

The role of succinylcholine in the prevention of the obturator nerve reflex during transurethral resection of bladder tumors

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ABSTRACT

الأهداف: لتقديم خبرتنا للدراسة التي استمرت ثمان سنوات في منع انعكاس العصب الساد أثناء إجراء عملية الاستئصال لأورام المثانة عبر الإحليل.

الطريقة: أجريت هذه الدراسة بمستشفى أتاتورك الجامعي - تركيا، في الفترة ما بين 1999م وحتى 2007م. قمنا بمراجعة سجلات تسعة وثمانون مريضاً يعانون من أورام المثانة السفلية الجانبية بطريقة استعادية، والذين خضعوا لإجراء عملية استئصال الأورام عبر الإحليل تحت تخدير فوق الأم الجافية أو التخدير العام، وتطليبت حالتهم تثبيت ارتداد العصب الساد. في سبعة وخمسون مريضاً تم استخدام تخدير فوق الأم الجافية، بينما خضع المرضى الباقين وعددهم 32 مريضاً للتخدير العام عبر القناع، وتلقوا عقار ساكسينيلكولاين قبل عملية الاستئصال.

النتائج: تم استعمال تخدير فوق الأم الجافية في 57 مريض من بينهم 18 مريضاً شخصت حالته بأورام المثانة السفلية الجانبية خلال تنظير البطن وخضعوا للتخدير العام. في المرضى الباقين وعددهم تسعة وثلاثون مريضاً، تمت محاولة سد العصب الساد قبل العملية، ولكن فشلت عملية تحديد العصب، ولوحظ حالة حدوث ورم دموي، وأربع حالات من انعكاس العصب الساد على الرغم من السد ووضع هؤلاء المرضى على التخدير العام بعقار ساكسينيلكولاين. أعطى 56 مريضاً (32 مريضاً تلقى في البداية التخدير العام و24 مريضاً الذين تم تحويلهم من التخدير فوق الأم الجافية إلى التخدير العام) عقار ساكسينيلكولاين فقط قبيل عملية الاستئصال. لم يتم ملاحظة حدوث تفاعل لدى أي مريض تلقى عقار ساكسينيلكولاين.

خاتمة: نتيجة لميكانيكية التفاعل، يعتبر عقار ساكسينيلكولاين فعال بالكامل، ويمثل بديل بسيط لسد العصب الساد.

Objective: To present our 8 year experience in the prevention of the obturator nerve reflex during transurethral resection of bladder tumors.

Methods: This study was performed in Ataturk University Hospital between 1999 and 2007. We

retrospectively reviewed the records of 89 patients with inferolateral bladder tumors, who underwent transurethral resection under epidural or general anesthesia and requested obturator nerve reflex inhibition. Epidural anesthesia was administered to 57 patients, while the remaining 32 patients underwent general anesthesia via mask; and succinylcholine was administered prior to resection.

Results: Of the 57 patients received epidural anesthesia, 18 were diagnosed as inferolateral bladder tumors during endoscopy and had to undergo general anesthesia. Obturator nerve block was attempted preoperatively in 39 patients. However, a nerve identification failure, a hematoma, and 4 obturator nerve reflex events, despite the block, were observed and these patients were subjected to general anesthesia with succinylcholine. Fifty-six patients (32 patients initially had general anesthesia and 24 converted from epidural to general anesthesia) were all given succinylcholine prior to resection.

Conclusion: Due to its mechanism of action, succinylcholine is completely effective and represents a simple alternative to obturator nerve block. No contraction was observed in any patient given succinylcholine.

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Cystoscopy and transurethral resection (TUR) are the most common diagnostic and surgical techniques employed for superficial bladder tumors.¹ Spinal/epidural and general anesthesia without neuromuscular blockers (NMBs) are the preferred anesthetic approaches for outpatient treatment in these procedures. However, due to the obturator nerve passes in close proximity to the inferolateral bladder wall, TUR of this area under spinal/epidural or general anesthesia without NMB may stimulate the obturator nerve and can cause the obturator nerve reflex. This reflex leads to an unintentional violent contraction of the thigh-adductor muscles and unexpected sudden displacement of the bladder wall against the cutting loop, resulting in severe complications, such as bladder wall perforation, bleeding, incomplete resection, and/or dissemination of tumor.^{1,2} To avoid these complications, obturator nerve block has been preoperatively performed for inferolateral bladder tumors.³ However, this nerve block technique is not always successful⁴ and the procedure involves specialized skills, as well as additional time and cost. In addition, to prevent this reflex, NMBs have been used in conjunction with general anesthesia. However, no data exists in the literature regarding the differential effects of depolarizing or non-depolarizing NMBs for the prevention of this reflex. Depolarizing agents differ from non-depolarizing NMBs not only in their short action, also on their distinct mechanism of action. In this retrospective study, we present 8 years of experience with obturator nerve reflex inhibition using obturator nerve block and succinylcholine during TUR in patients under epidural or general anesthesia with mask.

