Multislice computed tomography urography in the diagnosis of urinary tract diseases

Višeslojna kompjuterizovano-tomografska urografija u dijagnostici oboljenja urinarnog trakta

Olivera Nikolić, Sanja Stojanović, Viktor Till, Marijana Basta Nikolić, Kosta Petrović, Viktorija Vučaj Ćirilović

Clinical Center of Vojvodina, Center of Radiology, Novi Sad, Serbia

Abstract

Background/Aim. Multislice computed tomography (MSCT) has triggered considerable changes in uroradiological imaging. The aim of this study was to establish the place of MSCT urography (MSCTU) in comparison with intravenous urography (IVU) and to determine the sensitivity and specificity of MSCT in the evaluation of urothelial abnormalities. Methods. This prospective study included 120 patients with a high clinical suspicion of urinary tract diseases divided into two groups. The group I consisted of 60 patients with macroscopic hematuria, bladder carcinoma and malignant pelvic tumors after radiotherapy or operation. They underwent both IVU and MSCTU. The group II included 60 patients (≥ 40 years old) with retroperitoneal and malignant pelvic tumors, complicated pyelonephritis, microscopic hematuria, acute urinary tract obstruction (without visible calculi on unenhanced scans), and they were submitted to computed tomography with additional scan phase enabling MSCTU. Results. Compared with IVU, MSCTU is more sensitive for the detection of urinary tract diseases (parenchymal changes, renal tumors, urolithiasis, fibrosis) and extrarenal processes. MSCTU is more specific than IVU for renal parenchymal abnormalities, tumors of the excretory system, urolithiasis, bladder tumors, fibrosis and extrarenal diseases. MSCTU is equally sensitive, but more specific for hydronephrosis compared to MSCT. The diagnosis made by the use of MSCTU in patients with macroscopic and microscopic hematuria and with obstruction not caused by stones, perfectly comply with operative findings and histological diagnosis. Conclusion. The obtained results support MSCTU to be the modality of choice in the diagnostic algorithm of patients with macroscopic hematuria and in the evaluation of microscopic hematuria and unexplained obstruction of the urinary tract. The only remaining role for IVU in our institution is imaging of the upper urinary tract in patients with hematuria under the age of 40.

Key words: urologic diseases; diagnosis; urography; tomography, x-ray computed; diagnostic techniques and procedures.

Apstrakt

Uvod/Cilj. Uvođenje višeslojne kompjuterizovane tomografije (multislice computed tomography – MSCT) dovelo je do značajnih promena u uroradiološkom snimanju. Cilj ove studije bio je da se utvrde mesto MSCT urografije (MSCTU) u odnosu na intravensku urografiju (IVU), kao i da se odredi senzitivnost i specifičnost MSCTU za određivanje patoloških promena urotela. Metode. U ovo prospektivno istraživanje bilo je uključeno 120 bolesnika sa višokom sumnjom na oboljenje urinarnog trakta. Bolesnici su bili podeljeni u dve grupe. U grupi I bilo je 60 bolesnika sa makro- skopskom hematurijom, karcinomom mokraće bešike i malignim tumorima u karlici nakon zračenja ili operacije i svima su urađeni IVU i MSCTU. U grupi II bilo je 60 bolesnika životnog doba ≥ 40 godina sa retroperitonealnim i malignim tumorima u karlici, komplikovanim pijelonefritismom, mikrokoskopskom hematurijom, akutnom opstrukcijom urinarnog trakta (bez prisustva konkretnih simptoma), a svima je urađen pregled kompjuterizovanoj tomografiji i dodatna faza koja omogućava MSCTU. Rezultati. U odnosu na IVU, MSCTU je senzitivnija u detekciji oboljenja urinarnog trakta (parenhimske promene, tumori bubrega, urolitijazu, fibrozu) i ekstra-urinarnih procesa. Tehnika MSCTU je specifičnija od IVU za parenhimske promene bubrega, tumore ciskretornog sistema, urolitijazu, tumore mokraće bešike, fibrozu i ekstra-urinarnim oboljenjem. Tehnika MSCTU podjednako je senzitivna, ali specifičnija za hidronefroz u odnosu na MSCT. Dijagnosticne postavljene pomoći MSCTU kod bolesnika sa makroskopskom i mikroskopskom hematurijom, kao i opstrukcijom koja nije izazvana konkretnijom, u visokoj su saglasnosti sa operativnim i patohistološkim nalazom. Zaključak. Dobijeni rezultati ukazuju na to da je MSCTU metoda izbora u dijagnostičkom algoritmu kod bolesnika sa makroskopskom i mikroskopskom hematurijom, kao i za analizu bolesnika sa nerazjašnjenoj opstrukcijom urinarnog trakta. Jedina preostala primena za IVU u našoj ustanovi je vizualizacija gornjeg urinarnog trakta kod bolesnika sa hematurijom mladih od 40 godina.

