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# Evaluation of the Relationship between Bladder Wall Thickness and Pathological Findings in Patients with Hematuria

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## ABSTRACT

**Objective:** This study aimed to evaluate the relationship between bladder wall thickness (BWT), measured via ultrasonography, and histopathological findings in patients presenting with hematuria, and to determine the predictive value of BWT for urothelial malignancy.

**Methods:** Patients diagnosed with hematuria and who underwent bladder biopsy between January 2010 and June 2023 were retrospectively analyzed. Patients were categorized into benign and malignant pathology groups. Demographic data, BWT measurements, and biopsy results were compared.

**Results:** Benign pathology was detected in 86.8% and urothelial carcinoma in 13.2% of 175 patients. The malignant group was older (median 67.0 vs. 44.5 years; $p<0.001$) and had a higher proportion of males compared to the non-malignant group ($p=0.002$). No significant difference in BWT was observed between the groups ($p=0.132$).

**Conclusion:** Although increased BWT may indicate an underlying pathological process in patients with hematuria, it is not sufficient alone to predict malignancy. BWT should be assessed alongside clinical evaluation and advanced diagnostic methods.

**Keywords:** Bladder cancer, bladder wall thickness, biopsy, chronic cystitis, hematuria

## INTRODUCTION

Hematuria is a prevalent symptom of both urological and nephrological disorders, with a prevalence ranging from 2.5% to 20% in the general population (1). In normal urine, fewer than three red blood cells per high-power field are expected, and any value exceeding this threshold is classified as hematuria. This condition is indicative of a range of benign and malignant diseases affecting the urinary system, necessitating a comprehensive investigation for accurate diagnosis and management. Hematuria has a wide spectrum of etiologies. The urological causes include urinary tract infections, nephrolithiasis, trauma, benign prostatic hyperplasia, and urothelial malignancies (2). Nephrological hematuria is associated with glomerular damage, vascular diseases, and inflammatory kidney disorders (3). Patients presenting with macroscopic hematuria are at an elevated risk of malignancy, making prompt and effective evaluation imperative (4). Various diagnostic methods have been used to assess hematuria. The dipstick test, commonly used in the initial phase, is favored for its rapid and straightforward application. However, it may produce false-positive results owing to the presence of free hemoglobin or myoglobin in the urine. Consequently, microscopic examination and additional laboratory tests are recommended to confirm hematuria (5). Ultrasonography (USG) is a critical imaging modality for the evaluation of patients with hematuria. The measurement of bladder wall thickness (BWT) can yield valuable insights into differentiating between benign and malignant pathologies. An increase in BWT is typically associated with chronic inflammatory processes and bladder outlet obstruction, whereas a thinner bladder wall structure is observed in malignancies (6,7). Nonetheless, studies exploring the relationship between BWT and pathological findings are limited. This study examined the relationship between BWT measured using ultrasound and pathological findings obtained from biopsy in patients presenting with hematuria. This study aimed to ascertain whether BWT serves as a predictive parameter for urothelial malignancies and other benign pathologies, thereby contributing to the clinical management of patients with hematuria.

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## METHODS

This study was approved by the local Ethics Committee of Hisar Intercontinental Hospital (decision no: 25-26, date: 28.02.2025). This study involved a retrospective analysis of patients who presented to the urology outpatient clinic with various symptoms between January 2010 and June 2023, and were diagnosed with hematuria during their evaluations. Cystoscopy and bladder biopsy results of these patients were reviewed. Patients who were diagnosed with hematuria and subsequently underwent bladder biopsy were included in the study. A comprehensive retrospective analysis of clinical and laboratory data was performed. The exclusion criteria were as follows: a history of urinary tract infection, presence of proteinuria, use of aspirin or other anticoagulants (e.g., warfarin), detection of suspicious or malignant cells in urine cytology prior to cystoscopy, presence of lesions causing filling defects in the ureters or bladder, detection of tumors in the upper urinary tract, and incomplete or insufficient patient data.

In the selected cohort, detailed retrospective data extraction was carried out, encompassing demographic characteristics, clinical presentations, and diagnostic work-up findings. Laboratory evaluations included complete blood count, coagulation parameters (international normalized ratio and activated partial thromboplastin time), renal function markers (urea, creatinine, electrolytes), urine cultures, and cytological analysis. USG measurement of BWT was recorded in all patients, while contrast-enhanced computed tomography urography was performed when further evaluation of suspected structural or tumor pathology was warranted.

