Avoiding the Obturator Jerk during TURBT

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\textbf{Abstract}

\textbf{Introduction:} Bladder cancer is the seventh most common cancer in the UK. Transurethral resection of bladder tumor (TURBT) is a relatively common procedure used to treat cancer of the bladder. A serious complication of TURBT is bladder perforation, the risk of which is greatly increased in the presence of an “obturator jerk”. \textbf{Methods:} A literature search was performed on PubMed using the following search criteria “obturator nerve block”, “obturator nerve block in transurethral resection of bladder tumor”, “adductor spasm during transurethral resection of bladder tumor”, “bi-polar diathermy obturator nerve”, and “transvesical obturator nerve block”. Articles describing surgical and anesthetic techniques for reducing adductor spasm during resection of bladder tumors were included. \textbf{Discussion:} TURBT is a relatively common urological operation performed to remove tumors of the bladder. Every measure should be taken to avoid serious complications from both anesthesia and surgery. Surgical measures to reduce the likelihood of an obturator jerk include reducing the diathermy current, avoiding over-distention bladder, and using bipolar diathermy as opposed to monopolar diathermy (although there is conflicting evidence for this in the literature). Anesthetists should consider the use of neuromuscular blockade or an obturator nerve block to reduce the incidence of obturator jerk and risk of bladder perforation.

\textbf{Key Words}

Obturator jerk • Obturator reflex • Adductor spasm • Transurethral resection of bladder tumor

\textbf{Review}

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\textbf{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 [1].

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 [2] 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 [3]. 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.

**Anatomy**

The obturator nerve is a mixed nerve with motor and sensory fibers. It arises from the anterior primary rami of L2, L3 and L4 in the lumbar plexus. It is a large nerve, which descends vertically within the psoas major muscle, before emerging from the inner border of the muscle in the abdomen. It then travels with the lumbosacral trunk, crossing into the pelvis at the level of the sacroiliac joint (L5) under the common iliac artery and vein, and runs anterior/lateral to the ureter. At this level it courses close to the wall of the bladder on its inferior/lateral portion, and then takes place anterior to the obturator vessels within the superior part of the obturator foramen. It exits the pelvis below the superior pubic ramus, passing through the obturator canal before entering the adductor region of the thigh [4]. During this course, the nerve divides into anterior and posterior branches. The point of division varies, with one cadaveric study showing the point of division to be intrapelvic in 23%, within the obturator canal in 52%, and in the thigh in 25% [5]. In its intrapelvic course, the nerve is separated from the femoral nerve by the iliopsoas muscle and iliac fascia. It innervates the parietal peritoneum on the lateral pelvic wall and contributes collateral branches to the obturator externus muscle and the hip joint. The anterior division of the nerve enters the medial compartment of the thigh and gives off branches which innervate adductor brevis, adductor longus and gracilis, as well as branches which supply sensation to the skin along the mid-portion of the medial thigh. The posterior division pierces through obturator externus muscle. Branches of the posterior division innervate both the obturator externus and adductor magnus muscles.

**Preventing “Obturator Jerk”**

**Surgical Techniques**

Reducing the diathermy current used during resection reduces the risk of obturator jerk. Using bi-polar diathermy current is widely accepted to be lead to a lower risk of obturator jerk. Studies, however, show conflicting evidence for the superiority of bipolar over monopolar diathermy current. Bolat et al. [6] demonstrated that the use of bipolar diathermy had a significantly lower incidence of obturator jerk and bladder perforation. Xishuang et al. [7] also showed a lower complication rate (including obturator jerk and bladder perforation) with the use of bipolar diathermy versus monopolar diathermy. In a large Japanese study carried out by Sugihara et al. [8], bipolar resection was found to be associated with a significantly lower incidence of severe bladder injury when compared with monopolar resection.

Other studies, however, failed to demonstrate similar results [9, 10]. Both of these studies found the use of bipolar diathermy to be comparable to monopolar diathermy with regards to efficacy and safety.

