(International Print/Online Journal)

SJIF IMPACT FACTOR: 4.617
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume3, Issue 2, Page No: 157-164
March-April 2020

Ultrasound-Guided Obturator Nerve Block: an interfascial injection approach without nerve stimulation

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Type of Publication: Original Research Paper
Conflicts of Interest: Nil

ABSTRACT

Introduction: Ultrasound (US)-guided obturator nerve block is simpler to perform and more reliable than surface landmark–based techniques. There are two approaches to performing a US-guided obturator nerve block. 1.The interfascial injection technique relies on injecting local anesthetic solution into the fascial planes that contain the branches of the obturator nerve by identifying the adductor muscles and the fascial boundaries within which the nerves lie. 2. Alternatively, the branches of the obturator nerve can be visualized with US imaging and blocked after eliciting a motor response. **Indications**: Relief of painful adductor muscle contractions to prevent adduction of the thigh during transurethral bladder surgery, additional analgesia after major knee surgery, and may provide postoperative analgesia after hamstring tendon harvest for anterior cruciate ligament (ACL) reconstruction. **Transducer position:** medial aspect of the proximal thigh. **Goal:** Local anesthetic spread in the interfascial plane in which the nerve lie or around the anterior and posterior branches of the obturator nerve. **Local anesthetic:** 5 mL of 0.5% Inj. Bupivacaine (plain) and 5ml of 2% Inj. Lignocaine with epinephrine into each interfascial space or around the branches of the obturator nerve. **Methods:** Thirty patients scheduled for knee surgery under general anesthesia with nerve block for postoperative analgesia had ONB performed using USG. 10 mL of combined drug was injected between the pectineus and obturator externus muscles in 15 patients randomly allocated and rest 15 patients received 10ml of combined drug each between the adductor longus and adductor brevis muscles and adductor brevis and adductor magnus muscles. The strength of thigh adduction was measured at 5, 10, and 15mins after injection, and 50% strength reduction at 15mins indicated a successful block. **Results:** All patients showed reduction of strength and 26 of 30 (86.66%) met the criteria for successful block with mean strength reduction of 62.5% (SD 14.5%) at 15mins. Blocks were completed in 109 secs (SD 18.56 secs).Further results were evaluated using proximal and distal approach US guided ONB. **Conclusion:** Obturator nerve block using USG to achieve interfascial injection without nerve stimulation had success similar to that reported in studies using nerve stimulation. The proximal approach would be superior for achieving successful blockade of the obturator nerve when compared to distal approach.

Keywords: Ultrasound (US)-guided, Obturator nerve block, knee surgery, prevent adduction of thigh, post-op analgesia

INTRODUCTION

Bladder cancer is the seventh most common cancer in the UK with roughly 10,000 people diagnosed each year. Globally it is the ninth most common cancer. Incidence rates are higher in older males and females, with more than half of cases usually occurring in the population over 75 years old.

Surgery remains the mainstay of treatment for cancer of the bladder, and takes the form of either a transurethral resection of bladder tumor (TURBT) or removal of the whole bladder (cystectomy). TURBT is not without risk, one of the most serious of which is perforation of the bladder wall by the resectoscope loop. This serious complication increases the risk of TURP syndrome, and can also worsen oncological outcomes due to incomplete resection, the inability to give intra-vesical chemotherapeutic agents, and the possibility of tumor dissemination. Bladder perforation may also necessitate the need for a laparotomy, increasing patient morbidity. The commonest site of bladder perforation is the lateral wall, during TURBT for tumors at this site. Electrical stimulation of the nearby obturator nerve during electroresection of lateral wall tumors can result in a powerful adductor spasm of the leg known as an “obturator jerk”. An obturator jerk during TURBT greatly increases the risk of bladder perforation.

In recent times, ultrasound guidance has expanded the applications of regional anesthesia and its well-known benefits of superior postoperative analgesia, decreased postoperative nausea and vomiting, increased efficiency in terms of decreased block performance time, decreased block onset time, increased block success(93%–100%) and safety profile of peripheral nerve blocks including ONB. Labat first described an ONB technique based on surface landmarks in 1922 . Since then, several ONB approaches using surface landmarks with or without nerve stimulation to localize the nerve have been reported. During the last decade, ultrasound-guided ONB techniques have gained immense popularity, as have other types of peripheral nerve block. In this review, we describe the anatomy of the obturator nerve, illustrate the ultrasound- guided ONB techniques reported thus far, and identify issues that need to be addressed in the future.