Cystoscopic examinations were systematically reviewed in conjunction with histopathological analysis of bladder biopsy specimens. The pathological findings were subsequently classified into four main categories: (1) chronic cystitis, (2) squamous metaplasia or dysplasia, (3) urothelial carcinoma (low-grade or high-grade), and (4) other rare entities such as glandular cystitis, eosinophilic cystitis, and papilloma.

### Statistical Analysis

The normality of continuous variables was assessed using the Shapiro-Wilk test. Variables that were not normally distributed were reported as median [interquartile range, (IQR)] and compared between groups using the Mann-Whitney U test. Results were expressed in the tables as median (IQR) format for central tendency and dispersion, and p-value for significance testing. Categorical variables were analyzed using Pearson's chi-square test. In cases where expected cell counts were below 5, Fisher's exact test was used to ensure accurate results. A p-value <0.05 was considered statistically significant for all comparisons. All statistical analyses were performed using IBM SPSS Statistics for Windows, version 23.0 (IBM Corp., Armonk, NY, USA).

## RESULTS

A total of 175 patients diagnosed with hematuria who underwent bladder biopsy were included in the study. Histopathological analysis revealed benign lesions in 86.8% (n=152) of patients and malignant pathology, specifically urothelial carcinoma, in 13.2% (n=23) (Table 1). The most common benign diagnosis was chronic non-specific cystitis, identified in 77.1% (n=135) of patients. Among these, 40 cases were classified as mild, 27 as unspecified, and 13 as erosive cystitis. Squamous metaplasia or dysplasia frequently coexisted with chronic cystitis. Urothelial dysplasia was observed in 10.3% (n=18) of patients, predominantly mild (n=14) and moderate (n=4), all associated with chronic inflammation. Rare benign pathologies included urothelial papilloma, inverted papilloma, and bladder amyloidosis, each detected in one patient (0.6%). Other specific cystitis subtypes were glandular cystitis (4.0%), eosinophilic cystitis (2.9%), and cystitis cystica (3.4%).

All malignant cases (n=23) were diagnosed as urothelial carcinoma. The majority were non-muscle-invasive papillary tumors, with 78.2% (n=18) staged as pathological tumor (pT) stage 1 (lamina propria invasion) and 21.8% (n=5) as pT stage a (non-invasive). High-grade tumors were present in 52.2% (n=12), compared to 47.8% (n=11) that were low-grade. Notably, no cases exhibited muscle invasion (pT stage 2 or higher) or carcinoma in situ.

Patients were categorized into benign and malignant groups for comparative analysis. The median age was significantly higher in the malignant group than in the benign group [67.0 (61.0-74.0) vs. 44.5 (32.0–53.0) years, p<0.001]. Additionally, the proportion of male patients was significantly greater in the malignant group (87.0% vs. 50.7%, p=0.002). However, there was no statistically significant difference in BWT between the two groups [4.5 (3.975-5.0) mm vs. 4.3 (3.5-4.8) mm, p=0.132] (Table 2).

**Table 1. Demographic, preoperative, and postoperative characteristics of the patients**

| Parameter | p-value |
|---|---|
| Number of patients, n | 175 |
| Age (years) ± SD | 46.75±15.77 |
| Sex, n (%) | |
| Male | 97 (55.4%) |
| Female | 78 (44.5%) |
| Bladder wall thickness (mm) ± SD | 4.51±1.08 |
| Histopathological diagnosis, n (%) | |
| Benign | 152 (86.8%) |
| Malignant | 23 (13.2%) |

SD: Standard deviation

**Table 2. Patient characteristics in benign and malignant pathology groups**

| Characteristic | Benign (n=152) | Malignant (n=23) | p-value |
|---|---|---|---|
| Age (years) (median, IQR) | 44.5 (32.0-53.0) | 67.0 (61.0-74.0) | <0.001[a] |
| Male gender, n (%) | 77 (50.7%) | 20 (87.0%) | 0.002[b] |
| Bladder wall thickness (mm) (median, IQR) | 4.5 (3.975-5.0) | 4.3 (3.5-4.8) | 0.132[a] |

IQR: Interquartile range, [a]: Mann-Whitney U test, [b]: Chi-square test

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## DISCUSSION

In this study, we investigated the diagnostic value of BWT, measured via ultrasound, in distinguishing between malignant and benign lesions in patients presenting with hematuria. Although our findings revealed significant differences between malignant and benign pathologies in terms of age and sex, no statistically significant difference was observed in BWT. This suggests that BWT alone may not be a reliable predictive parameter for bladder cancer.

