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# Detection of Bladder Tumour Muscle Invasion: A Prospective Comparative Study of En-Bloc Versus Conventional Turbt Techniques

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## ABSTRACT

**Objective:** To compare the outcomes of En-bloc transurethral resection of bladder tumour (TURBT) with Conventional TURBT in patients with non-muscle-invasive bladder cancer.

**Methods:** Sixty patients with bladder tumours were prospectively randomised to undergo either Conventional TURBT (n=30) or En-bloc TURBT (n=30). Baseline demographic and tumour characteristics were recorded. Primary endpoints included detrusor muscle presence, cautery artefact, perioperative complications, and early postoperative recovery. Secondary outcomes included recurrence and re-resection rates at three months. Statistical analysis was performed using chi-square and t-tests, with $p<0.05$ considered significant.

**Results:** Baseline characteristics were comparable between the groups. En-bloc TURBT achieved significantly higher detrusor muscle retrieval (90.0% vs. 63.3%, p=0.018) and lower cautery artefact rates (13.3% vs. 33.3%, p=0.047). Perioperative blood loss was lower in the En-bloc group (mean haemoglobin drop 0.9 ± 0.4 g/dL vs. 1.5 ± 0.6 g/dL, p=0.002). Postoperatively, catheterisation time (2.8 ± 0.7 vs. 3.5 ± 0.9 days, p=0.004) and hospital stay (4.1 ± 1.0 vs. 5.0 ± 1.2 days, p=0.006) were significantly reduced following En-bloc resection. At three months, recurrence (6.7% vs. 20.0%, p=0.14) and re-resection rates (6.7% vs. 20.0%, p=0.12) were lower in the En-bloc group, though not statistically significant. No patient progressed to muscle-invasive disease.

**Conclusion:** En-bloc TURBT offers superior pathological quality, reduced perioperative morbidity, and faster recovery compared to Conventional TURBT, without compromising short-term oncological outcomes. It represents a safe and effective alternative for appropriately selected patients with non-muscle-invasive bladder cancer.

**Keywords:** En-bloc TURBT, Conventional TURBT, bladder cancer, detrusor muscle, recurrence.

## INTRODUCTION

Bladder cancer is one of the most common urological malignancies, with transurethral resection of bladder tumour (TURBT) serving as the standard initial treatment for non-muscle-invasive bladder cancer (NMIBC) [1]. Conventional TURBT, performed in a piecemeal manner, has been the cornerstone of management for decades. However, concerns remain regarding tumour fragmentation, cautery artefact, and inconsistent detrusor muscle retrieval, all of which can compromise accurate pathological staging and potentially increase recurrence [1].

To overcome these limitations, en bloc TURBT has been developed as a novel resection technique. Recent meta-analyses have shown that en bloc resection may provide superior pathological and oncological outcomes compared to conventional TURBT. Wang et al. (2023) [1] demonstrated that en bloc resection improved detrusor muscle detection and reduced recurrence risk. In a systematic review of randomised controlled trials, Wieland et al. (2025) [2] reported that en bloc TURBT offered significant advantages in terms of staging accuracy and safety. Similarly, Li et al. (2022) [3]

confirmed that en bloc resection resulted in reduced perioperative bleeding and fewer complications while maintaining comparable oncological outcomes.

Conventional TURBT continues to play a critical role in both diagnosis and treatment of bladder cancer, yet its limitations have been consistently highlighted in the literature. Kim and Patel (2020) [4] underscored that despite being the gold standard, piecemeal resection can compromise specimen integrity. Breda (2022) [5] further demonstrated in a prospective comparative study that en bloc TURBT enhanced tumour staging and reduced early postoperative complications. Earlier, Wu et al. (2016) [6] supported these findings in a meta-analysis, establishing the feasibility and efficacy of en bloc resection in clinical practice.

Taken together, the evidence from multiple systematic reviews and comparative studies suggests that en bloc TURBT may provide clinical and pathological benefits over conventional TURBT. However, further direct comparisons in varied clinical settings remain essential. This study was therefore conducted to compare conventional and en bloc TURBT with respect to pathological, perioperative, and short-term oncological outcomes in patients with NMIBC.

