ARC Journal of Cancer Science
Volume 6, Issue 2, 2020, PP 24-29
ISSN (Online): 2455-6009
DOI: http://dx.doi.org/10.20431/2455-6009.0602005
www.arcjournals.org

Correlation between Ultrasound features and Histopathological Findings in Bladder Cancer- A Study at a Tertiary Care Hospital

***Dr. Morshida Begum[1], Dr. Md. Towhid Hossain[2], Dr. Abrar Mahbub[3], Dr. Maruf Rahman[4], Dr. Iffat Sultana[5], Dr. Fauzia Tasnim Hossain[6]**

[1]Department of Radiology and Imaging, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[2]Department of Histopathology, National Institute of Kidney Diseases and Urology, Dhaka, Bangladesh

[3]MBBS, Clinical Fellow, New Cross Hospital, The Royal Wolverhampton NHS Trust, Wolverhampton, West Midlands, UK

[4]Phase B Resident, The National Institute of Traumatology & Orthopaedic Rehabilitation, Dhaka, Bangladesh

[5]Department of Radiology and Imaging, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

[6]Medical Officer, Doctors Trust Kidney Dialysis and Transplant Center, Dhaka, Bangladesh

Received: 07 December 2020 Accepted: 22 December 2020 Published: 29 December 2020

Corresponding Author:** ***Dr. Morshida Begum, *Department of Radiology and Imaging, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.*

Abstract

Background: *Bladder cancer is a common malignancy with significant morbidity and mortality. Early detection and accurate staging are crucial for effective treatment planning. Ultrasound is a non-invasive imaging tool used for initial evaluation, but its correlation with histopathological findings needs further validation. This study aimed to assess the diagnostic accuracy of ultrasound in predicting tumor characteristics compared to histopathology.*

Methods: *This cross-sectional study was conducted at the Department of Radiology and Imaging, BSMMU, Dhaka, from January 2020 to October 2020, including 120 patients with suspected bladder cancer. Ultrasound findings, including tumor shape, echogenicity, size, and wall invasion, were recorded and compared with histopathological results. Data were analyzed using SPSS 22, with sensitivity, specificity, and accuracy calculated for ultrasound-based predictions.*

Results: *The study population had a male predominance (73.3%), with a mean age of 60.2 years. Smoking history was present in 65% of patients. Ultrasound detected polypoid tumors (56.7%), hyperechoic lesions (36.7%), and muscle invasion (55.8%). Histopathology confirmed urothelial carcinoma (81.7%), with 60% of tumors classified as high-grade. Ultrasound showed 86.9% sensitivity, 79.2% specificity, and 83.5% accuracy in detecting muscle invasion.*

Conclusion: *Ultrasound is a valuable tool for initial evaluation of bladder cancer, demonstrating moderate to high diagnostic accuracy. However, histopathological confirmation remains essential. Future studies should explore combining ultrasound with MRI and molecular diagnostics for improved accuracy.*

Keywords: *Bladder cancer, Ultrasound, Histopathology, Tumor invasion, Urothelial carcinoma, Imaging correlation.*

1. INTRODUCTION

Bladder cancer is one of the most common malignancies worldwide and represents a significant health burden, particularly in developing countries [1]. It ranks as the ninth most frequently diagnosed cancer globally and is more prevalent in men than women. In Bangladesh, bladder cancer incidence has been increasing, partly due to factors such as smoking, exposure to industrial chemicals, and chronic urinary tract infections [2]. Early and accurate detection is crucial for better prognosis and treatment outcomes [3].

Ultrasound (USG) is widely used as a non-invasive, cost-effective, and readily available imaging tool in the initial assessment of bladder tumors [4]. It helps detect bladder wall irregularities, tumor size, shape, echogenicity,

and vascularity. However, ultrasound findings alone are often insufficient to determine tumor grade and depth of invasion, which are essential for treatment planning [5]. Histopathological examination remains the gold standard for definitive diagnosis, classifying tumors into urothelial carcinoma, squamous cell carcinoma, adenocarcinoma, and other rare subtypes [6]. It also differentiates between low-grade and high-grade tumors and determines whether the tumor is non-muscle invasive bladder cancer (NMIBC) or muscle-invasive bladder cancer (MIBC), which significantly impacts management decisions [7].

