Indirect block technique of the adductor canal using anatomical landmarks

Técnica de bloqueio indireto do canal dos adutores com marcos anatômicos

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Abstract

The adductor canal block can be performed for knee analgesia and is an anesthetic technique focusing on the saphenous nerve, usually performed with ultrasound assistance, aiming to improve accuracy and avoid neurovascular injury. Challenges in performing this block with ultrasound include the availability of an ultrasound machine in the perioperative setting and trained professionals. The objective is to describe a technique for the indirect block of the adductor canal guided by anatomical landmarks without ultrasound assistance. The technique involves locating anatomical landmarks such as the patella, adductor tubercle, and greater trochanter for blocking the adductor canal. The described technique enables the indirect block of the adductor canal without ultrasound assistance, to be performed by the surgeon or other surgical team members, such as the assisting surgeon and anesthetist in the perioperative period, including the intraoperative phase, just before the surgical incision.

Keywords: Nerve block; Pain; Regional anesthesia; Anesthesia.

Resumo

O bloqueio do canal dos adutores pode ser realizado para analgesia do joelho, e trata-se de uma técnica anestésica com foco no nervo safeno, usualmente realizada com o auxílio de um ultrassom, com o intuito de melhorar a assertividade e evitar uma lesão neurovascular. As dificuldades para realização deste bloqueio com ultrassom incluem a disponibilidade de um aparelho de ultrassom no perioperatório e profissionais treinados com a técnica. O objetivo é descrever uma técnica de bloqueio indireto do canal dos adutores guiada por marcos anatômicos sem a assistência da ultrassonografia. A técnica envolve a localização de marcos anatômicos como a patela, tubérculo adutor e grande trocanter para o bloqueio do canal dos adutores. A técnica descrita possibilita o bloqueio indireto do canal dos adutores de modo prático sem o auxílio da ultrassonografia, a ser realizado pelo próprio cirurgião ou por outros membros da equipe cirúrgica, como o cirurgião auxiliar e anestesista no perioperatório, inclusive no intra-operatório imediatamente antes da incisão cirúrgica.

Palavras-chave: Bloqueio nervoso; Dor; Anestesia regional; Anestesia.

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Introduction

The adductor canal block (ACB) primarily aims at anesthetizing the saphenous nerve and is a widely used technique in knee surgeries, including major procedures like total knee arthroplasty revisions[1]. It allows for early analgesia and ambulation compared to local infiltration and femoral nerve block, usually providing adequate analgesia while sparing the strength of the quadriceps femoris[2].

The adductor canal is a musculoaponeurotic tunnel located between the sartorius, vastus medialis, and long adductor (proximal) / adductor magnus (distally) muscles on the medial thigh. The only nerve consistently found in the adductor canal is the saphenous nerve, which is purely sensory, providing sensory coverage to the medial and anteroinferior aspects of the knee and the medial side of the leg and ankle[3]. The adductor canal may also contain the nerve to the vastus medialis, the medial cutaneous nerve of the thigh, and the anterior or posterior branch of the obturator nerve. The nerve to the vastus medialis, in addition to innervating the anteromedial capsule proximal to the patella and the medial retinaculum, has posteromedial branches to the oblique vastus medialis in the proximal part of the adductor canal, while its anterior branches responsible for the long vastus medialis likely preserve quadriceps strength in the block as they are outside the adductor canal. Anterior division branches of the obturator nerve contribute to the anterior cutaneous innervation of the knee and the long adductor and gracilis muscles, while posterior division branches contribute to the posterior capsule innervation of the knee as well as the short adductor, magnus, and external obturator muscles[4-6].

Challenges in performing this technique involve access to ultrasound, and usually, an anesthetist or surgeon trained in this conventionally ultrasound-assisted technique is required. Therefore, if the surgeon can perform an adductor canal block using anatomical landmarks intraoperatively, there may potentially be a reduction in costs related to anesthetic time and the need for an ultrasound machine[7,8].

The desire to create a technique for adductor canal block performed by the surgeon using anatomical landmarks, independent of ultrasound and anesthetist, has been expressed by several authors. However, the medical literature presents diverse results regarding the effectiveness of the needle in reaching the target, safety (risk of vascular puncture), and clinical benefits of this approach[7-10].

The advantage of the indirect adductor canal block technique performed using anatomical landmarks would be the possibility of performing the adductor canal block at a safe distance from the vessels in services without easy access to an ultrasound machine in the operating room, in addition to not requiring prior training, allowing it to be performed by the surgeon, including intraoperative application.

The objective of this study is to describe the step-by-step procedure of the indirect adductor canal block technique performed using anatomical landmarks.

Description of the indirect adductor canal block technique performed using anatomical landmarks

Positioning

The patient is placed in a supine position with the hip and knee in a neutral position.

