The role of ultrasound in diagnosis and evaluation of bladder tumors

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Abstract

Introduction: Bladder tumors are common and the only way to prove it is cystoscopy which is invasive and expensive. Finding noninvasive, well-accepted, and cost-effective method for early detection of bladder cancer is necessary. The aim of this study was to evaluate the role of ultrasonography in the diagnosis and evaluation of bladder tumors. Methods: This study was conducted on 75 patients with indications for cystoscopy. After recording demographic data, ultrasound, and cystoscopy was performed for all patients. Sensitivity and specificity of sonography in the diagnosis of bladder tumors were measured. Results: The most common form of bladder in ultrasound was papillary tumors (86%) and the lowest was related to cystic mass (4%). The sensitivity, specificity, positive predictive value, and negative predictive value of sonography for the diagnosis of bladder tumors were 93.24%, 100%, 100%, and 16.66%, respectively. Conclusion: The results of our study showed that ultrasonography has high sensitivity and specificity in the diagnosis of bladder cancer and since that ultrasound is a noninvasive, well-accepted, and cost-effective diagnostic technique, ultrasound can be performed in suspected patients in the first stage.

Keywords: Bladder tumor, cystoscopy, ultrasound

Introduction

With its increasing incidence, bladder cancer accounts for almost 4% of all malignant tumors. Incidence of bladder cancer rises with age. Its maximum incidence occurs in the seventh decade of life, and only 1% of patients of under 35 years develop it. In a study carried out in Mazandaran to investigate the incidence of bladder cancer over a period of 3 years, it was reported that 11.46% of the 1000 participants had bladder cancer. Furthermore, in a study that was conducted in Kurdistan, it was reported that the incidence rate of bladder cancer over 2003–2004 was 7.5%. Sixty percent of bladder cases are attributed to smoking which is the most important known and preventable cause of this cancer. Clinically, patients with bladder tumors refer with painless hematuria. This symptom exists in 85%–90% of patients. Cystoscopy is the gold standard diagnostics in patients with painless hematuria and consequently bladder tumors. It plays a remarkable role in the diagnosis of bladder tumors; however, it is necessary for it to be associated with biopsy for definitive diagnosis. This method is invasive and requires local or general anesthesia. Intravenous pyelography (IVP) is also the most common radiography test which is required for evaluating and detecting bladder tumors. This method, however, is insensitive and its accuracy is about 70%.[4] Since almost 36 years ago, the valuable role of ultrasound through the abdomen, bladder, rectum, and vagina in evaluation of bladder tumors has been reported.[5–11] Ultrasound is a well-accepted, cost-effective, noninvasive diagnostic method. Moreover, availability of ultrasound facilities in most teaching hospitals has led to an increase in its diagnostic application in patients with painless hematuria.[12,13]

In a study carried out by Stamatiou et al., the sensitivity and the specificity of this test for diagnosis of bladder tumors were
reported to be 87.1% and 97.8%, respectively. In another study carried out by Mwashambwa et al., the sensitivity and the specificity of sonography in diagnosing bladder tumors were respectively, 83% and 93%. Despite promising results, however, studies in this field have not yet become common; therefore, the present study was conducted to investigate the role of ultrasound in diagnosis and examination of bladder tumors.

### Methods

The present study is a prospective clinical trial. The patients who participated in the present study consisted of all patients suspected of having bladder tumors who had referred to the Golestan Teaching Hospital in Ahvaz during 2014–2015. Given the error level of 5%, test power of 80%, and the effect size (d) of 0.7, the sample size was calculated as 75 subjects.

The inclusion criteria included patients suspected of having bladder cancer who had referred to the hospital to have cystoscopy and had consent to participate in the study. The exclusion criteria included patients who were not consented to participate in the study and those who had recurrent superficial bladder cancer and had no access to definitive diagnosis.

The patients entered the study based on the inclusion criteria. Afterward, the patients underwent ultrasound. Ultrasound was carried out with GE Voluson 730 using a convex probe with a frequency of 5.3 Hz for all patients. All ultrasounds were carried out by a single individual. Afterward, the patients underwent cystoscopy which was conducted by an urologist who was not aware of the results of patients’ ultrasound. Afterward, tissue samples were prepared and sent to pathology laboratory for pathological examinations.

### Statistical analysis

The patients’ data including demographic factors and clinical symptoms were recorded in the researcher-designed checklists and were fed into SPSS 17.0 (IBM, Armonk, NY, United States of America). Descriptive and analytical statistical analyses were conducted. Patients’ demographic and clinical data were reported based on descriptive criteria. Based on the met statistical assumptions, suitable parametric and nonparametric tests were utilized in analytical section. The qualitative and quantitative data were analyzed through Chi-square test and independent t-test, respectively. When the primary assumption such as normality was not met, nonparametric test of Mann–Whitney was used. All tests were run based on the error level of 5%.

### Results

Out of the 126 patients who had referred to the Golestan Teaching Hospital in Ahvaz and entered the study, 51 individuals were

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**Table 1: Frequency of demographic variables of the patients under investigation**

| Variable                        | Frequency (%) |
|---------------------------------|---------------|
| Age (year)                      | 61.58±16.21   |
| Gender                          |               |
| Male                            | 68 (91)       |
| Female                          | 7 (9)         |
| Smoking background              | 61 (81)       |
| Clinical symptoms               |               |
| Painless hematuria              | 58 (89)       |
| Blood clotting                  | 24 (37)       |
| Burning on urination            | 40 (62)       |
| Irritative symptoms             | 52 (80)       |
| Abdominal pain                  | 6 (9)         |
| Obstructive symptoms            | 12 (19)       |
| General symptoms                | 5 (7)         |

