Ureteral Jet: A Diagnostic Tool to Detect Ureteral Patency in Migrating Ureteral Stone

Thesis

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LIST OF ABBREVIATIONS

IVU	Intravenous urograghy
U/S	Ultrasound
CT	Computed tomography
Htz	Hertiz
KUB	Kidney ureter bladder
MRI	Magnetic resonance imaging
T1	Thoracic vertebrae number one
T11	Thoracic vertebrae number eleven
L 2	Lumber vertebrae number two
S 2	Sacral vertebrae number two
S 4	Sacral vertebrae number four
PUJ	Pelvi-ureteric junction
Mm	Millimeter
SWL	Shock wave lithotripsy
MET	Medical expulsive therapy
NSAIDs	Non-steroidal anti-inflammatory drugs
HBB	Hyoscine-N-butylbromide
VAS	Visual analogue scale
TENS	Trans-cutaneous electrical nerve stimulation.
AUA	American European association of urology

ESWL	Extracorporeal shock wave lithotripsy
FEp	Value for Fisher Exact test
AUC	Area under the curve.
PPV	Positive predictive value
NPV	Negative predictive value
CDU	Color Doppler utrasonography
HO:YAG	Holmium Ytrium Aluminum Garnet

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Introduction

INTRODUCTION

Although urinary stone disease is one of the common applications of modern society and occupies a major role in daily urological practice, it has been described since antiquity **(Pearle et al, 2005).**

In a comprehensive study, urolithiasis generated $2.1 billion in health care expenditures in the United States, an increase of 50% from 1994 ***(Pearle et al., 2005)***.Approximately 7% of urolithiasis occurs in children younger than 16 years ***(Davis, 2004)***.

Urolithiasis is the commonest cause of acute flank pain precipitated by acute renal obstruction which is a common problem in patients presenting to emergency department **(Petro Pepe et al, 2005).**

Life time incidence of urinary tract stone reaches up to12% with recurrence rates up to 50% in the first five yaers in diagnostic and treatment algorithms, stone burden is the most important factor to consider and form the clinical decision making (**Ray et al, 2010).**

Chances of spontaneous stone passage depend principally on stone size, as well as distal ureteric patency. Between 90-98% of stones measuring <4mm will pass spontaneously. Average time for spontaneous stone passage for stones 4-6mm in diameter is 3 weeks **(James et al, 2007).**

There is growing evidence that medical expulsive therapy i.e. the administration of drugs to facilitate stone passage can be efficacious **(Glenn et al, 2007).**

Non migrating obstructive stones that have not passed in 2 months are unlikely to do so. Therefore, determination of stone size, as well as degree of obstruction, presence of ureteral stricture are important predicting factors for chances of spontaneous stone passage **(James et al,2007).**

However, obstruction without pyelocalicectasis is not in-frequent in many acute obstructions as well as severe dilatation may exist without obstruction (e.g. diabetes insipides, megacalycosis, etc.) **(Petro Pepe et al, 2005).**

It is thus necessary to follow those patients who have small stones in the ureter that could possibly pass spontaneously or with medical therapy, for a short period of time with repeated suitable radiological imaging.

In the last few years unenhanced computed tommograghy had provided an increasingly popular alternative imaging modality for evaluation of ureteral colic mostly caused by ureteral stone disease **(Sowter et al, 2006).**

Despite the advantages of unenhanced CT, ultrasound (US) is also commonly used as a diagnostic tool in the management of urolithiasis **(Ray et al, 2010**).

Ultrasound is recognized to be both less sensitive and specific than CT; however, it is commonly available, inexpensive to operate and poses no risk of radiation exposure. In many cases, renal and ureteric calculi are incidentally diagnosed in the workup of other conditions. It has been reported that US may detect stones as small as 0.5 mm under optimal conditions. For these reasons, some centers may still use US in the initial work-up of renal colic **(Ray et al, 2010**).

Although labor-intensive and requiring a highly skilled operator, ultrasound, as shown by these authors, remains the first-line modality with CT reserved for equivocal or unresolved cases. Intuitively, no radiation exposure must carry less risk than some radiation exposure, irrespective of how low the calculated dose is **(Andreoiu et al, 2009).**

Ultrasound can identify the full bladder easily which appears as echo-free cystic structure varies in shape from rounded to ovoid to oblong. The hyperechoic urine may show mobile echogenic particles floating freely within the lumen as crystals, protenious material, cellular debris, fat droplets and these structures can be differentiated from large particles as large amount of sediment cellular debris (known as urinary sludge), mucin, blood and small cystic calculi which appear hyperechoic curvilinear echogenicity which generally change position as patient position changes **(Ray et al, 2010**).

Despite the urinary bladder is ideally suitable for ultrasound examination because of excellent acoustic shadow by its fluid content, ultrasound could not often see the vesical calculi as false negative examination result in empty bladders, sand/too small calculus to resolve (<0.1-0.2 cm) or poor examination.