Anatomical landmarks

Locating the entry point on the thigh

On the cranio-caudal axis, we determine the height of the point on the thigh midway between the inferior border of the greater trochanter and the base of the patella. This point is located at the level of the adductor canal.

Another important parameter to consider is that the adductor canal is located 10 to 18 cm from the adductor tubercle (the length of the adductor canal is approximately 8 cm), with the distal/end part of the adductor canal typically being 10 cm proximal to the adductor tubercle (this anatomical landmark is usually at the level of the base of the patella)[11]. On the medio-lateral axis, we will puncture immediately medial to the femur. The intersection of these landmarks will be the puncture site (Figures 1 and 2).

Expected depth

Using a 22 G 22x80 mm needle (usually a spinal anesthesia needle), the puncture should be perpendicular to the skin at the previously marked location, passing close to the medial face of the femur. To define the depth, we can use two parameters simultaneously. When inserting the needle, we stop advancing the needle upon encountering increased resistance, indicating that we have reached the fascia between the vastus medialis muscle and the long adductor muscle. Figure 3 shows this. Usually, this depth leaves 3 cm

of the needle externally to the skin (a measurement previously observed when the same technique is performed by ultrasound).

Block with injection of the anesthetic solution

After aspirating the syringe plunger upon reaching the expected site, and verifying that there is no blood return in the plunger, we ensure the positioning is outside important vessels such as the subsartorial arteries and veins. From this moment, we can begin injecting the anesthetic into the fascia between the vastus medialis of the quadriceps femoris and the long adductor muscle, which by medial diffusion carries the injected medication to the adductor canal, achieving the same expected results as the direct block of the adductor canal performed conventionally guided by ultrasound.

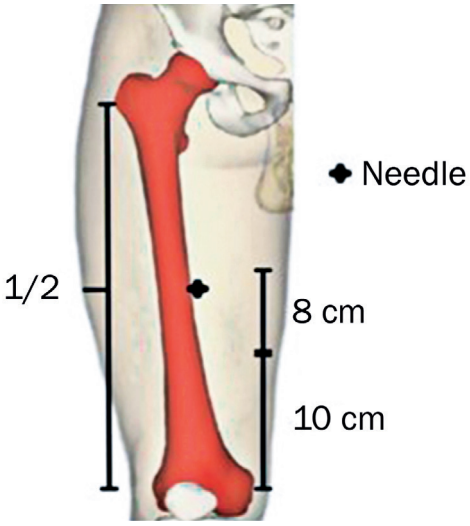


Figure 1. Represents the thigh of a patient in the coronal plane. On the left, the parameter presented is the midpoint of the distance between the inferior border of the greater trochanter and the base of the patella, being one of the anatomical landmarks of the adductor canal. The other parameter demonstrated on the right represents the distance of 10 cm to 18 cm in the proximal direction from the adductor tubercle, also used as a reference for the adductor canal. Usually, the adductor tubercle corresponds to the superior pole of the patella. Finally, the point demonstrated by the needle represents the location to be punctured.

Anesthetic solution injected

In a 10 ml syringe with a screw cap, we aspirate 2 ml of triamcinolone hexacetonide (20mg/mL) and 8 mL of ropivacaine hydrochloride (7.5 mg/mL). In a total knee arthroplasty surgery, we prepare 2 syringes this way. For the indirect (or even direct) block of the adductor canal, we inject a volume of 2 to 3ml, having used the remainder of the solution to additionally block genicular nerves and infiltrate the posterior capsule (with the same objective as an iPack block) under direct vision after performing the femoral and tibial cuts during the arthroplasty.

Block performed in the perioperative phase

If planned for intraoperative blocking, and if the surgeon opts to use a pneumatic tourniquet, we suggest checking the proper positioning of it to not hinder the block.

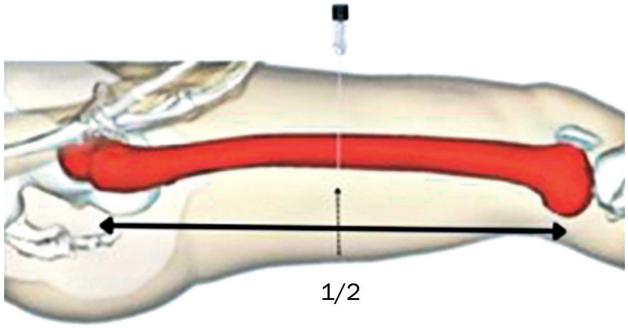
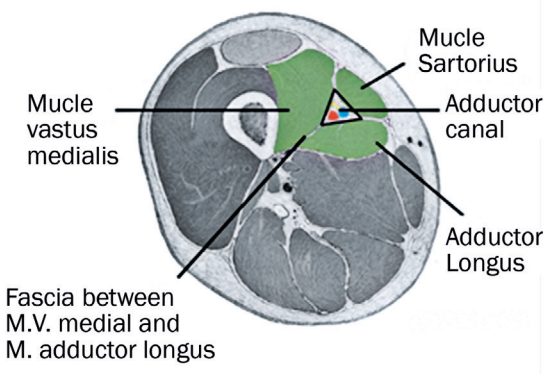


Figure 2. Is a sagittal representation of the patient's thigh. The parameter demonstrated represents the average distance between the lower limit of the greater trochanter and the base of the patella, being this the anatomical landmark for blocking the adductor canal. Above the image of the femur, the needle for blocking is represented and the depth that should be reached for a satisfactory result.



