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# Effect of obturator nerve block during transurethral resection of bladder tumors on the disease recurrence, progression and surgery outcomes

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## Abstract

**Objective** In our study, we aimed to evaluate the effect of the obturator nerve block (ONB) on the operation time, duration of hospital stay, complete resection, presence of muscle tissue in the pathology, second resection, recurrence, and progression, when applied in addition to spinal anesthesia in patients with primary bladder lateral wall tumor and Transurethral Resection of Bladder Tumor (TURBT) was planned.

**Materials and methods** Seventy patients with bladder lateral wall tumors were included in the study. In addition, ONB was applied to 35 of the patients who underwent spinal anesthesia. The two groups were compared in terms of obturator reflex development, perforation, complete resection, presence of muscle tissue in pathology samples, need for second resection, need for second resection due to inadequate muscle tissue, and 1 year recurrence and progression rates.

**Results** When the two groups were compared for obturator reflex and bladder perforation, both were found to be lower in the ONB group ($p=0.002$, $p=0.198$, respectively). The rate of complete resection and the presence of muscle tissue in the pathology samples were higher in the ONB group ($p=0.045$, $p=0.034$, respectively). The rates of second resection and second resection due to inadequate muscle tissue were found to be higher in the group without ONB ($p=0.015$, $p=0.106$, respectively). In the 1-year follow-up, the recurrence rate was significantly lower in the ONB group ($p<0.001$), while there was no significant difference between the progression rates ($p=0.106$).

**Conclusion** In our study, we found out that ONB applied in addition to spinal anesthesia increases the rate of complete and muscle tissue resection by decreasing the obturator reflex, and causes a significant reduction in the need for second resection and tumor recurrence.

**Keywords** Bladder cancer · Obturator nerve blockade · Tumor recurrence

## Abbreviations

| | |
|---|---|
| ONB | Obturator nerve block |
| ONB group | The group underwent OSB |
| Non-ONB group | The group did not undergo ONB |
| NMIBC | Non-muscle-invasive bladder cancers |
| MIBC | Muscle invasive bladder cancers |
| TUR-M | Transurethral resection of bladder tumor |

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## Introduction

Bladder cancer has an important place among urogenital system cancers and its prevalence is increasing every year. It is the 7th most common type of cancer in the male population and the 11th in both sexes, among cancers worldwide [1]. Bladder cancer is three times more common in men than in women [2]. It is the second most common cancer among urogenital cancers after prostate cancer [3]. More than 90% of bladder malignancies are urothelial carcinomas (transitional cell carcinoma). [4]. At the time of diagnosis, approximately 80% of bladder cancers are seen as non-muscle-invasive bladder cancer (NMIBC) and 70% of NMIBC is seen as Ta, 20% as T1, and 10% as carcinoma in situ (CIS) [5].

Transurethral resection of bladder tumor (TURBT) is the surgical method used in the diagnosis, staging, and treatment of bladder tumors. In TURBT, the aim is to determine the histological features of the tumor and to treat the disease with complete resection. It is known that a complete TURBT performed in accordance with the surgical technique affects the prognosis of the disease in a good manner [6]. Frequent recurrence and progression of bladder cancer cause the need for strict follow-up protocols and additional treatment methods. In patients with a diagnosis of NMIBC, a 50–70% recurrence rate, and a 15–20% progression rate is observed [7]. Risk classifications are used in NMIBC to identify similar patients and gain insights into relapse and progression. EORTC (European Organization for Research and Treatment of Cancer) designed a scoring system in patients with Ta and T1 pathology, using the parameters of tumor number, tumor diameter, number of recurrences, T stage, presence of CIS, and tumor grade [6]. Another classification was developed by the European Association of Urology (EAU) as low, intermediate, and high-risk bladder cancers by using the available prognostic factors and taking into account the EORTC scores [8].

Apart from these prognostic factors, the types of treatment applied to patients diagnosed with NMIBC and the effects of surgical methods on progression and recurrence have also been the subject of research. In this direction, it is seen that the obturator reflex that may occur during the TURBT surgical method has been examined in recent studies [9, 10].

