

# A Retrospective Study to Evaluate the Need of CT / IVU in the Management of Lower Ureteric Calculus

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## ABSTRACT

### BACKGROUND

Urinary stone disease is major health problem affecting 2 – 3 % population worldwide, and is more commonly seen in the working age group (30 - 60 years) of society. X-ray, USG, CT, and IVU are diagnostic modalities available to us. IVU is still being requested by clinicians as diagnostic tool for urolithiasis but we need to reassess the importance of this modality as it seldom makes a difference in the management decision and outcome.

### METHODS

Medical records of 184 patients who underwent ureteroscopic pneumatic lithotripsy from 2016 to 2019 for lower ureteric calculus were reviewed retrospectively. All patients of lower ureteric calculus (n = 184) were included in study; of which 130 patients had undergone USG and x-ray as pre-operative imaging; 54 underwent CT / IVU in pre-operative imaging along with USG and X-ray. Stone free rate, complication, requirement of repeat procedure, and post op fever were compared and analysed.

### RESULTS

Results were analysed in view of the need of second look surgery, post op fever, complication, and Stone Free Rate (SFR). The majority of patients who underwent URSL were with lower ureteric calculus 184 (43.8 %), upper ureteric 145 (34.5 %), middle ureteric 70 (16.7 %) and multiple 21 (5 %). The mean stone size of lower ureteric calculus was 10.4 ± 3.8 mm. Stone free rate for with URSL for lower ureteric calculus was 88 %, upper ureteric calculus 60 %, middle ureteric calculus 68 %. Overall SFR was 69.5 %. SFR in patients with imaging group was 61 % whereas in patients who didn't undergo imaging was 77.83 %; this difference is statistically significant with a p-value 0.0003 (< 0.05). The complication rates were group I 106 (50 %) and group II 95 (45.6 %) and the difference is not statistically significant. In patients with imaging study (CT and IVU) done in the pre-op period the average hospital stay is 3.89 ± 1.23 days.

### CONCLUSIONS

IVU has a limited clinical role, and its use should be strictly limited to highly select cases and can be avoided in straight forward cases. Similarly, CT can also be avoided in straight forward cases of lower ureteric calculus as it doesn't provide any added advantage in terms of decreasing intra-op complication and SFR.

### KEYWORDS

Computed Tomography, Intravenous Urography, Stone Free Rate, Stone Migration, Re Procedure

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## BACKGROUND

Urinary stone disease affects 2 – 3 % of world population and majority of people are from earning population, so it has great impact economic aspect of a person's life. It also has a high almost 50 % recurrence rate which makes it a costly affair. The most common age group affected is 30 – 60 yrs. It becomes major public health issue as it has great impact on social and monetary aspect of society.<sup>1</sup> Renal stone problem affect 12 % of Indian population and approximately 6 % of which can cause loss of renal function.<sup>2</sup> X-rays were discovered in 1895 and approximately a year later uro-radiology emerged after they were first applied in the detection of urinary tract calculi. New applications were introduced, including cystography in 1903 and retrograde pyelography in 1906, following the discovery of various contrast materials that could be installed into the urinary tract.<sup>3</sup> Intravenous urography has many advantages such as it provide information about structure of kidney, ureter, and bladder, to some extent it provide functional status of kidney and also tells us about various congenital anomalies such as bifid pelvis, double moiety, duplex ureter, horse shoe kidney; however, the need for exposure of patients with a risk of adverse reactions to intravenous contrast material are some unwanted side of IVU.<sup>4</sup> Until the end of the 20th century, Intravenous urography (IVU) was the most recommended radiologic examination for the diagnosis of urinary tract abnormalities.<sup>5</sup>

Now, the "gold standard" of urologic imaging is the CT scan.<sup>6</sup> Since its inception in the 1970s, axial imaging computer tomography has revolutionised the management and diagnosis of stone disease over last few decades, overall scan timing has reduced significantly, amount of radiation exposure has decreased with new emerging technology such as low voltage CT, and computerised 3D reconstruction has given better understanding of anatomy and plan of surgery, and diagnostic accuracy.<sup>6</sup> However, for calculus disease, IVU (Intra-Venous Urography) is still being requested by clinicians particularly urologists, and being performed by radiologists in developing countries, despite the recommendations.<sup>7</sup> There are various techniques in managing ureteric stones which varies from non-invasive to minimally invasive and open surgeries. Extra corporeal shock wave lithotripsy<sup>1</sup> Management depends upon the stone size, composition, site (location), number, duration, clinical factors of the patient, the availability of the expertise and technology, the cost of the treatment, and patient preference.<sup>8</sup> An opportunity exists to evaluate if in straight forward cases of lower ureteric colic, IVU can be avoided.