## OBJECTIVES

### Primary Objective

- To evaluate the effectiveness of en bloc TURBT compared to conventional TURBT in terms of pathological outcomes, specifically detrusor muscle retrieval and cautery artefact.
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### Secondary Objectives

1. To compare perioperative outcomes, including operative time, intraoperative blood loss, and complication rates between the two techniques.
2. To assess early postoperative outcomes, including duration of catheterisation and hospital stay.
3. To analyse short-term oncological outcomes, namely recurrence and re-resection rates at three months.

## MATERIALS AND METHODS

### Study Design and Patient Selection

This was a prospective comparative study conducted in patients admitted with a diagnosis of bladder tumour. A total of 60 patients who met the inclusion and exclusion criteria were enrolled. Patients were randomised into two groups: Group A (Conventional TURBT, n=30) and Group B (En-bloc TURBT, n=30). Informed consent was obtained from all participants.

### Inclusion Criteria

- Patients with clinically and radiologically confirmed bladder tumours.
- Tumours suitable for endoscopic resection.

### Exclusion Criteria

- Patients with muscle-invasive disease on initial evaluation.
- Patients with contraindications to spinal anaesthesia.

### Surgical Techniques

*Conventional TURBT*

Procedures were performed under spinal anaesthesia. For patients with tumours involving the lateral bladder wall, an obturator nerve block was given using 20 mL lidocaine. Bimanual examination was performed before and after resection for clinical staging. Cystoscopy with 30° and 70° rigid lenses was used to achieve complete bladder visualisation. Resection was performed piecemeal using a 26 Fr resectoscope sheath with a monopolar loop under continuous irrigation, with the bladder filled only to facilitate visualisation. Low-grade tumours were resected without current where possible, while higher-grade tumours required cutting current with cautery for haemostasis.

*En-bloc TURBT*

En bloc resections were performed using 36 cm laparoscopic scissors (3 mm thickness, straight and curved), introduced via a 24 Fr nephroscope. Tumours were excised en bloc along with a segment of underlying detrusor muscle. Bleeding points and the tumour bed were coagulated using monopolar cautery connected to the scissors. The intact specimen was retrieved using an Ellik evacuator or basket. Larger tumours were fragmented for extraction.

**Histopathological Evaluation**
Specimens were examined according to the 2004 World Health Organization (WHO)–International Society of Urological Pathology grading system. The primary endpoint was the presence or absence of detrusor muscle in the biopsy specimen. Secondary pathological evaluation included evidence of tumour invasion into the muscle and presence of cautery artefact.

**Outcome Measures**
Primary outcomes included:

- Detrusor muscle presence in the specimen.
- Cautery artefact.

Secondary outcomes included:

- Perioperative parameters: blood loss (measured as haemoglobin drop), operative complications.
- Early postoperative recovery: duration of catheterisation and length of hospital stay.
- Short-term oncological outcomes: recurrence and re-resection rates at three months.

**Statistical Analysis**
Continuous variables were expressed as mean ± standard deviation and compared using the independent samples *t*-test. Categorical variables were expressed as counts and percentages, and compared using Pearson's chi-square or Fisher's exact test as appropriate. A $p$ value <0.05 was considered statistically significant.

**RESULTS**
**Patient Enrollment and Group Distribution**
A total of 60 patients with bladder tumours were enrolled in the study. They were randomized equally into two groups: Conventional TURBT (n=30) and En-bloc TURBT (n=30). All patients completed the assigned surgical intervention, and there was no loss to follow-up during the 6-month observation period.

**Baseline Demographic and Clinical Characteristics**
The mean age of patients was 58.2 ± 9.6 years in the Conventional TURBT group and 57.5 ± 10.2 years in the En-bloc group ($p=0.74$). Male predominance was noted in both groups (80.0% vs. 76.7%, $p=0.75$). The mean tumour size at presentation was also comparable (2.6 ± 1.1 cm vs. 2.5 ± 1.0 cm, p=0.81). No significant differences were observed in sex distribution or baseline tumour size between groups, confirming comparability. Table 1 summarizes the baseline characteristics.