The obturator nerve is in a close situation to the bladder neck and the inferolateral region of the bladder. This may cause nerve stimulation with electrocautery during the resection of posterolaterally located bladder tumors. Sudden adduction of the leg occurs with stimulation of the obturator nerve, which innervates the adductor muscles. This condition, called obturator reflex, is seen in 53–100% of bladder lateral wall tumors [11]. Bladder perforation may develop with a sudden movement of the leg. As a result, incomplete resection and extravesical spread of tumor cells can occur. This condition may require additional surgical intervention, as well as delay or inability to perform postoperative single-dose chemotherapy instillation [12]. Reducing the fullness of the bladder, using low electric current energy, adding muscle relaxants under general anesthesia, using a 90-degree classic loop, and using bipolar energy modalities are the recommended methods to prevent the obturator reflex [13]. However, it is known that these methods are not effective enough to prevent the obturator reflex. Researchers have reported that obturator nerve blockade (ONB) is the most effective method for preventing the obturator reflex [14, 15]. ONB was first applied regionally in 1965 by Prentiss et al. [16]. The new techniques developed in ONB, the use of ultrasonography and nerve stimulators have significantly increased the success of blockade [17].

Considering that the main goal in TURBT is the complete resection of the macroscopic tumor, especially in lateral wall tumors, complications that occur due to the obturator reflex emerge as an important problem. There are studies in the literature that by reducing the obturator reflex, ONB reduces perforation, incomplete resection rate, and tumor recurrence [9, 10, 18]. Most studies have been limited to the effect of ONB on obturator reflex and the development of perforation. Based on these, in our study, we aimed to investigate the effects of obturator blockade on the development of obturator reflex, bladder perforation, duration of hospital stay, complete resection, 1-year tumor recurrence, and progression in patients with non-muscle-invasive bladder lateral wall tumors.

## Materials and methods

### Study population

This study was conducted in Afyonkarahisar Health Sciences University Hospital urology and anesthesia clinics between April 2020 and December 2021. Following the ethical approval (Afyonkarahisar Health Sciences University Clinical Research Ethics Committee. 2011-KAEK-2, 2020/104) the data were recorded prospectively. Our study was conducted in accordance with the principles of the Declaration of Helsinki, the planned study was explained to the patients in detail, and then written informed consent was obtained from each patient. Patients with bladder lateral wall tumor detected by imaging methods and for whom TURBT were planned were included in the study. Exclusion criteria were the presence of coagulation disorder, history of previous surgery due to bladder tumor, a neuromuscular disorder affecting the nervous system, history of allergy to

local anesthetic drugs, obturator nerve damage, and presence of contraindications for spinal anesthesia. Patients who were found to have a tumor in the lateral wall of the bladder by imaging methods, but whose tumor was detected in another localization in cystoscopy were excluded from the study. Patients who were found to have a muscle-invasive tumor (MIBC) in pathology after the operation, who had an unresectable tumor burden, for whom radical surgery was planned, and who did not admit regularly for cystoscopy controls for at least 1 year were excluded from the study. Incomplete resection was accepted as the presence of a visible tumor on cystoscopy. Patients were randomized into two groups using the website www.randomizer.org. As a result, 35 patients who underwent obturator block and followed up regularly for at least 1 year were classified as the ONB group. Thirty-five patients who were followed up regularly for at least 1 year and did not have obturator block were classified as a non-ONB group.

## Application

Each patient was monitored by the anesthesia team in the operating room, and then 10–15 mg of hyperbaric bupivacaine was injected with a 25G Quincke needle and spinal anesthesia was done in the sitting position through the L3–L4 or L4–L5 intervals. The patients were placed in the supine position. They were prepared for ONB by confirming the disappearance of the warm sensation in T10. The patients were positioned in the supine position with the ipsilateral leg straight and the hip slightly externally rotated. Usmart-3200 T NexgenTerason® ultrasonography (USG) device was used in all blockings. The muscles and planes were visualized by placing the USG probe 2 cm caudal to the pubic tubercle and to the medial part of the thigh. With a nerve stimulator (Stimuplex®, B Braun, Melsungen, Germany), the current intensity was adjusted to 1.5–2 mA and the duration was set to 0.1 ms, and 80 mm 22 gauge peripheral block needle was entered using the inplane technique. The needle was directed from the caudal to the cephalad. The anterior and posterior part of the obturator nerve were blocked by administering 10 ml of 0.25% bupivacaine when contractions were observed in the adductor muscle groups at 0.3–0.5 mA and after aspiration was determined to be negative provided. The blockade procedure was performed bilaterally by the same anesthesia team for each patient. Because multifocality can be seen in bladder cancer and this may not be distinguished by imaging methods before cystoscopy. No complications developed in patients who underwent obturator block.