We wanted to determine the stone free rates and complications among those who underwent pre-op imaging and those who did not, for the management of lower ureteric calculus.

## METHODS

Data of patients from January 2016 to December 2019 from Department of Urology at VIMS Hospital, Bellary, was

collected. Patients who underwent Uretero-Scopic Lithotripsy (URSL) for lower ureteric calculus have been included in this retrospective study. The study has been approved by the Ethical Committee. Written informed consent was taken from all patients regarding the possibility of the requirement of the open procedure and the need for repeat procedure explaining all the possible complications associated with the procedure.

All the patients above 18 yrs. of age both males and females were included in the study. Patients with sepsis were excluded from the study. As per institute protocol, all stable patients coming in OPD with evidence of ureteric calculus were started on silodosin / tamsulosin and antibiotics. Those patients who showed worsening of symptoms, derangement of renal function, or non-responder to medical treatment were planned for surgery (URSL), in pre-operative work up all patient underwent complete blood count, renal function test, serum electrolyte, urine routine microscopy and culture. All patients underwent routine imaging that is x-ray chest, USG KUB (Kidney Ureter Bladder) region, and x-ray KUB region. Some patients were taken up for specific imaging those were IVU and NCCT (Non-Contrast Computer Tomography) abdomen and pelvis for better diagnosis and management.

IVU was done in patients with persistent stone for more than 10 days despite medical management, hallow shadow by side of stone on x-ray, pain not subsiding on analgesics, abnormal shape / spike on stone, oblique lying stone, skeletal deformity, stone > 1.5 cm.

CT was done in patients with increased creatinine, hard stone on x-ray, IVU inconclusive.

After admission in ward during the pre-op period patient was given a single dose of antibiotic on the morning of surgery and X-ray KUB did on the same morning for the exact location of the stone. The patient was put in a lithotomy position after giving spinal anaesthesia. Cystourethroscopy was done with the 30-degree scope and 22 Fr sheath. The urethra, bladder thoroughly examined, and findings were noted. Ureteric orifice identified and a guidewire inserted under fluoroscopy guidance. We used semi-rigid, tapered ureteroscope (8 / 9.8 or 6 / 7.5 Fr) Karl Storz. Lithotripsy is done with the help of pneumatic lithotripter (detail about machine) until each fragment of approximately 2 mm compared with the tip of the probe. DJ stent inserted over the guidewire of adequate length determined preoperatively as per age, height, and imaging (IVU, CT).

Any intraoperative complications such as bleeding, perforation, retropulsion of stone, oedema, difficulty in the negotiation of a guidewire, presence of fever, and chills on the operating table noted. In the post-op period patient kept under observation for 24 – 48 hrs. Intravenous antibiotics were given as per urine culture report / empirically. Foleys catheter was removed before discharging the patient.

The patient called for follow up at 1 week and a 1-month duration and stent removal was done once confirmed about no residual calculus with help of USG / X-ray.

The outcome was assessed based on various predetermined parameters such as, Stone Free Rate (SFR).

## Operational Definitions

1. Stone free rate: Patient who had complete fragmentation of stone and no stone found on ureteroscopy after completion of procedure or those who had 2 mm or less stone size compared to tip of lithotripsy probe were labelled as stone free procedure, also those where no evidence of calculus after 14 days of procedure assessed on x-ray / USG were included in stone free group.
2. Other complications: This included requirement of second look operations, development of post-operative (post-op) fever and complications viz.,

## Statistical Analysis

The data values were entered into MS-Excel and statistical analysis has been done by using SPSS Version 19. For categorical variables, the values are expressed as numbers and percentages, and to test the association between chi-square test was used. For continuous variables, the values are expressed as mean  $\pm$  standard deviation, p-values less than 0.05 were considered as statistically significant.

## RESULTS

The majority of patients who underwent URSL were with lower ureteric calculus 184 (43.8 %). The mean age of population is 43 (2.3) yrs. The mean stone size of lower ureteric calculus was  $10.4 \pm 3.8$  mm. For lower ureteric calculus 10 patients were taken up for IVU and 44 for CT remaining 130 were operated based on USG and x-ray. Overall complication rate in lower ureteric calculus patients who underwent URSL is 25 (13.58 %), stone free rate in lower ureteric calculus after URSL is 145 (78.80 %), post op fever is seen in 26 (14.13 %) of patients, and second look surgery needed in 21 (11.41 %) of patient which includes either repeat URSL or open surgery.

