

# Evaluation of Bilateral Ureteral Urinary Jet Flows for Patency of Uretero- Vesical Junctions by Color Flow Imaging

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## ABSTRACT

**Background:** Ureters are meant to transport urine from the pelvis to the urinary bladder in the form of urinary jet. This is continuous process with intermittent release of urine at uretero-vesical junction. This is regulated by autonomous nervous system. The urine coming to urinary bladder can be seen by color flow imaging (CFI) .This also reflects the patency of the ureter without any obstruction in the pathway. **Methods:** The size of the population was 30 patients (20 males and 10 females). In this study, the Color Doppler ultrasound was used to evaluate the ureteral jets flow in 10 healthy patients and 20 patients with obstructive uropathy. A probability sampling method was employed while collecting samples. **Results:** In the right ureteral-vesical junction there was complete absence of detectable jets in 5 patients, 6 patients had weak flow of jet and 19 patients had normal flow of jet. Similarly, in the left ureteral-vesical junction there was complete absence of detectable jet in 3 patients, 12 patients had weak flow and 15 patients had normal flow. **Conclusions:** The color Doppler evaluation of the ureteral jets is a valid method of evaluating ureteral and renal calculi obstruction and could be a first line of investigation to detect ureteric obstruction in patients with obstructive uropathy.

**Keywords:** Urinary jet, Ureterovesical junction, color flow imaging, obstruction.

## INTRODUCTION

Color Doppler ultrasound imaging is a powerful non-invasive diagnostic tool for many clinical applications that involve examining the anatomy and hemodynamics of human blood vessels. These clinical applications include cardio vascular disease, obstetrics, and abdominal diseases. The principle can be applied to study the ureteral jet in the urinary bladder through uretero-vesical junction.<sup>[1]</sup>

## MATERIALS & METHODS

A prospective study was carried out in Department of Radio-imaging and Diagnosis at Shree Guru Gobind Singh Tricentenary University (SGT Hospital), Gurugram, Haryana. Ultrasonography (USG) examination was performed by using a

commercially available color Doppler scanner(Philips, Affinity 50 G) with a 3.0–5.0 MHz convex probe (Figure1). Patients were instructed to drink a liter of water half an hour before the ultrasound examination to be well hydrated.



**Figure 1:** Philips Affinity 50 G color Doppler ultrasound equipment used for the study.

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This study was based on role of color doppler in evaluation of ureteral-vesical junction patency in patients with obstructive uropathy. Color doppler ultrasound was used to evaluate the jet flow or urine flow at ureteral-vesical junction in obstructive patients and non-obstructive patients (control group). This study was designed to be comparative study between the pattern changes of jet flow and clinical finding on ultrasound scan related to obstructive uropathy patients and control group. The patients who complained about the abdominal pain were diagnosed as some form of obstructive uropathy. The patients were first examined by B-mode ultrasonography of the kidneys to detect renal, ureteral or bladder stones and degree of renal hydronephrosis. The patients who had dilated system were then subjected to color Doppler examination. The urinary bladder was examined at the region of the trigone continuously for five to ten minutes. The scanning of the urinary bladder was done in the transverse or oblique planes where the two ureteral-vesical junctions were seen at the same time or separately, in supine position. The color box was adjusted to include both ureteral-vesical junctions. The color scale, gain and pulse repetition frequency (PRF) was adjusted as needed. The flow toward the transducer was assigned as red color and flow away from the transducer was assigned as blue color. In this method to see jet flow, the probe was kept at least 15 to 20 minute on bladder for each examination.

The clinical findings reported by radiologist were compared with the color jet flow achieved from patients who were undergoing ultrasound scan.

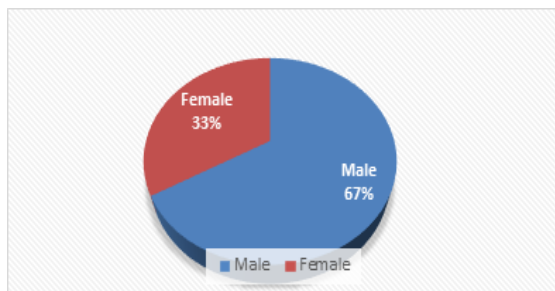
**Following inclusion criteria was considered**

- I. Obstructive Uropathy and normal control case patients
- II. All IPD and OPD patients
- III. All age group patients were included
- IV. Patients of both genders

**Following exclusion criteria was fixed**

- I. Unwilling patients
- II. Post operative patients.

