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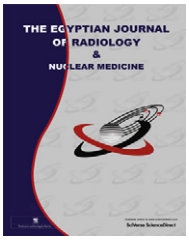

ORIGINAL ARTICLE

Assessment of ureteric obstruction with 16-MDCT: Curved planar reformats versus three-dimensional volume-rendered images and their corresponding maximum intensity projections

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KEYWORDS

Mutidetector CT urography;
Postprocessing techniques;
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Abstract *Aim:* To compare the sensitivity and diagnostic accuracy of curved planar reformation (CPR) image on the one hand versus combined volume-rendered (VR) image and its corresponding maximum intensity projection (MIP) image on the other hand for determination of the cause and level of ureteral obstruction.

Materials and methods: The study included 60 patients with clinical and sonographic manifestations of ureteral obstruction who underwent two-phase multidetector CT urography (MDCTU) using a 16-slice machine. A total of 82 ureters were examined. CPR images were performed to display the entire course of ureters in the same image. 3D VR reformats and their corresponding MIP were used to enhance visualization of opacified ureters. The sensitivity and accuracy of CPR, and combined 3D VR and MIP for diagnosis of ureteral obstruction were calculated and compared in reference to the gold standard.

Abbreviations: MDCTU, multidetector CT urography; CPR, curved planar reformation; 3D VR, three-dimensional volume-rendered; MIP, maximum intensity projection.

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Results: The cause of ureteral obstruction was calculous in 28/82 ureters (34.14%), and noncalculous in 50/82 (61%). The lower third ureter was the most affected level in 48/82 ureters (58.5%). The total sensitivity and accuracy of CPR for the cause of the ureteric obstruction (97.5% and 95.3%, respectively) were higher than those of 3D VR and its corresponding MIP (75% and 73.2%, respectively). CPR also was more sensitive and accurate (total sensitivity of 100% and accuracy of 100%) compared with those of combined 3D VR and its corresponding MIP (79.5% and 75.9%, respectively) for the level of ureteral obstruction.

Conclusions: CPR had superior diagnostic accuracy than 3D VR and MIP in detecting the cause and level of ureteral obstruction.

1. Introduction

Ureteric obstruction is defined as the blockage of any part of the ureter causing obstruction of urine flow from the kidney to the urinary bladder (1). It can be classified into congenital and acquired, intraluminal or extraluminal (2,3). Many imaging modalities are used to evaluate the obstructive uropathy each with its own benefits and limitations (4). Technologic advances in both computed tomography (CT) and magnetic resonance (MR) imaging have resulted in the ability to image the urinary tract in ways that surpass the intravenous urogram (5).

With the introduction of multidetector technology, multidetector CT urography (MDCTU) has become the test of choice for many urologic problems (5). The main advantage of multidetector CT urography (MDCTU) is its ability to provide a detailed anatomic depiction of each portion of the urinary tract (6). It also offers several advantages for imaging of the obstructive uropathy including: single breath-hold coverage of the entire urinary tract and rapid imaging with optimum contrast medium opacification (7–9).

By using MDCT, it is possible to employ different postprocessing techniques in addition to source axial images. Multiplanar reformation (MPR), curved planar reformations (CPR), maximum intensity projections (MIP), volume-rendering technique (VRT), and shaded surface displays (SSD) are currently the most frequently used (10). MPR is the most commonly used post processing technique, however its limitation is that visualized structures must be on the same plane. CPR provides the most useful luminal assessment and improves the visualization of tortuous anatomy. High-density structures, such as contrast-filled vessels and the collecting system, are demonstrated nicely in maximum intensity projection (MIP) images. Volume-rendered technique (VRT) is an excellent 3D technique that provides a summary picture for the referring physician (10–13).

A deeper knowledge of the potential of postprocessing techniques and their application will allow optimization of the MDCTU. The aim of our study was to compare the sensitivity and diagnostic accuracy of CPR on one hand versus combined VRT and MIP on the other hand for determination of the cause and level of ureteral obstruction.

2. Patients and methods

2.1. Patient population

This prospective study was approved by the local research ethics committee of our institution. During the period between March 2011 and April 2012, 60 consecutive patients (38 males and 22 females, age range, 38–64 years; mean age, 45.3 years ± 14.8[SD]), were referred from Urology Clinic with a diagnosis of un-explained ureteral obstruction based on ultrasound and plain radiography findings. In particular, the main reason for referral to MDCTU is a sonography examination that showed a hydronephrosis with no sufficient information about the cause and level of ureteral obstruction. Patients were referred for MDCTU as a part of investigatory work up. Exclusion criteria for the study consisted of contraindications to iodinated contrast media, such as a known allergy to iodinated contrast material, or elevated renal function tests (serum creatinine level > 1.5 mg/dL).

2.2. MDCTU technique

MDCTU examinations were performed for all patients using a 16-detector CT scanner (BrightSpeed 16; GE Medical Systems, GE Healthcare-America: Milwaukee, USA). The acquisition parameters were 120 kVp, 350 mAs, a helical pitch of 1.375:1, 0.6-s scan time, 16 × 0.625 mm detector configuration, 18.4-s total exposure time, 0.625 mm helical slice thickness, and 0.625 mm reconstruction interval with a large FOV. Patients were prepared by giving 500–750 mL of water over a 15- to 20-min period before the start of a renal CT examination.

Phases of MDCTU: two phase MDCTU (pre-contrast and delayed excretory phased) was performed for all patients. First phase, pre-contrast imaging of the abdomen extended from the dome of the liver to the symphysis pubis. An average amount of 80–100 mL of nonionic contrast material, iohexol (Omnipaque, 300 mg iodine/mL) was used at a rate of 3 mL per second using a power injector (Medrad, Stellant) via an 18-gauge catheter placed in the antecubital vein followed by 100 mL of saline infusion at the same rate. Oral contrast was not given for better detection of ureteral stones, and to facilitate MIP and 3D reformations of the contrast-filled ureters. Second phase (delayed or excretory phase) was obtained 10 min after contrast media administration and extended from the copula of the diaphragm to the symphysis pubis.

Image reconstruction and postprocessing techniques: the axial source images with a 0.625-mm slice were transferred to an Advantage Workstation (AW) Volume Share 2 (GE Healthcare). Curved planar reformatted (CPR) images were performed to display the entire length of ureters in the same image. It was obtained manually by drawing a line over the course of the ureter. Three-dimensional (3D) volume-rendered