Key words: urologic diseases; diagnosis; urography; tomography, x-ray computed; diagnostic techniques and procedures.

Apstrakt

Uvod/Cilj. Uvođenje višeslojne kompjuterizovane tomografije (multislice computed tomography – MSCT) dovelo je do značajnih promena u uroradiološkom snimanju. Cilj ove studije bio je da se utvrde mesto MSCT urografije (MSCTU) u odnosu na intravensku urografiju (IVU), kao i da se odredi senzitivnost i specifičnost MSCTU za određivanje patoloških promena urotela. Metode. U ovo prospektivno istraživanje bilo je uključeno 120 bolesnika sa višokom sumnjom na oboljenje urinarnog trakta. Bolesnici su bili podeljeni u dve grupe. U grupi I bilo je 60 bolesnika sa makroskopskom hematurijom, karcinomom mokraće bešike i malignim tumorima u karlici nakon zračenja ili operacije i svima su urađeni IVU i MSCTU. U grupi II bilo je 60 bolesnika životnog doba ≥ 40 godina sa retroperitonealnim i malignim tumorima u karlici, komplikovanim pijelonefritismom, mikroskopskom hematurijom, akutnom opstrukcijom urinarnog trakta (bez prisustva konkretna simptoma) i ekstra-urinarnim oboljenjem. Tehnika MSCTU je podjednako senzitivna, ali specifičnija za hidronefroz u odnosu na MSCT. Dijagnosticne postavljene pomoći MSCTU kod bolesnika sa makroskopskom i mikroskopskom hematurijom, kao i opstrukcijom koja nije izazvana konkretnijom, u visokoj su saglasnosti sa operativnim i patohistološkim nalazom. Zaključak. Dobijeni rezultati ukazuju na to da je MSCTU metoda izbora u dijagnostičkom algoritmu kod bolesnika sa makroskopskom i mikroskopskom hematurijom, kao i za analizu bolesnika sa nerazjašnjenoj opstrukcijom urinarnog trakta. Jedina preostala primena za IVU u našoj ustanovi je vizualizacija gornjeg urinarnog trakta kod bolesnika sa hematurijom mladih od 40 godina.

Key words: urologic diseases; diagnosis; urography; tomography, x-ray computed; diagnostic techniques and procedures.

Ključne reči: urološke bolesti; dijagnoza; urografija; tomografija, kompjuterizovana, rengdenska; dijagnostičke tehnike i procedure.

Correspondence to: Olivera Nikolić, Clinical Center of Vojvodina, Center of Radiology, Hajduk Veljkova 1–7, 21 000 Novi Sad, Serbia. Phone: +381 21 520 577. E-mail: nikolic.olivera@gmail.com
Introduction

Until the beginning of the 21st century, intravenous urography (IVU) was the initial method for urinary tract imaging in patients with hematuria, renal colic and other urological disorders. The introduction of multislice computed tomography (MSCT) had considerable impact on uroradiological imaging and imaging algorithms. The application of MSCT specifically designed for the evaluation of urinary tract diseases is called MSCT urography (MSCTU). MSCTU implies the examination of the complete urinary tract, as well as the surrounding anatomic structures, during a single examination, by multiple thin overlapping scans and 2D and 3D postprocessing with specific software packages. This procedure provides images with high spatial resolution similar to IVU. 

In literature, there are no available on prospective surveys reporting that MSCTU possesses equal capacity in imaging morphological details as IVU. Although clinical comparative studies are lacking, a complete shift from IVU to MSCTU is expected. Bearing this in mind, it is a challenge to make a scientific step-out in this field, which is likely to trigger further surveys in order to confirm the position and the value of MSCTU in modern uroradiological diagnostic algorithm.