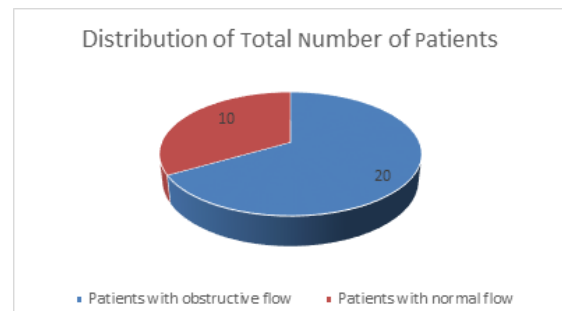
The population consisted of patients of all age groups excluding the patients who fell under exclusion criteria. The size of the population was 30 patients including 20 males and 10 females [Figure 2].



**Figure 2: Distribution of the cases as per gender.**

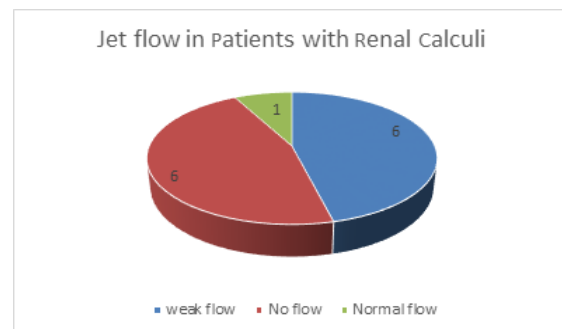
**RESULTS**

A prospective, observational study carried out with the sample size of 30 patients (20 males and 10 females) on the topic “Role of color Doppler in evaluation of ureteral-vesical junction in patients with obstructive uropathy” gave the following results which are represented in pie chart, bar diagram and table. Color Doppler ultrasound was used to evaluate the ureteral jet flow in 10 healthy patients and 20 patients with obstructive uropathy. A probability sampling method was employed while collecting samples [Figure 3].



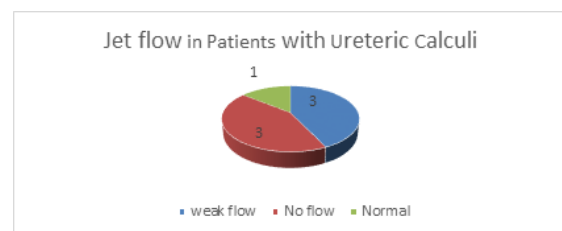
**Figure 3: Distribution of the patients on the basis of obstructive and normal flow.**

There were 13 patients with renal calculi among which 6 patient had weak flow of jet, 6 patients had no detectable flow (no flow) and 1 patient had normal flow [Figure 4].



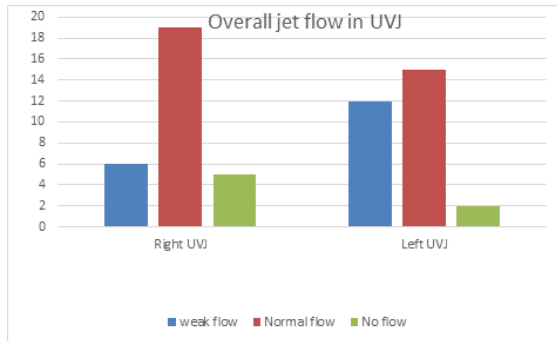
**Figure 4: Distribution of patients with renal calculi and the pattern of the flow.**

There were 7 patients with ureteric calculi among which 3 patients had weak flow, 3 patients had no detectable flow (no flow) and 1 patient had normal flow [Figure 5].



**Figure 5: Distribution on the basis of jet flow in patients having ureteric calculi.**

The overall jet flow seen in ureteral- vesical junction with obstructive patients and non – obstructive patients. In the right ureteral-vesical junction there was complete absence of detectable jets in 5 patients, 6 patients had weak flow of jet and 19 patients had normal flow of jet. Similarly, in the left ureteral-vesical junction there was complete absence of detectable jet in 3 patients, 12 patients had weak flow and 15 patients had normal flow [Figure 6].



**Figure 6: Overall distribution of both the jet flows in patients who underwent the investigation.**

The normal flow can be demonstrated in the form of bilateral jet in the form of red color coming from both the uretero-vesical junctions either at the same time or at different time [Figure 7].