The obturator nerve is a mixed nerve derived from the anterior primary rami of L2, L3, L4. It descends through psoas major and passes along its medial border. The obturator nerve then runs along the lateral wall of the lesser pelvis and extends to the anterior thigh after passing through the obturator canal. During its course, the obturator nerve divides into anterior and posterior branches. The anterior and posterior branches of the obturator nerve, or the common obturator nerve, run between the pectineus and obturator externus muscles immediately after the nerve emerges from the obturator canal. Beyond this point, the two branches are usually separated by some of the fibers of the obturator externus muscle. The anterior obturator nerve branch initially passes through the interfascial plane between the pectineus and adductor brevis muscles. Further caudad, it runs between the adductor longus and adductor brevis muscles, innervating the adductor longus, adductor brevis, and gracilis muscles.The anterior branch rarely innervates the pectineus muscle. The posterior obturator nerve branch travels in the fascia between the adductor brevis and adductor magnus muscles. Throughout its course, the nerve usually supplies multiple branches to the adductor magnus and adductor brevis muscles and occasionally innervates the obturator externus and adductor longus muscles as well .

The obturator nerve also provides articular branches for the hip and knee joints . The articular branch supplying the hip joint is derived from the common obturator nerve or its branches at different levels in conjunction with the obturator canal . The posterior branch of the obturator nerve supplies terminal branches to the capsule of the knee joint in some individuals . The obturator nerve provides no cutaneous innervation in more than 50% of cases (Figure-1).

Obturator nerve block is also indicated in relief of persistent painful hip adductor spasticity is a major complication of spinal cord injury, traumatic brain injury, cerebral palsy and multiple sclerosis, which causes hip joint deformity, pain, and scissoring of the hips preventing maintenance of perineal hygiene, causing skin infection and break down in patients requiring long-term care. It provides analgesia after major knee surgery and postoperative analgesia after hamstring tendon harvest for ACL reconstruction as the anterior branch of the obturator nerve innervates the gracilis muscle. Addition of ONB to a femoral nerve block improves analgesia following both total knee replacement and anterior cruciate ligament reconstruction. It also treats chronic hip pain and post operative analgesia in hip surgery as. the hip joint receives sensory innervation from branches of the femoral, obturator, superior gluteal, and sciatic

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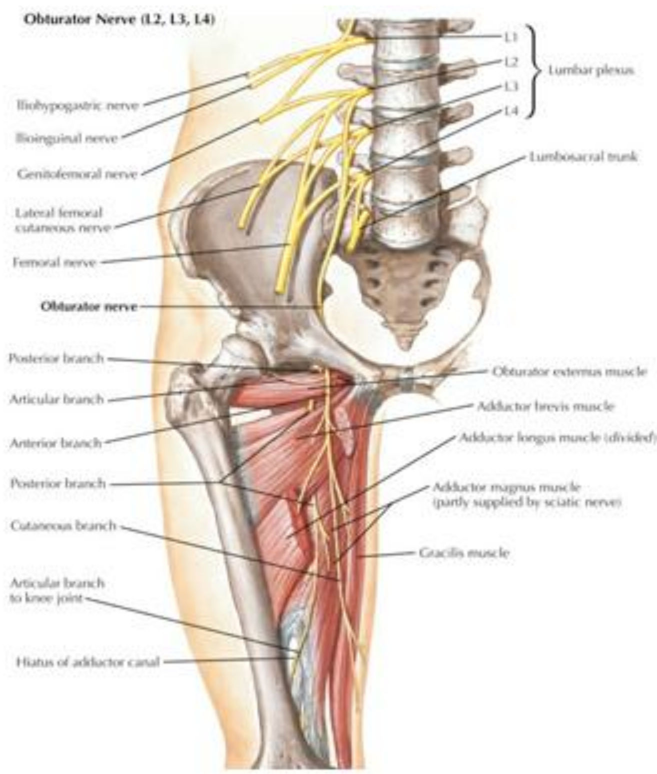
nerves, as well as the nerve to quadratus femoris . Among these, the articular branch of the obturator nerve innervates the anteromedial hip joint capsule. A RCT demonstrated that a combination of obturator and lateral femoral cutaneous nerve blockade was effective in controlling acute pain after surgery for hip fracture. ONB also helps to get rid of groin and thigh pain frequently arising from the articular branch of the obturator nerve and trochanteric pain arising from the articular branch of the femoral nerve. Case series reports have suggested that percutaneous radiofrequency lesioning or pulsed radiofrequency treatment of the articular branch of the obturator nerve, performed under fluoroscopy guidance,can be an effective alternative treatment in patients with hip joint pain if a diagnostic ONB using LA provides transient pain relief at the hip joint.