Methods

This single institution prospective analysis was performed on 120 patients with a high clinical suspicion of urinary tract disease. The patients were divided into two groups. Depending on the referring diagnosis the patients underwent both IVU and MSCTU or MSCTU as a single examination. The study was approved by the Ethical Committee of the hospital. The advantages of MSCTU in diagnosing urinary tract diseases were evaluated in comparison with IVU and a ‘conventional’ MSCT examination. In the group I of patients undergoing IVU and MSCTU the correlation of findings was focused on: renal parenchymal abnormalities, renal pelvis and calices, renal calculi, proximal ureter, middle ureter, distal ureter, bladder.

The analyses by segments listed for the group I was also performed in the group II of patients (scheduled for MSCTU only). MSCTU was performed according to the following protocol: plain unenhanced scan (low-dose scan) from the kidneys to the pubic symphysis; 10 mg of ioverside injected intravenously (iv) prior to iv administration of iv iodinated contrast medium; arterial phase of the kidneys (25 sec delay); venous phase 60 seconds (sec) after the arterial phase; the area from the kidneys to the symphysis scanning; ten min after the iodinated contrast was injected, a single control scan through the middle part of the kidney was performed to confirm appropriate filling of the renal pelvis. The appropriate filling of the renal pelvis initiated a scout topogram from the kidneys to the symphysis to evaluate appropriate ureteral opacification. If the scout topogram was satisfactory, the next phase was performed; excretory phase or ‘urography’ (low-dose scan).

The patients were given to drink 600 mL of water 20 min prior to the examination to distend bowel loops and to increase diuresis and distension of the collecting system. A quantity of 120 mL of iodinated contrast medium (300 mg I/mL) was injected at a rate of 4 mL/sec. All examinations were performed in the Institute of Radiology, Clinical Center, Novi Sad. Computed tomography (CT) and MSCTU were performed by a Siemens Somatom Sensation Cardiac 64 scanner and IVU by Telestatix Ei Nis X ray machine, a control unit Innomed TOP-X HF. Examinations were independently interpreted by the two radiologists with equal expertise in uroradiology and the results were analyzed statistically.

Sample selection

The prospective study included 120 patients with a high clinical suspicion of urinary tract disease – 1) patients with macroscopic hematuria scheduled for IVU: both IVU and MSCTU were performed; 2) patients with bladder cancer discovered by cystoscopy or ultrasonography (US) planned for IVU: both IVU and MSCTU were performed; 3) patients with malignant pelvic tumors, after radiation and/or operation, having signs of urinary tract obstruction: both IVU and MSCTU were performed; 4) patients with a suspicion of acute obstruction of the urinary tract (renal colic): MSCTU was performed when no visible calculi on unenhanced scans were detected; 5) patients with retroperitoneal and malignant pelvic tumors planned for CT examination before operation and/or radiation therapy; CT examination + additional phase enabling MSCTU examination were performed; 6) patients with complicated pyelonephritis planned for CT examination: CT examination + 1 phase enabling MSCTU examination were performed; 7) patients (older than 40) with microscopic hematuria: CT examination + additional phase enabling MSCTU were performed.

The group I consisted of 60 patients who underwent IVU + MSCTU. The group II consisted of 60 patients who underwent a CT examination + additional phase enabling MSCTU examination. All the patients included in the study had urea and creatinine levels within normal limits. The exclusion criteria used in the selection of the subjects were low suspicion of urinary tract disease, and patients with microscopic hematuria below the age of 40.

The aim of this study was to examine the place of MSCTU in comparison with IVU as well as to determine the sensitivity and specificity of MSCTU in the evaluation of urothelial abnormalities.

Results

Visualization of urinary tract abnormalities

The Wilcoxon signed rank test p-values (the patients from the group I, the first and the second radiologist) for the quality of urinary tract abnormalities visualization (intraluminal defects, urinary tract without excretory function, intraluminal soft tissue abnormalities, calculi, extraluminal abnormalities) by IVU and MSCTU were statistically significant (Table 1). Comparing the p-values for urinary tract abnormalities visualization (the patients from the group I) in-

dependently interpreted by the two radiologists, there were no statistically significant differences found.

The Wilcoxon signed rank test \( p \)-values (the patients from the group II, the first and the second radiologists) for the quality of urinary tract abnormalities visualization (urinary tract without excretory function, calculi, extraurinary abnormalities) by MSCT and MSCTU were not statistically significant. Comparing the \( p \)-values for urinary tract abnormalities visualization (MSCT and MSCTU) independently interpreted by the two radiologists, there were no statistically significant differences found.

