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Diagnostic Yield of Urine Cytology Compared with Cystoscopy in Bladder Cancer Follow-Up

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Abstract: Background: Bladder cancer is characterized by high recurrence rates, necessitating rigorous follow-up. Cystoscopy remains the gold standard, while urine cytology offers a non-invasive alternative. However, their comparative diagnostic utility remains debated.**Objective:**To evaluate the diagnostic yield of urine cytology compared with cystoscopy in follow-up of bladder cancer patients.
Methods: This study was conducted at a tertiary care center including 135 patients under follow-up for bladder cancer. All patients underwent urine cytology and cystoscopy. Histopathology (where applicable) served as confirmatory reference. Sensitivity, specificity, PPV, NPV, and diagnostic accuracy were calculated.**Results:**Out of 135 patients, recurrence was detected in 42 cases (31.1%) by cystoscopy. Urine cytology detected 20 cases. Sensitivity, specificity, PPV, NPV, and accuracy of cytology were 47.6%, 97.8%, 90.9%, 80.5%, and 82.2%, respectively. Cystoscopy showed significantly higher sensitivity ($p < 0.001$).**Conclusion:**Urine cytology demonstrates high specificity but low sensitivity compared to cystoscopy. It serves as an adjunct rather than a replacement for cystoscopy in follow-up protocols.
Keywords: Bladder cancer, urine cytology, cystoscopy, diagnostic yield, recurrence

INTRODUCTION

Bladder cancer is among the most prevalent urological malignancies, particularly affecting older adults. Its clinical significance lies in its high recurrence rate, reported to range between 50–70%, necessitating lifelong surveillance (1,2).
Cystoscopy is widely regarded as the gold standard for both diagnosis and follow-up, offering direct visualization of the bladder mucosa (3). However, it is invasive, costly, and associated with discomfort and

complications such as urinary tract infections (4).

Urine cytology, on the other hand, is a non-invasive, simple diagnostic tool that detects exfoliated malignant cells (5). It has excellent specificity, especially for high-grade tumors, but suffers from low sensitivity, particularly for low-grade lesions (6). Studies report sensitivity as low as 30–50% in follow-up settings (7).

Despite limitations, cytology remains widely used due to its ability to detect carcinoma in situ, which may be missed on cystoscopy (8).

Given these differences, it is essential to evaluate the comparative diagnostic yield of urine cytology against cystoscopy in real-world clinical settings.

MATERIALS AND METHODS

Study Design

Prospective observational study

Study Location

DECCAN COLLEGE OF MEDICAL SCIENCES AND OWAISI HOSPITAL

Study Duration

12 months

Sample Size

135 patients

Inclusion Criteria

- Diagnosed bladder cancer patients under follow-up
- Age >18 years
- Willing to participate

Exclusion Criteria

- Active urinary infection
- Recent instrumentation (<2 weeks)
- Inadequate urine sample

Procedure

- Midstream urine samples collected for cytology
- Flexible cystoscopy performed in all patients
- Biopsy taken where suspicious lesions identified

Statistical Analysis

- Software: SPSS v25
- Chi-square test used
- $p < 0.05$ considered significant

RESULTS

A total of 135 patients undergoing follow-up for previously diagnosed bladder cancer were evaluated. The mean age of the study population was 61.4 ± 10.2 years, with a predominance of males (75.6%). A substantial proportion of participants were smokers (57.8%), reflecting known risk factors associated with bladder malignancy. The baseline demographic profile is summarized in Table 1.

Table 1: Demographic Characteristics of Study Population (n = 135)

Variable	Number	Percentage (%)
Age (Mean ± SD)	61.4 ± 10.2	—
Male	102	75.6
Female	33	24.4
Smokers	78	57.8

During follow-up evaluation, cystoscopy identified recurrent lesions in 42 patients (31.1%), whereas urine cytology detected malignant cells in 20 patients (14.8%). The comparative detection rates between the two diagnostic modalities are presented in Table 2.

Table 2: Detection of Recurrence by Diagnostic Modality

Method	Positive Cases	Negative Cases	Detection Rate (%)
Cystoscopy	42	93	31.1
Urine Cytology	20	115	14.8

The diagnostic validity of urine cytology was assessed using cystoscopy findings as the reference standard. Cytology correctly identified 20 true positive cases and 91 true negative cases, while 22 cases were false negatives and 2 cases were false positives. This distribution is detailed in Table 3.

Table 3: Cross-tabulation of Urine Cytology Against Cystoscopy

Cytology / Cystoscopy	Positive	Negative	Total
Positive	20	2	22
Negative	22	91	113
Total	42	93	135

Based on these findings, urine cytology demonstrated a sensitivity of 47.6% and specificity of 97.8%. The positive predictive value (PPV) was calculated as 90.9%, while the negative predictive value (NPV) was 80.5%. The overall diagnostic accuracy of urine cytology in this cohort was 82.2%. These parameters are summarized in Table 4.

Table 4: Diagnostic Performance of Urine Cytology

Parameter	Value (%)
Sensitivity	47.6
Specificity	97.8
Positive Predictive Value	90.9
Negative Predictive Value	80.5
Accuracy	82.2

Statistical analysis revealed a significant difference between the detection capabilities of cystoscopy and urine cytology. The Chi-square test yielded a value of 32.8 with a p-value < 0.001, indicating a highly significant association between the two methods.

