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Original Article

Minilaparoscopy-assisted en bloc transurethral resection of bladder tumors

Yunzhi Lin*, Ning Xu*, Yupeng Wu*, Xiaodong Li, Qingshui Zheng, Xueyi Xue, Yong Wei

*Departments of Urology, The First Affiliated Hospital of Fujian Medical University, Fuzhou, China. *Equal contributors.*

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Abstract: *Objective:* To investigate the feasibility and efficacy of the application of minilaparoscopy-assisted en bloc transurethral resection of bladder tumors (TURBT). *Methods:* A total of 63 patients who underwent minilaparoscopy-assisted en bloc TURBT were evaluated. A plasmakinetic resection system was used during the operations. The minilaparoscopy instruments were placed in the bladder cavity from the puncture point, which was located at the ventral suprapubic midline. After the minilaparoscopy instruments had been placed in the bladder cavity, the bladder tumor was clamped and lifted, and then the tumor was dissected through the superficial muscular layer under the circumferentially incised area. *Results:* Among all 63 patients, the mean operation time and hospitalization time were 39.8 ± 23.7 minutes and 4.7 ± 1.7 days, respectively, and the mean catheterization time and bladder irrigation times were 3.4 ± 1.7 days and 1 day, respectively. Intraoperative hemorrhage was rare, and no obturator nerve reflex occurred. The pathological staging and depth of invasion were accurately evaluated in all specimens. *Conclusion:* This study demonstrated that minilaparoscopy-assisted en bloc TURBT is a safe and effective procedure that provides an alternative treatment for bladder tumor with minor trauma, few complications, and quick recovery. The pathological stage, depth of invasion, and positive margin status were accurately evaluated in all high-quality specimens.

Keywords: Minilaparoscopy, bladder tumor, en bloc resection, pathological staging

Introduction

Bladder tumors are one of the most commonly diagnosed tumors in males worldwide. Transurethral resection of bladder tumors (TURBT) is the mainstay surgical treatment for low-grade, non-muscle-invasive bladder cancer (NMIBC) [1]. Improvements in surgical techniques have been made in recent years; however, tumor staging, tumor grading, and determination of the depth of invasion of specimens obtained by conventional TURBT still lack accuracy because poor anatomic orientation with fragmented tumor specimens are inevitable in conventional TURBT. Ukai *et al.* [2] first performed en bloc TURBT using a 26-F resectoscope mounted with a J-shaped needle electrode (J knife). A loop electrode was cut in half and bend manually as J knife [3]. The hereindescribed method has been adopted by subsequent researches. This method was also modified for different kinds of energy sources, such as lasers (Ho: YAG: Holmium yttrium aluminium garnet laser, Tm: YAG: Thulium yttrium aluminium garnet laser) or the HybridKnife [4-7]. We performed en bloc TURBT with the assistance of minilaparoscopy instruments for 63 patients with newly diagnosed NMIBC. Compared with conventional TURBT, minilaparoscopy-assisted en bloc TURBT is a feasible and effective tool for pathological staging of bladder tumors in patients without any obturator nerve reflex (ONR).

Methods

Registry

The work was reported in line with the PROCESS criteria [8]. Additionally, the study was registered at Research Registry, with a registration number researchregistry 2445.

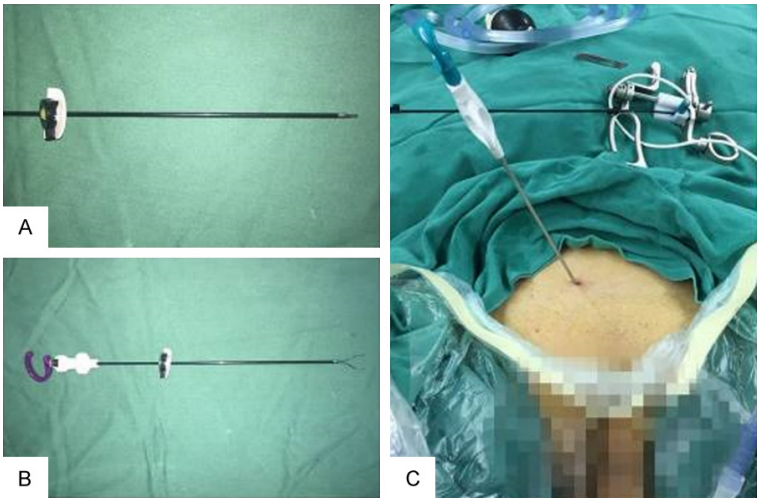

Figure 1. A. MiniLap Instruments (the US Stryker); B. On the top of the MiniLap Instruments was the puncture needle, at the end of the MiniLap Instrument was the operator controlled the opening and closing; C. The puncture point was located on the four transverse finger of suprapubic of the median line of hypogastric region. MiniLap Instrument was punctured into the abdomen under the endoscopic monitoring.