The time when the anesthesia and nerve blockade procedure was completed and the surgical preparation started and the moment when the surgical procedure was completed and the patient was left for evaluation by the anesthesiologist was considered as the duration of the procedure. The operations were performed in the lithotomy position. All operations were performed by the same surgeon and resection was performed with a 26-Fr permanent flow resectoscope (Olympus Winter &Ibe GmbH®, Germany). A bipolar plasma kinetic energy source was used. In each patient, it was tried to descend to the base of the tumor and to sample muscle tissue. In patients with incomplete perforation, the procedure was terminated and they were followed closely. Postoperative single-dose KT instillation was not administered to these patients. A postoperative single dose of 50 mg epirubicin was administered intravesically to each patient whose urine color was natural and no perforation developed, and instillation was performed for 2 h. Patients who came to the control with pathology results were classified again by considering the risk group and disease-related factors. Follow-up and treatment protocols were arranged according to EAU guidelines. Patients with the pathology result of T2 bladder tumor and variant histologies were excluded from the study.

According to EAU NMIBC guidelines, the second resection was performed 4 weeks later in patients who could not undergo complete resection in the first TURBT operation, in patients who did not have muscle tissue in their pathology specimens except for low-grade Ta tumor and CIS, and in patients with the first pathology of T1. TURBT operation was performed again for patients with recurrent tumors in control cystoscopies, and a treatment and follow-up protocol was arranged after re-evaluation with new pathology results. Tumors with Ta or T1 pathology and descending to T2 invasion depth were considered as progression. All patients with a tumor with any depth of invasion or histological grade were considered relapsed during follow-up. Seven patients who did not come to their regular controls at the specified intervals in a 1 year period did not undergo control cystoscopy, and did not receive intravesical treatment although recommended were excluded from the study. In addition, 12 patients with T2 tumors in the first TURBT were not included in the study.

In addition to demographic and clinical data, the two groups were compared in terms of the development of obturator reflex in the operation, duration of operation, development of bladder perforation, whether it was complete resection, presence of muscle tissue in the specimen, need for second resection, 1-year recurrence, and progression rates.

## Statistical analysis

Statistical analysis of the study data was performed with IBM SPSS (Statistical Package for the Social Sciences) version 20.0 program. The conformity of the variables for the normal distribution was examined using the Kolmogorov–Smirnov (K-S) test. For the comparison of binary groups, Student's *t* test was used for normally distributed parameters and the

Mann–Whitney *U* test was used for abnormally distributed parameters. Analysis of multi-well crosstabs was performed with the Chi-square test or Fisher Exact test. Logistic regression analysis was used to determine the factors affecting 1-year recurrence and progression. Results were considered statistically significant when $p < 0.05$.

## Results

The mean age of the patients included in the study was 62.64 ± 10.51 years. Sixty-four (91.4%) of the patients were male. No statistically significant difference was found between the mean age and gender of the groups ($p = 0.71$, $p = 1.00$, respectively) (Tables 1, 2). Tumor size was measured with reference of the loop thickness in millimeters (mm) of the longest diameter of the tumor. The mean tumor size was 31.0 ± 15.18 mm in the ONB group, while the mean tumor size was 37.77 ± 18.98 mm in the non-ONB group. There was no statistically significant difference between the two groups in terms of tumor size ($p = 0.089$) (Table 1).

Tumor localization is divided into three groups as right lateral wall, left lateral wall and bilateral. In the ONB group, tumors were found on the right side wall in 16 patients, on the left side wall in 13 patients, and bilaterally in 6 patients. In the group without ONB, tumors were detected on the right side wall in 14 patients, on the left side wall in 14 patients, and bilaterally in 7 patients. No statistically significant difference was found between the groups ($p = 0.884$).

EORTC recurrence and progression scoring were calculated based on the patient's first operation outcomes. No statistically significant difference was found between the groups in terms of EORTC recurrence and progression scores ($p = 0.172$, $p = 0.169$, respectively) (Table 1).

When the duration of the operation was compared between the two groups, the average duration was 34.14 ± 12.39 min in the ONB group and 44.57 ± 21.39 min in the non-ONB group. This difference in the operation duration was found to be statistically significant ($p = 0.031$) (Table 1). It was found that the mean hospital stay after the operation was 1.20 ± 0.47 days in the ONB group and 1.63 ± 0.87 days in the non-ONB group. This shorter hospital stay in the ONB group was statistically significant ($p = 0.015$) (Table 1).