The complication rate in patients who underwent CT / IVU before URSL was 9 (16.6 %), whereas only 16 (12.3 %) patients developed complication among patients who didn't undergo CT / IVU and were managed only on basis of USG / x-ray. The stone free rate in patients who had CT / IVU before operation is 39 / 54 (72.2 %), in patients who didn't have CT / IVU in pre op period have stone free rate of 106 (81.5 %). Development of post op fever was seen in 8 / 54 (14.8 %) of patients who underwent CT / IVU in pre op period, as compared to 18 / 130 (13.4 %) of patients who had just UCG and XRAY in pre op period. Need of second look surgery was seen in 7 / 54 (12.9 %) of patients who had CT / IVU in pre op period, total 15 / 130 (11.5 %) patients who didn't have CT / IVU in pre op period were in need of second look surgery.

Out of 184 patients with lower ureteric calculus 54 underwent imaging (CT and IVU). There was no statistical difference in proportion of complication rate among patients with CT and without CT (p-value 0.985). Proportion of SFR in patients with and without CT also showed no statistically significant difference (p-value 0.399). IVU showed no statistical difference in proportion of complication and SFR

when compared with patients without IVU for lower ureteric calculus with p-value (0.722 and 0.135) respectively.

The average size of stones in patients with lower ureteric calculus is  $10.4 \pm 3.8$  mm. Average hospital stay for lower ureteric calculus URSL patient is  $4.1 \pm 1.9$  days which include one pre-op day and one OT day. In patients with imaging study (CT and IVU) done in the pre-op period average hospital stay is  $3.89 \pm 1.23$  days.

Male	102
Female	82
Stone Size	$10.4 \pm 3.8$ mm
Stone Positions: Lower	184 (43.8 %)
Total Patient with CT / IVU	54
CT	44
IVU	10
Overall SFR in Lower Ureteric Calculus	145 (78.80 %)
Post Op Fever	26 (14.13 %)
Complication Rate	25 (13.58 %)
Second Look Operation	21 (11.41 %)

**Table 1. Demographic Data**

SFR and Other Complications	Subjects with No Imaging (Non CT / IVU)	Subjects with Imaging (CT / IVU)	P Value
SFR	106 (81.5 %)	39 (72.2 %)	0.159
Second look operation	15 (11.5 %)	7 (12.9 %)	0.982
Post op fever	18 (13.4 %)	8 (14.8 %)	0.951
Complications	16 (12.3 %)	9 (16.6 %)	0.582

**Table 2. Association of Imaging and No Imaging with Outcomes among the Subjects with Lower Ureteric Calculus**

## DISCUSSION

Since its introduction in 1923 until around 2000," the gold standard" to image the urinary tract was intravenous pyelogram / urography (IVU). However, over the past two decades, with the development of CT scan and advancement in technology of CT, CT is currently the "gold standard" to image the urinary tract.<sup>6</sup> Compared to CT scan, IVU is still preferred by some urologist despite having obvious disadvantages of procedure. Non-contrast helical CT became the standard for renal and ureteral colic, not long after its introduction,<sup>9</sup> for the very fact that CT offers many benefits over IVU. CT doesn't require bowel preparation and patient can be taken up for CT in emergency situation also. Time required to perform CT is around 10 - 15 mins but IVU is lengthy procedure which consumes around 1 hr. in IVU multiple imaging is required whereas CT is single imaging and no need to expose patient again and again. No need of contrast injection in CT which is biggest disadvantage if IVU. Sensitivity of CT is around 97 - 98 % and specificity is 96 - 100 % making it the most important advantage. CT also provides detail analysis of other organs and other pathology of kidney which seriously lack in IVU imaging<sup>9,10</sup>

The advantages of ultrasound is that there is no danger of radiation, it's portable, and doesn't require IV contrast material, and it can be very sensitive if combined with Doppler study and studying resistive indices.<sup>11</sup> However, the limitation of ultrasound includes poor ureter visualization in obese patients.

