



# Bridging old and new: obturator nerve block in the obturator canal to prevent obturator jerk during transurethral resection of bladder tumor

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## Introduction

Obturator nerve block (ONB) has been utilized for surgical anesthesia or analgesia, and for suppressing the obturator jerk during transurethral resection of bladder tumor (TURBT). Bladder perforation by the resectoscope loop is among the most serious complications of TURBT; the risk of bladder perforation is increased by the obturator jerk [1]. The obturator jerk is a reflex response that occurs during TURBT due to stimulation of the obturator nerve. This reflex can lead to sudden adductor muscle spasms.

Surgical measures to reduce the likelihood of the obturator jerk include reduction of the diathermy current, use of bipolar as opposed to monopolar diathermy, avoidance of an over-distended bladder, tumor resection through thinner slicing, laser resection, reversal of the diathermy current polarity, and changing the inactive electrode site [1, 2]. Nevertheless, there is conflicting evidence regarding the selection of diathermy. Anesthesiologists should apply measures to prevent the obturator jerk by considering the use of ONB [3, 4] or neuromuscular blocking agents [5, 6]. ONB is considered the safest and most effective method to prevent the obturator jerk [7]. In this issue of the *Journal of Anesthesia*, Yoshida et al. introduced a novel ultrasound-guided ONB [8]. Alternatively, neuromuscular blocking agents can be used in cases in which TURBT is performed under general anesthesia. The incidence of obturator jerk during TURBT under general anesthesia was 20.8% when rocuronium was incrementally

administered to achieve a goal of 0 or 1 twitches [6]. Maintaining the intense neuromuscular blockade, indicated by a post-tetanic count  $\leq 1$ , may be essential to prevent the obturator jerk [5].

## Anatomy of the obturator nerve related to the obturator jerk

The obturator nerve, a branch of the lumbar plexus, arises from the ventral rami of spinal nerves L2, L3, and L4. It descends through the fibers of the psoas major muscle and emerges from its medial border near the pelvic brim. From there, it travels posterior to the common iliac vessels, close to the prostatic urethra, bladder neck, and inferolateral bladder wall [3] before exiting the pelvis through the obturator canal into the medial thigh. When the bladder is excessively filled, the lateral wall of the bladder moves closer to the obturator nerve. This increases the likelihood of nerve stimulation during TURBT procedure on the lateral wall of the bladder. The obturator canal is a narrow passageway located in the superior part of the obturator foramen and surrounded by the superior pubic ramus, obturator membrane, and the obturator internus muscle. The obturator nerve and vessels pass through the obturator canal. The obturator nerve runs laterally to the obturator artery and vein at the distal end of the obturator canal [9].

In relation to the obturator jerk, the obturator nerve is responsible for innervating the muscles involved in thigh adduction, such as the adductor longus, adductor brevis, adductor magnus (adductor part), gracilis, and pectineus muscles. The obturator nerve bifurcates into the anterior and posterior branches around the obturator canal. Kendir et al. reported that the bifurcation was observed within the obturator canal (27.2%) or in the thigh (72.7%) [9]. On the other hand, Anagnostopoulou et al. revealed that the bifurcation

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was within the obturator canal (51.78%), in the thigh (25%), or intrapelvic (23.22%) [10].

The anterior branch runs anterior to the adductor brevis muscle and deep into the adductor longus muscle. It provides motor innervation to the adductor longus, adductor brevis, gracilis and, occasionally, pectineus muscles. The anterior branch also gives rise to cutaneous branches that supply sensation to the skin over the proximal part of the medial thigh and an articular branch to the hip joint. The posterior branch often pierces the obturator externus muscle [4] and passes between the adductor brevis and magnus muscles. It innervates these muscles and provides articular branches that supply the knee joint capsule. Notably, it does not innervate the hamstring part of the adductor magnus, which is supplied by the tibial nerve. Both the anterior and posterior branches can form anywhere from one to four subdivisions [10].