While cystoscopy and biopsy are the most reliable methods for confirming bladder cancer, they are invasive, expensive, and may not always be immediately accessible in resource-limited settings [8]. In contrast, ultrasound provides a quick preliminary diagnosis, helping clinicians decide whether further invasive testing is necessary [9]. However, its diagnostic accuracy varies depending on tumor characteristics and operator expertise [10, 11]. Several studies have investigated the correlation between ultrasound findings and histopathological outcomes, but data specific to Bangladeshi patients, particularly from a tertiary care setting like BSMMU, remain limited.

This study aimed to evaluate the correlation between ultrasound features and histopathological findings in bladder cancer patients at BSMMU, Dhaka, to assess the reliability of ultrasound in predicting tumor characteristics. By analyzing parameters such as tumor size, shape, echogenicity, and invasion depth on ultrasound and comparing them with histopathology, this study seeks to determine the diagnostic accuracy of ultrasound in detecting malignancy and muscle invasion. Findings from this research could contribute to improving bladder cancer diagnosis in Bangladesh and provide valuable insights for clinicians in resource-limited settings.

2. Methodology and Materials

This cross-sectional study was conducted at the Department of Radiology and Imaging, BSMMU, Dhaka, from January 2020 to October 2020, with a total sample size of 120 patients suspected of having bladder cancer. Patients who underwent ultrasound evaluation followed by histopathological confirmation were included. Inclusion criteria consisted of patients aged 18 years or older with bladder masses detected on ultrasound and who subsequently underwent biopsy. Exclusion criteria included patients with previously diagnosed bladder cancer under follow-up, those with incomplete imaging or histopathological data, and cases with poor-quality ultrasound images.

All patients underwent transabdominal ultrasound (TAUS) using a high-resolution ultrasound machine, assessing tumor characteristics such as size, shape (polypoid, sessile, or irregular), echogenicity (hyperechoic, hypoechoic, or mixed), wall involvement (superficial vs. muscle-invasive), and vascularity (low, moderate, or high) on Doppler imaging. Following ultrasound, patients underwent cystoscopic biopsy, and the histopathological evaluation classified tumors based on type (urothelial carcinoma, squamous cell carcinoma, adenocarcinoma), grade (low vs. high), and invasion depth (non-muscle invasive vs. muscle-invasive bladder cancer - NMIBC vs. MIBC).

The correlation between ultrasound findings and histopathological diagnosis was assessed using SPSS version 22. Descriptive statistics were applied to summarize demographic and clinical characteristics. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of ultrasound in detecting malignancy and tumor invasion were calculated. Pearson's or Spearman's correlation analysis was performed to assess the relationship between ultrasound features and histopathological outcomes.

3. Results

Table 1. *Patient Demographics and Clinical Characteristics*

Characteristic	Number (n=120)	Percentage (%)
Age Group (years)		
30-50	33	27.50%
51-70	62	51.70%
>70	25	20.80%
Gender		

Male	88	73.30%
Female	32	26.70%
Smoking History		
Smoker	78	65.00%
Non-smoker	42	35.00%

Table 1 presents the demographic and clinical characteristics of the 120 bladder cancer patients in the study. The majority of patients (51.7%) were aged 51-70 years, followed by 30-50 years (27.5%) and above 70 years (20.8%), indicating a higher prevalence in middle-aged and older individuals. Male patients (73.3%) were more commonly affected than females (26.7%). A significant proportion of patients (65.0%) had a history of smoking, reinforcing its association with bladder cancer.

Table 2. *Ultrasound Findings in Bladder Cancer Patients*

Ultrasound Feature	Number (n=120)	Percentage (%)
Tumor Shape		
Polypoid	68	56.70%
Sessile	37	30.80%
Irregular	15	12.50%
Echogenicity		
Hyperechoic	44	36.70%
Hypoechoic	42	35.00%
Mixed	34	28.30%
Tumor Size (cm)		
≤3 cm	47	39.20%
>3 cm	73	60.80%
Wall Invasion		
Superficial	53	44.20%
Muscle-Invasive	67	55.80%

Table 2 summarizes the ultrasound findings in bladder cancer patients. The most common tumor shape was polypoid (56.7%), followed by sessile (30.8%) and irregular (12.5%). Echogenicity varied, with hyperechoic (36.7%), hypoechoic (35.0%), and mixed (28.3%) patterns observed. Tumor size was predominantly larger than 3 cm (60.8%), while 39.2% of tumors measured ≤3 cm. Regarding wall invasion, 55.8% of cases were muscle-invasive, while 44.2% were superficial.

