ROLE OF MULTI-DETECTOR C.T. IN THE EVALUATION OF PATIENTS WITH HEMATURIA

Thesis
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Abstract:

With the advent of MDCT it is possible to do comprehensive examination for hematuria patients. The imaging plan is to be decided, either to perform thin slice non-enhanced cuts in suspected stone disease or multiphasic series for suspected renal or urothelial lesions or to perform CT urethrography in suspected urethral lesions, depending on the clinical data & previous examinations that the patient had.

Multiphasic CT technique performed with a combination of cortico-medullary, nephrographic-phase, and excretory-phase imaging can demonstrate a wide spectrum of disease in those patients using a single modality. Unenhanced imaging can be sacrificed depending on cortico-medullary & nephrographic phase images from kidney to the UB to assess for stones. Then we depend on the three phases in assessment for neoplastic lesions putting in mind the pattern of enhancement of such lesions. Findings at excretory-phase imaging mimic IVU findings and allow excellent evaluation of the collecting systems and ureters. Bladder disease is often well seen on enhanced & excretory-phase images & with virtual cystoscopy.

Urethral lesions can be properly assessed by voiding or ascending CT urethrography providing interesting reformat including curved plane, vessel analysis & virtual images, that are informative about the site, extent & degree of urethral stricture & it may be helpful for detection of periurethral lesions like periurethral fibrotic tissue or fistulous tracts.

In our study, everyday’s causes of hematuria were almost covered using a 4-detector scanner giving good quality images with informative reformat that was very conclusive compared to the previous traditional examinations that the patient had. Those reformatted images have met good acceptance by the referring urologist that was comparable to the endoscopic & surgical results, proving that MDCT can give accurate evaluation for hematuria patients instead of performing multiple traditional studies that may expose the patient to frequent contrast material & to frequent radiation exposure.

KEY WORDS

MDCT_HEMATARIA

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List of abbreviations

AV : Arterio-venous.

CT : Computed tomography.

CTA : CT angiography.

CTU : CT urography.

CP : Curved plane.

HU : Housefield unit.

IVP : Intravenous pyelography.

IVU : Intravenous urography.

LN : Lymph node.

MDCT : Multi-detector computed tomography.

MPR : Multi-planar reformat.

MIP : Maximal intensity projection.

MRI : Magnetic Resonance Imaging.

MRU : MR urography

RA : Renal artery.

RV : Renal vein.

RCC : Renal cell carcinoma.

TCC : Transitional cell carcinoma.

UPJO: Uretro-pelvic junction obstruction.

US : ultrasound.

VR : Volume rendering.

3D : Three dimentional.

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INTRODUCTION

Hematuria has a wide range of causes, including calculi, neoplasms, infection, trauma & coagulopathy ***(Grossfeld GD, et al. 2001).***

Many imaging modalities have been used in the evaluation of patients with hematuria. Historically, intravenous urography (IVU) has been the primary method of imaging in these patients. Currently, the examinations that are commonly used to evaluate patients with hematuria include IVU, ultrasonography (US), computed tomography (CT), magnetic resonance (MR) imaging, retrograde ureterography and pyelography, cystoscopy, and ureteroscopy **(*Sandor A. Joffe. et al, 2003*).**

With the advent of spiral CT and particularly multi–detector row CT, it is possible to perform a comprehensive evaluation of hematuria patients with a single examination. Multidetector CT can be performed with a combination of unenhanced, arterial, nephrographic-phase, and excretory-phase imaging ***(Caoili EM. et al, 2003).***

Unenhanced images may be obtained to evaluate the urinary tract for calculi and to assist in the characterization of renal masses. Arterial-phase images through the kidneys and bladder to evaluate for vascular abnormalities. Arterial-phase images may be particularly helpful in detecting arteriovenous malformations and demonstrating the arterial anatomy in surgical candidates. Other vascular abnormalities such as aberrant renal veins and venous thrombosis can usually be seen on nephrographic-phase images. Nephrographic phase images to assess the renal parenchyma &

characterization of masses. Excretory phase images to assess pelvicalyceal system, ureters & urinary bladder ***(Sandor A. Joffe. et al, 2003).***