**Sensitivity**

The \( p \)-values for the matched pairs sensitivity (patients from the group I) of IVU and MSCTU for parenchymal abnormalities, renal tumors, hydronephrosis, urolithiasis, extraurinary abnormalities and fibrosis were statistically significant. The \( p \)-values for the matched pairs sensitivity (the patients from the group I) of IVU and MSCTU for pelvicaliceal and bladder tumors were not statistically significant (Table 2).

The Wilcoxon signed rank test \( p \)-values for the comparison of the diagnosis based on MSCTU and operative findings and those based on MSCTU and histological findings (the patients from the group I) were not statistically significant.

The Wilcoxon signed rank test \( p \)-values (the patients from the group II) for the sensitivity of MSCT and MSCTU for pyelonephritis, renal tumors, hydronephrosis, pelvic tumors, renal calculi, extrarenal lithiasis, extraurinary abnormalities, fibrosis, spontaneous rupture and bleeding were not significant.

The \( p \)-value for the matched pairs diagnosis based on MSCTU and operative findings and the diagnosis based on MSCTU and histological findings (the patients from the group II) were not significant.

**Specificity**

The Wilcoxon signed rank test \( p \)-values (the patients from the group I) for the specificity of urinary tract abnormalities (parenchymal abnormalities, renal tumors, hydronephrosis, pelvicaliceal tumors, urolithiasis, bladder tumors, extraurinary abnormalities and fibrosis) by IVU and MSCTU were statistically significant (Table 3).

### Table 1

<table>
<thead>
<tr>
<th>Matched pairs of variables</th>
<th>No.</th>
<th>( Z )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraluminal defect by IVU &amp; MSCTU</td>
<td>21</td>
<td>3.723555</td>
<td>0.000196*</td>
</tr>
<tr>
<td>No. excretory function by IVU &amp; MSCTU</td>
<td>15</td>
<td>3.179797</td>
<td>0.001474*</td>
</tr>
<tr>
<td>Intralum. soft tissue abnormal. by IVU &amp; MSCTU</td>
<td>17</td>
<td>3.621365</td>
<td>0.000293*</td>
</tr>
<tr>
<td>Calculus by IVU &amp; MSCTU</td>
<td>14</td>
<td>2.934058</td>
<td>0.003346*</td>
</tr>
<tr>
<td>Extra-urinary abnormalities by IVU &amp; MSCTU</td>
<td>38</td>
<td>5.372093</td>
<td>0.000000*</td>
</tr>
</tbody>
</table>

*statistically significant differences

IVU – intravenous urography; MSCTU – multislice computed tomography urography

### Table 2

<table>
<thead>
<tr>
<th>Matched pairs of variables</th>
<th>No.</th>
<th>( Z )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parenchymal abnormalities by IVU &amp; MSCTU</td>
<td>9</td>
<td>2.665570</td>
<td>0.007686*</td>
</tr>
<tr>
<td>Renal tumors by IVU &amp; MSCTU</td>
<td>4</td>
<td>2.665570</td>
<td>0.007686*</td>
</tr>
<tr>
<td>Hydronephrosis by IVU &amp; MSCTU</td>
<td>21</td>
<td>2.934058</td>
<td>0.003346*</td>
</tr>
<tr>
<td>Pyelocaliceal tumors by IVU &amp; MSCTU</td>
<td>6</td>
<td>1.000000</td>
<td>0.316983</td>
</tr>
<tr>
<td>Urolithiasis by IVU &amp; MSCTU</td>
<td>14</td>
<td>2.665570</td>
<td>0.007686*</td>
</tr>
<tr>
<td>Bladder tumors by IVU &amp; MSCTU</td>
<td>15</td>
<td>2.022600</td>
<td>0.043115</td>
</tr>
<tr>
<td>Extra-urinary abnormalities IVU &amp; MSCTU</td>
<td>11</td>
<td>2.934058</td>
<td>0.003346*</td>
</tr>
<tr>
<td>Fibrosis by IVU &amp; MSCTU</td>
<td>10</td>
<td>2.803060</td>
<td>0.005062*</td>
</tr>
</tbody>
</table>