Ozer et al. [11] found a statistically significant difference in the incidence of obturator reflex and bladder perforation. In contrast to the aforementioned studies, however, they found that this complication had a higher incidence with the use of bipolar diathermy. They hypothesize that this is due to the resection loop getting warmer when using bipolar diathermy, leading to increasing the risk of major complications.

A distended bladder brings the lateral bladder wall closer to the obturator nerve. Therefore, avoiding overfilling of the bladder reduces the risk of obturator nerve stimulation. Various other strategies have also been described, such as resecting the tumor on thinner slices, laser resection, reversing the polarity of the diathermy current, and changing the site of the inactive electrode [12].

**Anesthetic Techniques**

TURBT can be performed under general anesthesia or regional anesthesia (neuraxial block). A common misconception is that a neuraxial (spinal) block will inhibit the obturator jerk. This is not the case. An obturator jerk will still occur in response to direct obturator nerve activation from diathermy. Spinal anesthesia remains a popular technique, however, due to its perceived safety in this predominantly elderly patient population [13]. Studies of patients undergoing a transurethral resection of the prostate (a similar patient population to that discussed here) have failed to show any significant benefit of spinal anesthesia over general anesthesia [14]. Techniques employed to reduce the risk of obturator jerk include:

- the use of neuromuscular blockade, which necessitates the need for a general anesthetic, often with an endotracheal tube to secure the airway
- selective blockade of the obturator nerve
Neuromuscular Blockade

Neuromuscular blockade can be achieved by using either non-depolarising or depolarising neuro-muscular blocking agents (NMBAs). Both of these techniques require a general anesthetic. Endotracheal intubation will allow the anesthetist to positive-pressure ventilate the patient with complete protection of the airway from aspiration of gastric contents. Some anesthetists would argue the safety of using a supraglottic airway device, particularly those newer devices which sit over the laryngeal inlet more securely and those devices which have a gastric port to detect and suction refluxed gastric contents.

Depolarising NMBAs

Succinylcholine is the depolarising NMBA used in common practice. First introduced in 1952 it had the significant advantage of providing profound muscle relaxation of short duration. Succinylcholine mimics the action of acetylcholine at the neuromuscular junction, causing membrane depolarisation. The transmission of any further action potentials is prevented, resulting in muscle relaxation for approximately 2–3 minutes.

In their paper, Cesur et al. [15] presented their 8-year experience of preventing the obturator reflex during TURBT, with the use of succinylcholine just prior to tumor resection. None of the 56 patients displayed an obturator jerk. However, as detailed above, all of these patients required a general anesthetisa.

Non-Depolarising NMBAs

This class of drugs inhibits the actions of acetylcholine at the neuromuscular junction by binding competitively to the receptor on the post-junctional membrane. Commonly used non-depolarising NMBAs include the benzylisoquinolinium compound atracurium, and the aminosteroidal compounds rocuronium and vecuronium.

Obturator Nerve Block (ONB)

Various techniques have been described to selectively block the obturator nerve. Other indications for an ONB include for the treatment of hip pain, for the relief of adductor muscle spasm associated with hemi- or paraplegia, and as part of an analgesic regimen following surgical procedures such as knee arthroplasty.

First described by Labat in 1922 [16], the classical ONB originally described a paresthesia method before the advent of nerve stimulation. During this technique the patient is supine with the ipsilateral leg abducted to 30 degrees. Needle insertion is perpendicular at a point 1.5 cm lateral and 1.5 cm caudal to the pubic tubercle. The classical approach consists of carrying out 3 consecutive movements of the needle until the tip of the needle is placed over the top of the obturator foramen, where the nerve runs. The needle is initially advanced to make contact with the inferior border of the superior pubic branch. The needle is then slightly withdrawn and then slipped along the anterior pubic wall. Finally the needle is withdrawn again and slightly redirected cephalic and lateral at an angle of 45 degrees until contractions of the thigh adductor muscles are observed [17].

