ORIGINAL ARTICLE

Performance of computed tomographic urography for the detection of bladder tumors in patients with microscopic hematuria

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KEYWORDS
Bladder tumor; Hematuria; Cystoscopy; Computed tomography

Abstract
Objective: Our objective was to evaluate the sensitivity, specificity, predictive value, and accuracy of computed tomographic urography for the detection of bladder tumors in patients with microscopic hematuria.

Material and methods: Patients with microscopic hematuria initially evaluated with computed tomography and cystoscopy from January 2006 to December 2009 were evaluated. Computed tomography detecting a bladder lesion suspicious of malignancy was considered positive. Cystoscopy was classified as positive when a lesion requiring biopsy or resection was found. Performance characteristics of computed tomography were determined by comparing with cystoscopic and pathological findings.

Results: A total of 112 patients were eligible for analysis. Seven tumors were found on cystoscopy; of these, 2 were correctly diagnosed by computed tomography and 5 were missed. An additional case was considered erroneously positive. The results are a sensitivity of 29%, specificity of 99%, positive predictive value of 67%, negative predictive value of 95%, and accuracy of 95%.

Conclusions: Although computed tomography has a high specificity its sensitivity is limited. For this reason conventional cystoscopy should be considered the standard for bladder evaluation of patients with microscopic hematuria.

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\textsuperscript{† †} The study was approved by the Institutional Human Biomedical Research in our institute (number of reference 75).

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Performance of computed tomographic urography for the detection of bladder tumors in patients

PALABRAS CLAVE
Tumor vesical; Hematuria; Cistoscopia; Tomografía computarizada

Exactitud de la urotomografía computarizada para detectar tumores vesicales en pacientes con hematuria microscópica

Resumen
Objetivo: Evaluar la sensibilidad, especificidad, valores predictivos y exactitud de la tomografía computarizada en la detección de tumores vesicales en pacientes con hematuria microscópica. Material y métodos: Analizamos retrospectivamente los casos de hematuria microscópica evaluados con tomografía computarizada y cistoscopia de enero de 2006 a diciembre de 2009. Ambos estudios se consideraron como positivos en caso de identificarse una lesión sospechosa de neoplasia. El desempeño de la tomografía computarizada fue determinado mediante los resultados de la cistoscopia y los hallazgos histológicos. Resultados: Ciento doce pacientes fueron analizados. En 7 de ellos se identificó un tumor vesical por cistoscopia. La tomografía computarizada solo diagnosticó correctamente 2 casos y falló en 5. Un caso más fue considerado erróneamente como positivo en la tomografía computarizada. Esto resulta en una sensibilidad del 29%, especificidad del 99%, valor predictivo positivo del 67%, valor predictivo negativo del 95% y exactitud del 95%. Conclusiones: Aunque la tomografía computarizada tiene una especificidad alta en la evaluación de pacientes con hematuria microscópica, su sensibilidad es limitada. Por tal motivo la cistoscopia debe seguir siendo el estándar en estos casos.

Introduction

According to the American Urological Association (AUA for its acronym in English), the recommended definition of microscopic hematuria is the presence of 3 or more erythrocytes per high-power field in the urinary sediment analysis, confirmed in 2 out of 3 properly collected urine samples. The prevalence of this finding is from 0.19 to 21%, depending on the population studied, and those patients who are at risk of developing urological diseases or primary renal diseases should be evaluated comprehensively. This includes medical history with physical examination, laboratory and imaging studies of the upper urinary tract, and cystoscopy. In some cases, cytologic examination of exfoliated cells in urine can be performed. These recommendations are based on what was published in 2001 by the AUA, which establishes the need to perform cystoscopy because “imaging studies have limited utility for the detection of bladder tumors”. However, these guidelines are more than a decade old and technological advances have made the accuracy of imaging studies increase significantly.

Currently, computed tomography (CT) of the urinary tract is the gold standard for the study of various urological diseases, including microscopic hematuria. This method makes it possible to delineate the anatomy of the collecting systems during the elimination phase, which indirectly enables us to evaluate the urothelium. In the form of multiple detectors (MDCT), it provides complete assessment of the urinary tract by obtaining thin sections with high spatial resolution. This technique includes acquiring images before and after administration of intravenou contrast, and it has been proposed as the initial method for evaluating the urinary tract, so as to achieve the identification of anomalies of both the upper and lower tract.

The need to perform a cystoscopy in those patients with microscopic hematuria that have a normal CT has recently been questioned. For this reason, we decided to evaluate the accuracy of multislice CT for the detection of bladder tumors in a contemporary series of patients evaluated due to microscopic hematuria who also underwent cystoscopy.

Material and methods

All the patients with microscopic hematuria, evaluated from January 2006 to December 2009, referred to cystoscopy by the urologists members of our department, were included. This study was previously approved by the Institutional Committee of Biomedical Research in Humans of our institute. Microscopic hematuria was defined as the presence of 3 or more erythrocytes per high-power field in the microscopic evaluation of 2 consecutive urine samples. In all cases, the evaluation included a CT scan of the urinary tract and cystoscopy, with a maximum time between both studies of 4 months. In this analysis, we did not include patients who had previously identified urogenital malignancies or who had had gross hematuria or active urinary tract infection during the previous 12 months.