**Figure 7: Bilateral normal jet flow seen at uretero-vesical junctions.**

Weak flow can be demonstrated very clearly in color coding [Figure 8]



**Figure 8: Weak ureteric jet flow on right side because of ipsilateral ureteric calculus.**

Normal flow with normal velocity was demonstrated in one patient on left side who had no flow on right side [Figure 9]



**Figure 9: Normal jet flow on left side and absence of jet flow on right side because of calculus at right uretero-vesical junction.**

Similarly normal flow was noticed on right side of a patient who had no flow on left side because of obstructive uropathy [Figure 10].



**Figure 10: Normal jet flow on right side but absent on left side because of complete obstruction on that side.**

## DISCUSSION

The purpose of this case study is to bring best out of image quality to give best diagnostic services by the role of color Doppler in evaluation of ureteral-vesical junction in patients with obstructive uropathy. In this case, we tried to find out the pattern changes of jet flow or urine flow at ureteral-vesical junction (UVJ). There were three types of jet flow seen in both right ureteral-vesical junction and left ureteral-vesical junction. These flow were a weak flow of jet, no detectable jet flow (absent) and normal flow of jet. These jet flow varied according to their clinical findings. Color Doppler is a type of Doppler ultrasound study, using high frequency (3.5 MHz to 5.0MHz) sound wave to visualize color flow images of the blood vessel. Transducer frequency varies from manufacturer to manufacturer and model to model. Color Doppler ultrasound imaging is a powerful non- invasive diagnostic tool for many clinical applications that involve examining the anatomy and hemodynamics of human blood vessels. These clinical application include cardio vascular disease, obstetrics, and abdominal diseases.<sup>[2]</sup>

Ultrasonic color Doppler is an imaging technique that combines anatomical information derived using pulse-echo techniques with velocity information derived using Doppler techniques to generate color-coded maps of tissue velocity superimposed on grey-

scale images of tissue anatomy. The most common use of the techniques is to image the movement of blood through the heart, arteries and veins, but it may also be used to image the motion of solid tissues such as the heart walls.<sup>[3,4]</sup> Color Doppler imaging is now provided on almost all commercial ultrasound machines, and has been found to be of great value in assessing blood flow in many clinical conditions. Although the method for obtaining the velocity information is in many ways similar to the method for obtaining the anatomical information, it is technically more demanding for a number of reasons. It also has a number of weaknesses, perhaps the greatest being that in conventional systems, the velocities measured and thus displayed are the components of the flow velocity directly towards or away from the transducer, while ideally the method would give information about the magnitude and direction of the three-dimensional flow vectors.<sup>[5,6]</sup> This review briefly introduces the principles behind color Doppler imaging and describes some clinical applications. It then describes the basic components of conventional color Doppler systems and the methods used to derive velocity information from the ultrasound signal. In our study, statistically significant difference were found between the diseased ureter or kidney having a stone and the healthy ureter or kidney. In obstructive uropathy patients there were three type of jet flow seen: no detectable flow, weak flow of jets and normal flow of jets.<sup>[7-9]</sup> This is in line with Burge, H. J., et al. who had found in their study that the side with ureteric stone showed abnormal pattern of ureteric jets in both low grade and high grade obstruction, however they depended upon the flow pattern (direction and appearance) and not the velocity.<sup>[10-12]</sup> In our study, we found no statistical significant difference between the right sideureteral- vesical junction and the left sideureteral- vesical junction of the healthy control group and this is in agreement with Vivian Yee-fong , who had found in their study on a large group - to evaluate the ureteric jet patterns and factors affecting it regarding age, sex and others - that, the studied adult group, there were no statically significant difference between right and left side of ureteric jets in healthy asymptomatic subjects.<sup>[13,14]</sup> Also they stated that the mean average number of normal jets per 5 minutes was 8 jets and the mean velocity was 57 – 63 cm/s. In our study, no statistically significant difference was found between the healthy side of the patient group and the control healthy group and the number and velocity of ureteric jets were not calculated.<sup>[15]</sup>

## CONCLUSION

The study had emphasises the importance of the modality which brings results without subjecting the patient to either IVP or CT urography. This has got the advantage of radiation free modality. The color

Doppler evaluation of the ureteral jets is a valid method of evaluating ureteral and renal calculi obstruction and could be a first line of investigation to detect ureteric obstruction in patients with obstructive uropathy.

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