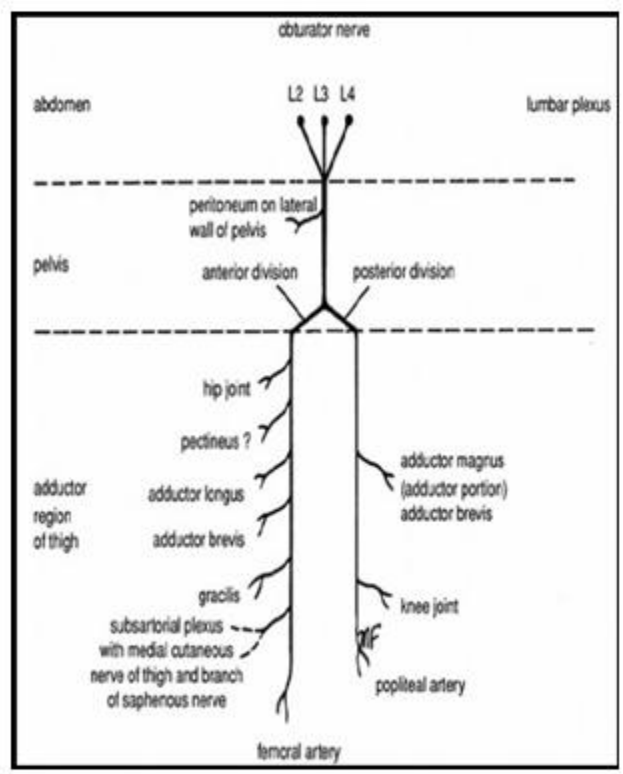
USG-guided ONB approaches can be classified as distal and proximal approach.

- Distal approach - the anterior and posterior branches are blocked separately by two injections of LA directed toward the interfascial planes where each branch lies.

Proximal approach - USG guided injection of LA into the interfascial plane between the pectineus and obturator externus produces blockade of both the anterior and posterior branches of the obturator nerve.

Fig-1: ANATOMY OF OBTURATOR NERVE





METHODOLOGY

An interventional study was conducted under Department of Anesthesiology & Intensive Care, VIMSAR, Burla. After obtaining hospital ethical committee approval and informed consent from patients, thirty patients under ASA-1&2 with no co-morbities, scheduled for TURBT (Trans urethral resection of bladder tumour) surgery under spinal anesthesia with nerve block were selected randomly for suppressing 'Obturator Reflex' and relief of painful adductor spasticity. All patients underwent pre anaesthetic examination and were fasted for 8 hours pre-operatively. An 18-gauge intravenous cannula was inserted into their forearm. They were premedicated with Inj. Ranitidine 150mg IV and Inj. Ondensetron 4mg IV. All the emergency drugs (atropine, ephedrine, phenylephrine, midazolam, propofol, muscle relaxant, thiopentone sodium),

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airway equipment (facemask, ET tube, airways), suction apparatus, ultrasound machine with linear transducer(8-14MHz),sterile sleeve and gel, 10cc syringe, 20-25ml local anesthetic, sterile gloves and 10-cm, 21- to 22-gauge, short-bevel, insulated needle were kept ready. All the routine monitors (Pulse oximetry, Noninvasive BP,ECG, RR, BIS monitor) were applied on the patients. USG guided ONB was performed using injection of 5mL 0.5% bupivacaine (plain) and 5ml of 2% lignocaine with epinephrine. 15 patients (Group A) were positioned in lithotomy/supine position with hip fully flexed and externally rotated. Linear transducer was placed lateral to the perineum on the medial aspect of the thigh along the extended line of the inguinal crease and orientated cephalad. Using in-plane ultrasound guidance, Group A patients received 10 ml of the combined drug between pectineus and obturator externus and rest 15 patients (Group B) were laid in supine position with thigh slightly abducted and externally rotated. Linear Transducer was placed at the inguinal crease and perpendicular to the skin to identify the pectineus, adductor longus, adductor brevis, and adductor magnus. Using in-plane ultrasound guidance, Group B patients received 10ml of the combined drug between the adductor longus and adductor brevis and 10ml between the adductor brevis and adductor magnus. The strength of thigh adduction was measured at 5, 10, and 15 mins after injection, and 50% strength reduction at 15 mins indicated a successful block.

