CT cystoscopy capability in bladder tumor detection

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Purpose

Our goal is to assess the reliability of CT cystoscopy in patients with newly diagnosed bladder tumors in comparison with ultrasound findings, CT urography findings, cystoscopy and operative findings, as well as to determine how patients tolerate this method compared with conventional cystoscopy.

The aim of our study is to:

1. Determine whether there is a statistically significant difference in detection of bladder lesions by CT cystoscopy examination compared with other diagnostic methods we used.

2. Determine whether there is a statistically significant difference in determining the size of lesions by CT cystoscopy examination compared with other diagnostic methods we used.

3. How sensitive is this method in the detection of bladder tumor lesions compared with the operative findings, as well to determine is the method sensitive in the detections of bladder lesions smaller than or equal to 5 mm, compared with operative findings.

4. Ascertain how patients tolerate CT cystoscopy compared with conventional cystoscopy.
Methods and Materials

Clinical prospective nonrandomized study is performed in Center for radiology diagnostics in Clinical Hospital Center "Dr Dragisa Misovic - Dedinje", Belgrade, in cooperation with Clinic for Urology.

Patients characteristics:

The study group consisted of 32 patients (28 males, 4 females, from 42 to 78 years old, average age 60.59±9.43), with ultrasoundly diagnosed newfound intraluminal changes in urinary bladder, which was indication for cystoscopy. All patients were hospitalized at the Clinic for Urology, and before planned cystoscopy, with possible transurethral resection (TUR) of bladder (if they needed), CT cystoscopy was performed, for which patients were previously signed consent for its implementation.

Characteristics of patients were determined by gender, age, performance status, number and size of lesions in relation to each of the methods we used, also by the localisation of the tumor.

Performance status of patients was determined according to the recommendations of the World Health Organisation (WHO).

In all patients included in the study, diagnostic processing implied:

1. initial urological examination, then cystoscopic examination with biopsy
2. ultrasound examination of abdomen and pelvis
3. computerised tomography of abdomen and pelvis
4. chest radiography
5. laboratory findings

Ultrasound examinations of the abdomen and pelvis were performed on the equipment Alocca and Toshiba, with the sector probe of 3.5 MHz. Patients were placed in the supine position, had to have a full bladder, if it was not possible in a natural way, in terms of delay urinating, then clamping of previously appointed catheter or with its filling with saline. We also examined focal changes in the liver, retroperitoneal lymph nodes status (including all groups), a possible stasis in the kidneys due to infiltration of the bladder, as well as increasing of adrenal glands. Good ultrasound examination is a prerequisite for
accurate diagnosis, but also better and more accurate CT examination, especially when it comes to the differential diagnosis of focal changes in the liver (hemangioma in relation to metastases).

All CT cystoscopies are performed on Somatom Emotion 16, Siemens producer, with offered protocol, which includes examination of the entire abdomen and pelvis, i.e. the length of examined region is 40 cm, duration less than 40 seconds, collimation 1.5, slice thickness 1.5 mm, length of tube rotation 0.6 seconds, table movement 1.5 mm. The reconstruction is done at 1 mm. Contrast agent is intravenously applied, in the amount of 100 ml, through an automatic pump.

After emptying bladder, Foley catheter, diameter 10 - 12 F, was placed in it, in order to eliminate residual urine. Examination begins with insufflations of 300 - 500 ml of air (depending on tolerance) in the previously administrated patient’s urinary catheter. After scout scan, made while patient was lying on his back, so that the bladder can be located and determined the extent of its distension, we done CT breath hold examination. Then, the patient was turned on stomach, and CT scan was repeated with the same parameters. Scanning is done both in pronation and supination because of possible residual urine and its possibility to cover small changes in the urinary bladder.

Time of procedure performance, including catheter placement, was about 30-35 minutes, and the time of findings interpretation for each patient was no longer than 30 minutes. Data were transferred to an independent workstation with equipped software in order to intraluminal navigation with algorithm of surface rendering can be done.