By the use of ultrasound we can easily diagnose the presence of blood clot within the bladder, the ultra-sonographer is expecting this finding based on history as blood clot occurs usually secondary to trauma, infection, bleeding disorder or neoplasia **(Ray et al, 2010**).

The blood clot appears generally medium echogenic to mildly hyperechoic, no shadowing echogenicity, with an irregular/amorphous shape. They are generally mobile and settle to the dependent portion of the bladder or may be adherent to the bladder wall and may have associated mucosal irregularities(mural mass);look for underling bladder wall thickness which more likely indicates neoplasia. One may agitate the bladder or do positional studies to assess wall attachment **(Andreoiu et al, 2009).**

Many pathologies can be diagnosed by the use of ultrasound in urology as bladder diverticulum, ureterocele, rupture bladder, retroperitoneal abscess, urinoma and perinephric collections **(Tamm et al, 2003**).

The greatest challenge with regard ultrasound is the identification of ureteral calculi, primarily due to obscurement by overlying bowel gas and deep central location of ureters within the retroperitonum **(Andreoiu et al, 2009).**

There are several factors that may affect US diagnosis and interpretation of stone size including the presence of hydronephrosis, stones abutting renal sinus fat, the presence of vascular calcifications, and the presence of bowel gas, which may obscure ureteral calculi **(Ray et al, 2010**).

However, U/S may also be of benefit in the evaluation of hydronephrosis and should be considered in patients at risk of repetitive CT scans.

Once the presence of hydronephrosis has been established, it is important to evaluate ipsilateral ureter being at its junction with the renal pelvis following the ureter throughout its course. The dilated ureter allows the ultra-sonographer to follow the fluid level to the point of obstruction **(Ray et al, 2010**).

The importance of ultrasound is not only being noninvasive technique but also as good alternative to IVU in cases of renal shut down and in cases of renal colic as it is not suitable for a patient with a ureteric calculus to undergo an intravenous urogram (IVU), which may precipitate a further bout of renal colic **(Raftery et al, 2008).**

Some of our collages think that ultrasound cannot see ureteral stones, but there are few causes make it not surprising that good specificity is found in diagnosis of ureteral stones by ultrasound which greatly aided by the presence of hydroureter **(Ray et al, 2010**).

In contrast, in the kidney, vascular calcifications and other artifacts may be mistaken for calculi and may partially account for the reduction in specificity **(Ray et al, 2010**).

Furthermore, in the determination of the mild collecting system dilatation, it is well known that the ultrasound has only 50% predictability value **(Ray et al, 2010**).

Any restriction to urinary outflow which left untreated will cause progressive renal deterioration". It may, however, indicate a stage of irreversible parenchymal damage. Experimental data show a progressive decrease of renal tissue 2-6 weeks after partial outlet obstruction; the severity is proportional to the degree of obstruction and the time of relief critical for parenchymal recovery. Acute urinary obstruction causes a short-term increase in renal blood flow followed by a prolonged decrease of flow **(Andreoiu et al, 2009).**

There is obvious lack of correlation between U/S imaging and the degree of obstruction. It seems logical from a pressure-compliance point of view: "kidneys with an intra-renal pelvis, that is small and not distensible are more vulnerable to obstructive injury than kidneys with extra renal pelvis that can enlarge with less functional deterioration in addition to dilated low pressure systems **(Raftery et al, 2008).**

Ultrasound morphometry (thinning and increased echogenicity of the renal cortex) correlates well with renal function in ureteral obstruction **(Raftery et al, 2008).**

It is well known that the sound beam penetration power of the US equipment's has increased in parallel to the technologic advances in radiology. The power of the sound beam, thus, penetration has been increased with new innovations, which allowed higher resolution **(Yildirim et al, 2010**).

In a variety of situations other than obstructive uropathy, such as in the normal variants, with excessive hydration, during diuretic treatment, in case of bladder over distension, with the structural variations (extra renal pelvis, calyceal diverticulum, etc.) or with distension of the renal vascular structures or in vesico- ureteral reflux disease; gray scale US may show mild dilatation, which may mimic hydronephrosis **(Yildirim et al, 2010**).

Considering the low sensitivity of US in the setting of ureteral stone diagnosis, the true stone burden may not be appreciated by the treating physician. Some of them believe that use of US should be limited to routine follow-up of radiolucent calculi as well as a first-line investigative tool for pediatric and pregnant patients with suspected urolithiasis in whom radiation exposure is undesirable **(Ray et al, 2010**).

Given the low sensitivity of gray scale US, there are alot of studies in the literature which have investigated new methods that may help to differentiate the obstructive and non-obstructive causes of the collecting system dilatation **(Yildirim et al, 2010**).

By the use of ureteral jet, unilateral ureteral obstruction may be suggested in the presence of unilateral absence of jets or continuous low-level flow and asymmetry between diseased ureter and unobstructed contralateral one. So examination of ureteral jet adds significant value to standard renal and bladder sonograghy **(Ciftici et al, 2010).**