M = Medial; V = Vastus.

Figure 3. Represents an axial cut of the mid-thigh. Here, it is possible to identify the adductor canal and the fascia between the vastus medialis of the quadriceps femoris and the long adductor muscle. This fascia is the final target of the injection, which by diffusion reaches the adductor canal.

Block performed at outpatient level

When performed with the patient at an outpatient level for treating pain caused by knee osteoarthritis or chronic pain after knee arthroplasty, the patient may experience pain in the adductor magnus following the block, which can often be quickly alleviated with dry needling using a long acupuncture needle. One hypothesis is that this phenomenon of pain in the adductor magnus following the block occurs when we additionally block the innervation of the oblique vastus medialis muscle (within the adductor canal) in a patient whose adductor magnus muscle is contracted. Fan Chiang et al.[4] believe that the quadriceps strength is preserved as the innervation of the long vastus medialis is not affected by the adductor canal block. If the block is performed at an outpatient level, we suggest skin anesthesia with lidocaine and a 13 X 0.45mm 26G hypodermic needle prior to the procedure.

Discussion

The objective of this article is to describe the indirect adductor canal block technique so that orthopedic surgeons can perform the block even without ultrasound use. Pepper et al. (2016)[12] observed that the direct block of the adductor canal without ultrasound in cadaveric specimens succeeded in 86% of cases when a blunt needle was directed to the distal part of the adductor canal, 57% when the blunt needle was directed to the proximal part, and 14% when a spinal needle was directed to the proximal part. Additionally, it was noted that the femoral artery was punctured in 43% of cases with the spinal needle.

Kavolus et al.[7] in 2018 described an adductor canal block technique guided by anatomical landmarks in cadaveric specimens, succeeding in 8 out of 11 studied specimens.

Vanamala et al. (2021)[8] described a direct block technique of the adductor canal guided by anatomical landmarks that achieved 100% success in 27 cadaveric specimens with no vascular injury detected.

The direct adductor canal block technique with anatomical landmarks described by Yuvarajan et al.[10] in 2024 suggests performing the puncture 10.6cm from the superior pole of the patella. This point may be at the end of the adductor canal or outside it, possibly favoring foot drop postoperatively since the anesthetic may diffuse into the popliteal fossa[4,10]. Furthermore, Fan Chiang et al.[4] suggest that ideally, the adductor canal block should be performed in the proximal part of the adductor canal, as the saphenous nerve penetrates the vastoadductor membrane and exits the adductor canal in the middle to distal third of the canal.

One challenge of any direct adductor canal block technique performed with anatomical landmarks without ultrasound is knowing the correct needle depth. In the technique described here, the plane between the vastus medialis and the long adductor is easily perceived by the increase in resistance. In this model, we use the concept of diffusion of the anesthetic agent between the planes, similar to the erector spinae plane block (ESP Block), which uses the erector spinae muscle as a landmark and "gate" for the diffusion of the anesthetic to the region of the ventral branches of the spinal nerves[13].

Although no injection technique is entirely free from the risk of puncturing large vessels, the procedure described in this document offers an added margin of safety. By puncturing medially to the femur, we create relative distance from large vessels, minimizing the likelihood of occurrence. It is crucial to remember that in any technique based on anatomical landmarks, pre-injection aspiration is mandatory to confirm the correct position of the needle and avoid intravascular injection.

If this block is performed at an outpatient level for treating chronic pain after knee prosthesis, the needle is certainly very distant from the joint, minimizing any possibility of joint infection from the arthroplasty caused directly by the anesthetic block.

In some patients, even with ultrasound use, the clear identification of the saphenous nerve within the adductor canal is difficult, even for experienced individuals[14], due to the small size of the nerve and the presence of adjacent structures such as the sartorius muscle and genicular artery[15,16], complicating the direct block. Therefore, in these cases, we can add the indirect adductor canal block technique to ensure better accuracy.

Despite observing excellent clinical results with the indirectly described adductor canal block technique, even with the technique isolated in outpatient patients, additional studies involving cadaveric specimens and real patients are necessary to compare the effectiveness and safety of the indirect technique with the direct adductor canal block technique.

Conclusion

The adductor canal block can be performed quickly and easily by physicians without access to or training with ultrasound.

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