**Table 2: The frequency of results obtained from intravenous pyelography, sonography, and cystoscopy in patients**

| Variable                        | Frequency (%) |
|---------------------------------|---------------|
| IVP results                     |               |
| Tumor shadow below 2 cm         | 2 (4)         |
| Tumor shadow over 2 cm          | 11 (23)       |
| Numerous tumor shadows          | 15 (31)       |
| Inflammation of the kidneys and ureters | 9 (19) |
| Negative                        | 13 (27)       |
| Sonography results              |               |
| Tumor below 2 cm                | 10 (13)       |
| Tumor over 2 cm                 | 28 (37)       |
| Numerous tumors                 | 22 (29)       |
| Irregularities in the bladder wall | 9 (12) |
| Papillary tumor                 | 64 (86)       |
| Unfounded tumor                 | 20 (27)       |
| Calcification                    | 4 (5)         |
| Cystic compounds                | 3 (4)         |
| Bladder and ureteral inflammation | 20 (27) |
| Negative                        | 6 (8)         |
| Cystoscopy results              |               |
| Tumor on the side walls         | 20 (26.6)     |
| Tumor in the bladder triangle   | 8 (10.7)      |
| Tumor on the front wall         | 6 (8)         |
| Tumor on the rear wall          | 9 (12)        |
| Tumor in the bladder neck       | 4 (5.3)       |
| Numerous tumors                 | 27 (36)       |
| Negative                        | 1 (1.3)       |

**Table 3: Sensitivity, specificity, positive predictive value, and negative predictive value of sonography in diagnosing bladder tumors**

|              | Sensitivity | Specificity | Positive predictive value | Negative predictive value | Positive probability | Negative probability | Total precision |
|--------------|-------------|-------------|---------------------------|---------------------------|----------------------|----------------------|-----------------|
| Sonography   | 93.24       | 100         | 100                       | 16.66                     | ∞                    | 0.068                | 93.33           |
crossed out due to lack of access to definitive diagnosis. Out of the 75 participating patients, 68 (91%) were male and 7 (9%) were female [Table 1]. The participants’ mean age was 61.58 ± 16.21 years (with a range of 18–86 years), with the highest frequency related to the age group of 61–70 years (34%). Moreover, it was concluded that 61 patients (81%) had the background of smoking. In addition, it was known that the most common symptoms included painless hematuria (89%) and irritative symptoms (80%).

Out of the 75 patients who entered the study, 48 underwent IVP [Table 2], and the most common finding in IVP was the presence of numerous shadows (31%) followed by the negative result (27%), and the lowest frequency was related to the presence of shadows with a diameter of below 2 cm (4%).

Out of the 75 patients who went under sonography, it was concluded that the most common finding was the presence of papillary tumors in bladder (86%) followed by the presence of tumors >2 cm (37%) and the lowest frequency was related to the presence of cystic tumors (4%) and negative result (8%). Cystoscopy results obtained from the 75 patients indicated that the most common finding was the presence of numerous tumors (36%) and only one case was negative (1.3%). Pathological findings also showed that 96% of the patients suffered from TCC, 2.7% suffered from SCC, and 1.3% were normal. Furthermore, 23% suffered from first-degree tumor, 33% from second-degree tumor, and 44% from third-degree tumor.

Therefore, it can be figured out that sensitivity, specificity, positive predictive value, and negative predictive value of sonography in diagnosing bladder tumors were, respectively, 93.24%, 100%, 100%, and 16.66% [Table 3].

**Discussion**

The results of the present study indicated that sensitivity, specificity, positive predictive value, and negative predictive value of sonography for the diagnosis of bladder tumors were respectively 93.24%, 100%, 100%, and 16.66%. Stamatiou et al. studied 173 patients with painless hematuria and concluded that the sensitivity and the specificity of this test for diagnosis of bladder tumors were reported to be 87.1% and 978.1%, respectively.[14] They also showed that positive and negative predictive values of sonography were, respectively, 94.4% and 95.4%. The results of that study are similar to those of the current study with this difference that negative predictive value was 16.66% in the present study. At last, it was concluded that sonography has a lower value than cystoscopy; however, since patients cannot tolerate cystoscopy, sonography can be used for further examinations for patients with problems in using cystoscopy, especially in patients with painless hematuria.[14]

In another study carried out by Mwashambwa et al., the sensitivity and the specificity of sonography in diagnosing bladder tumors were, respectively, 83% and 93% and both positive and negative predictive values were 89%.[15] The results of that study are lower than those of the present study; specificity was reported to be 100% in the current study. Since specificity is significant in determining the validity a test, the results of the present study are more reliable, and since sonography is a highly operator-dependent test, the difference between the two studies can be attributed to the differences in the operators’ experiences in the two studies.

Datta et al. conducted a study that was aimed at investigating the value of sonography in diagnosing bladder tumors. They indicated that sensitivity, specificity, and positive predictive value of this test were respectively 63%, 99%, and 100%. The results of that study were similar to those of the present study in terms of positive predictive value while sensitivity was reported to be higher in the present study. Silva-Ramos et al. also carried out a study to investigate the precision of three-dimensional (3D) sonography in diagnosing bladder tumors. The results of their study indicated that sensitivity, specificity, and positive and negative predictive values of 3D sonography were respectively 83.3%, 100%, 100%, and 93.8%. The results of their study are similar to those of the current study.

**Conclusion**

Results of the present study indicated that sonography has a high sensitivity and specificity (100%) in diagnosis of bladder tumors. And since it is considered as a noninvasive diagnostic procedure, ultrasound can be used as a screening tool to rule out bladder tumors in patients with painless hematuria, avoiding unnecessary cystoscopy.

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**Conflicts of interest**

There are no conflicts of interest.

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