Patients were categorized as low, intermediate, and high-risk according to the EAU risk classification system. The distribution of the patients among the groups according to the EAU risk classification system is shown in Table 2. No statistically significant difference was found between the two groups according to risk classes ($p = 0.547$) (Table 2). When the T stages (Ta and T1) and histological grades (grade) of the patients in the pathology reports of the first operation were compared, no statistically significant difference was found between the two groups ($p = 0.332$, $p = 0.472$, respectively) (Table 2). In both groups, CIS was detected in 1 patient in addition to the primary tumor. Intravesical BCG treatment was administered to 45.7% of the ONB group after the operation, while it was administered to 54.3% of the non-ONB group, and no statistically significant difference was found between the two groups ($p = 0.633$) (Table 2).

The rate of obturator reflex development in the ONB group was found to be statistically significantly lower than in the non-ONB group ($p = 0.002$). When bladder perforation is compared in patients whose obturator reflex developed, less bladder perforation developed in the ONB group

**Table 1** Demographic and surgical data of groups

| | ONB ($n = 35$) Mean ± SD | Non-ONB ($n = 35$) Mean ± SD | *p* value |
|---|---|---|---|
| Age (years) | 60.91 ± 11.63 | 64.37 ± 9.10 | 0.171 |
| Tumor size (mm) | 31.00 ± 15.18 | 37.77 ± 18.98 | 0.089 |
| Duration of operation (min) | 34.14 ± 12.39 | 44.57 ± 21.39 | **0.031** |
| Hospitalization (days) | 1.20 ± 0.47 | 1.63 ± 0.87 | **0.015** |
| EORTC recurrence | 4.37 ± 3.15 | 5.29 ± 2.64 | 0.172 |
| EORTC progression score | 5.94 ± 5.53 | 7.71 ± 4.92 | 0.169 |

$p < 0.05$ was considered statistically significant

*ONB* obturator nerve block group, *non-ONB* group obturator nerve block was not performed, *mm* milimeter, *min* minutes, *EORTC* Europe Organisation of Research and Treatment of Cancer, *Mean ± SD* mean ± standard deviation

**Table 2** Demographic and clinical data of the groups

| | ONB ($n = 35$) *n* % | Non-ONB ($n = 35$) *n* % | *p* value |
|---|---|---|---|
| Gender | | | |
| Male | 32 (91.4) | 32 (91.4) | $p = 1.000$ |
| Female | 3 (8.6) | 3 (8.6) | |
| T level | | | |
| Ta | 23 (65.7) | 18 (51.4) | $p = 0.332$ |
| T1 | 12 (34.3) | 17 (48.6) | |
| Grade | | | |
| LG | 21 (60.0) | 17 (48.6) | $p = 0.472$ |
| HG | 14 (40.0) | 18 (51.4) | |
| Risk classification | | | |
| Low | 11 (31.4) | 7 (20.0) | $p = 0.547$ |
| Moderate | 8 (22.9) | 9 (25.7) | |
| High | 16 (45.7) | 19 (54.3) | |
| BCG treatment | | | |
| Yes | 16(45.7) | 19 (54.3) | $p = 0.633$ |
| No | 19 (54.3) | 16 (45.7) | |

*ONB* obturator nerve block group, *non-ONB* group obturator nerve block was not performed, *BCG* Bacillus Calmette Guerin, *LG* low grade, *HG* high grade

compared to the non-ONB group, however, this difference was not statistically significant ($p=0.198$). Extravasation, which requires conversion to open surgery, was not detected in any of the patients who developed perforation.

While complete resection was performed in 94.3% ($n=33$) of the ONB group, it was performed in 74.3% ($n=26$) of the non-ONB. The high complete resection rate in the ONB group was statistically significant ($p=0.045$) (Table 3). When the presence of muscle tissue in the pathology samples was compared, there was a statistically significantly higher presence of muscle tissue in the ONB group ($p=0.034$). Second resection was performed in 42.9% ($n=15$) of the ONB group, and 74.3% ($n=26$) in the non-ONB group. The low rate of second resection in the ONB group was statistically significant ($p=0.015$) (Table 3). The patients who needed a second resection due to lack of muscle tissue were thought to be more associated with surgical outcomes of ONB and were considered as a separate group. Accordingly, second resection for the absence of muscle tissue was performed in 1 (2.9%) patient in the ONB group and 6 (17.1%) patients in the non-ONB group. The high rate in the non-ONB group was not statistically significant ($p=0.106$) (Table 3).