### Nerve stimulator-guided ONB

In 1922, ONB was first described by Labat [11]. The technique was modified by Parks and Kennedy Jr. in 1967, who simplified the approach, rendering it more accessible to practitioners [12]. Currently, this technique is termed the traditional pubic approach [3, 4, 13]. In this technique, the needle is inserted perpendicularly 2 cm inferiorly and 2 cm laterally to the pubic tubercle. In 1993, Wassef introduced the interadductor approach [14], which further refined the technique. This approach was designed to improve efficacy and reduce complications associated with the traditional pubic approach. The needle is inserted 1 cm behind the adductor longus tendon and 2 cm lateral to the pubic arch, and directed laterally with slight posterior and superior inclination. In 2005, a simple and reliable method (the inguinal approach) was described by Choquet et al. [15]. The needle is inserted at the mid-point of the femoral arterial pulse and the inner border of the adductor longus tendon on the inguinal crease, and directed slightly cephalad.

The anterior and posterior branches exhibit multiple branching patterns, which are widely distributed among the adductor muscles. Therefore, although muscular contraction is observed in one of the adductor muscles with the neurostimulation technique, this response can be induced by the stimulation of a subdivision, rather than the main trunk of the obturator nerve. Thus, injection of the local anesthetic at this point may lead to an unsuccessful block [10].

### Ultrasound-guided ONB

With recent advancements in ultrasound technology, modern techniques for performing ONB have become more reliable and widespread. Ultrasound guidance allows for better visualization of anatomical structures, needle, and

local anesthetic spread, thereby improving accuracy and reducing complications associated with blind techniques. Various approaches to perform ultrasound-guided ONB has been advocated. Recently, Labandeyra et al. categorized the techniques into three types based on anatomy [16]. Firstly, the inter-adductor approach uses the adductor muscles to identify the anterior and posterior branches of the obturator nerve [17, 18]. This technique requires needle redirections to access the branches. Secondly, the subpectineal approach uses the pectineus and external obturator muscles as landmarks to perform ONB [19]. The effectiveness of these two approaches may be limited by missing the proximal branches and anatomically variant branches of the obturator nerve. Finally, the proximal approach at the level adjacent to the superior pubic ramus has been reported [4, 16, 20, 21]. The landmark for this approach includes the superior pubic ramus, the pectineus, and external obturator muscles. Similar to the nerve stimulator-guided ONB, unsuccessful block can be induced by missing some of the subdivisions of the anterior or posterior branches on the ultrasound image.

### Rationale for performing ONB in the obturator canal

As mentioned above, the branching pattern of the obturator nerve is highly variable. Additionally, there is no reliable method to confirm that all the nerve fibers of the obturator nerve innervating the adductor muscles are completely blocked in a clinical setting. Considering that all the obturator nerve branches that innervate the adductor muscles pass through the obturator canal, it is reasonable to predict that local anesthetic spread into the obturator canal results in successful ONB to prevent obturator jerk [4, 9]. This idea was introduced at least 30 years ago [22].

According to Enguchi et al. [22, 23], when ONB was performed inside the obturator canal with approximately 3 mL of local anesthetic, there was no obturator jerk observed during TURBT. In addition to the detection of adductor contraction using a nerve stimulator to determine the initial needle tip position, they further adjusted the needle tip position so that the contrast dye spread into the obturator canal before local anesthetic injection to complete ONB [22, 23]. A similar process was executed by Uchino et al. [4]. Without adjustment of the needle tip position under fluoroscopic guidance, local anesthetic spread into the obturator canal was < 50% by the pubic and inguinal approaches of nerve stimulator-guided ONB [4].

Similarly, the previously reported incidence of dye spread into the obturator canal during ultrasound-guided ONB ranged 65–100% [4, 16, 21]. In this issue of the journal, Yoshida et al. reported a modified ultrasound-guided ONB at the distal end of the obturator canal [8]. They injected 10 mL of local anesthetic through a needle placed at the distal end of the obturator canal under ultrasound guidance, which was

spread towards the obturator canal. This spread was confirmed by cadaver examination. There was no occurrence of obturator jerk in six patients. The ultrasound image for this novel technique was obtained by sliding the transducer from the lateral to the medial direction. Hence, it could be closer to the obturator nerve rather than the obturator vessels [9].

Considering these previous reports [4, 22, 23], the minimum required local anesthetic volume for the novel technique [8] may be < 10 mL. The possible advantage of the novel technique [8] is that the appropriate needle tip position can be determined without exposure to radiation. Further investigation is warranted to validate the effectiveness, safety, and reliability of the novel technique [8] that provides ONB in the obturator canal with sole ultrasound guidance.

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