

Pathology-linked administrative data reveal bladder cancer natural history and contemporary care: a longitudinal population-based study in Ontario

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Key Takeaway



NMIBC is associated with substantial procedural burden and ongoing surveillance/interventions; this has meaningful impacts for patients and contributes to high costs for healthcare systems

Conclusions & Future Directions



Manual abstraction of pathology reports linked with administrative databases allow for robust population-based analyses that overcome limitations in registry and single-centre studies



Future studies, leveraging large language model (LLM)-enhanced abstraction, will expand this work to include 136,699 bladder cancer procedures. This will allow for novel, generalizable population-based insights into bladder cancer management including longitudinal assessment of pathology¹



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Introduction

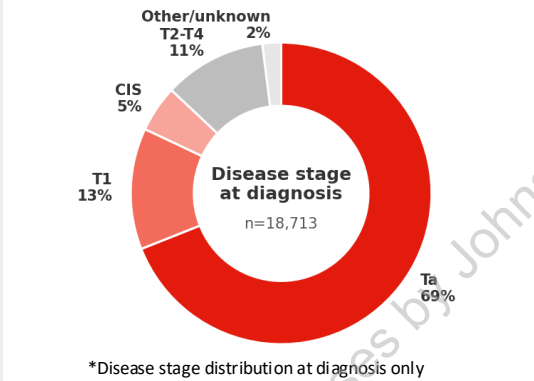
- Bladder cancer is well-recognized as a high-cost tumor site, largely due to repeated recurrences and the need for intensive surveillance as well as intervention
- Understanding the natural history of bladder cancer and current management is key for integration of novel treatments
- Addressing limitations of registry-based and single center/collaborative studies, we evaluated disease characteristics and treatments in a novel pathology-verified population-based dataset in Ontario, Canada

Results

Patient Demographics and Clinical Characteristics

- Among 43,534 pathology reports abstracted on bladder cancer procedures, 18,713 newly diagnosed bladder cancer patients were identified
- Median age was 72 years (IQR 63-79) (Table 1)
- 75.4% were male, consistent across NMIBC (75.7%) and MIBC (72.5%) (Table 1)
- At diagnosis, 87% had NMIBC (69% Ta, 13% T1, 5% CIS), 11% T2-T4 (Figure 1)
- Histological subtypes were identified in 6.6% of cases and were more frequently observed in MIBC than NMIBC (24.1% vs 4.6%)

Figure 1. Disease stage at diagnosis*



*Disease stage distribution at diagnosis only

Table 2. NMIBC Treatment Patterns

	Total n=18,713	NMIBC		
		Low Risk n=8,027	Intermediate Risk n=3,788	High Risk n=4,349
Median follow-up (IQR), years	9.4 (3.7-12.2)	10.1 (6.4-12.4)	9.7 (5.1-12.2)	8.3 (2.9-12.3)
Re-resection between 2-10 weeks following the initial TURBT	1,573 (8.4%)	239 (3.0%)	312 (8.2%)	829 (19.1%)
Subsequent 2 nd TURBT (>=10 weeks after the initial TURBT)	10,257 (54.8%)	4,453 (55.5%)	2,422 (63.9%)	2,781 (63.9%)
Time from the initial to the 2 nd TURBT among those with subsequent TURBT, median (IQR), months	9.6 (4.9-25.0)	13.3 (6.0-34.5)	8.8 (4.9-22.2)	7.0 (4.4-15.2)
Number of Subsequent TURBTs, median (IQR)	2 (1-4)	2 (1-5)	2 (1-5)	2 (1-4)
Number of Subsequent TURBTs, mean (SD)	3.6 (4.0)	3.8 (4.1)	3.6 (3.9)	3.5 (3.8)
Radical Cystectomy (RC) at any point following diagnosis (n)	4.2% (795)	1.6% (130)	3.6% (136)	7.0% (304)
Median (IQR), (from initial TURBT to the RC) among those with RC, months	15.6 (3.3-62.5)	69.8 (31.1-106.0)	34.8 (15.3-76.4)	19.7 (4.9-59.4)

*Intermediate risk defined as recurrent multifocal and/or large (>3 cm) LG Ta or primary solitary and small (<3cm) HG Ta as per CUA/EAU guidelines. Where tumor size was missing, LG Ta were classified as low risk and HG Ta were classified as high risk. Abbreviations: HG, high grade; HR, High risk; IQR, interquartile range; IR, Intermediate risk; LG, low grade; LR, Low risk; MIBC, Muscle invasive bladder cancer; NMIBC, Non-muscle invasive bladder cancer; RC, Radical cystectomy; SD, standard deviation; TURBT, Transurethral resection of bladder tumor

Reference

1. Initial validation of an automated large language model pipeline for population-scale extraction of bladder pathology reports. UT, Nguyen DQ, Kwong JCC, Chenuvathur J, Ibraj Z, Hickey E, Farcas M, Wettstein M, Wallis CJD, Kulkarni GS. J Urol. 2026 (in press)