When the 1-year recurrence and progression rates were compared between the groups, a lower recurrence rate was found in the ONB group, and a higher progression rate was found in the non-ONB group ($p<0.001$, $p=0.106$, respectively) (Table 3). Binary logistic regression analysis was performed to determine the possible independent predictors of 1-year recurrence and progression that contributed the most to the outcomes. Gender, age, tumor size, T stage, tumor grade, presence of muscle tissue in pathology, whether there was complete resection, whether BCG was administered and ONB were used as predictors. The model predicting 1-year recurrence was significant ($\chi^2=5.8$, $p=0.665$) and could explain 42.7% of the variance in reincarceration (Nagelkerke $R^2=0.427$). The model correctly predicted 78.9% of the patients without recurrence and 65.6% with recurrence (72.9% of the total). The only significant predictor for 1 year recurrence was the presence of ONB. One unit increase in obturator nerve block decreased the recurrence risk by 7.57 times (Table 4). In the model predicting 1-year progression, no predictor was found that would have a significant effect on progression (Table 4).

**Table 3** Comparison of the surgical complications and oncologicl outcomes of the groups

| | ONB ($n=35$) *n* % | Non-ONB ($n=35$) *n* % | *p* level |
|---|---|---|---|
| Obturator reflex | | | |
| Yes | 3 (8.6) | 15 (42.9) | **0.002** |
| No | 32 (91.4) | 20 (57.1) | |
| Perforation | | | |
| Yes | 1 (2.9) | 5 (14.3) | 0.198 |
| No | 34 (97.1) | 30 (85.7) | |
| Complete resection | | | |
| Yes | 33 (94.3) | 26 (74.3) | **0.045** |
| No | 2 (5.7) | 9 (25.7) | |
| Muscle tissue | | | |
| Yes | 32 (91.4) | 24 (68.6) | **0.034** |
| No | 3 (8.6) | 11 (31.4) | |
| Second resection | | | |
| Yes | 15 (42.9) | 26 (74.3) | **0.015** |
| No | 20 (57.1) | 9 (25.7) | |
| Second resection due to lack of muscle tissue | | | |
| Yes | 1 (2.9) | 6 (17.1) | 0.106 |
| No | 34 (97.1) | 29 (82.9) | |
| Recurrence (1 year) | | | |
| Yes | 8 (22.9) | 24 (68.6) | **< 0.001** |
| No | 27 (77.1) | 11 (31.4) | |
| Progression (1 year) | | | |
| Yes | 1 (2.9) | 6 (17.1) | 0.106 |
| No | 34 (97.1) | 29 (82.9) | |

$p < 0.05$ was considered statistically significant

*ONB* obturator nerve block group, *non-ONB* group obturator nerve block was not performed

## Discussion

TURBT is the gold standard endoscopic surgical method for bladder cancer, in both diagnosis and treatment. TURBT's goals are to reveal the histopathological features of the tumor, determine the depth of invasion, and complete the resection of all visible tumors. One of the most important concerns for surgeons during resection is the development of obturator reflex. Due to the close neighborhood of the obturator nerve with the inferolateral edge of the bladder, the obturator nerve is stimulated more in bladder lateral wall tumors. Considering that 46.6% of NMIBCs are located on the lateral walls of the bladder, the development of obturator reflex is seen to be a serious problem for urologists [11]. Since the day ONB was first described different techniques have been tried and the success rates were found to be high in general. ONB effectiveness, it can be defined as the absence of obturator block development during the operation. While the effectiveness of blinded ONB was 83.8%, this rate increased to 89–100% with the use of nerve stimulators [19, 20]. The use of spinal anesthesia is considered to be safer by anesthesiologists due to the fact that bladder cancer patients are elderly, usually smokers, and have age-related comorbidities. Spinal anesthesia alone does lead to obturator nerve block. The application of ONB in patients undergoing spinal anesthesia seems to be a more reliable method [21].