The potential drawbacks of CT evaluation are higher radiation doses than IVU in conventional helical CT evaluation; however, modern CT scan have come up with low dose of radiation exposure and it is continuously

evolving.<sup>12</sup> In children and pregnant women, when considering evaluation, radiation is of particular importance. Dose of radiation can be reduced in CT by using technique such as low dose or ultra-low dose CT protocol. With the help of this protocol dosages can be reduced to IVU level without compromising on sensitivity and specificity of diagnosis.<sup>13</sup> Though it looks like cost of imaging by IVU is low but very fact that it doesn't give complete diagnosis and many a time we need additional imaging for further diagnosis it increases overall cost of diagnosis. A study conducted in Europe by Pfister SA et al found that actually cost of IVU is more than CT when you compare other factors related to study such as need of extra personal to inject contrast, contrast material, charges of room, need of observation post procedure, extra time required for procedure in the same time 4 - 5 CT's can be done.<sup>4</sup> But despite all these drawbacks use of IVU can't be totally ignored as at some places IVU has advantage over CT such as in patients of trauma in whom functioning of contralateral kidney is of immense important before operating on affected kidney and on table single shot IVP comes to rescue of surgeon, some institutes still not equipped with latest CT machine at such places IVU still runs the diagnostic imaging role. In many centres worldwide, the ureteroscopic lithotripsy is treatment of choice for lower ureteric calculus. Some places still prefer ESWL (Extracorporeal Shock Wave Lithotripsy), as ESWL is non-invasive. Nowadays, URSL is recommended as a first-line surgical management of lower ureteral calculi according to some authors, for the very fact it gives prompt stone clearance, lower complication rate, single procedure and higher stone clearance rate.<sup>14</sup> There are other factors also which determine stone clearance, and safety and outcome of surgery such as size of stone, position, associated anomalies, infection, use of instrument and surgeons experience are some of the factors. The complication and pain associated with ureteroscopy have decreased with time with the miniaturization of the ureteroscope and use of small calibre intracorporeal lithotripsy devices.<sup>1</sup>

Turk TMT et al<sup>15</sup> in their study of comparison of ureteroscopy with shock wave lithotripsy have come with findings in favour of ureteroscopy. They found ureteroscopy gives immediate improvement in symptoms compared to ESWL. In ureteroscopic stone clearance they used pneumatic lithotripter. They found positive correlation with learning curve and experience of URSL with improve success rate of procedure. URSL with pneumatic lithotripsy is very economical and efficient procedure for stone clearance. Success rate of variety of ureteroscopy procedure carries from 86 – 100 % as shown by various published studies.<sup>15</sup> Another study by K. Isen (2012) showed similar results. The stone-free rate of lower ureteric stones (93.3 %) and middle ureteric stones (87.5 %) was significantly higher compared with upper (73.3 %) ureteric stones ( $p < 0.05$ ).<sup>16</sup> Our results are also comparable and show a statistically significant difference in SFR for lower vs. upper ureteric calculus in URSL with pneumatic lithotripsy SFR for lower ureteric calculus (88 %) and upper ureteric calculus (62 %) ( $p <$

0.05). Main drawback of pneumatic lithotripsy is that it produces large stone fragments and stone migration which lead to problem for spontaneous stone passage.

Various possible complications in URSL for lower ureteric calculus such as intra-op bleeding, perforation, mucosal injury, unable to put DJ stent, intra op fever and post-op fever and post-op bleeding. In our study complication rate for lower ureteric calculus among imaging and non-imaging group is (16.6 % and 12.3 %) this difference is statistically not significant with p value of 0.582, similarly rate of repeat procedure among both groups imaging (12.9 %) and non-imaging (11.5 %) also shows no statistically significant difference with p value 0.982. When SFR was compared in both groups, imaging group shows 72.2 % and non-imaging group shows 81.5 % SFR, but this difference is not statistically significant. Our results are comparable to established study results such as the Krishna Reddy SV et al<sup>1</sup> in his study on ureteroscopic lithotripsy for mid and lower ureteric calculus showed 83 % and 89.06 % stone free rate. Another study by Isnan K<sup>16</sup> in 2012 showed pneumatic lithotripsy is good treatment option and shows good stone free rate of 8.5 %.

There are some limitation in our study. This is a retrospective single institution study, as it's a teaching institute majority of procedures are performed by postgraduates under the guidance of the consultant, and so the learning curve of PG has affected some of the study results when compared to established studies. Groups are not comparable as number of patient in imaging (CT / IVU) is half of that with only USG and / or X-ray.

## CONCLUSIONS

It's still very common in our health care system to use imaging and diagnostic imaging which are no more part of established guidelines for particular disease for the very fact that it is convenient and easily available. But we need to point to modalities which are more appropriate, have high quality, have higher specificity and sensitivity for stone disease. At the same time, we need to actively assess our current protocol from time to time to avoid unnecessary radiation exposure. IVU can be avoided in straight forward cases. Similarly, CT can also be avoided in straight forward cases of lower ureteric calculus as it doesn't provide any added advantage in terms of decreasing intra-op complication and SFR.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

Financial or other competing interests: None.

Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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