By CT cystoscopy we detected tumors, analyzed the number and the size of tumors and determine the localization of lesions. From the clinical characteristics we analyzed gender, age, general condition of the patient. We also wanted to ascertain how patients tolerated this examination and how they feel afterwards. Patients were given questionnaire, based on how they felt about the intervention cystoscopy compared with CT cystoscopy, but the day after intervention, in order to eliminate the influence of anesthesia during answering. /Fig 1-4/

**Statistical methodology:**

The data, presented in clinical research, in order to be analized, required:

1. establishment of the database
2. statistical analysis of the data
3. tabulation and graphical presentation of the data
Images for this section:

Fig. 1

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Fig. 2

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Fig. 3

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Fig. 4

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Results

Demographic characteristics of patients:

In our group, gender patients distribution was 28:4 (87.5% males : 12.5% females), the majority of patients was aged 61 to 70 (12 patients, 37.5%), youngest patient had 42 years, oldest had 78 years, mean age was 60.59±9.43. /Fig 5./

Performans status

In the study group, most patients had good general condition. From 32 patients, 26 of them had performance status 0 (81.25%), 3 patients had performans status 1 (9.37%), 1 patient had performance status 2 and two patients (6.25%) had performance status 3. None of patients had performans status 4. /Fig 6./

Number of detected lesions

In 32 patients, 45 lesions were detected by ultrasound, and 3 more lesions were detected by CT urography. Virtual cystoscopy method detected 50 lesions, one more lesion was detected by conventional cystoscopy method, while 54 lesions were confirmed by operative findings. /Fig 7./

Comparison of the number of lesions detected by virtual cystoscopy compared to other diagnostic methods we used:

Comparing the number of detected lesions by virtual cystoscopy with other used diagnostic methods, using the Paired Samples T-test, a statistically significant difference (0.023, p<0.05) was noticed in detecting number of lesions by virtual cystoscopy and ultrasound examination. We also observed a statistically significant difference (0.044, p<0.05) in the number of lesions detected by virtual cystoscopy and operative findings. CT urography and conventional cystoscopy did not confirm statistically significant difference in the number of lesions comparing with CT cystoscopy.

Table 1. Statistical diagram of comparing the number of lesions detected by virtual cystoscopy to other diagnostic methods we used

<table>
<thead>
<tr>
<th>Method</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT cystoscopy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ultrasound</td>
<td>2.396</td>
<td>0.023*</td>
</tr>
<tr>
<td>CT urography</td>
<td>1.438</td>
<td>0.161</td>
</tr>
</tbody>
</table>
**Lesions size:**

A minimum lesion size, up to 5 mm, were diagnosed using ultrasound, CT urography and virtual cystoscopy, while smaller lesions, the size of 3 mm, were only diagnosed by conventional cystoscopy and confirmed by operative findings. The maximum size of the lesion was 66 mm.

<table>
<thead>
<tr>
<th>Diagnostic method</th>
<th>Number of lesions</th>
<th>Min.(mm)</th>
<th>Max.(mm)</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ultrasound</td>
<td>46</td>
<td>4</td>
<td>63</td>
<td>18,89</td>
<td>14,48</td>
</tr>
<tr>
<td>CT urography</td>
<td>48</td>
<td>4</td>
<td>65</td>
<td>18,13</td>
<td>14,34</td>
</tr>
<tr>
<td>CT cystoscopy</td>
<td>50</td>
<td>4</td>
<td>66</td>
<td>18,08</td>
<td>14,76</td>
</tr>
<tr>
<td>conventional cystoscopy</td>
<td>51</td>
<td>3</td>
<td>66</td>
<td>17,71</td>
<td>14,79</td>
</tr>
<tr>
<td>operative findings</td>
<td>54</td>
<td>3</td>
<td>66</td>
<td>17,02</td>
<td>14,65</td>
</tr>
</tbody>
</table>

Total of 9 lesions smaller or equal to 5 mm were diagnosed using virtual cystoscopy, 5 of them were 5 mm size.

**Comparison of the size of lesions detected by virtual cystoscopy compared to other diagnostic methods we used**

<table>
<thead>
<tr>
<th>Diagnostic method</th>
<th>Number of lesions</th>
<th>Min.(mm)</th>
<th>Max.(mm)</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>convenc. cystoscopy</td>
<td></td>
<td></td>
<td></td>
<td>-0,442</td>
<td>0,662</td>
</tr>
<tr>
<td>operative findings</td>
<td></td>
<td></td>
<td></td>
<td>-2,104</td>
<td>0,044*</td>
</tr>
</tbody>
</table>

* p< 0,05 statistically significant difference
Comparing the size of detected lesions by virtual cystoscopy with other used diagnostic methods, using the Pair Samples T-test, there was no statistically significant difference (p<0.05) in the size of lesions detected by virtual cystoscopy and other diagnostic methods we used.