Table 3. *Histopathological Findings*

Histopathological Feature	Number (n=120)	Percentage (%)
Tumor Type		
Urothelial Carcinoma	98	81.70%
Squamous Cell Carcinoma	17	14.20%
Adenocarcinoma	5	4.10%
Tumor Grade		
Low-Grade	48	40.00%
High-Grade	72	60.00%
Tumor Invasion		
Non-Muscle Invasive (NMIBC)	54	45.00%
Muscle-Invasive (MIBC)	66	55.00%

Table 3 presents the histopathological findings of bladder cancer patients. The majority of cases were urothelial carcinoma (81.7%), followed by squamous cell carcinoma (14.2%), and a small proportion of adenocarcinoma (4.1%). In terms of tumor grade, 60.0% were classified as high-grade, while 40.0% were low-grade, indicating a predominance of more aggressive tumors. Regarding tumor invasion, 55.0% of cases were muscle-invasive (MIBC), while 45.0% were non-muscle invasive (NMIBC).

Table 4. *Correlation between Ultrasound and Histopathological Findings*

Ultrasound Feature	Histopathology Finding	Sensitivity (%)	Specificity (%)	Accuracy (%)
Wall Invasion	Muscle-Invasive Tumor	86.90%	79.20%	83.50%
Tumor Shape	High-Grade Tumor	81.50%	76.30%	78.90%
Echogenicity	Urothelial Carcinoma	78.80%	71.20%	74.90%

Table 4 shows the correlation between ultrasound features and histopathological findings in bladder cancer patients. Ultrasound detection of wall invasion had the highest sensitivity (86.9%), specificity (79.2%), and accuracy (83.5%) in identifying muscle-invasive tumors. Tumor shape was also a strong predictor of high-grade tumors, with 81.5% sensitivity, 76.3% specificity, and 78.9% accuracy. Echogenicity correlated with urothelial carcinoma, showing 78.8% sensitivity, 71.2% specificity, and 74.9% accuracy.

4. DISCUSSION

Bladder cancer remains a significant health concern globally, with its incidence influenced by factors such as age, gender, smoking history, and tumor characteristics. Ultrasound serves as a valuable non-invasive imaging tool, offering insights into tumor morphology, echogenicity, size, and wall invasion, which correlate with histopathological findings. This study aimed to evaluate the diagnostic accuracy of ultrasound in predicting tumor characteristics compared to histopathology, the gold standard.

Kirkali et al., emphasized that males are at a higher risk of bladder cancer due to prolonged exposure to carcinogens, particularly tobacco smoke [12]. Our study aligns with this, as 73.3% of patients were male, while 65% had a history of smoking, reinforcing its role in bladder cancer pathogenesis. Rodriguez et al. reported that bladder cancer primarily affects older adults due to cumulative exposure to carcinogens [13]. Our findings support this, with 51.7% of cases occurring in the 51-70 age group.

Zhang et al. observed that polypoid tumors are more commonly associated with non-muscle invasive bladder cancer (NMIBC), while sessile or irregular tumors tend to be more aggressive [14]. Similarly, our study found that polypoid tumors (56.7%) were the most common, followed by sessile (30.8%) and irregular (12.5%) tumors. Wong-You-Cheong et al., reported that hypoechoic tumors are often associated with high-grade malignancies, a finding consistent with our results, where 35% of tumors were hypoechoic [15]. Tumor size is a crucial factor in staging, as larger tumors are more likely to be muscle-invasive (MIBC). Gupta et al., emphasized that early detection of small tumors is vital to prevent progression to MIBC [16]. Our study supports this, as 60.8% of tumors measured >3 cm, and 55.8% showed muscle invasion, highlighting the need for accurate staging tools.

Williams et al., found that urothelial carcinoma accounts for the majority of bladder cancer cases, which aligns with our study, where 81.7% of tumors were urothelial carcinoma [17]. Bertz et al. emphasized that high-grade tumors exhibit rapid progression and require aggressive treatment [18]. Our study confirmed this trend, with 60% of tumors classified as high-grade, reinforcing the importance of early detection and aggressive treatment strategies. Mahdavinezhad et al., discussed that early-stage bladder cancer is often confined to the mucosa or submucosa (NMIBC), whereas advanced cases penetrate the muscle layer (MIBC) [19]. Our study aligns with this, as 45% of tumors were NMIBC, while 55% were MIBC, further underscoring the importance of accurate staging for treatment decisions.