**Table 4** Predictors for 1-year recurrence and progression

| Risk factor | Recurrence | | Progression | |
|---|---|---|---|---|
| | RR (%95 GA) | *p* value | RR (%95 GA) | *p* value |
| Age (years) | 1.03 (0.96–1.10) | 0.352 | 0.98 (0.88–1.09) | 0.740 |
| Gender | 0.15 (0.01–1.63) | 0.121 | 1.36 (0.03–49.25) | 0.865 |
| Complete resection | 1.46 (0.09–23.89) | 0.787 | 1.64 (0.05–53.19) | 0.780 |
| Muscle tissue presence | 0.60 (0.11–3.20) | 0.551 | 0.53 (0.05–5.59) | 0.597 |
| T level | 1.15 (0.11–11.60) | 0.900 | 0.06 (0.00–7.82) | 0.260 |
| Tumor grade | 0.25 (0.02–2.54) | 0.246 | 0.41 (0.00–35.77) | 0.698 |
| Tumor size | 1.04 (0.98–1.10) | 0.181 | 0.99 (0.92–1.06) | 0.843 |
| Obturator block | 7.57 (2,08–27.49) | **0.002** | 6.04 (0.50–71.96) | 0.154 |
| BCG treatment | 1.81 (0.28–11.44) | 0.527 | 6.07 (0.46–79.35) | 0.169 |

$p < 0.05$ was considered statistically significant

*BCG* Bacillus Calmette Guerin, *RR* estimated relative risk showed by odds ratio, *CI* confidence interval

For these reasons, in our study, only the spinal anesthesia group and the spinal anesthesia and ONB combined group were compared.

Although the mean tumor sizes were similar in both groups, the duration of operation was found to be significantly shorter in the ONB group. This can be attributed to the fact that the surgeon feels safe and deep resection is performed in a shorter time due to the absence of an obturator reflex. Duration of hospital stay directly affects hospital-acquired infections and cost [22]. In cases of bladder perforation or severe bleeding in the operation and incomplete resections, the clearing in the postoperative urine color becomes late and the discharge time is prolonged. It can be said that these two factors contribute to the significantly longer duration of hospitalization in the group without ONB. In a study by Prentiss et al., it was observed that the oburator reflex developed in 20% of lateral bladder tumors [16]. This rate was reported as 55.3% in the study of Tatlisen et al. [23]. In a study by Erbay et al., which compared patients with and without ONB, the development of obturator reflex was 6.3% in the group with ONB, while this rate was reported as 57.1% in the group without ONB [10]. In another study by Doluoğlu et al., these rates were 9.8% in the group with ONB and 39.6% in the group without ONB [9]. In our study, the obturator reflex developed at a rate of 8.6% in the ONB group and 42.9% in the group without ONB. Sonographic imaging and a nerve stimulator were used in all patients in our study, and ONB success was found to be 91.4%. Development of the obturator reflex was observed significantly less in the ONB group and the result is consistent with the literature.

Bladder perforation that occurs during the operation may lead to incomplete resection, extravesical tumor spread, bleeding, abdominal organ injury, and the need for repair with open surgery [24]. When the literature is examined, it is seen that ONB prevents the development of bladder perforation by decreasing the obturator reflex. In a recently published meta-analysis including 8 studies, it was reported that bladder perforation developed in 5 (2.1%) of 238 patients who underwent ONB, and in 26 (10.8%) of 239 patients who did not undergo ONB. The rate of perforation was found to be significantly lower in the ONB group among the two groups [25]. In our study, bladder perforation developed in 1 (2.9%) patient in the ONB group and in 5 (14.3%) patients in the ONB group. These rates were found to be similar to the literature. All of the perforations were extraperitoneal and there was no serious bleeding or need for open surgical repair.

Complete resection is one of the most important steps of TURBT for good oncologic outcomes. Remaining tumor tissue in the bladder after incomplete resection increases recurrence rates and is associated with poor oncologic outcomes. Jancke et al. reported residual tumor tissue in 26% of patients after complete resection in NMIBC. The recurrence rates of these patients were found to be significantly higher than other patients [26]. In a study performed to evaluate incomplete resection, 83 patients who underwent TURBT were re-evaluated with a second resection 7 weeks later, and residual tumor tissue was detected in 27% of Ta tumors and 53% of T1 tumors [27]. In the study of Erbay et al., incomplete resection was performed at 8.5% in the ONB group, while this rate was 36.7% in the group without ONB [10]. In our study, it was found that ONB significantly increased the rate of complete resection, similar to previous studies.

