therapy, in total hip arthroplasties.

These realities must not be ignored by the current doctors, if a real evolution of regional anesthesia is considered. The lumbar plexus block will be doubtlessly considered, in the following years, an usual technique in most hospitals in Europe, even though, currently, there are fears concerning possible complications (damage of intra-abdominal organs, intra-vessel injections, etc.), mostly where no routine related to this technique has been implemented, or where the medical devices are insufficient, exceeded as performances or totally inexistent. In this regard, a range of equipment, of which we mention the peripheral nerve stimulator, the ultrasound device or the catheterization sets, is essential for the good implementation of the lumbar plexus block technique.

The consequences of such a laborious surgery as is the total hip arthroplasty may be severe, causing even extreme pains and the impossibility to move the patient to be attended by a physiotherapist. The lack of postoperative gymnastics may generate a series of complications, among which we must mention the post-

operative infections, muscle atrophy, contractions of muscles of the back or back head, articular fibrosis with motion deficit or deep venous thrombosis.

Therefore, it is imperative to correct in an accurate manner these postoperative pains by the regional anesthesia technique, described below, and the immediate benefits are the improvement of the patients’ life quality, early movement and decrease of the consumption of opioids.

METHODS

In this prospective study, the analysis included, initially, the patients that received the psoas compartment block as pain therapy during and after the surgery, in the total hip arthroplasty surgery. The following parameters were monitored, in their order of importance: the necessary amount of opioids during and after the surgery, both in the wake-up room and in the ward, throughout the interval when the pain catheter is preserved; the average of hypo blood pressure (decrease of blood pressure during the surgery as hemodynamic instability factor); beginning of postoperative mobilization; minimum pain after the surgery, verbally expressed by the patient on a scale from 0 to 10; maximum pain after the surgery, verbally expressed by the patient on a scale from 0 to 10; the patients’ satisfaction degree on a scale from 0 to 15; waking up during the night because of pain in the operated area; mood alterations.

The criteria for inclusion in the study were: age (18-80 years old), ASA I-III, diagnosis of coxarthrosis of the hip side (right/left) that was to be operated.

The patients with morbid obesity, chronic use of opioids, pregnancy, breast-feeding, allergies to NSAID, COX-2 inhibitors, sedatives, amid-type local anesthetics, infection of the area of the future puncture, those refusing pain therapy through catheterization, but also those that were unsuccessful in setting up a pain catheter were excluded from the study.

All the patients received, as medication, Midazolam 3.75 or 7.5 mg p.o. according to their age or to other chronic disease history, Etoricoxib 90 mg p.o. and Oxycodone 10 mg p.o., and after the insertion of the

pain catheter, they were administered 20 ml of Ropivacaine 0.75% fractioned (initially 5 ml of test dose, then, after a few minutes, another 15 ml); afterwards, they underwent general anesthesia by endotracheal tube or laryngeal mask. Before the surgery (about 1h), throughout the surgical intervention, but also in the wake-up room, the patients were monitored by EKG, pulse oximeter and measuring of arterial blood pressure.

After the surgery, all the patients remained in the wake-up room for several hours, according to the waking/consciousness degree (here, they were administered Pirtramid 3.75 mg-7.5 mg for one NRS>4), then they were transferred to the peripheral surgical ward responsible for orthopedic cases. The pain catheter was connected to a perfusor, so that patients were administered on an ongoing basis Ropivacaine 0.375% 10 ml/h, as well as Novaminsulfon 5 g per day, fractioned, as drops. Likewise, patients were informed about the NRS pain scale, and they could immediately notify the ward nurses whether the pains exceeded the intensity degree 4, in which case opioids could be administered (Oxycodone acute 5 mg p.o.), auxiliary to the ongoing therapy.