Wassef [18] described the inter-adductor approach in 1993. In this approach, the needle is inserted behind the upper end of the adductor longus muscle and directed laterally, with slight upward and posterior inclination, toward the obturator canal. Nerve stimulation allows identification of the nerve. Pladzyk et al. [19] demonstrated the efficacy of the inter-adductor approach to the obturator nerve in the lithotomy position. In their study, the efficacy of 542 ONB was 94% and the risk of complications was low.

Studies have demonstrated that both of the approaches detailed above are very effective at reducing obturator jerk. Kakinohana et al. [20] in 2002 compared both techniques, finding that the inter-adductor approach allowed significantly faster identification of the obturator nerve. They found no significant difference in the success rate, completion of the block, and plasma lidocaine concentrations.

Khorrami et al. [21] in 2010 studied a transvesical approach to blocking the obturator nerve in 60 patients. Using a nerve stimulator to locate the obturator nerve, they then injected 10 ml of 1% lidocaine via the working channel of the cystoscope. They were unable to detect the obturator nerve in 6 patients; lidocaine was injected blindly in these cases. One patient experienced adductor contraction despite the intervention. The authors concluded that local blockade of the obturator nerve during cystoscopy via a transvesical approach was an effective method to avoid its stimulation during TURBT.

Sharma et al. [12] compared ONB performed via a nerve stimulator under spinal anesthesia, to a transvesical approach. They found a statistically significant difference between the groups with regards to the occurrence of obturator jerk, and concluded that blocks performed using a nerve locator appeared to be more effective than a transvesical approach.
More recently, an inguinal approach to the obturator nerve has been described by Choquet et al. [22]. The patient is placed supine with the legs slightly abducted. A mark on the skin is made in the inguinal crease at the midpoint of a line drawn between the inner border of the adductor longus tendon and the femoral arterial pulse. The needle is inserted at this point in a cephalad direction until contractions of the gracilis or adductor longus muscles are elicited. After reducing the current and ensuring loss of twitch, local anesthesia can be injected to anesthetize the anterior branch. The needle is then inserted deeper in a lateral direction until contractions of the adductor magnus muscle are elicited. In the same manner, local anesthetic can be injected to anesthetize the posterior branch. Amongst other things, the investigators found that the inguinal approach significantly decreases discomfort and pain during application of the block, as well as the number of minor complications.

Recent studies have compared sonographic identification of the obturator nerve versus neurostimulation techniques [23, 24]. Techniques can be classified depending on whether the approach is distal or proximal. The distal approach involves placing the ultrasound probe in the inguinal crease and blocking the anterior and posterior branches of the nerve with 2 local anesthetic injections directed towards the interfascial planes where each branch lies. The proximal approach consists of a single injection of local anesthetic into the interfascial plane between the pectineus and obturator externus muscles [25]. Several proximal approaches have been described in the literature.

Smith et al. [26] in 2016 described a combined ultrasound and nerve stimulator approach to the obturator nerve. With the patient supine and the ipsilateral leg slightly abducted and externally rotated, they used ultrasound to identify the anterior branch of the adductor longus, brevis and magnus muscles in the medial thigh, inferior to the inguinal crease. The needle was passed under ultrasound guidance to the obturator nerve, situated in the plane between adductor longus and adductor brevis, medial to pectineus.

Discussion

TURBT is a relatively common urological operation performed to remove tumors of the bladder. These tumors occur predominantly in the elderly population. Every measure should be taken to avoid serious complications from both anesthesia and surgery. One of the most serious surgical complications of TURBT is perforation of the bladder, the risk of which is increased by the “obturator jerk”. Surgical measures to reduce the likelihood of an obturator jerk include reducing the diathermy current, using bipolar as opposed to monopolar diathermy, and avoiding an over-distended bladder. Anesthetists should factor in the obturator jerk when considering the most appropriate anesthetic technique for a particular patient, and should consider the use of neuromuscular blockade or an obturator nerve block to reduce the risk of bladder perforation.

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