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Original article

The value of three-dimensional helical computed tomography for the retrograde flexible ureteronephroscopy in the treatment of lower pole calyx stones

Yan Xu, Jian-Lin Lyu*

Department of Urology, Affiliated Hospital of Nanjing University of Traditional Chinese Medicine, Jiangsu Province Hospital of Traditional Chinese Medicine, Nanjing, Jiangsu 210046, China

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Abstract

Objective: The aim of our study was to determine if there is any advantage of three-dimensional helical computed tomography (3D-HCT) over intravenous urogram (IVU) for the retrograde flexible ureteronephroscopy in the treatment of lower pole calyx stones.
Methods: From June 2012 to January 2014, a total of 52 cases of lower pole renal stones underwent retrograde intrarenal surgery (RIRS) in our center. All patients underwent a preoperative IVU and three-dimensional helical computed tomography urography (3D-CTU) program to define the collecting system anatomy, manly concerning the following lower pole features; infundibulopelvic angle (IPA), infundibular length (IL), and infundibular width (IW). The examinations were performed in the same center of reference with a standardized method and with 3D-HCT Siemens Somaton Plus equipment. The measurements were performed by the same researcher, using a ruler and a square.
Results: Based on clinical threshold difference of the anatomic factors on an IVU image to compare the difference between an IVU image and a 3D-CT image of 52 patients, the IPA was <30° when measured on intravenous pyelography (IVP) for 21 patients. We found that with the IPA of <30° measured with IVP only 19% (4/21) were correctly classified in the same size category using 3D-HCT, whereas 81% (17/21) were upgraded to 40–50° on 3D-CT. This difference was significant between IVP and 3D-HCT.
Conclusions: 3D-HCT has advantages over IVU when analyzing the morphometric and the morphological features of kidney lower pole spatial anatomy for the retrograde flexible ureteronephroscopy in the treatment of lower pole calyx stones.
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Keywords: Intravenous urogram; Computed tomography urography; Flexible ureterorenoscopy; Lower pole; Renal stones

* Corresponding author. Department of Urology, Affiliated Jiangning Hospital, Nanjing Medical University, Gushan Road 176, Nanjing, Jiangsu 211100, China. Tel./fax: +86 25 52178496.
E-mail address: ljlxx01@163.com (J.-L. Lyu).
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Introduction

The life-long incidence of stones in the population is 5−15%, and it has often been questioned whether gravity was the only factor responsible for lower pole lithiasis. The frequency of stones in the lower renal calyces had increased from 2% in mid eighties to 48% in the early nineties, which is roughly the same time as the widespread use of extracorporeal shock wave treatment (ESWL).[1] Over the past 20 years, based on the anatomical structure of the lower pole renal stones, a lower pole infundibu-lopelvic angle (IPA) of <45°, infundibular length >30 mm, and an infundibular width <5 mm are considered unfavorable for drainage of stone fragments.[1−4] These ideas are based on the SWL, and the anatomical topography of the inferior caliceal system plays an important role in the outcome of extracorporeal treatment, but along with better instrumentation and technology, these anatomic parameter are considered unfavorable for flexible ureterorenoscopy treatment.

The anatomy of the lower pole is classically studied in an intravenous urogram (IVU). However, IVU is being phased out of clinical practice as the imaging technique of choice, since CT is more frequently used in the diagnosis of urolithiasis. Along with the development of three-dimensional imaging in CT, three-dimensional helical computed tomography (3D-HCT) is a commonly used examination in the investigation of much renal pathology such as lithiasis, tumors, vascular anomalies and also in the study of the vascular anatomy in renal donors.

Although an European Association of Urology (EAU) guideline has already recommended that CT is preferable because it enables 3D reconstruction of the collecting system, as well as measurement of stone density and skin-to-stone distance. there are few prospective studies comparing the anatomical measurements of the lower pole collecting system obtained using IVU with those obtained using three-dimensional helical computed tomography (3D-HCT). A study reported[5] that there was no significant difference in the measurements of the lower IPA obtained with 3D-HCT when compared with values obtained with IVU. However, we found there are some differences between 3D-HCT and IVU in clinical practice.

Therefore, the objective of our study was to compare the morphometric evaluation of some features of the lower pole collecting system spatial anatomy that would be involved in fragment elimination after retrograde flexible ureteronephroscopy, using IVU and 3D-HCT.

Methods

From June 2013 to September 2014, a total of 52 cases of lower pole renal stones underwent retrograde intrarenal surgery (RIRS) in our center. All patients underwent a preoperative intravenous urogram (IVU) and three-dimensional helical computed tomography urography (3D-CTU) program to define the collecting system anatomy.

Patients were preoperatively evaluated with a history, physical examination, and image system (including a plain roentgenogram and ultrasound). Preoperative laboratory evaluation included urinalysis, urine culture, coagulation profile, serum creatinine level and complete blood count. The Institutional Ethics Committee on Human Research approved the study and all patients signed an informed consent.

This study compared the findings obtained using IVU and 3D-HCT, concerning the following lower pole features: IPA, infundibular width (IW), and infundibular length (IL). The examinations were performed with the same center of reference with a standardized methodology and with the 3D-HCT Siemens Somaton Plus equipment. The measurements were performed by the same researcher, using a ruler and a square. The patients who were allergic to the iodinated contrast medium as well as those who presented with a doubtful radiological analysis were excluded. All patients were informed that they would undergo two examinations.

The IPA was determined by the intersection of the infundibular axis (which is a line connecting the center of the pelvis with the bottom of the stone bearing calyx) and the ureteropelvic axis (which is a line connecting the center of the pelvis with a point in the upper ureter opposite the lower pole of the kidney). The IW was measured as the narrowest point in the axis of the lower infundibulum. The IL was measured as the distance between the most distal point of the calyx containing the calculus and the midpoint of the lower lip of the renal pelvis (Figs. 1−3).

All procedures were carried out with a URF-V digital flexible ureteroscope (Olympus, Tokyo, Japan) through a ureteral access sheath (Flexor ureteral access sheath with AQ Fus-120 04512/14F; Cook Medical, Bloomington, IN).

Statistical analysis was conducted comparing the IPA, IL, and IW obtained using 3D-HCT versus IVU. For the statistical analysis and comparison of the values obtained using the two examination methods, data were processed using SPSS-15 for Windows. The

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