The on-call anesthetist, in charge with making visits to see the patients, joined by a pain nurse, evaluates the patients' degree of pain twice a day, in the morning and in the evening, and he/she fills in the charts with data concerning the evolution of the pain, sensitivity and motility of the leg, appearance of the bandage and of the injection spot (bleeding, puss, etc.). The pain catheter is preserved for minimum 48 hours, and afterwards, according to the patient's degree of pain, the dose is reduced, or a break of 12 hours is taken from administering Ropivacaine. If the NRS remains stable and <3, then the catheter may be removed.

The anesthesia of the lumbar plexus has been made, in this study, by using the peripheral nerve stimulator. The lumbar plexus is made by unifying the ventral branches of the spinal nerves T12-L4. Situated between the muscular planes of the large psoas muscle, it plays the part of serving the lower limb from the sensitive and motor points of view, through its collateral branches (iliohypogastric, ilioinguinal, genitofemoral, lateral femoral cutaneous nerves) or terminals (femoral, obturator and accessory obturator nerves).

The patient is placed in lateral decubitus or in sitting positions, with the spine in full flexion. The line uniting the iliac crests (Tuffier's line) is used as landmark to appreciate the spine apophysis L4. The puncture area is traced 3 cm below the L4, and then measuring at the right angle 5 cm sideways²⁴.

It is advanced by isolated protection needle between 7-11 cm, and with an electrical impulse of low intensity (1 mA), transmitted to the lumbar plexus by the peripheral nerve stimulator through this needle, the motor fibers are stimulated, thus identifying its proximity. The anode of the stimulator is connected to an electrode placed on the patient's skin, on the opposite side of the needle insertion spot. The cathode of the stimulator is connected to the stimulation needle. The approximate localization of the nerve is made, with the voltage of 1 mA, which, close to the nerve, must be reduced to 0.2-0.5 mA. The occurrence of muscular fasciculation is noticed on the distribution territory of the lateral femoral cutaneous, femoral and obturator nerves (femoral quadriceps, iliopsoas, sartorius, pectineus, long and short adductor, gracilis muscles).

The use of the peripheral nerve stimulator has a series of advantages that must be thoroughly analyzed before choosing the technique of localization of the lumbar plexus. Among these advantages, we enumerate: the lack of any contact between nerve and needle, in most interventions (by gradually inserting the needle, the proximity of the nerves is quickly detected by the stimulator, and the lesion of the peripheral nerves is very rare); the spontaneous occurrence of muscular fasciculations (of the motor feedback), without the patient's help; the patient's increased degree of comfort, due to the previous informing of the occurrence of muscular fasciculations; the possibility for all the doctors under training to learn this technique very quickly.

The localization of the lumbar plexus by means of the ultrasound device is performed only by specialists and is considered to be a delicate procedure²⁵. Because it is very deep, at the depth of about 10-12 cm, the localization technique differs from those applied to other blocks, that occur closer to the surface. It is more common to use the abdominal probe of 2-5 MHz, enabling the doctor to see more deeply. Initially, the nerves cannot be emphasized by ultrasound device, but, after injecting the local anesthetic directly into the psoas muscle, it grows in diameter, and the targeted nerves are successfully emphasized.

The patient is placed in lateral position, and the probe of the ultrasound device is displayed perpendicularly on the spine process L4, until it is noticed in central position on the screen of the ultrasound device. The probe then moves to one side, until the spine process appears on the screen sideways. After showing at depth the erector spinal and square lumbar muscles, a puncture towards the medial is made, right between these

muscles, directly in the tissues of the psoas muscle, with the probe placed longitudinally.

To increase the patient's safety and comfort, the peripheral nerve stimulator may be additionally used at this moment. After the tip of the needle pierced the psoas muscle, by stimulator, the motor feedback of the thigh is caused, by the previously described technique, then the medicine is injected. The muscle increases in volume and, normally, a series of oval or round hypoechoic structures are revealed, resembling to small air bubbles, in this case, the lumbar plexus nerves; this shows that the block was successfully performed.