*statistically significant differences

### Table 3

<table>
<thead>
<tr>
<th>Matched pairs of variables</th>
<th>No.</th>
<th>( Z )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parenchymal abnormalities by IVU &amp; MSCTU</td>
<td>9</td>
<td>2.665570</td>
<td>0.007686*</td>
</tr>
<tr>
<td>Renal tumors by IVU &amp; MSCTU</td>
<td>4</td>
<td>2.665570</td>
<td>0.007686*</td>
</tr>
<tr>
<td>Hydronephrosis by IVU &amp; MSCTU</td>
<td>21</td>
<td>2.934058</td>
<td>0.003346*</td>
</tr>
<tr>
<td>Pyelocaliceal tumors by IVU &amp; MSCTU</td>
<td>6</td>
<td>2.665570</td>
<td>0.007686*</td>
</tr>
<tr>
<td>Urolithiasis by IVU &amp; MSCTU</td>
<td>11</td>
<td>2.665570</td>
<td>0.007686*</td>
</tr>
<tr>
<td>Bladder tumors by IVU &amp; MSCTU</td>
<td>15</td>
<td>3.295765</td>
<td>0.000982*</td>
</tr>
<tr>
<td>Extra-urinary abnormalities IVU &amp; MSCTU</td>
<td>11</td>
<td>2.934058</td>
<td>0.003346*</td>
</tr>
<tr>
<td>Fibrosis by IVU &amp; MSCTU</td>
<td>10</td>
<td>2.803060</td>
<td>0.005062*</td>
</tr>
</tbody>
</table>

*statistically significant differences

IVU – intravenous urography; MSCTU – multislice computed tomography urography

---

The Wilcoxon signed rank test \( p \)-values (the patients from the group II) for the specificity of urinary tract abnormalities (pyelonephritis, renal tumors, pelvic tumors, renal lithiasis, extrarenal lithiasis, extraurinary abnormalities and fibrosis) by MSCT and MSCTU were not statistically significant.

The \( p \)-value for the matched pairs specificity of hydronephrosis by MSCT and MSCTU was statistically significant.

Figure 1 (a and b) shows the right-sided tumor of the renal pelvis detected by intravenous urography and multiplanar reformated coronal image. The maximum intensity projection and multiplanar reformated axial images, revealed the left-sided hydronephrosis as a consequence of fibrous changes caused by Morbus Crohn (Figures 2, a and b).

**Discussion**

Visualization of the excretory system was better by the MSCTU method due to a dedicated protocol, including routine administration of diuretic, oral hydration (facilitating distension of excretory system and urinary bladder) and scout topogram (at the level of iliac crests). In some cases there were problems with optimal opacification of distal ureter by the MSCTU. That result was similar to the results of the studies performed by Kawamoto et al. 4 and Ernsting et al. 5.

MSCTU was more precise in the visualization of the urinary tract pathologies in the group I of patients. The differential diagnosis for intraluminal defect at IVU included non-calcified concrement, tumor, clot, mycetoma or...
sloughed renal papilla. In our study, like in the majority of the reported studies, the defect could be clearly defined on MSCTU.

In the cases of adequate renal function, IVU and MSCTU were equally sensitive for hydronephrosis. However, in our survey, there were patients with impaired kidney function or even with preserved renal function (renal and multifocal transitional cell carcinoma – TCC, bladder TCC with infiltration of ureteral orifice and subsequent hydronephrosis, postirradiation fibrosis and obstruction by cervical cancer) where the pelvicaliceal system and ureter was not opacified at IVU, while the excretory system was clearly outlined at MSCTU.

This survey confirmed that MSCTU was superior to IVU in the visualization of urinary calculi and other causes of acute lumbar pain, including extrarrenal disorders. The cited authors reported that unenhanced CT was 100% sensitive for calculi. Contrary to IVU, MSCTU was reported to visualize extrarrenal pathologies, considered as a major advantage.

As in the previous studies, this study confirmed that MSCTU and MSCT were more sensitive in detecting renal parenchymal disorders than IVU. MSCTU was more sensitive for kidney tumors than IVU in our prospective study, which was proved in the cited literature.

IVU and MSCTU were equally sensitive in detecting tumors in the renal pelvis in 5 of 6 patients from the group I. In one case they were different (the patient with multifocal TCC), as IVU had not visualized the pelvicaliceal system (the absence of renal function due to hydronephrosis).

In our study MSCTU was more sensitive and specific in detecting urolithiasis than IVU. Such results were confirmed in the literature.