Methods. After obtaining institutional ethics committee approval, we retrospectively reviewed the records of 89 patients underwent transurethral resection for unilateral inferolateral bladder tumors and requested obturator nerve reflex inhibition in Ataturk University Hospital from January 1999 to December 2007. All patients were provided information on the procedures and the possible complications, and written informed consent was obtained. General anesthesia via face mask was administered to the patients in whom central blocks were contraindicated and patients with spinal column disorders, including scoliosis and herniated disks, or previous spinal surgery, otherwise epidural anesthesia was administered. After premedication with midazolam and atropine, and routine monitoring, lumbar epidural anesthesia was performed at the L4-5 or L3-4 interspace using 15 mL 1.5% lidocaine. If the patient was diagnosed with an inferolateral bladder tumor by a previous cystoscopic assessment, a direct obturator nerve block was applied by the same experienced anesthetist following confirmation of an adequate anesthesia level

(namely sensory block at the T10 dermatome) for the TUR procedure. The obturator nerve block technique was performed as follows: with the patient supine and legs slightly abducted, a 22-gauge 50-mm insulated needle (Stimuplex; B/Braun Inc., Melsungen, Germany) was inserted almost perpendicularly to the skin, 2-3 cm caudal and 2-3 cm lateral to the pubic tubercle. The needle was connected to a nerve stimulator (Stimuplex HNS 11; B/Braun Inc., Melsungen, Germany), generating 2 Hz, 1.5 mA electrical current with a pulse duration of 0.1-ms, and was advanced until it contacted the inferior border of the superior pubic ramus bone before it was redirected posteriorly and slightly laterally to walk off the inferior margin of the superior pubic ramus. When thigh adductor muscle contraction was obtained, the current was gradually decreased until the muscle twitched at 0.3-0.4 mA for 0.1 ms at 1 Hz. Then, 10 mL of 2% lidocaine was injected. Fifteen min following the obturator nerve block, TUR was initiated using an output power of 220-250 watts with an electro-surgical generator (Valleylab Force 30, Boulder, CO, USA). When obturator nerve identification failed, a hematoma occurred during block, or an obturator nerve reflex was observed despite nerve block, 0.5-2 mg.kg⁻¹ propofol was applied intravenously until a loss of eyelash reflex, then 1 mg/kg succinylcholine was administered intravenously and ventilated via face mask manually. The anesthesia was maintained with intermittent intravenous injections of 20% of the initial dose of propofol and succinylcholine every 5 minutes. After resection was completed, anesthesia was maintained with propofol and ventilated with mask until full recovery of motor functions. Patients, for whom epidural anesthesia was contraindicated or who were not diagnosed previously as having inferolateral bladder tumors, underwent general anesthesia. General anesthesia was induced with 2-3 mg.kg⁻¹ propofol intravenously and maintained under assisted ventilation via face mask with inhalation of 1-2% sevoflurane in a mixture of 60% oxygen and 40% nitrous oxide. After an adequate depth of anesthesia, a transurethral resectoscope was inserted into the urethra, and 1 mg.kg⁻¹ succinylcholine was administered just before resection. Then, 0.2 mg.kg⁻¹ succinylcholine was administered every 5 minutes until the resection was completed.

Demographic data were analyzed using an unpaired t-test. The success rate of the obturator nerve reflex inhibition was analyzed by a Pearson Chi-Squared test with Yates Continuity Correction. Values are presented as numbers (%) and/or mean \pm SD. Results were considered statistically significant when p value was less than <0.05.

Results. There were no significant demographic differences between the group of patients who

Table 1 - Demographic data and success rates.

Demographic data and other parameters	Obturator nerve block (n = 39)	Succinylcholine (n = 52)
Gender (M/F)	33/6	44/8
Age (year) (mean±SD)	62.2 ± 18.3	60.3 ± 11.1
Weight (kg) (mean±SD)	66.8 ± 16.4	64.6 ± 12.8
Duration of transurethral resection (min) (mean±SD)	24 ± 3.6	21 ± 3.6
Dose of succinylcholine (mg) (mean±SD)	0	110 ± 22
Success rates (%)	33 (84.6)	52 (100)*

**p*=0.013

underwent obturator nerve block, and the group given succinylcholine (**Table 1**). Epidural anesthesia was administered to 57 patients. Of these, 18 had inferolateral bladder tumors that were diagnosed during endoscopy, and these patients underwent general anesthesia as there was not enough time to administer an obturator block. In the remaining 39 patients, an obturator nerve block was attempted preoperatively. In one case (2.6%), it was not possible to locate the obturator nerve, and in another patient (2.6%) a hematoma occurred during the attempted obturator nerve block. Therefore, in both cases these patients subsequently underwent general anesthesia. In addition, an obturator nerve reflex occurred (1 violent and 3 minor) in 4 of the 37 (10.8%) patients who were administered the block. Twenty-four patients were initially given epidural anesthesia and then underwent mask anesthesia with propofol and succinylcholine prior to resection, and 32 patients were directly administered general anesthesia via mask and given succinylcholine before resection, and no contraction of the adductor muscle was observed during the TUR procedure, and these surgeries were completed uneventfully. Four patients, in whom the obturator nerve reflex was observed despite the obturator block, were managed successfully with succinylcholine and were not taken into account.