Thanks to its technical-medical features, the ultrasound device is able to optimally render complex anatomic structures, such as blood vessels or organs bordering the areas of interest, examined by sonograph, and their length of localization is low, if we try a comparison with the peripheral nerve stimulator. Among the disadvantages of this technique are the high costs of an ultrasound device, provided with a special probe for regional anesthesia, training of doctors, which may take a very long time, and the frequent damaging of peripheral nerves, precisely because they are impossible to locate by ultrasound in the first place.

RESULTS

The consumption of opioids is the factor of major importance in surgically treating hip coxarthrosis, which makes it imperative to minimize the side effects on the short and long run of the opioids (addiction, constipation, fatigue, nausea, vomit, sleep, vision or hearing disorders, fear, depression, anger, confusion, euphoria, dizziness, asthenia, tremor, headaches, heart rate disorders, paresthesia, alterations of cognitive or reflexive capacities, decrease of appetite, decrease of libido or impotence, etc.). By using the psoas compartment block during pain therapy, the regional anesthesia will register, in the years to come, a significant success in decreasing the consumption of opioids, mostly in patients suffering from chronic pain, usually requiring larger doses of active substances, where the pain catheter is rather an elective option.

Only 5 patients out of 30 (16.66%) made it necessary, in instants immediately after the surgery, in the wake-up room, to be administered Piritramid, in doses between 3.75 mg and maximum 15 mg i.v., and of all the patients transferred in the surgery ward, in the first 72 h, only 6 of them (20%) complained of NRS>4 pains, receiving Oxycodone acute 5 mg p.o.

During the surgery, blood pressure has been monitored, according to the anesthesia protocol, every 5 minu-

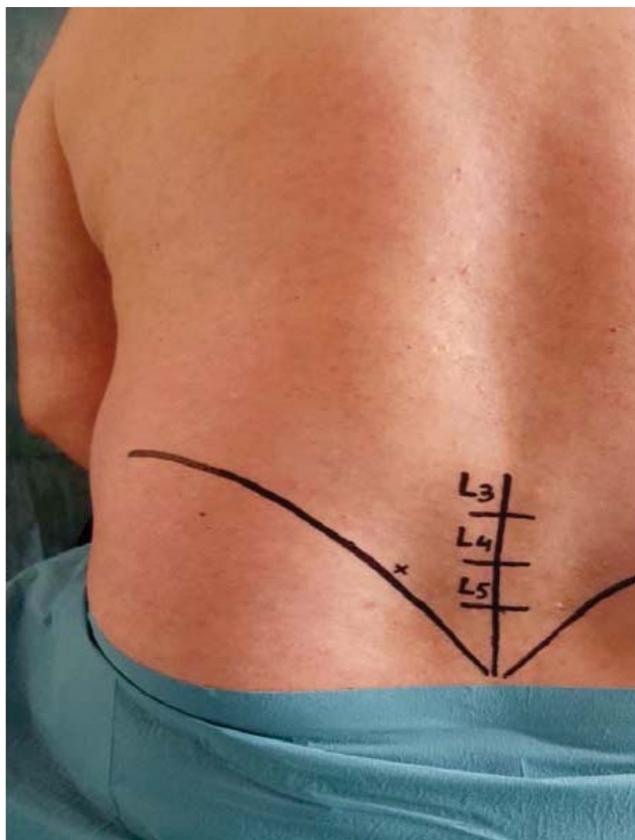
tes, the hypo blood pressure values of the patients have been monitored throughout the entire procedure and at the end, the means of these values has been calculated. The result consisted in the value of 63.25 mmHg, representing the means of hypo blood pressure (MAP). 70% of the patients showed, during the surgery, the best value of MAP of over 60 mmHg, while they were under general inhalational anesthesia. More precisely, this value indicates that the patients who received this kind of pain catheter needed diminished doses of anesthetic and of analgesic during the surgery, because the pain was highly attenuated by Ropivacaine, by the amid-type local anesthetic, administered to block the lumbar plexus, helping maintain the best blood pressure.

