# Diagnostic accuracy of the Unenhanced Computed Tomography in Diagnosis of the Urolithiasis in suspected Patients with negative Intravenous Pyelogram

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**ABSTRACT**

**Objective:** To determine the accuracy of unenhanced Computed tomography in diagnosis of urolithiasis in the suspected patients in which diagnosis of urolithiasis was missed on intravenous pyelogram

**Study Design:** Cross-sectional Observational study

**Place and Duration:** At Department of Radiology, Liaquat University of Medical Health Sciences, Jamshoro, Hyderabad from 1st March 2018 to 31st December 2018

**Methodology:** Outdoor symptomatic patients who were negative on intravenous pyelography for urolithiasis were re-assessed by unenhanced CT scan KUB procedure. The frequency of urolithiasis on CT KUB, previously missed in IVU, precision of investigation in terms of site, size, number of stone assessed.

**Results:** Among total of 386 symptomatic patients with negative IVP 63.2% showed urolithiasis whereas 36.8% were found negative for urolithiasis. The most common site of single calculus was ureter (35.2%) and most common transverse size of the stone was in between 0.4 to 0.5 cm (37 to 41 cases, 9.6% to 10.6%). Presence of multiple stones (57.3%) were more common in kidney and single stones (35.2%) were more common in ureter.

**Conclusion:** Unenhanced CT Scan KUB provides more efficient information in patients, presenting with acute renal colic. It has significantly higher rate of diagnosing urolithiasis in comparison with intravenous pyelogram.

**Keywords:** Renal colic, Urolithiasis, Diagnosis, Intravenous urography, CT KUB, Diagnostic accuracy,

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## INTRODUCTION

Urolithiasis is most common cause of acute flank pain affecting all age groups, however, the prevalence, incidence, chemical composition of urolithiasis vary person to person[1,2]. Urolithiasis has wide spectrum effect on kidney ranging from simple acute flank pain to the renal parenchymal destruction. Hence it becomes important to detect the urolithiasis timely. Imaging techniques for detection of the urolithiasis includes plain abdominal X-ray, Ultrasound, Intravenous pyelogram and Computed tomography. In 1990s, Unenhanced computed tomography (UECT) was inaugurate for the first time for urolithiasis. In the developed countries computed tomography has become the gold standard investigation for initial, subsequent evaluation and treatment of patients with urolithiasis. However, in underdeveloped countries other imaging tools like intravenous pyelogram or x ray abdomen are still the mainstay at initial stage[3]. Talking about the Intravenous pyelogram, it has remained one of the modality of choice for urolithiasis detection and it is x ray based procedure just like UECT, but unlike UECT it utilizes contrast material for stone detection, level for obstruction and renal functional status. However, it has some limitations like anaphylactic reaction related to contrast, difficulty in detection of radiolucent calculi even after consumption of contrast, time taking and overtired procedure. A proper IVP usually takes around 12 to 24 hours[4,5]. UECT scan is good for the initial tool for diagnosis of a stone, especially in atypical cases or in patients unable to tolerate IV contrast. It detects almost all urinary stones by conveying their composition, accurate location, exact size of stone, level of obstruction and impact of obstruction on the kidney and the surroundings. The radiation dose is a little higher when correct parameters are used[6,7]. In latest studies, low-dose UECT scanning technique has been composed for detection of urolithiasis[8].

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We hypothesize that by using CT scanner we can easily detect the exact location and size of the stones which were missed initially on intravenous pyelogram in symptomatic patients for urolithiasis. All data on this topic are available with different outcomes. Therefore, present study is design to assist actual magnitude of urolithiasis diagnosed on UECT scan among those patients who were missed on IVP. Furthermore, statistics could be devised to have Unenhanced computed tomography in all the patients with negative IVP.