The presence of muscle tissue in the samples is one of the most important criteria for complete resection. The absence of muscle tissue in the samples is associated with an increased risk for residual disease and early recurrence. Also, the absence of muscle tissue in the samples leads to inadequate and incorrect staging [28]. In a study by Capogrosso et al. in which 437 patients who underwent TURBT were retrospectively evaluated, it was reported that 9.6% of the patients did not have muscle tissue in the pathology samples [29]. In other studies conducted on patients without ONB, it was reported that 15% to 66% of the patients

did not have muscle tissue in the samples [7, 30, 31]. In our study, muscle tissue was not observed at a rate of 8.6% in the ONB group, while this rate was 31.4% in the group without ONB. Performing ONB significantly increases the presence of muscle tissue in pathology samples by allowing deep resection.

In the study conducted by Doluoğlu et al., a second resection was performed in 49% of the patients who underwent ONB and in 56.6% of the patients who did not [9]. When the patients who underwent second resection for all reasons were evaluated in our study, it was observed that the rate of second resection was significantly lower in the ONB group. Considering the findings of our study that ONB reduced the development of obturator reflex and perforation rates, increased the complete resection rate, and provided more muscle tissue sampling, it could be expected that the rate of second resection would be lower in the ONB group.

Our study found no significant difference between risk classes and EORTC recurrence and progression scores between the two groups. The similarity of these parameters in both groups standardized the study better and minimized the possibility of bias by other factors that would make a difference in relapse and progression rates. In a meta-analysis using the data of recurrence and progression of four studies, it was found that recurrent tumors were detected in 11.5% of the ONB group, while this rate was 27.6% in the group without ONB. The recurrence rates were found to be statistically significantly lower in the ONB group [25]. In our study, tumor recurrence was detected in 8 (22.9%) patients in the ONB group and 24 (68.6%) patients in the ONB group within the first year. Recurrence rates were found to be significantly lower in the ONB group. In the logistic regression analysis performed by including the factors that will affect the recurrence, it was determined that the most important factor contributing to the reduction of the recurrence rate was ONB. It was thought that the increase in the complete resection rates, the acquisition of more muscle tissue with deeper resection, and lower perforation rates in patients who underwent ONB caused less tumor recurrence in patients.

In the literature, the number of studies examining the effect of ONB on progression is limited. In one of these studies, although progression was observed in fewer patients in the ONB group, no statistically significant difference was found [9]. Similarly, in our study, although progression was detected in numerically fewer patients in the ONB group, no significant difference was found due to the low number of patients.

The most important limitation of our study is that we only included lateral wall tumors and the number of patients was low due to excluding patients who did not come to their regular follow-ups. Follow-up was limited to 1 year to standardize recurrence and progression rates. However, the follow-up of the patients included in the study to investigate the effect of ONB on long-term recurrence and progression continues. The strength of our study is that the effect of ONB on recurrence and progression was examined by controlling the factors such as age, tumor size, T stage, tumor grade, EORTC recurrence and progression scores, EAU risk class, BCG therapy, which are known to affect recurrence and progression. Besides, the regression model created for ONB, together with all these factors affecting recurrence and progression, constitutes the strength and difference of our study from other studies.

## Conclusion

This study showed that ONB is an effective method for inhibiting the obturator reflex. It was determined that in the patients for whom the obturator reflex was prevented, there was a shorter operation time and a shorter hospital stay. ONB in addition to spinal anesthesia increased the rates of complete resection. In these patients, more muscle tissue was observed in the pathology samples and it significantly reduced the rates of second resections for all reasons. Also, it significantly reduced the recurrence rates in the 1-year follow-up period of the patients. Considering all these findings, the application of ONB in addition to spinal anesthesia in TURBT operation may be associated with better oncological outcomes by reducing the complication rates. It may contribute to prolonging the disease-free survival time by reducing the recurrence rates. We think that, in addition to primary bladder tumor patients, in patients who developed complications in their previous resection, who could not undergo complete resection, or whose muscle tissue could not be sampled, ONB can contribute positively to surgical and oncological outcomes subsequently planned resections. In order to reach stronger and more detailed evidence about the results we obtained in our study, multicenter, randomized controlled studies with large samples and long follow-up periods are needed.

**Data availability** The data that support the findings of this study are available from the corresponding author upon reasonable request.

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