ONB EVALUATION: As described above, the obturator nerve provides no cutaneous innervation in more than half of individuals; therefore, successful ONB can be achieved despite a lack of sensory block at the medial thigh and/or knee which is evaluated by confirming a decrease in adductor muscle strength using a sphygmomanometer as described by Lang et al. .

Using this measurement method, patients are asked to extend both knees fully, dorsiflex both ankles in the supine position, and squeeze a BP cuff (preinflated to 40mmHg) between their knees by adducting the blocked hip while the nonblocked leg is restrained. The maximal pressure sustained is defined as adductor muscle strength. A simple method of assessing adductor muscle strength (motor block) is to instruct the patient to adduct the blocked leg from an abducted position against resistance. Weakness or inability to adduct the leg indicates a successful obturator nerve block. Because of multiple innervations of a muscle, patients may adduct the hip joint to some extent even if ONB is successful. According to previous studies, a decrease in adductor muscle strength of more than 40%–50% has been defined as successful ONB.

Fig-2: PROXIMAL APPROACH ONB

Fig-3: DISTAL APPROACH ONB

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Fig-4: US-GUIDED IMAGE PROXIMAL APPROACH ONB

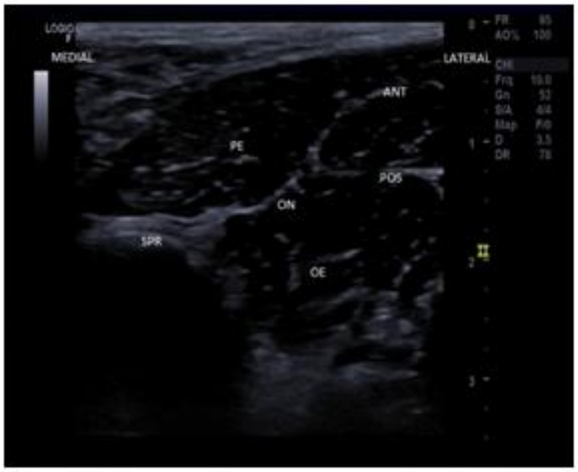
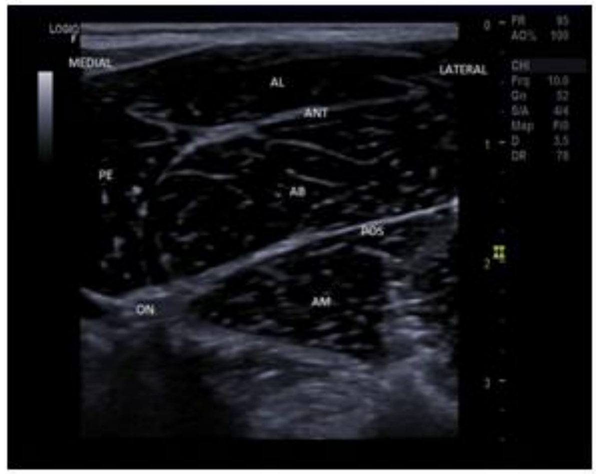


Fig-5: US-GUIDED IMAGE DISTAL APPROACH ONB



(SPR- Superior pubic ramus, PE- Pectinius muscle, ON- Obturator nerve, OE- Obturator externus muscle, ANT- Anterior branch, POS-Posterior branch of Obturator nerve, AL- Adductor longus muscle, AB- Adductor brevis muscle, AM- Adductor magnus muscle)

RESULTS

Table 1: ONB Evaluation

PARAMATER	GROUP A (n=15)	GROUP B (n=15)	p value
ONB completion time in secs	92.33 ± 4.865	127.13 ± 6.435	**0.0001**
Mean strength reduction at 15mins in %	65 ± 13.63	60 ± 15.35	0.8231

All patients showed reduction of strength, and 26 of 30 or 86.66% met the criteria for successful block with mean strength reduction of 62.5% (SD 14.5%) at 15 mins in 109 secs (SD 18.56 secs).. Group A completed successful block with mean strength reduction of 65% (SD 13.63%) at 15 mins in 92secs (SD 5secs) whereas Group B completed successful block with mean strength reduction of 60% (SD 15.35%) at 15 mins in 127 secs (SD 6 secs) (Table 1).

DISCUSSION

ONB for TURBT

The obturator nerve is situated directly adjacent to the lateral wall of the bladder during TURBT when the irrigation fluid fills the bladder. Any electrical stimulation caused by tumor resection involving the bladder may induce sudden adductor muscle contraction, which may lead to perforation of the bladder accompanied by extravesical spread of the tumor and even injury to the obturator artery. One retrospective finding suggests that an ONB can facilitate complete resection of a lateral wall bladder tumor by immobilizing the surgical field and could also prolong the mean time to recurrence of the bladder tumor. An ONB is essential for performing TURBT safely and effectively.