There were no statistically significant differences in sensitivity between MSCTU and IVU for bladder tumors in our survey. IVU was insufficient in displaying focal thickening of the bladder wall in patients who previously underwent transurethral resection (TUR) of bladder tumor. Thickening of the bladder wall was observed on MSCTU, and recurrence was suspected, but cystoscopy showed fibrous changes after TUR. IVU and MSCTU were equally sensitive for larger polypoid bladder tumors. Infiltrative tumors of the urinary bladder on IVU were presented as finger-like filling defects, while MSCTU visualized thickening of the wall, as well as perivesical changes (fat tissue infiltration, locoregional lymphadenopathy, infiltration of surrounding organs – seminal vesicles and prostate) for which IVU was insufficient. In a patient with retroperitoneal infiltration, spreading to the anterior-upper wall of the urinary bladder, IVU presented normal findings, while MSCTU displayed the disease. In general, MSCTU was more sensitive for urinary bladder tumors with a preserved bladder shape and with minimal wall thickening, but in our survey bigger polypoid bladder tumors were detected, for which IVU and MSCTU were equally sensitive.

When analyzing the diagnosis set by MSCTU compared to the operative findings and histological diagnosis, there were no statistically significant differences, which indicated that MSCTU enabled the correct diagnosis for the majority of patients in our study. MSCTU diagnosis was not correct in the two patients from the group I. One patient had massive hematuria, with the presence of soft tissue structure in the region of ureteropelvic junction (UPJ) and upper pole calyces, with attenuation numbers suggesting the presence of clots. The suspicion of underlying malignancy was not confirmed on imaging studies. However, the clinicians decided to perform total nephrectomy, as hematuria was long-lasting and massive. Histological diagnosis showed chronic pyelonephritis, with areas of dysplastic epithelium. In another patient with massive hematuria from the group I, intraluminal clots and discrete irregularities of several calices were seen on MSCTU, raising suspicion of papillary necrosis. After the surgery, histological analysis showed the presence of TCC.

MSCTU was superior to IVU when comparing the specificity for parenchymal abnormalities in the group I of patients. In our survey, the superiority of MSCTU for parenchymal abnormalities related to the changes in pyelonephritis and parenchymal tumors was obviated. Such results have already been reported. MSCTU was more specific for hydronephrosis than IVU in the group I of patients, because it could determine the cause of hydronephrosis even in the patients with the absence of renal excretory function. MSCTU was more specific compared to IVU for tumors of the excretory system (Figure 1) and bladder in the group I of patients. IVU visualized defects, but IVU alone did not enable the final diagnosis, as the same appearance might be mimicked by neoplasm, coagulum, non-calciﬁed concrement or sloughed papillae. MSCTU provides information on lesion characterization and on tumor stage. Cystoscopy is still considered the gold standard in the diagnosis of urinary bladder tumors, but MSCTU is a challenging competitor.

MSCTU was more specific than MSCT for hydronephrosis in the group II of patients, i.e. deﬁning the cause of hydronephrosis. This result was obtained because of the superiority of MSCTU to MSCT in patients with obstruction without visible concrement on plain, unenhanced scans (in 7 patients). The causes of hydronephrosis were rectosigmoidal cancer with extraluminal spread and inﬁltration of the distal ureter, aberrant arteries, stenosis of UPJ, Crohn’s disease with ﬁbrous alterations involving the ureter (Figure 2) and ﬁbrous postoperative changes in the pelvis. The ﬁndings were equivocal in all the listed cases (with the exception of ﬁbrous changes) because of the wall thickening, which could also indicate inﬁltration. Despite the equivocality, MSCTU provided an accurate diagnosis. MSCTU was performed according to the special protocol which enabled better visualization of the urinary tract compared to the standard MSCT examination, and, therefore, the level of obstruction can be evaluated appropriately. The integral part of MSCTU protocol is the arterial phase, which can clearly show aberrant arteries and maximum-intensity projection (MIP) reconstructions in postprocessing can show stenosis. MSCT findings suspected hydronephrosis without a visible concrement, but MSCTU in excretory phase clearly showed peripelvic cysts in one patient from the group II.
Conclusion

The obtained results support MSCTU to be the modality of choice in the diagnostic algorithm of patients with macroscopic hematuria and in evaluation of microscopic hematuria and unexplained obstruction of the urinary tract. The only remaining role for IVU in our institution is imaging of the upper urinary tract in patients with hematuria under the age of 40.

REFERENCES


Received on February 11, 2010. Accepted on March 17, 2010.