Discussion. Succinylcholine, the only depolarizing neuromuscular blocker in clinical use, differs from the non-depolarizing agents not only of its fast onset and very short acting effects, simply due to its distinct mechanism of action. All neuromuscular blockers bear a structural resemblance to acetylcholine (ACh), the neurotransmitter at the neuromuscular junction. However, succinylcholine acts as ACh receptor agonist, while non-depolarizing agents function as competitive antagonists.⁵ Therefore, ACh molecules, released by an extrinsic or intrinsic mechanism, strengthen the depolarization induced by succinylcholine and thereby produce a depolarization block that prohibits muscular stimulation until the succinylcholine is hydrolyzed. If

strong extrinsic nerve stimulation (such as obturator nerve stimulation during TUR) leads to a great enough release of ACh to compete the non-depolarizing agents away from the receptors, muscular contraction may occur despite non-depolarizing neuromuscular blockade. This mode of action has been well described, and its implication for clinical practice has never been discussed in the literature. This information has well known for a long time, however, no data highlighting its implication in clinical practice have been documented in literature. Indeed, in our practice as well as in others⁶ reported that adductor muscle contraction may have occurred despite routine doses of non-depolarizing agents. However, high doses of non-depolarizing agents can compete with the released ACh and prevent the reflex. This may result from activity of non-depolarizing agents on presynaptic receptors inhibiting calcium entry, and therefore decreasing ACh release. However, administration of high doses of the non-depolarizing blockers induces a prolonged effect, even with the shortest-acting agent, which results in delay in recovery and discharge. In addition, non-depolarizing agents require pharmacological reversal, often resulting in complications.⁷ Obturator nerve motor block, when successful, can prevent inadvertent adduction during transurethral surgery.³ However, this block requires experience and it is not always successful nor is it completely reliable,⁴ even in the most experienced hands. In fact, adductor muscle contraction occurring despite prior blockade of the obturator nerve has been reported.^{4,8,9} Uncertainty in the effectiveness of the obturator block can be attributed to the following factors: First, due to its anatomical variations such as the location of the accessory obturator nerve or its abnormal branching, the obturator nerve can be missed or partially blocked.⁴ Secondly, the effect of local anesthetic agents on nerve fibers varies according to the size of the nerve fiber, whether or not it is myelinated, the concentration of the local anesthetic used, and the duration of contact with the nerve. Depending on these conditions, the nerve block may not affect all of the

motor neuron fibers of the obturator nerve (namely thick A alpha fibers). The largest type A alpha fibers are blocked last, and recover first. Accordingly, to obtain a full motor block, recovery of motor function varies, and early or late resection procedures (namely before full motor block and after recovery of motor function) can result in stimulation of the adductor muscles. Finally, there are many obturator nerve-blocking techniques, and there is no consensus on which one is the best.^{10,11} Therefore, each technique may have its own unique drawback. In addition to potential complications such as hematoma, nerve damage, or systemic toxicity, the nerve block procedure is time-consuming and costly. Particularly when the tumor is diagnosed during endoscopy as inferolateral, and therefore inhibition of the obturator nerve reflex is necessary, the immediate time constraints are considerable. Identification of the obturator nerve and the subsequent nerve block take at least 30 minutes, which is a great deal of time for high-turnover surgical units. In contrast to obturator block, no additional skills are required to administer succinylcholine. However, succinylcholine has some possible adverse effects including increases of ocular, cranial and gastric pressures, increase in serum potassium concentration, myalgia, triggering malignant hyperthermia in susceptible patients, prolonged paralysis in patients with deficient pseudocholinesterase activity or in the ones using some drugs such as echothiophate, trimethaphan and certain chemotherapeutic agents such as cyclophosphamide.¹² Fortunately, since it is a well-studied agent, most of those complications and how to manage them are widely known. Therefore, succinylcholine can be safely used in patients for whom it is not contraindicated. There are some new techniques to prevent the obturator nerve reflex such as bipolar technologies and transurethral resection in saline (TURIS) system,¹³⁻¹⁵ which they have a return electrode on the sheath of the telescope, which allows the electric current without passing through the patient, namely without stimulating the obturator nerve. They present an improved safety profile, and it is very early to be a standard for transurethral resection procedures. Although we performed these surgeries using a rigorously applied protocol, the present study is a retrospective, non-randomized and non-blinded analysis. Due to its retrospective nature, although we did not observe any other complications, we did not have any follow-up documentation on myalgia. Therefore, these results should be confirmed by a large, prospective, blind, and randomized study.

In conclusion, no additional skills, equipment, or time are required, and there is little chance of failure

due to its unique mechanism of action, succinylcholine can be safely administered to inhibit the obturator nerve reflex. This approach represents a simple, cheap, reliable and safe alternative to the traditional obturator nerve block.

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