Methods

Study Design

- Pathology reports from the Ontario Cancer Registry were abstracted and linked to a provincial administrative database (IC/ES)
- Pathology reports for bladder cancer were abstracted on procedures performed between JAN 1, 2001 – DEC 31, 2022
- This analysis focused on the results from the initial diagnostic procedure. Data from subsequent procedures will be presented in future

Patient Selection

- Adult patients (aged ≥18 years) with a bladder cancer diagnosis
- Patients were followed up from their index date up to DEC 31, 2024
- Both NMIBC and MIBC patients were included

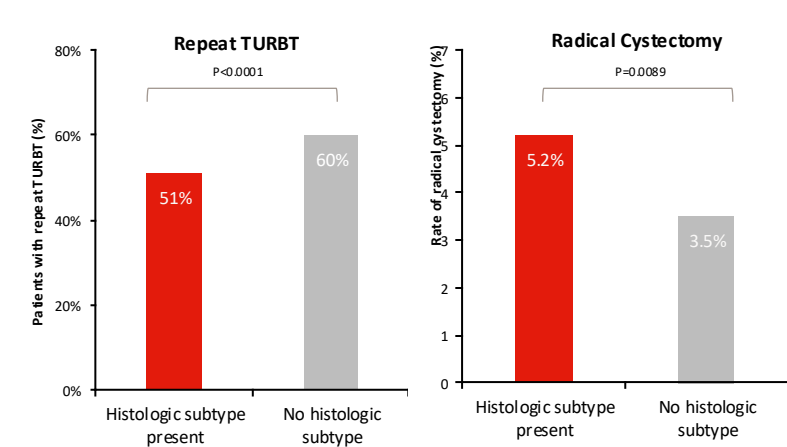
Table 1. Baseline demographic characteristics at diagnosis

Characteristics		Total n=18,713	NMIBC					MIBC n=1,994
			Low Risk n=8,027	Intermediate Risk* n=3,788	High Risk n=4,349	Unknown Risk n=555	Total NMIBC n=16,719	
Age at diagnosis	Median	72.0 (63.0-79.0)	71.0 (62.0-78.0)	72.0 (63.0-80.0)	73.0 (64.0-80.0)	73.0 (65.0-80.0)	72.0 (63.0-79.0)	74.0 (65.0-80.0)
Year of diagnosis	2000-2011	9,348 (50.0%)	3,199 (39.9%)	1,491 (39.4%)	2,835 (65.2%)	456 (82.2%)	7,981 (47.7%)	1,367 (68.6%)
	2012-2022	9,365 (50.0%)	4,828 (60.1%)	2,297 (60.6%)	1,514 (34.8%)	99 (17.8%)	8,738 (52.3%)	627 (31.4%)
Gender	Female	4,611 (24.6%)	2,173 (27.1%)	836 (22.1%)	885 (20.3%)	169 (30.5%)	4,063 (24.3%)	548 (27.5%)
	Male	14,102 (75.4%)	5,854 (72.9%)	2,952 (77.9%)	3,464 (79.7%)	386 (69.5%)	12,656 (75.7%)	1,446 (72.5%)
Residence	Urban	16,477 (88.1%)	7,091 (88.3%)	3,337 (88.1%)	3,838 (88.3%)	499 (89.9%)	14,765 (88.3%)	1,712 (85.9%)
	Rural	2,236 (11.9%)	936 (11.7%)	451 (11.9%)	511 (11.7%)	56 (10.1%)	1,954 (11.7%)	282 (14.1%)

NMIBC Patient Treatment Patterns

- Among NMIBC, 48% were low-risk (LR), 23% intermediate risk (IR), and 26% high-risk (HR) at initial TURBT (Table 2)
- 26% of patients with T1 disease underwent re-resection within 2-10 weeks after initial TURBT
 - Higher re-resection rates when muscle was not sampled initially (28% vs 26%, p=0.0019)
- Over a median follow-up of 9.4 years, patients underwent a median of 2 (IQR 1-5) subsequent TURBTs (Table 2)
 - Median time to first subsequent TURBT decreased with increasing risk: 13.3 month (LR), 8.8 months (IR) and 7.0 months (HR)
- The rate of radical cystectomy (RC) at any point during follow-up was 4.2% and increased with disease risk at initial diagnosis: 1.6% (LR), 3.6% (IR) and 7.0% (HR) (Table 2)
 - Corresponding median times were 69.8 months (LR), 34.8 months (IR), 19.7 months (HR)
- Patients with variant histology were less likely to undergo repeat TURBT (re-resection 2-10 weeks following diagnosis) (51% vs 60%; p<0.001) but more likely to undergo RC (5.2% vs 3.5%; p=0.0089) (Figure 2)

Figure 2. NMIBC treatment patterns by histologic subtype



UROTHELIAL CANCER