Numerous studies have evaluated the diagnostic value of ultrasonographic findings in bladder tumors. Mostafaloo et al. (8) reported that USG in patients with hematuria has relatively high specificity but low sensitivity. The literature indicates that benign pathologies are associated with notable thickening of the bladder wall, whereas malignant conditions, such as urothelial carcinoma, typically manifest as focal lesions (9). Previous studies have demonstrated that benign inflammatory processes result in diffuse thickening of the bladder wall, particularly in conditions such as chronic cystitis, glandular cystitis, and eosinophilic cystitis (10,11). In the literature, BWT in healthy adults is generally reported to be less than 3 mm (12). In our study, BWT was increased in the benign group, with a median of 4.5 mm, relative to that of a normal bladder, which is consistent with the literature. However, there was no statistically significant difference between the benign and malignant groups, indicating that BWT is insufficient as a predictive marker for malignancy.

The impact of sex on the incidence of bladder cancer has been the subject of extensive research. Epidemiological studies suggest that men are at a greater risk of developing bladder cancer than women. Data from the National Cancer Institute's Surveillance, Epidemiology, and End Results program report an incidence rate of 31.6 per 100,000 men and 7.8 per 100,000 women, resulting in a male-to-female ratio of approximately 4:1 (13). In the present study, 87% of the malignant cases were male, which is consistent with these findings.

The research conducted by Kluth et al. (14) revealed that although men exhibit a higher risk of developing bladder cancer, female patients are frequently diagnosed at more advanced stages. This delay in diagnosis is associated with poor oncological outcomes in women. The elevated incidence of bladder cancer in men is not yet fully understood; however, factors such as smoking, exposure to environmental toxins, and hormonal influences are considered contributory (13).

Our study revealed a statistically significant difference in age between patients with malignant and benign bladder pathologies, with older age being strongly associated with malignancy ($p<0.001$). This finding aligns with previous epidemiological data indicating that bladder cancer is predominantly a disease of older adults. Age-related accumulation of genetic mutations, prolonged exposure to environmental carcinogens such as tobacco and industrial chemicals, and a decline in immune surveillance are among the key factors believed to contribute to the increased risk of malignancy in elderly individuals (13,15).

This study highlights the potential utility of measuring BWT using ultrasound as a diagnostic parameter in the assessment of patients presenting with hematuria. While increased BWT may reflect an underlying pathological process in patients with hematuria, it cannot be solely relied upon to exclude malignancy. This should be considered in conjunction with the clinical findings, laboratory tests, and advanced imaging techniques. Notably, none of the patients with BWT exceeding 5 mm were diagnosed with malignancy in this study, indicating that inflammatory processes in benign conditions may contribute to more pronounced thickening. However, given that urothelial carcinoma often manifests as small superficial lesions in its early stages, cystoscopic evaluation remains essential for patients with hematuria.

### Study Limitations

This study represents one of the most comprehensive retrospective analyses examining the relationship between BWT and pathological diagnoses in patients presenting with hematuria. The retrospective design of the study constitutes a limitation, as a prospective approach could yield more robust and generalizable results. Additionally, subjectivity in the measurement of BWT should be considered, including potential interobserver variability among radiologists and factors such as the degree of bladder filling at the time of measurement.

## CONCLUSION

While ultrasonographic measurement of BWT offers valuable insights into underlying bladder pathology in patients with hematuria, it falls short as a standalone predictor of urothelial malignancy. Our findings emphasize that reliance solely on BWT may lead to missed or delayed diagnoses of bladder cancer. Therefore, BWT should be considered a complementary tool within a multidisciplinary diagnostic approach. Integrating USG findings with cystoscopy and clinical assessment remains essential for timely and accurate detection of malignancies. Prospective studies are needed to refine non-invasive diagnostic strategies in hematuria management.

### Ethics

**Ethics Committee Approval:** This study was approved by the local Ethics Committee of Hisar Intercontinental Hospital (decision no: 25-26, date: 28.02.2025).

**Informed Consent:** This study involved a retrospective analysis of patients who presented to the urology outpatient clinic with various symptoms between January 2010 and June 2023, and were diagnosed with hematuria during their evaluations.

### Footnotes

**Author Contributions:** Surgical and Medical Practices - B.Ç.; Concept - C.T.G., B.Ç.; Design - C.T.G., B.Ç.; Data Collection and/or Processing - B.Ç.; Analysis and/or Interpretation - C.T.G.; Literature Search - C.T.G., B.Ç.; Writing - C.T.G., B.Ç.

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