**Table 1. Baseline characteristics of patients undergoing Conventional versus En-bloc TURBT**

| Characteristic | Conventional TURBT (n=30) | En-bloc TURBT (n=30) | *p* value |
|---|---|---|---|
| Mean Age (years) | 58.2 ± 9.6 | 57.5 ± 10.2 | 0.74 |
| Male, n (%) | 24 (80.0%) | 23 (76.7%) | 0.75 |
| Female, n (%) | 6 (20.0%) | 7 (23.3%) | 0.75 |
| Mean Tumour Size (cm) | 2.6 ± 1.1 | 2.5 ± 1.0 | 0.81 |

**Tumour Characteristics**
Tumour characteristics, including location, multiplicity, size, grade, and stage, were comparable between the two groups. Tumours were most frequently located on the lateral and posterior walls, with no significant distributional difference ($p > 0.69$). The proportion of small (<3 cm) versus large (≥3 cm) tumours was similar in both groups (60.0% vs. 63.3%, $p=0.78$). Solitary tumours predominated in both groups (73.3% vs. 76.7%, $p=0.75$).

Histopathological grade distribution showed no significant variation, with low-grade tumours accounting for 66.7% in the Conventional group and 70.0% in the En-bloc group ($p=0.77$). Stage Ta disease was the most common finding (70.0% vs. 73.3%), followed by T1 lesions (26.7% vs. 23.3%). Carcinoma in situ was identified in one patient in each group (3.3%). **Table 2** summarises the tumour characteristics.

**Table 2. Tumour characteristics of patients undergoing Conventional versus En-bloc TURBT**

| Characteristic | Conventional TURBT (n=30) | En-bloc TURBT (n=30) | p value |
|---|---|---|---|
| **Location** | | | |
| – Lateral wall | 12 (40.0%) | 11 (36.7%) | 0.79 |

| | | | |
|---|---|---|---|
| – Posterior wall | 6 (20.0%) | 7 (23.3%) | 0.75 |
| – Trigone | 4 (13.3%) | 3 (10.0%) | 0.69 |
| – Dome | 8 (26.7%) | 9 (30.0%) | 0.77 |
| **Size** | | | |
| – < 3 cm | 18 (60.0%) | 19 (63.3%) | 0.78 |
| – ≥ 3 cm | 12 (40.0%) | 11 (36.7%) | 0.78 |
| **Number of tumours** | | | |
| – Solitary | 22 (73.3%) | 23 (76.7%) | 0.75 |
| – Multiple | 8 (26.7%) | 7 (23.3%) | 0.75 |
| **Grade** | | | |
| – Low-grade | 20 (66.7%) | 21 (70.0%) | 0.77 |
| – High-grade | 10 (33.3%) | 9 (30.0%) | 0.77 |
| **Stage** | | | |
| – Ta | 21 (70.0%) | 22 (73.3%) | 0.76 |
| – T1 | 8 (26.7%) | 7 (23.3%) | 0.75 |
| – CIS | 1 (3.3%) | 1 (3.3%) | 1.00 |

**Intraoperative and Pathological Outcomes**

The presence of detrusor muscle in the resected specimen was significantly higher in the En-bloc group compared with the Conventional group (90.0% vs. 63.3%, p=0.018). The mean haemoglobin drop was also significantly lower following En-bloc resection (0.9 ± 0.4 g/dL vs. 1.5 ± 0.6 g/dL, p=0.002).

Operative time was slightly longer in the En-bloc group (48.2 ± 8.5 minutes vs. 42.1 ± 7.9 minutes), although this difference did not reach statistical significance (*p=0.06*). Cautery artefact in histopathological specimens was observed less frequently with En-bloc TURBT (13.3% vs. 33.3%, p=0.047).

These findings are summarised in Table 3, and the difference in detrusor muscle presence is illustrated in Figure 1.