Figure 2. With the assist of MiniLap Instruments, the left lateral wall of the bladder tumor is fixed and lifted from basal part under the under the endoscopic monitoring.

Patient characteristics

A total of 63 patients (48 males and 15 females) with newly diagnosed bladder tumors (45 single tumors and 18 multiple tumors) who underwent minilaparoscopy-assisted en bloc TURBT were enrolled in our study. The patients' age ranged from 43 to 77 years (mean, 60 ± 11.2 years). Among these 63 patients, 22 tumors were located in the posterior wall of bladder, 14 were located in the trigone, and 25 tumors were located in the posterior wall of bladder. Biopsy specimens of all lesions were obtained by preoperative cystoscopy and were histologically or urinary cytology confirmed to be urothelial carcinoma. Preoperative computed tomography or magnetic resonance imaging was also used to determine the presence of muscle invasion and lymph node metastasis.

Inclusion criteria

The inclusion criteria were a primary bladder tumor histologically confirmed to be an urothelial carcinoma, either a solitary tumor or two to three multiple tumors, tumor size of ≤7 cm, and radiographic tumor stage of ≤T2.

Exclusion criteria

The exclusion criteria were postoperative recurrence of a bladder tumor, the presence of more than three multiple tumors, tumor size of >7 cm, radiographic tumor stage of >T2, location of tumor in the anterior wall or neck of the bladder, and presence of lymph node metastasis or distant metastasis as determined during radiographic tumor staging.

Surgical procedure

The present study included 63 patients who underwent minilaparoscopy-assisted en bloc TURBT by experienced urologists in our department. The minilaparoscopy instrument was used in all cases (Stryker, Kalamazoo, MI, US). The patients underwent general anesthesia and peridural block in the lithotomy position. Saline solution was used as the washing fluid. The size, location, and shape of the bladder tumor and the position of the bilateral ureters were observed using a resectoscope. A plasmakinetic resection system was used (model 744000; Gyrus, Cardiff, UK) and was set at 160 W for cutting and 80 W for coagulation. At the beginning, surgeons first identified and demarcated the bladder tumor, and then made some small marks circumferentially with a loop electrode in the normal-appearing urothelium at least 1 to 2 cm from the edges of the lesion. Eventually, a circumscribed incision was made to connect the marks [2]. After that, the mini-

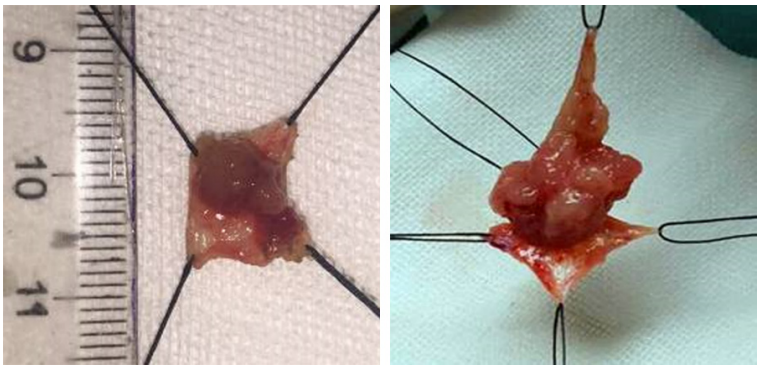

Figure 3. Resected Specimens were immediately stretched and fixed on a flat gauze before fixed in formalin. Integrity of the papillary tumor and the surrounding normal urothelial carcinoma were observed.

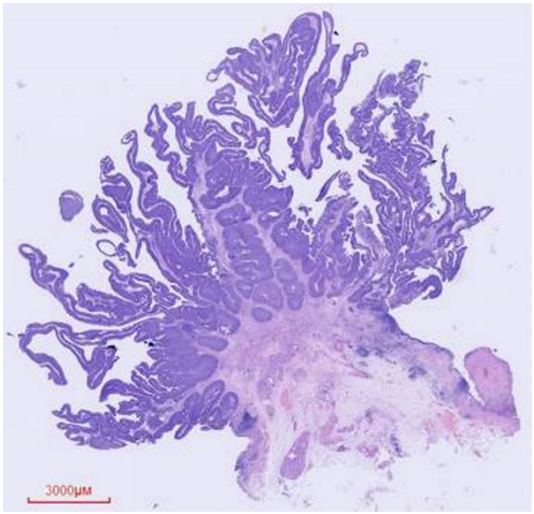

Figure 4. The largest section of the tumor along the longitudinal section, and the nodular tumor section was observed under a microscope at low magnification.