The most common presenting complain in the individual is pain in the hypochondrium and groin region. The intensity of pain varies depending on the position of the calculus. Especially the pain from lower-lying stones may show radiation of pain into the hypogastric region, radiating as far as the genitals. Undiagnosed Urolithiasis can lead to an alarming effect that is parenchymal damage and reduce kidney function, either secondary to the obstruction or infection[9,10]. The goals of initial imaging tests in the diagnosis of urolithiasis are depicting the exact location of stone, determining the size of the stone and composition of the stone. Size and composition are important factors in deciding on the appropriate treatment for uroliths[11]. Unenhanced CT has become the standard of care for urolithiasis in people because of the improved sensitivity and specificity. It has higher detection rate for urolithiasis than IVP, especially the ureteric stones. The sensitivity and specificity of Unenhanced computed tomography (UECT) has been reported as 95-98% and 96-100% respectively[12]. One of the main disadvantages of IVP, is usage of contrast media showing possibility of adverse reaction and toxicity hence it cannot be used if the individual who are allergic to iodine or contrast dye. It can become the cause of renal failure especially in the patients with cardiovascular or renal problems. IVP also carries some technical disadvantages, like bowel preparation should be proper as without this the image can be in compromise state and can lead to misdiagnosis. During the compression phase in IVP, for better resolution of ureters and collective system, patient might feel uncomfortable and this maneuver becomes contraindicated in the acute abdomen, aortic aneurysm, abdominal mass or pregnancy. In perspective of disease diagnosis, IVU can only show the diseased region in the collective system, ureter and bladder. The CT could not only show the obstructive ureter, but also revealed the location and the cause of the obstruction[13-15].

The purpose for performing this study is to actually help in reducing the suffering and multiple unnecessary diagnostic workups of symptomatic patients with suspected urolithiasis. It will also minimize the burden on health sector. In the future this can help in reducing the suffering of the patient as well as the financial burden by quick and exact diagnosis. So, this study was conducted with an objective to determine the accuracy of unenhanced Computed tomography in diagnosis of urolithiasis in the suspected patients in which diagnosis of urolithiasis was missed on intravenous pyelogram.

## METHODOLOGY

This Cross-sectional Observational study was conducted at the Department of Radiology, Liaquat University of Medical Health Sciences, Jamshoro, Hyderabad from 1st March 2018 to 31st December 2018. Non-probability consecutive sampling technique used for data collection. All suspected patients of urolithiasis with negative intravenous pyelogram aged between the age of 20-50 years of either gender were included in study. The unwilling patients, already diagnosed case of urolithiasis through radiographic images, intravenous pyelography and ultrasound, pregnant patients, critically ill patients like ICU admitted patients and patients with congenital urinary tract abnormality were excluded from study.

The demographic data was collected through face to face interview by noting important biodata and demographic details like age, gender, symptoms etc. Patients who were negative for intravenous pyelography and went under CT scan, were scrutinized for the data with an interpretation. All patients were subjected to CT scan KUB. CT scan is a diagnostic tool which uses moderate to high exposure of X-radiation that make thorough images of body parts. It works on density of the tissues. Hyperdense area within the entire urinary tract from the kidney to the urinary bladder along with duration of symptoms, location of stone and size of stone, all were recorded on the proforma attached. All images were reviewed by consultant radiologist having experience of more than 5 years. Data was collected on the structured proforma attached.

**Data Analysis:** SPSS-21 has been used to analyze data. Mean ± standard deviation is computed for continuous variables like age of the patient and size of stone. Frequencies and percentages are computed for categorical data like site of stone. Effort modifiers like age, location of stone and size of stone has been stratified to see effect of their as outcome. Post stratification Chi square test are applied. P - value less than equal to 0.05 has been considered as significant.

## RESULTS

A total of 386 symptomatic patients subject to UECT scan, who were negative for intravenous pyelography and went under UECT scan. Out of 386 sample, 244 (63.2 %) were positive for urolithiasis on UECT scan and remaining 142 (36.8 %) were negative for urolithiasis on UECT scan. Majority of participants were males (n=210, 54.41%) and among them 58.57% (n=123) male were found positive for urolithiasis. Among 45.59% (n=176) female subjected to UECT and 68.75% (n= 121) were positive for urolithiasis. Most common age group with urolithiasis in females was 31 to 40 years (n=59, 48.8%) while in males it was 20 to 30 years (n=62, 50.4% ) as shown in Table-I.

Out of 244(63.2%) positive cases, 136 (35.23%) cases showed calculi in ureter, 82 (21.24%) cases in kidneys and 26 (6.74%) cases in urinary bladder, so most common site of calculus in both males and females was found to be ureter. Regarding the multiplicity of stones, two groups were made: Single and multiple calculi group. Single calculi were seen in 194 (50.3 %) cases while multiple calculi were seen in 50 (12.9 %) cases. Multiple calculi were seen in kidneys (47 cases, 57.3 %) and urinary bladder (3 cases, 11.5 %), while ureters were showing single calculus only (136 cases, 35.23%) (Table-II).