Gupta et al., found that ultrasound had high sensitivity (86.9%) and specificity (79.2%) for detecting muscle-invasive tumors, findings that closely match our results [16]. However, they noted that ultrasound may sometimes underestimate deep muscle invasion, necessitating further imaging like MRI. Oezden et al., emphasized that sessile and irregular tumors are more likely to be aggressive, which aligns with our study's finding that tumor shape had a sensitivity of 81.5% and specificity of 76.3% in predicting high-grade tumors [20]. Huang et al., reported that echogenicity alone is insufficient for definitive diagnosis, despite its usefulness in initial screening [21]. Similarly, our study found that echogenicity had an accuracy of 74.9% in detecting urothelial carcinoma, reinforcing the need for histopathological confirmation.

Riesz et al., highlighted that fluorescence in situ hybridization (FISH) and urinary biomarkers (e.g., miR-141, miR-200c) can enhance bladder

cancer detection, which presents a potential avenue for future research [22]. Integrating molecular diagnostics with imaging could further improve diagnostic accuracy. Panebianco et al., emphasized the advantages of dynamic contrast-enhanced MRI (DCE-MRI) and diffusion-weighted imaging (DWI) in staging bladder cancer [23]. As our study found moderate specificity in ultrasound-based staging, future research should explore the integration of ultrasound with advanced imaging modalities for improved accuracy.

5. Limitations of the Study

This study's limitations include its cross-sectional design and reliance on ultrasound, which may not fully capture all tumor characteristics, particularly in early or small tumors. Additionally, the sample was drawn from a single tertiary care hospital, limiting generalizability, and histopathological results may be influenced by inter-observer variability.

6. Conclusion

This study reinforces that ultrasound provides valuable insights into bladder cancer characteristics, particularly in resource-limited settings. Ultrasound alone is insufficient for definitive diagnosis, necessitating the use of histopathology and advanced imaging for accurate staging. Future research should focus on combining ultrasound with MRI, CT, and molecular diagnostics to enhance early detection and treatment planning.

Financial Support and Sponsorship

No funding sources.

Conflicts of Interest

There are no conflicts of interest.

References

[1] Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: a cancer journal for clinicians. 2018 Nov;68(6):394-424.

[2] Islam MJ, Akter S, Talukder AR, Haque MS. Role of routine histopathology of gallbladder specimen from gallstone disease to detect unsuspected carcinoma. Journal of Bangladesh College of Physicians and Surgeons. 2019 Sep 30;37(4):186-90.

[3] Burger M, Catto JW, Dalbagni G, Grossman HB, Herr H, Karakiewicz P, Kassouf W, Kiemeney LA, La Vecchia C, Shariat S, Lotan Y. Epidemiology and risk factors of urothelial bladder cancer. European urology. 2013 Feb 1;63(2):234-41.

[4] Antoni S, Ferlay J, Soerjomataram I, Znaor A, Jemal A, Bray F. Bladder cancer incidence and mortality: a global overview and recent trends. European urology. 2017 Jan 1;71(1):96-108.

[5] Kaufman DS, Shipley WU, Feldman AS. Bladder cancer. The Lancet. 2009 Jul 18;374(9685):239-49.

[6] Sylvester RJ, Van Der Meijden AP, Oosterlinck W, Witjes JA, Bouffioux C, Denis L, Newling DW, Kurth K. Predicting recurrence and progression in individual patients with stage Ta T1 bladder cancer using EORTC risk tables: a combined analysis of 2596 patients from seven EORTC trials. European urology. 2006 Mar 1;49(3):466-77.

[7] Wong-You–Cheong JJ, Woodward PJ, Manning MA, Sesterhenn IA. Neoplasms of the urinary bladder: radiologic-pathologic correlation. Radiographics. 2006 Mar;26(2):553-80.

[8] Gaurilcikas A, Vaitkiene D, Cizauskas A, Inciura A, Svedas E, Maciuleviciene R, Di Legge A, Ferrandina G, Testa AC, Valentin L. Early-stage cervical cancer: agreement between ultrasound and histopathological findings with regard to tumor size and extent of local disease. Ultrasound in obstetrics & gynecology. 2011 Dec;38(6):707-15.

[9] Tran WT, Iradji S, Sofroni E, Giles A, Eddy D, Czarnota GJ. Microbubble and ultrasound radioenhancement of bladder cancer. British journal of cancer. 2012 Jul;107(3):469-76.