For the urinary tract CT (Siemens Somaton Sensation 64™ CT scanner, Siemens Medical Solutions), we administered 1.5 ml/kg body weight of nonionic intravenous contrast (Ultravist 300™; iopromide 300 mg/ml) at a speed of 3 ml/s. The thickness of each cut was 3 mm. Cranio-caudal images were acquired in 4 phases: 1 without contrast and 3 with contrast (corticomедullary, nephrographic, and pyelographic), with 120 kVp voltage, 300 mAs current, with CARE Dose 4D; acquisition of 64 mm x 0.6 mm, pitch of 1.4, FoV 395 mm, and B31 homogeneous medium filter. We did not use the bolus-tracking method. The corticomедullary phase was acquired at 35 s for the administration of the intravenous contrast, the nephrographic one at 100 s, and the pyelographic one at 10 min.

All patients underwent cystoscopy and this was considered positive in those where an injury requiring biopsy or
Table 1  Characteristics of the 7 tumors diagnosed in patients with microscopic hematuria.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Histopathological diagnosis</th>
<th>Tumor size</th>
<th>Detected in CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low-grade Ta TCC</td>
<td>10 mm</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>Papilloma</td>
<td>10 mm</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>Low-grade Ta TCC</td>
<td>30 mm</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>High-grade T1 TCC</td>
<td>15 mm</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>Malakoplakia</td>
<td>10 mm</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>Papilloma</td>
<td>2 mm</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>Low-grade Ta TCC</td>
<td>10 mm</td>
<td>No</td>
</tr>
</tbody>
</table>

TCC: transitional cell carcinoma.

resection and that was reported as malignant was found. We then compared the cystoscopic and histopathological findings with the radiological ones; the latter were considered positive if an injury suspicious for malignancy was reported.

We determined the specificity, sensitivity, positive predictive value (PPV), and negative predictive value (NPV) of the urinary tract CT for the detection of bladder tumors.

Results

A total of 112 patients were included. Of these, 71 were women and the rest men. The average age was 56 years. 42 (37.5%) had a history of smoking, 32 (28.5%) had autoimmune disease, and 2 (1.7%) reported occupational exposure to chemical agents. In the case of men, 20 (48.8%) had been previously diagnosed with benign prostatic enlargement.

In 7 cases a bladder tumor was diagnosed, 4 of them transitional cell carcinoma, resulting in a prevalence of 3.5% in this series of patients with microhematuria. The histopathological and image details are listed in Table 1.

Of the 7 tumors diagnosed, 2 were correctly identified in the CT (true positives) and 5 were not detected accurately (false negatives). In one additional case, the CT was considered positive, but the cystoscopy ruled out the presence of tumor (false positive).

The sensitivity was 29%, the specificity 99%, the PPV 67%, and the NPV 95%, with a diagnostic accuracy of 95%.

Discussion

The superiority of CT over other imaging methods has been proven, especially in case of upper urinary tract abnormalities or non-urological causes of microscopic hematuria, including vascular abnormalities. In recent years, the urological applications of CT have expanded and its accuracy in detecting bladder tumors has been evaluated. About 5% of patients with asymptomatic hematuria, and up to 22% of those with gross hematuria will have bladder cancer, so that effective diagnosis is crucial in this population.

Our results, which highlight the low effectiveness of CT as the only method of detecting bladder tumors, have been previously reported. Other authors are against the routine use of endoscopic evaluation in the event that the CT detects no abnormalities. Turney et al. analyzed the effectiveness of cystoscopy in patients over 40 with gross hematuria. They detected bladder cancer in 24% of the cases, with a sensitivity of 93%, specificity of 99%, and NPV of 98%. According to these results, the authors concluded that cystoscopy can be avoided in patients with negative CT for bladder cancer. Lang et al. reported similar results. Out of 350 patients evaluated, 12 had bladder tumors, all correctly identified by CT (sensitivity 100%). By contrast, other studies report a lower sensitivity. Sadow et al. evaluated 373 patients with gross hematuria and 249 with microhematuria. They found 54 bladder tumors in the first group and 7 in the second one. The sensitivity, specificity, accuracy, PPV, and NPV were 83, 94, 93, 71, and 97% in case of gross hematuria, and 43, 99, 97, 50, and 98% for microhematuria. Based on these results, they concluded that cystoscopy is not necessary when the CT is negative; however, in our opinion, in this analysis we would not have detected 9 out of 54 tumors in the group of macroscopic hematuria, and 4 out of 7 in the one of microhematuria that were identified by cystoscopy. Sudakoff et al. evaluated 468 patients with both macroscopic and microscopic hematuria by CT. In total, we found 39 bladder tumors, of which 16 (41%) were not correctly identified on the CT. They concluded that due to the low sensitivity of this study the cystoscopy cannot be eliminated in the evaluation of hematuria.

Our work has some flaws, including the retrospective nature of the analysis. Moreover, only conventional light cystoscopy was used. Although it was not one of our goals, technological advances and the use of other light sources could improve the detection of tumors not identified in imaging studies, which would impact on the diagnostic accuracy of CT. In addition, the imaging studies were performed by several radiologists. However, we believe that this situation is typical of an academic hospital and reflects everyday practice in a department of urology. Although a second evaluation by an uroradiologist, with emphasis on bladder anatomy could improve the results reported here, this strategy would be different from everyday clinical practice.

Conclusion

Although CT has a high specificity for the detection of bladder tumors, their sensitivity is low. For this reason, we believe that cystoscopy should remain an essential part of the evaluation of patients with microscopic hematuria and it should not be suppressed even when the CT reports normal findings.

Conflict of interest

The authors declare that they have no conflict of interest.
References