The amounts of Fentanyl received by the patients to induce anesthesia, but also to complete the analgesia during the surgery, are rendered in the diagram below. Therefore, 43% of the patients required only 0.15 mg of Fentanyl i.v., and 27%, only 0.2 mg, in total, 70% of the patients received reduced doses of this type of opioid during the surgery (about 1.5 – 3 hours), comparable doses, for instance, with those administrated during laparoscopic surgery of appendicitis.

The minimum postoperative pain while at rest, until the catheter is removed, is one of the parameters found on the protocols attached to patients benefiting from such a regional procedure. From this point of view, a percentage of 53.33% declared a NRS=0 and only one patient (3.33%) had the index NRS=4, which was also the biggest value of pain recorded at rest. Here is how, by using the lumbar plexus block, more than half of the patients have not pointed out any pain at rest, which is of major importance in improving the quality of life of these patients.

According to the same principle, the maximum pain from surgery to the removal of the catheter has been measured. Here, we notice a mosaic of values, varying from 1 to 10 on the NRS scale, of which we relevantly point out the 23.33 %, given to the patients registered with NRS=5.

A significant benefit brought by the lumbar plexus block technique is the probability of early movement, even beginning with the first day after the surgery, and this probability making the object of somewhat delicate controversies among doctors. Some show reserves regarding the use of this type of catheter, on the one hand, concerning an alleged impossibility to move surgical patients (THA), and, on the other hand, concerning the probability of accidents during physiotherapy. One particularly important aspect of the use of the pain catheter must be mentioned: the correct dosage



of the local anesthetic, administered in a continuous flow to patients, induces the abolition of sensitivity on the operated side, with the minimum or inexistent motor block of the upper limb. Naturally, between the two potential effects, there is a very fine marking line, and it is precisely the patient who may provide the attending doctor with the necessary answers, during "pain visits" organized twice a day, in the morning and in the evening, beginning with the first day. During the day of the surgery (day 0), only one visit is made, in the evening. During these visits, the motility and sensitivity of the operated limb are tested and, according to the result, the concentration of local anesthetic may be decreased (Ropivacaine) to 0.2%, or the medicine dosage (the number of millimeters is usually decreased by two units). The doctor-patient communication is, during pain therapy, like in any other aspect of clinical practice, the basis of any treatment.

The statistic setting of an average value to preserve the pain catheter shows the length of 4.9 days, in total, without other complications.

As previously described, in this article, the satisfaction degree of the patients at the end of the pain therapy has also been monitored, by making a questionnaire that includes a gradual scale (from 0 to 15 units). With

relevance for our study, the satisfaction degree exceeded all expectations, as 53.33% patients chose the value 15, therefore the „very satisfied“ degree.

DISCUSSIONS

The results specified above prove that the psoas compartment block decreases the level of opioids both during the surgery and in the wake-up room, as well as on the peripheral ward. This is very important, because, seen on the long run, the patients have great chances not to become addicted to these drugs, and those that were already administered those opioids in the daily medication, as Oxycodone tablets or Tilidin drops, may give them up immediately after the surgery, by continuing to receive Ropivacaine through the pain catheter.

No patient underwent intra-vessel injection of Ropivacaine, and the patients remained under observation after the catheter was implemented in the ante-chamber of the operating room, until the anesthesia was induced (approximately 15 minutes). In this time, the patients remained awake, with the value of the GCS of 15, and stable from the hemodynamic point of view. Likewise, there has been no case of dissemination of the local anesthetic up to the epidural area, and no patient complained of bilateral analgesia.

In the surgical ward, at about 4 hours after the surgery, only one patient suffered a collapse, of hypovolemic causes, and the cases where the catheter was immediately dislocated after the surgery, during the transfer into the wake-up room, could not be included in the study.

After the surgical intervention, during pain visits to patients' beds, as well as during the removal of the catheter, no hematoma, infections or pain at the injection spot have been noticed.