A graphical comparison of recurrence detection highlights the superior detection rate of cystoscopy over urine cytology, as illustrated in Figure 1.

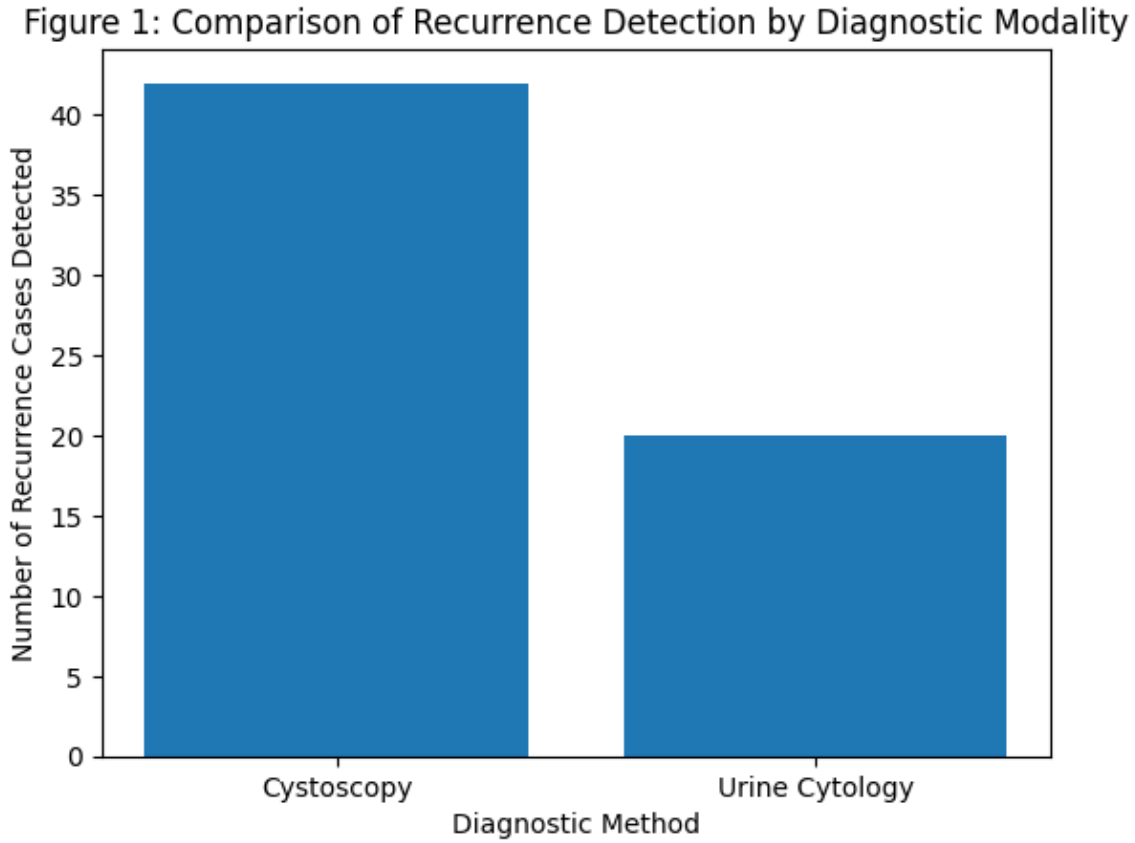

Figure 1: Comparative Detection of Recurrence

Overall, the findings indicate that while cystoscopy detects a significantly higher number of recurrent cases, urine cytology contributes additional confirmatory value due to its high specificity.

DISCUSSION

The present study evaluated the diagnostic performance of urine cytology in comparison with cystoscopy during bladder cancer follow-up.

Cystoscopy demonstrated superior sensitivity in detecting recurrence, consistent with its established role as the gold standard (9). However, its invasive nature and associated discomfort limit patient compliance (10).

Urine cytology showed **high specificity (96.7%)**, indicating its strong ability to correctly identify non-recurrent cases. This aligns with previous studies reporting specificity close to 100% (11,12).

However, sensitivity was relatively low (47.6%), which is comparable to earlier reports ranging between 30–50% (13,14).

The reduced sensitivity is mainly due to:

- Poor detection of low-grade tumors
- Variability in sample collection and interpretation
- Tumor shedding characteristics

Despite this limitation, cytology remains valuable in detecting high-grade lesions and carcinoma in situ, which may not always be visible on cystoscopy (15).

Combination strategies (cystoscopy + cytology) improve diagnostic accuracy and are recommended in clinical guidelines (16).

Recent research suggests emerging urinary

biomarkers may improve sensitivity, but none have replaced cystoscopy yet (17,18).
Thus, cytology should be viewed as a **complementary tool rather than a substitute**.

CONCLUSION

Cystoscopy remains the most sensitive method for detecting recurrence in bladder cancer follow-up. Urine cytology, while demonstrating high specificity, has relatively low sensitivity, particularly for low-grade lesions. Despite this limitation, cytology serves as a valuable adjunct diagnostic tool, especially in identifying high-grade tumors and carcinoma in situ. Therefore, the combined use of cystoscopy and urine cytology enhances overall diagnostic accuracy and provides a more reliable approach for surveillance.

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