

Variation of ureteric jet characteristics according to size and site of ureteric calculi

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Abstract- Colour Doppler ultrasound scan has a recognized place in evaluation of patients with ureteric calculi. The purpose of this study was to assess the ureteric jet characteristic variations according to size and site of ureteric calculi. This descriptive study was conducted using 83 patients with suspected calculus disease, aged 20-60years, who presented to genitourinary clinic, Teaching Hospital Peradeniya, Sri Lanka. All the patients underwent X-ray KUB and Colour Doppler Sonography with ureteral jet assessments, their S.Creatinine and UFR. Ultrasound KUB and Colour Doppler evaluation of ureteric jet was done by a radiologist as a non-variable single observer test. This study was conducted over one year period. As the results, there were 56.1% (N=46) subjects with right sided calculi and 43.9% (N=36) subjects with left sided calculi. There was no significant difference of stone sizes in relation to presence of ureteric jets ($P = 0.619$). Majority of calculi were impacted at VUJ. Mid ureteric calculi associated with highest percentage of absent ureteric jet and frequency of ureteric jet was significantly associated with the degree of obstruction.

Index Terms- ureteric jet, size and site, X-ray KUB, Color Doppler ultrasound scan.

I. INTRODUCTION

Colour Doppler ultrasound scan has a recognized place in evaluation of patients with ureteric calculi.⁽¹⁾ Ultrasound scan together with Color Doppler effect can be used to visualize ureteric jets which are pulses of urine expelled in to the bladder from the ureters.⁽⁴⁾ The urine flow, which is also called ureteric jet, can be demonstrated by Doppler ultrasound at the uretero vesical junction (UVJ). Visualization of ureteric jet with color Doppler US is a well-recognized phenomenon. It is easy to demonstrate the jet flows with color or power Doppler techniques. The Doppler waveforms of the ureteric jets are formed by propagation of the peristaltic waves which arise from the renal pelvic pacemaker units.^(2,3) These waves modify the ureteral peristalsis in order to relax the sphincteric mechanism of the ureterovesical junction.⁽¹⁾

There are six jet wave form patterns have been identified: monophasic, biphasic, triphasic, polyphasic, square and continuous.⁽⁴⁾ Ureteric jet flow patterns are predominant in monophasic form at the side with calculi.⁽¹⁾ The monophasic jet has the shortest duration, lowest velocity and smallest initial slope.⁽⁴⁾

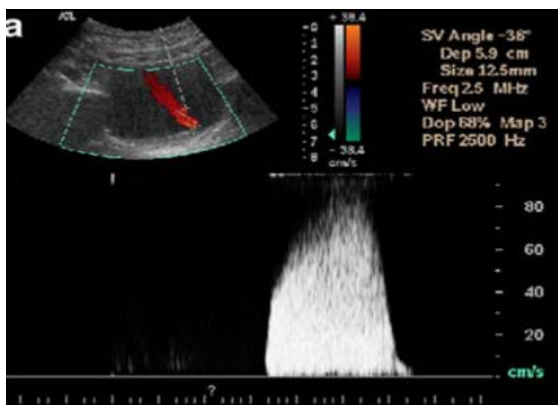


Figure 01- monophasic jet with color Doppler US

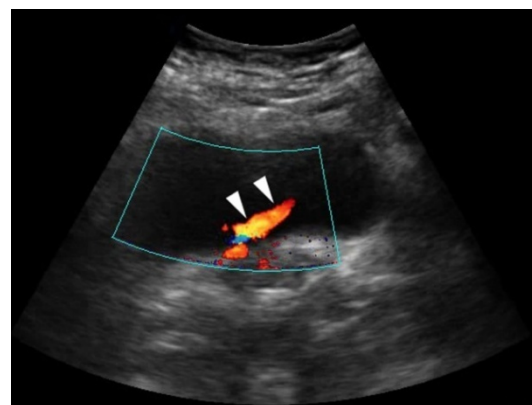


Figure 02- ureteric jet with color Doppler US

The characteristics of ureteric jet change when ureters get obstructed by calculi. Therefore these can be used as indirect indices of degree of obstruction. As one of the literature which was to evaluate the flow pattern changes of the urine at the UVJ in patients with non-obstructive nephrolithiasis, there was a slight increase in the duration of the ureteric jet, peak velocity and frequency of the jet flow in patients with nephrolithiasis.

This process may be related to the hyperactivity of the pacemaker cells due to micro stasis from local obstruction or irritation and/or inflammation induced by the stone. Since there is no significant difference between the normal and abnormal sides in the patient group, it can be hypothesized that the primary abnormalities the dysfunctional propagative peristaltic activity which induces stasis and later formation of calculi. Also the

presence of the immature and monophasic jet type dominance in the patient group.^(3,5,6)

The purpose of this current study was to assess the ureteric jet characteristic variations according to size and site of ureteric calculi.