The result of this study, showing the percentage of 83.33% of the patients where early movement has been initiated, eliminates any correlation between the lumbar plexus block technique and the impossibility to undergo the medical gymnastics sessions by the patients benefiting from such a surgical intervention. The full motor block of the operated limb has not been reported for any patient, not even on the surgery day (day 0). Physiotherapists play a decisive part in urging and encouraging patients to move, naturally, with the permanent participation of the designated medical staff. Even though, before the surgery, when the patient is in the ante-chamber of the operating room, some surgeons wish to keep away the pain catheter, motivating this choice by the alleged lack of time, though it is imperative to match the amplitude of the surgical cure with a

suitable pain therapy. Even though the time necessary to prepare the patient for anesthesia before the surgery is rather long (30-40 minutes), and it also includes the checking of the patients' data, already existing in the anesthesiology protocol, as well as the connection of venous catheters, the benefits provided to the patient by using the psoas compartment block are significant and they cannot be neglected in the future of medical practice. It is easy to discharge the patients, giving them painkiller prescriptions, including opioids, which, in time, may remain under the monitoring of the family doctor, including them in the medicine plan, but this is not an ideal way to deal with the situation. It would be more appropriate to properly treat the pain, even at the intraoperative stage.

An alternative solution, implemented in some hospitals by our fellow doctors working in orthopedic branches, consists in the intra-articular catheter, inserted only at the end of the surgery, playing a part in the postoperative pain therapy²³. As an example, Kutzner et al. makes an interesting comparison between the intra-articular catheter and the femoral nerve catheter, in total knee arthroplasty, using for the first mentioned a mixture of three substances: 200 ml Ropivacaine 0,75%, 2 ml Morphine and 148 ml NaCl 0,9%. Apparently, the intra-articular catheter facilitates a quicker mobilization and concerning the intensity of pain, the results for both catheters are similar.

However, during the surgery, the blood pressure vacillates significantly, and it may reach, at certain moments, alarming maximal values, particularly due to pain, thus causing abundant intraoperative bleeding. Once more, we notice the importance of inserting a catheter for pain therapy prior to the surgery.

Another point of interest related to the lumbar plexus block technique is whether this procedure of regional anesthesia shortens the patient's hospitalization length or not. This study, however, cannot analyze this parameter, because the patients remain in the hospital, according to a standard protocol, between 10 and 14 days, and the only criterion of discharge, if the surgery was satisfactory, consists in finding a place in a rehabilitation clinic where they are to be further treated (medical gymnastics, massages) for another 3 weeks.

Although it has not been used in this study, the ultrasound guided technique of localization of the lum-

bar plexus may be a usual choice in the future, combined with the peripheral nerve stimulator, in the current medical practice. Without using this later device, there are no insurances that the implantation of the catheter was successful; only one single dose of Ropivacaine may be injected, but it would only provide intraoperative analgesia and maybe 6 hours after the surgery, at most.

CONCLUSIONS

In conclusion, the lumbar plexus block (with posterior approach) as long-term pain therapy during and after the surgery, until the extraction of the pain catheter, in the surgical cure by THA, is a relatively simple procedure, that is learnt very quickly by means of the nerve stimulator. The psoas compartment block abolishes the sensitivity of the territory related to the lumbar plexus, decreases the need for opioids during and, more particularly, after the surgery, preserves the blood pressure during the surgery at an optimal level, facilitates the early start of physiotherapy and determines a good quality of hospital life for the patients.

Even though the results specified above must be included, in the future, in wider studies, they must encourage the use of the psoas compartment block in the professional training of the young anesthetists.

The lack of an academic pedagogic system favorably oriented and the scarce funds, on the one hand, and certain ungrounded fears concerning any adverse effects, on the other hand, are however tracing a hostile trend against the habitual use, in the current medical practice, of the psoas compartment block, despite the many advantages that this regional anesthesia procedure provides.

Abbreviations

ASA - American Society of Anesthesiologists
 COX-2 - Cyclooxygenase-2
 GCS - Glasgow Coma Scale
 mA - miliampere
 MAP - Mean Arterial Pressure
 MHz - Megahertz
 NRS - Numeric rate scale
 NSAID - Non Steroidal Antiinflammatory Drugs
 THA - Total Hip Arthroplasty

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