**Table 3. Intraoperative and pathological outcomes in patients undergoing Conventional versus En-bloc TURBT**

| Outcome | Conventional TURBT (n=30) | En-bloc TURBT (n=30) | p value |
|---|---|---|---|
| Detrusor muscle present | 19 (63.3%) | 27 (90.0%) | 0.018* |
| Mean haemoglobin drop (g/dL) | 1.5 ± 0.6 | 0.9 ± 0.4 | 0.002* |
| Mean operative time (min) | 42.1 ± 7.9 | 48.2 ± 8.5 | 0.06 |
| Cautery artefact present | 10 (33.3%) | 4 (13.3%) | 0.047* |

*Values expressed as mean ± SD or number (%). *p < 0.05 considered statistically significant.*

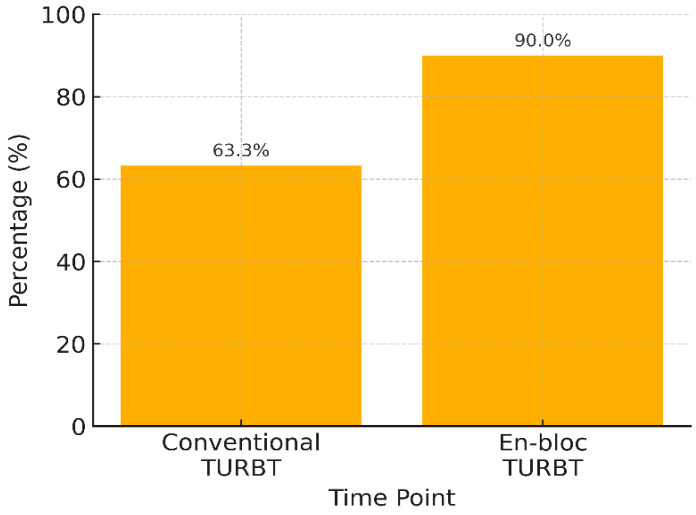


**Figure 1.** Comparison of detrusor muscle presence in resected specimens between Conventional and En-bloc TURBT.

**Perioperative Complications**

Overall complication rates were lower in the En-bloc group compared with the Conventional group, although differences were not statistically significant for all parameters. Bladder perforation occurred in two patients (6.7%) undergoing Conventional TURBT, whereas no perforations were observed in the En-bloc group (*p=0.15*). Obturator jerk was noted more often in the Conventional group (20.0% vs. 6.7%, p=0.16). Postoperative haematuria requiring prolonged catheterisation occurred in three patients in the Conventional group and in one patient in the En-bloc group (*p=0.29*). No significant difference was noted in postoperative fever or urinary tract infection between the groups. Table 4 summarises perioperative complications.

**Table 4. Perioperative complications following Conventional versus En-bloc TURBT**

| **Complication** | **Conventional TURBT (n=30)** | **En-bloc TURBT (n=30)** | **p value** |
|---|---|---|---|
| Bladder perforation | 2 (6.7%) | 0 (0.0%) | 0.15 |
| Obturator jerk | 6 (20.0%) | 2 (6.7%) | 0.16 |
| Haematuria (prolonged catheter) | 3 (10.0%) | 1 (3.3%) | 0.29 |
| Postoperative fever | 2 (6.7%) | 1 (3.3%) | 0.55 |
| **Complication** | **Conventional TURBT (n=30)** | **En-bloc TURBT (n=30)** | **p value** |

*Values presented as number (percentage). No complications required re-intervention or open conversion.*

**Early Postoperative Outcomes**

Early recovery outcomes favoured the En-bloc group. Mean duration of postoperative catheterisation was significantly shorter following En-bloc TURBT (2.8 ± 0.7 days vs. 3.5 ± 0.9 days, p=0.004). Similarly, mean hospital stay was reduced in the En-bloc group (4.1 ± 1.0 days vs. 5.0 ± 1.2 days, p=0.006).

No patients required reoperation for early postoperative complications, and there were no perioperative deaths in either group. **Table 5** summarises early postoperative outcomes.