laparoscopy instrument was placed into the bladder cavity from the puncture point, which was located on the ventral midline, two horizontal finger-widths in the suprapubic direction (**Figure 1**). The bladder tumor was then clamped, lifted, and dissected through the superficial muscular layer under the circumferentially incised area. Therefore, the lesion was removed with the surrounding normal tissues [2]. The superficial muscularis propria was included in this procedure. Coagulation was used to achieve complete hemostasis. Random biopsies of the basal layer were performed. Finally, clotting of the surgical site was ensured to the satisfaction of the surgeon. A three-way urethral catheter was placed with continuous-flow irrigation of 0.9% saline. The en bloc resected bladder tumor was sent for histopathologic examination (**Figure 2**).

Postoperative treatment

Postoperative adjuvant intravesical chemotherapy with pirarubicin or epirubicin or bacillus Calmette-Guerin was administered immediately after surgery based on the risk group and tumor stage, then once weekly for 8 weeks, and once monthly thereafter. An indwelling Foley urethral catheter was placed immediately after the operation and left in place for 2 to 4 days. Bladder irrigation was performed for 1 day.

Results

A total of 63 eligible patients underwent en bloc TURBT. The mean operative time was 39.8 ± 23.7 minutes (range, 11-75 min). Intraoperative bleeding was rare, and no ONR occurred intraoperatively. No patients developed secondary hematuria, bladder hematorrhea, or bladder perforation postoperatively. The mean hospital stay was 4.7 ± 1.7 days. The mean catheterization time was 3.4 ± 1.7 days. The mean duration of postoperative bladder irrigation was 1 day. Postoperative pathological evaluation was performed by two senior pathologists of our hospital. The tumor specimen was sectioned along with the maximum longitudinal surface (**Figures 3**-**5**). Tumors were classified according to the TNM system of the Union Internationale Contre le Cancer (UICC) updated in 2002 [9] (**Table 1**). The depth of invasion and stage were accurately determined in all sections.

Discussion

Internationally, tumor resection is divided into three categories according to the condition of the resection margin: R0 (microscopic confirmation of no tumor cells), R1 (inability to observe residual tumor with the naked eye but microscopic confirmation of residual tumor cells in the resection margin), and R2 (ability to observe residual tumor cells with the naked eye). En bloc TURBT with negative margins (R0 resection) conforms to the principle of tumor-

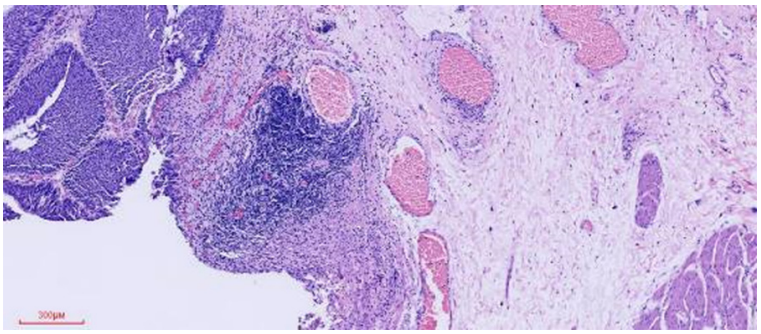

Figure 5. Tumor morphology and infiltration were observed under the microscope at high magnification. Low-grade urothelial malignance was observed in muscular layer without infiltration.

Table 1. Postoperative pathological results.

	N	%
Tumor stage		
pTa	30	47.6
pT1	33	52.4
Histological grade		
Low	45	71.4
High	18	28.6