II. METHODOLOGY

This descriptive study was conducted using 83 patients with suspected calculus disease, aged 20-60years, who presented to genitourinary clinic, Teaching Hospital Peradeniya. All the patients underwent X-ray KUB and Colour Doppler Sonography with ureteral jet assessments, their S.Creatinine and UFR. Ultrasound KUB and Colour Doppler evaluation of ureteric jet was done by a radiologist as a non-variable single observer test. This study was conducted over one year period from 1st May 2013 to 31st April 2014.

Patients with metabolic etiologies such as hypercalcemia, hyperparathyroidism and etc. were excluded. Ureteric stone site and size were collected and analyzed with independent sample t-test and chi-square test.

III. RESULTS

Descriptive statistics of the study population showed mean age of the participants was 39.63±11.63; youngest was 17 years old and eldest was 60 year old. There were 91.6% (n=76) males and 8.4% (n= 7) females.

Table01 - Ureteric tract stones with gender difference

Gender distribution	Male	Female
Ureteric tract stones percentage	91.6% (N= 76)	8.4% (N= 8.4)

Table 02 - Prevalence of colic according to the side

Side of the colic	Right	Left
Prevalence of colic	56.1% (N=46)	43.9 % (N=36)

There were 6.4% upper ureteric, 19.0% mid ureteric, 11.1% distal ureteric and 63.5% vesico ureteric junction calculi. The mean sizes of calculi in each site were 10.5, 6.8, 6.6 and 6.4 mm respectively. Absent ipsilateral jet was noted in 25%, 70%, 60% and 59% according to the site. There was no significant difference of stone sizes in relation to presence of ureteric jets ($P = 0.619$). For the patients who had bilateral jets despite the presence of calculus, the means of frequency, velocity and duration of ureteric jet of affected side were 6.5/min, 37.78cm/s and 3045.58 milliseconds. For the normal side the values were 11.8/min, 54.17cm/s and 3062.87 milliseconds respectively. All

three characters described are lower in affected side, but only the frequency is significantly lower ($P = 0.020$).

IV. DISCUSSION

Urolithiasis also known as uroliths or calculi, the third most common prevalent urinary disorder that involves the process of stone formation in any part of urinary tract by the successive physiochemical events of super saturation, nucleation, aggregation, and retention at the site of stone formation.^(8,9) It is a multi-factorial disorder that results from multi factorial etiopathogenesis like epidemiological, biochemical, metabolic, nutritional, socio-economic, drug induced and genetical risk factors.^(10,11)

As our results 91.6% of male patients and 8.1% of female patients had urolithiasis. Previously different studies suggest that men were affected two to three times more frequently than women.⁽¹²⁾

The reason may be due to the differences of genetic factors, age, weight, water intake, occupation and diet between genders. The size of the stones was larger in females than males. Smaller the size, it is capable of passing spontaneously or entering and impacting in the ureter.⁽¹³⁾ Hence it is symptomatic. Most of the male patients admit into hospitals due to this reason. Therefore the proportion between male to female will increase.⁽¹²⁾ Female have more chance for infections. Infections may also a risk factor for genesis of stones.⁽¹³⁾

Literature said that the stones in men were commonly found in right and female were more common on the left side than men. According to our study with 91.1% of male population, it results 51.6 % right sided urinary stones. Therefore, stones in men were commonly found in right. It also matches with the previous literature.^(12,13) There are a number of previous studies evaluating characteristics of the ureteric jet based on Doppler US. It was found that the Doppler waveform parameters of jet direction, duration, frequency, velocity and shape do not help in predicting VUR. A lateral ureteric orifice is not seen in normal patients, but is identified in subjects with VUR and other urinary tract disorders.⁽⁷⁾

Urinary stones can be classified according to size, location, X-ray characteristics, etiology of formation, composition and risk of recurrence.⁽¹⁻⁴⁾ Stone size is usually given in one or two dimensions, and stratified into those measuring up to 5, 5-10, 10-20, and > 20 mm in largest diameter. However according to our results, there was no significant difference of stone sizes in relation to presence of ureteric jets.

Stones can be classified according to anatomical position: upper, middle or lower calyx; renal pelvis; upper, middle or distal ureter; and urinary bladder. According to our results, majority of calculi were stuck at vesico ureteric junction (VUJ) by calculi. Mid ureteric calculi associated with highest percentage of absent ureteric jet and mid ureteric calculi were more susceptible to cause complete ureteric obstruction.

V. CONCLUSION

Ureteric jet is not affected by location and size of the stone, thus as an independent parameter it gives an accurate

measurement of degree of obstruction. Frequency, velocity and duration of ureteric jet indicate the degree of obstruction. Mid ureteric calculi associated with highest percentage of absent ureteric jet and mid ureteric calculi are more susceptible to cause complete ureteric obstruction. Majority of calculi were stuck at VUJ. There was no significant difference of stone sizes in relation to presence of ureteric jets.

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