**Table 3. Statistical diagram of comparing the size of lesions detected by virtual cystoscopy to other diagnostic methods we used**

<table>
<thead>
<tr>
<th>Method</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT cystoscopy</td>
<td>-1.170</td>
<td>0.248</td>
</tr>
<tr>
<td>ultrasound</td>
<td>0.248</td>
<td></td>
</tr>
<tr>
<td>CT urography</td>
<td>-0.066</td>
<td>0.947</td>
</tr>
<tr>
<td>convenc. cystoscopy</td>
<td>0.402</td>
<td>0.689</td>
</tr>
<tr>
<td>operative findings</td>
<td>1.400</td>
<td>0.168</td>
</tr>
</tbody>
</table>

*p< 0.05 statistically significant difference*

Using CT cystoscopy we did not detected 4 lesions, which were confirmed by operative findings. Each of these lesions was less than 5 mm.

**Lesions localization:**

We accepted anatomical segmentation of the urinary bladder in six segments: anterior, posterior, right and left wall, superior and inferior. With the method of CT cystoscopy, from total of 50 lesions detected, the majority of patients had a lesion on the posterior wall of the bladder, which is 42% of all lesions detected by virtual cystoscopy (21 lesions). 22% of lesions were detected on the inferior part of the urinary bladder and 18% of lesions were found on the right wall of the bladder. A smaller percent of lesions, 8%, were detected on the left wall and almost identical percent of lesions was detected in the anterior and the superior segment of the urinary bladder. Two patients had a lesion in the urinary bladder diverticulum. /Fig 8./

**Increased lymph nodes and metastases:**

In our group of 32 patients, 21.87% (7 patients) had enlarged lymph nodes, two of them were female. 12.5% of patients (4 patients) had secondary deposits and only one person
was female. The youngest patient with secondary deposits was 48 years old and the oldest was 76 years old. A female who had secondary deposits was 65 years old.

The questionnaire that patients filled out a day after the examination on computed tomographic cystoscopy contained, except the basic demographic data, the following questions:

1. Did you feel discomfortable during the CT cystoscopy examination?
2. Did you feel pain during the CT cystoscopy examination?
3. Would you repeat this examination if its needed?
4. Did you tolerate this examination easier than conventional cystoscopy examination?

Patients were offered a choice of two answers: "yes" and "no".

From the total number of examined patients by CT cystoscopy, 7 of them (21.9%) said that they felt uncomfortable during this examination. The most common answer was that they felt claustrophobic, had fear of unknown and two patients said they are afraid of radiation.

Only 4 patients (12.5%) stated that they felt the pain during the CT cystoscopy examination and all patients were male gender.

From the total number of examined patients, 27 of them (84.4%) would repeat CT cystoscopy, if it would be needed.

From the total of 32 patients, 4 patients (12.5%) easier tolerated conventional cystoscopy comparing with CT cystoscopy.
Fig. 5: Age structure of patients

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Fig. 6: Performance status of patients

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Fig. 7: Number of detected lesions according to diagnostic method

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**Fig. 8:** Distribution of urinary bladder lesions according to the localisation

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Conclusion

1. CT cystoscopy is reliable method for urinary bladder lesions detection.

2. CT cystoscopy is reliable method for urinary bladder lesions size detection.

3. CT cystoscopy is sensitive in the diagnosis of bladder lesions. Precision of the method compared to operative findings was 92.5%. In the detection of lesions equal or smaller than 5 mm compared with conventional cystoscopy, accuracy was 75%.

4. In our study, patients better tolerated CT cystoscopy examination comparing with conventional cystoscopy.

CT cystoscopy is the examination method of choice for patients who can not be examined by conventional cystoscopy: patients with urethral strictures or prostate hypertrophy, patients with penis cancer, cardiac patients problematic for anesthesia or those who are allergic to it. Also, it is suitable for patients in monitoring the primary disease of the urinary bladder, important for detecting tumor changes in bladder diverticulum, that are not detected in conventional cystoscopy examination.

The negative aspects are certain dose of radiation, problem in detecting lesions smaller than 5 mm size, and the "flat" lesions or carcinoma in situ, also impossibility of biopsy and histopathological verification of the lesion. Sometimes, the problem can be thickening of the mucosa of the bladder caused by fibrosis, when it can not be distinguished from neoplasmas.

Although CT cystoscopy examination in our study proved as extremely valuable examination in the detection and definition of lesion size in the urinary bladder, it can not be the only method in the detection of these lesions. It is not competitive technique, but it can be complementary method in the future, also with the improvement of the software system, expecting one day to include in the diagnostic algorithm of recommendations for hematuria evaluation. /Fig 9-11/
Fig. 9

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Fig. 10

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Fig. 11

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