Three-dimensional reformation is performed with volume rendering (VR) or maximum-intensity-projection (MIP) techniques. Calyceal detail is occasionally better seen on MIP images. Three-dimensional (3D) reformation of the excretory-phase images can produce images that mimic the appearance of intravenous urograms, thus providing images in a format that is familiar to many referring physicians ***(Sandor A. Joffe. et al, 2003).***

Recent advances in MDCT, rapid image acquisition, and software have made 2D and 3D reformatted images available for the newer diagnostic techniques. The thin-section transverse images and high scanning speed of CT have led to the development of promising new techniques for urethral evaluation: CT voiding urethrography and virtual urethroscopy. With these techniques, the voiding, contrast-filled urethra is scanned with MDCT in few seconds. Real-time 3D rendering of CT images is performed to visually simulate urethroscopic examination ***(Rubin GD et al, 1996).***

Aim of work

The purpose of this study is to evaluate the patients coming with hematuria, using the different capabilities of MDCT to evaluate the whole urinary system including renal parenchyma, renal vasculature, ureters, urinary bladder & urethra, producing reformatted & virtual images to which the clinicians are familiar, so as to detect any pathological abnormality explaining the this hematuria.

NORMAL ANATOMY OF THE URINARY SYSTEM

The urinary organs comprise the kidneys, which secrete the urine, the ureters which convey urine to the urinary bladder, where it is for a time retained; and the urethra, through which it is discharged from the body.

The Kidneys

The kidneys are situated in the posterior part of the abdomen, one on either side of the vertebral column, behind the peritoneum, and surrounded by a mass of fat and loose areolar tissue. Their upper extremities are on a level with the upper border of the twelfth thoracic vertebra, their lower extremities on a level with the third lumbar. The right kidney is usually slightly lower than the left, probably on account of the vicinity of the liver. The long axis of each kidney is directed downward and laterally; the transverse axis backward and laterally. Each kidney is about 11.25 cm. in length, 5 to 7.5 cm. in breadth, and rather more than 2.5 cm. in thickness. The left is somewhat longer, and narrower, than the right. The kidney has a characteristic form, and has two surfaces, two borders, and an upper and lower extremities ***(Hall-Craggs, 1985).***

At the level of the kidneys, the retro peritoneum is divided into three spaces the anterior para-renal, the peri-renal, and the posterior para-renal spaces. The anterior para-renal space extends from the posterior parietal peritoneum anteriorly, to the anterior renal fascia posteriorly. This space contains the pancreas, the duodenum the descending and ascending colon. The anterior para-renal spaces are continuous across the midline ***(Harell, 1989).***

The peri-renal space is bounded anteriorly by the anterior renal fascia, and posteriorly, by the posterior renal fascia, It contains a variable quantity of fat. The medial border is concave in the center at the hilum and convex toward either extremity, related above to the adrenal gland. The hilum transmits the renal vein in front, the renal artery in the middle, and the ureter behind ***(Harell, 1989).***

The posterior pararenal space extends from the posterior renal fascia to the fascia overlying the quadratus lumborum and the psoas muscle, it has a variable medial extent and is open laterally towards the flank. It contains no retroperitoneal organs (Fig. 1) ***(Harell, 1965).***

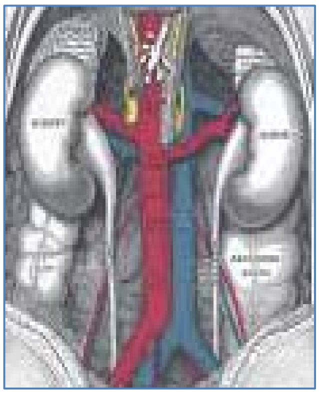

Fig.1: Kidneys & their location in the abdominal cavity (Williams PL. et al, 1995).

<u>General Structure of the Kidney</u>: The cortex is the outer region. It lies immediately beneath the capsule and extends inward as the renal columns of Berlin. The cortex is about 1 cm in thickness, it is well vascularized and envelops the renal pyramids. The medulla, the inner region, is made up of several conical structures (up to 16 medullary pyramids may be present). The bases of the pyramids are located at the cortico-medulry junction and the apices extend into the hilum of the kidney as the papillae. Each papilla is "grasped" by a hollow minor calyx. The minor calyces are the branches of 3-