ULTRASOUND-GUIDED ONB TECHNIQUES

In recent times, USG guidance has been used to improve the success rate(93%–100%) and safety profile of peripheral nerve blocks including ONB. USG-guided ONB approaches can be classified as distal or proximal.

Distal ONB Approach -:The distal approach is defined as one in which the anterior and posterior branches of the obturator nerve are blocked separately by two injections of local anesthetic directed toward the interfascial planes where each branch lies. Patients are placed in the supine position with the thigh slightly abducted and externally rotated. An ultrasound transducer is placed at the inguinal crease and perpendicular to the skin to identify the pectineus, adductor longus, adductor brevis, and adductor magnus muscles. Local anesthetics are injected into the fascia between the pectineus and adductor brevis muscles or between the adductor longus and adductor brevis muscles using in-plane ultrasound guidance to block the anterior branch of the obturator nerve. Subsequently, local anesthetic is injected in the fascia between the adductor brevis and adductor magnus muscles to block the posterior branch of the obturator nerve (Figure-3,5).

Sudden adductor muscle contraction during TURBT might occur even if an ONB using the distal approach is correctly performed because of various patterns of ramification of the obturator nerve(eg. a branch which diverges proximal to the inguinal crease) when it terminates in the adductor muscles.

Using the distal approach, the local anesthetic injection points are also further away from the bifurcation of the hip joint branch of the obturator nerve when compared with the proximal approach, resulting in less possibility of blockade of the hip joint branch.

Proximal ONB Approach -:*Taha* reported that ultrasound guided injection of local anesthetic into the interfascial plane between the pectineus and obturator externus muscles successfully produces blockade of both the anterior and posterior branches of the obturator nerve (Figure-2,4).

It uses different patient positions (i.e., supine or lithotomy), transducer locations (i.e., the inguinal crease or medial thigh), modes of needle insertion (i.e., out-of-plane or in-plane), and needle trajectories (i.e., anterior-to-posterior, inferior-to-superior, or lateral-to-medial). Most recently, Yoshida et al. have described a new approach.The patients are placed either in the lithotomy position or in the supine position with the hip fully flexed and externally rotated. A linear transducer is placed immediately lateral to the perineum on the medial aspect of the thigh along the extended line of the inguinal crease and orientated cephalad. The superior pubic ramus should be identified first, after which the obturator externus muscle can be seen lying superficial to the superior pubic ramus. The pectineus muscle is identified anterior (i.e., on the right hand side of an ultrasound monitor screen) to the obturator externus muscle and the superior pubic ramus . A hyperechoic thick fascia between the pectineus and obturator externus muscles contains the obturator nerve. A needle is inserted a few centimeters (depending on the depth of the target fascia) cephalad from the anterior side of the transducer and advanced in-plane with the transducer toward this fascia. The needle can be directed almost perpendicularly to the ultrasound beam. Hence,this technique would be theoretically superior for achieving real-time needle visualization. Various technical differences that are used in ultrasound-guided nerve block are described in the following table (Table-2)

Table 2: Technical differences in ultrasound-guided obturator nerve block techniques

	Soong et al. Fujiwara et al. Sinha et al.	Akkaya et al.	Anagnostopoulou et al. Taha	Lin et al.	Yoshida et al.
Ultrasound probe orientation	In-plane	In-plane	Out-of-plane	In-plane	In-plane
Transducer position	Inguinal crease	Pubic region	Inguinal crease	Inguinal crease	Medial thigh
Transducer	Not required	Not required	Required	Required	Not

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tilt					required
Needle-ultrasound beam angle	Small (posterior branch)	Small	NA	Small	Large
Nerve stimulation guidance	Recommended	Recommended	Not needed	Not needed	Not needed
Patient position	Supine	Supine	Supine	Supine	Lithotomy

CONCLUSION

Various ultrasound-guided ONB techniques have been reported and can be classified according to whether the approach is distal or proximal.

The proximal approach, which comprises a single injection of local anesthetic into the interfascial plane between the pectineus and obturator externus muscles, would be superior for reducing the minimum dose of local anesthetic required and for achieving successful blockade of the obturator nerve, including the hip articular branch, when compared with the distal approach.

Nevertheless, this hypothesis should be validated in future studies. The pros and cons of each proximal ONB technique also need to be evaluated in a randomized controlled trial.

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