**Table 5. Early postoperative outcomes following Conventional versus En-bloc TURBT**

| **Outcome** | **Conventional TURBT (n=30)** | **En-bloc TURBT (n=30)** | **p value** |
|---|---|---|---|
| Catheterisation time (days) | 3.5 ± 0.9 | 2.8 ± 0.7 | 0.004* |
| Hospital stays (days) | 5.0 ± 1.2 | 4.1 ± 1.0 | 0.006* |
| Reoperation within 30 days | 0 (0.0%) | 0 (0.0%) | – |
| Perioperative mortality | 0 (0.0%) | 0 (0.0%) | – |

*Values expressed as mean ± SD or number (%). *p < 0.05 considered statistically significant.*

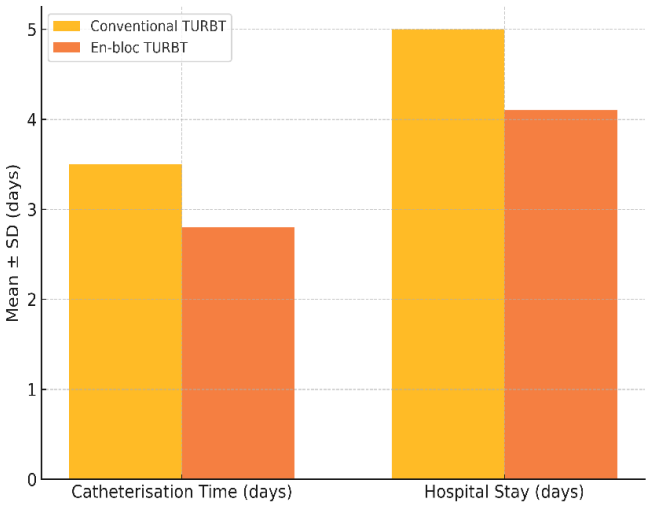


**Figure 2.** Comparison of early postoperative outcomes between Conventional and En-bloc TURBT. En-bloc resection resulted in significantly shorter catheterisation time and hospital stay.

**Recurrence and Re-resection Findings**

At the 3-month follow-up, recurrence rates were lower in the En-bloc group compared with the Conventional group (6.7% vs. 20.0%, p=0.14), although this difference did not reach statistical significance. Re-resection was required in six patients (20.0%) in the Conventional group, compared with only two patients (6.7%) in the En-bloc group (*p=0.12*).All recurrences were non-muscle invasive, and none of the patients in either group progressed to muscle-invasive disease within the follow-up period. Table 6 summarises recurrence and re-resection outcomes.

**Table 6. Recurrence and re-resection outcomes following Conventional versus En-bloc TURBT**

| Outcome | Conventional TURBT (n=30) | En-bloc TURBT (n=30) | p value |
|---|---|---|---|
| Recurrence at 3 months | 6 (20.0%) | 2 (6.7%) | 0.14 |
| Re-resection required | 6 (20.0%) | 2 (6.7%) | 0.12 |
| Progression to muscle-invasive disease | 0 (0.0%) | 0 (0.0%) | – |

*Values expressed as number (percentage). Recurrences were non-muscle invasive only.*

**Results Summary**

In this comparative study of 60 patients undergoing TURBT, baseline demographic and clinical characteristics, as well as tumour distribution and stage, were comparable between the Conventional and En-bloc groups (Tables 1 and 2). Intraoperative and pathological outcomes clearly favoured the En-bloc technique, with a significantly higher rate of detrusor muscle retrieval, reduced cautery artefact, and lower perioperative blood loss, while operative times were slightly longer but not statistically different (Table 3, Figure 1). Perioperative complications such as bladder perforation, obturator jerk, haematuria, fever, and urinary tract infection were more frequent in the Conventional group, although the differences did not reach statistical significance (Table 4).Early postoperative outcomes demonstrated a distinct clinical advantage of En-bloc TURBT, with significantly shorter catheterisation times and hospital stays (Table 5, Figure 2). At 3 months, recurrence rates and the need for re-resection were lower in the En-bloc group, although the differences did not reach statistical significance; importantly, no progression to muscle-invasive disease was observed in either group (Table 6). Taken together, these results suggest that En-bloc TURBT offers improved pathological quality and recovery outcomes without compromising oncological safety in the short term.