free technique for avoidance of tumor metastasis and implantation. Therefore, en bloc TURBT allows for accurate tumor staging and classification, which facilitates appropriate treatment modalities and follow-up. For example, secondary TURBT or radical cystectomy depends on accurate clinical pathological evidence provided by en bloc-resected specimens [1, 10]. Thus, use of a tumor-free technique should be ensured during resection. During conventional TURBT, tumor tissues are often resected in small pieces for purpose of extirpating the tumor from the bladder. To enable this procedure, the bladder is continuously irrigated with 0.9% saline. A large amount of eschar is produced during resection and coagulation procedure, which is why the muscular layer is always missing or indistinguishable during conventional TURBT [11]. As a result, the initial tumor biological data are missing, which may increase the difficulty of accurately determining the tumor stage and whether R0 resection has been achieved. Also during conventional TURBT, particularly when performing the divisional resection, the tumor tissue is compressed and divided into small pieces, which may increase the risk of implantation metastasis on the bladder wall [12]. Consequently, a distinct margin of muscularis propria under the tumor base is needed to accurately determine the clinical stage and depth of invasion [2]. In the present study, we performed minilaparoscopy-assisted en bloc TURBT in 63 patients. MiniLap Instruments (Stryker) are minilaparoscopy instruments that were initially designed for percutaneous abdominal puncture (instrument diameter of 2.3 mm), and the ultra-mini and minor trauma design can reduce scar formation. The application of these instruments to en bloc TURBT is feasible and effective based on the surgical principles of en bloc TURBT. These instruments were used to assist the endoscope in pulling and lifting the bottom of the basal aspect of the tumor, which facilitated inspection of the whole contour of the tumor base and performance of the cutting procedure. Moreover, when the bladder is irrigated with 0.9% saline, the saline flow strongly affects the conventional TURBT procedure. For example, the tumor floats on the flowing saline, which increases the difficulty of the fixation procedure. As a result, the resection time is prolonged. In contrast, when the tumor was lifted and fixed by the minilaparoscopy instruments in the present study, the depth of invasion and extent of the tumor were visible and complete resection was achieved despite the saline flow during the irrigation procedure.

During conventional TURBT, an ONR may occur when saline passes through the obturator nerve, leading to sudden muscle contractions. Therefore, general anesthesia and muscle relaxants are often used intraoperatively to avoid this severe complication. Furthermore, the use of drugs increases the burden on the cardiovascular and pulmonary systems. The high rate of postoperative recurrence can be attributed to incomplete resection of the tumor at the basal layer [13, 14]. No ONR occurred during the en bloc TURBT procedure in the present study because our technique greatly enhances safety by inflicting minimal damage to the bladder wall. Postoperatively, the incisions recovered rapidly because the wound surface was protected well. Postoperative com-

plications, including urinary leakage and bladder diverticulum formation, were rare [15].

Few studies from Western countries have been performed to evaluate en bloc TURBT. The efficacy and feasibility of en bloc TURBT are still controversial [16-18]. A few centers in China have reported the use of en bloc techniques [19-21]. In terms of the indications for en bloc TURBT, the tumor size and presence of multiple tumors are also controversial. The largest bladder tumor successfully resected with en bloc TURBT was reportedly about 7 cm [6, 22]. The tumor size in our study is almost 3-5 cm, which is smaller than reported before. The efficacy and feasibility of monopolar, bipolar and laser resection combined with en bloc technology have been infrequently reported worldwide [6, 23]. Currently the lack of cases and single-center study is a defect of this study, and the feasibility and effectiveness needs long-term effect analysis. The follow-up will also include more cases in the future. And the recurrence rate and treatment effect also need forward analysis. Additionally, the optimal distance between the circumferential safety margin of resection and the target tumor remains controversial. The extent of surgery should be appropriate, and different surgical strategies should be applied to different tumor locations. The efficacy and feasibility of en bloc TURBT applies to tumors located in the front wall, at the bladder neck, and near the urethral orifice are unclear because of the lack of experience and systematic research [16, 24]. When minilaparoscopy instruments are used for suprapubic bladder puncture, a further major concern during the minilaparoscopy-assisted TURBT is the possibility of extraperitoneal tumor cell dissemination. That is controversy within our group, bladder cancer seeding may potentially alter the natural course of the disease process. Existing literature supports that bladder perforation during transurethral resection has only a slight chance of extraperitoneal recurrence [25-27], but the number of study and cases reported were limited, also lack of long-term follow-up data. When the minilaparoscopy instruments were withdrawn from the bladder in the present study, the mucosa of the puncture site was coagulated to close the needle canal. However, long-term follow-up should be performed and new strategies should be explored to avoid the occurrence of implantation metastasis.

In conclusion, minilaparoscopy-assisted en bloc TURBT is feasible, safe, and effective, particularly for obtaining sufficient tissue for pathologic evaluation. This technique also effectively reduces the ONR with minimal trauma and few complications. Positive margins are avoided.

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Disclosure of conflict of interest

None.

Address correspondence to: Dr. Yong Wei, Department of Urology, The First Affiliated Hospital of Fujian Medical University, 20 Chazhong Road, Fuzhou 350005, China. Tel: +86-59187981687; E-mail: weiyong2017@fjmu.edu.cn

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