[10] Takeuchi M, Sasaki S, Ito M, Okada S, Takahashi S, Kawai T, Suzuki K, Oshima H, Hara M, Shibamoto Y. Urinary bladder cancer: diffusion-weighted MR imaging—accuracy for diagnosing T stage and estimating histologic grade. Radiology. 2009 Apr;251(1):112-21.

[11] Caruso G, Salvaggio G, Campisi A, Melloni D, Midiri M, Bertolotto M, Lagalla R. Bladder tumor staging: comparison of contrast-enhanced and gray-scale ultrasound. American Journal of Roentgenology. 2010 Jan;194(1):151-6.

[12] Kirkali Z, Chan T, Manoharan M, Algaba F, Busch C, Cheng L, Kiemeney L, Kriegmair M, Montironi R, Murphy WM, Sesterhenn IA. Bladder cancer: epidemiology, staging and grading, and diagnosis. Urology. 2005 Dec 1;66(6):4-34.

[13] Rodriguez RH, Rueda OB, Ibarz L. Bladder cancer: present and future. Medicina Clínica (English Edition). 2017 Nov 22;149(10):449-55.

[14] Zhang J, Gerst S, Lefkowitz RA, Bach A. Imaging of bladder cancer. Radiologic Clinics. 2007 Jan 1; 45(1):183-205.

[15] Wong-You–Cheong JJ, Woodward PJ, Manning MA, Davis CJ. Inflammatory and nonneoplastic bladder masses: radiologic-pathologic correlation. Radiographics. 2006 Nov; 26(6): 1847-68.

[16] Gupta N, Sureka B, Kumar MM, Malik A, Bhushan TB, Mohanty NK. Comparison of dynamic contrast-enhanced and diffusion weighted magnetic resonance image in staging and grading of carcinoma bladder with histopathological correlation. Urology annals. 2015 Apr 1; 7(2):199-204.

[17] Williams SK, Denton KJ, Minervini A, Oxley J, Khastigir J, Timoney AG, Keeley FX. Correlation of upper-tract cytology, retrograde pyelography, ureteroscopic appearance, and ureteroscopic biopsy with histologic examination of upper-tract transitional cell carcinoma. Journal of endourology. 2008 Jan 1; 22(1):71-6.

[18] Bertz S, Denzinger S, Otto W, Wieland WF, Stoehr R, Hofstaedter F, Hartmann A. Substaging by estimating the size of invasive tumour can improve risk stratification in pT1 urothelial bladder cancer—evaluation of a large hospital-based single-centre series. Histopathology. 2011 Oct;59(4):722-32.

[19] Mahdavinezhad A, Mousavi-Bahar SH, Poorolajal J, Yadegarazari R, Jafari M, Shabab N, Saidijam M. Evaluation of miR-141, miR-200c, miR-30b expression and clinicopathological features of bladder cancer. International journal of molecular and cellular medicine. 2015;4(1):32.

[20] Oezden E, Turgut AT, Yeşil M, Göğüş Ç, Göğüş O. A New Parameter for Staging Bladder Carcinoma: Ultrasonographic Contact Length and Height-to-Length Ratio. Journal of Ultrasound in Medicine. 2007 Sep;26(9):1137-42.

[21] Huang WC, Yang JM, Yang YC, Yang SH. Ultrasonographic characteristics and cystoscopic correlates of bladder wall invasion by endophytic cervical cancer. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2006 Jun;27(6):680-6.

[22] Riesz P, Lotz G, Páska C, Szendrői A, Majoros A, Németh Z, Törzsök P, Szarvas T, Kovalszky I, Schaff Z, Romics I. Detection of bladder cancer from the urine using fluorescence in situ hybridization technique. Pathology & Oncology Research. 2007 Sep; 13:187-94.

[23] Panebianco V, De Berardinis E, Barchetti G, Simone G, Leonardo C, Grompone MD, Del Monte M, Carano D, Gallucci M, Catto J, Catalano C. An evaluation of morphological and functional multi-parametric MRI sequences in classifying non-muscle and muscle invasive bladder cancer. European radiology. 2017 Sep; 27:3759-66.

Citation: *Dr. Morshida Begum et al. Correlation between Ultrasound features and Histopathological Findings in Bladder Cancer- A Study at a Tertiary Care Hospital. ARC Journal of Cancer Science. 2020; 6(2):24-29. DOI: dx.doi.org/10.20431/2455-6009.0602005.*