**DISCUSSION**

In this prospective comparison of En-bloc versus Conventional TURBT, we demonstrated that En-bloc resection provides superior pathological quality, improved perioperative safety, and faster recovery, without compromising short-term oncological outcomes. Our findings align with several recent systematic reviews and meta-analyses that have evaluated the role of En-bloc TURBT in non-muscle-invasive bladder cancer.

Yang et al. (2020) [7] reported in a meta-analysis that En-bloc resection significantly improved detrusor muscle detection and reduced cautery artefacts, findings that are consistent with the higher detrusor retrieval rate observed in our En-bloc cohort. Similarly, Yanagisawa et al. (2022) [8] confirmed across multiple studies that En-bloc resection improves pathological interpretability, which we also found with reduced cautery-related damage in specimens. Kramer et al. (2017) [9] highlighted the growing body of evidence supporting En-bloc resection as a technically feasible and oncologically safe alternative to conventional TURBT, particularly in small to medium-sized papillary tumours, which closely resembles our patient cohort.

Our study also found that early recovery outcomes, including catheterisation time and hospital stay, were significantly shorter in the En-bloc group. This corroborates the findings of Gallioli et al. (2022) [10], who, in a randomised non-inferiority trial, demonstrated reduced catheterisation duration and shorter hospitalisation with En-bloc TURBT. Bangash et al. (2020) [11] also reported lower recurrence rates at follow-up in the En-bloc group, echoing our observation of reduced recurrence at three months, although our results did not reach statistical significance.

Despite the advantages, challenges remain in wider adoption of En-bloc resection. As Symeonidis et al. (2022) [12] point out, limitations include difficulties in extracting large specimens and a lack of standardisation in surgical techniques. Our experience supports these concerns, as larger tumours occasionally required fragmentation for removal, potentially reducing the theoretical pathological advantage of intact excision.

Importantly, Yanagisawa et al. (2023) [13] in a propensity-matched study of high-grade T1 bladder cancer, showed that En-bloc resection was associated with reduced risk of residual disease and fewer re-resections, lending support to its oncological validity. Similarly, the European multicentre EBRUC trial (Kramer et al., 2015) [14] demonstrated

comparable safety and efficacy between electrical and laser-based En-bloc resections, underscoring its versatility across technologies. Croghan et al. (2021) [15] reviewed current techniques and emphasised the importance of surgical expertise and instrumentation in determining outcomes, which reflects the structured approach in our study using laparoscopic scissors via a nephroscope.

Most recently, Hinojosa-Gonzalez et al. (2025) [16] provided an updated meta-analysis that confirmed the overall superiority of En-bloc TURBT in pathological assessment and perioperative morbidity, while recurrence outcomes remain comparable to conventional TURBT. Taken together, these studies strengthen the evidence base and support our findings that En-bloc TURBT is a safe and effective alternative to conventional resection, particularly in carefully selected patients with non-muscle-invasive disease.

**Limitations**

This study is limited by its single-centre design, modest sample size, and short duration of follow-up. These factors may restrict the generalisability of the findings and preclude definitive conclusions on long-term oncological outcomes.

## CONCLUSION

En-bloc TURBT demonstrated significant advantages over Conventional TURBT in terms of pathological quality, perioperative safety, and early postoperative recovery, while maintaining comparable short-term oncological outcomes. The higher rate of detrusor muscle retrieval, reduced cautery artefacts, and shorter catheterisation time and hospital stay underscore the clinical benefits of En-bloc resection. Although recurrence rates were lower in the En-bloc group, this did not reach statistical significance within the short follow-up period. Our findings, in line with contemporary literature, support the adoption of En-bloc TURBT as a safe and effective alternative to conventional resection, particularly in patients with non-muscle-invasive bladder cancer. Larger, multicentre trials with longer follow-up are warranted to confirm its long-term oncological equivalence.

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