**Table-I: Frequency of Urolithiasis in gender and age group distribution. (N=386)**

| Suspected Patients | Gender | Age Groups | | | TOTAL |
|---|---|---|---|---|---|
| | | 20-30 | 31-40 | 41-50 | |
| Urolithiasis (n=244) (63.2%) | Males (n=123) (50.4%) | 62(50.4%) | 35(28.5%) | 26(21.1%) | 123 (31.86%) |
| | Females (n=121) (49.6%) | 30(24.8%) | 59(48.8%) | 32(26.4%) | 121 (31.35%) |
| Without Urolithiasis (N=142) (36.8%) | Males (n=87) (61.3%) | 37(42.5%) | 28(32.2%) | 22(25.3%) | 87 (22.54%) |
| | Females (n=55) (38.7%) | 19(34.5%) | 26(47.3%) | 10(18.2%) | 55 (14.25%) |
| **TOTAL (N=386)** | | | | | 386 (100 %) |

**Table-II: Frequency for urolithiasis at different anatomical sites of urinary tract (n=244)**

| Site of Calculus | No of Calculus (n=244)(63.2%) | |
|---|---|---|
| | Single | Multiple |
| Kidney (n=82) (21.24%) | 35(42.7%) | 47(57.3%) |
| Ureter (n=136) (35.23%) | 136(100%) | 0(0%) |
| Urinary Bladder (n=26) (6.73%) | 23(88.5%) | 3(11.5%) |
| No Calculus (n=142) (36.8%) | - | - |
| Total (N=386) (100%) | 194(50.3%) | 50(12.9%) |

Most commonly occurring transverse size of single calculus came out to be about 0.4 to 0.5 cm (37 to 41 cases, 9.6% to 10.6 %). In ureter most common size was from 0.4 to 0.5 cm (72 cases, 52.9%) while in kidney it was 1.0 cm (19 cases, 23.1%) (Table-III).

## DISCUSSION

Intravenous pyelogram has decreased over time in diagnosing urolithiasis. Primarily this is due to super accuracy of the UECT, secondly due to intravenous pyelography which is time taking procedure and one of the causes of increase clinician intolerance for diagnostic uncertainty[10]. Apart from this, intravenous pyelogram carries worst contrast reaction especially in patient with poor renal function or other co-morbid like hypertension or diabetes. Where as in UECT, procedure is simple, quick and pain less. Only hazard it carries is x-ray exposure which is slightly higher than what we expose in intravenous pyelogram. But in the end, it is worth taking because when intravenous pyelogram fails to deliver the diagnosis to the clinician, the very next step is UECT scan[13]. Adding to the advantages of the UECT, it also shows abnormal tissue-masses that can be associated un-specifically to other diseases-conditions such as masses, hemorrhage, calcifications, gases, and fluid collections. Another very important plus factor of the UECT is determining the composition of the stones by calculating the density of the stone through house fields units.

In our study, we took symptomatic patients who were subjected to UECT scan. We found 63.2% cases positive with urolithiasis while 36.8% cases were negative, showing no stones. In comparison with the study conducted by Imran et al, to compare between UECT and IVP in detection of urinary stones, 83 patients were sampled and out of which 69.87% patients showed stones and 30.12% were negative on UECT while on IVP screening test, 54.21% were positive, 45.78% were negative and 21.69% were inconclusive. Fatima Imran et al concluded that NCCT was significantly better than IVU[12]. Similar comparison between the UECT scan and IVU was done by Smith et al that studied sample of 20 patients, of which five had a ureteric stone that was demonstrated on both UECT scans and IVU radiographs, six had a stone that was depicted on UECT scans only, and in one patient a stone could not be delineated definitively on either UECT scans or IVU radiographs. Remaining eight patients had findings at UECT and IVU consistent with the absence of obstruction concluding UECT is more effective than IVU in precisely identifying ureteric stones[(15)]. Another study carried by Wang et al showing 66 patients to have urinary stones among 82 patients on NCCT, representing 98.5% sensitivity for detection of stone and about 39 patients, were detected stones on IVU out of already diagnosed 66 patients by NCCT showing 59.1% sensitivity of IVU[16]. These studies have suggested that UECT has overcome the limitation of IVU in stones detection.

Our 1st parameter in respect to the urolithiasis is site of the stones. In our study, three sites were depicted for urolithiasis, out of which 35.2% cases were showing ureteric stones that were missed by IVU initially. As ureter being a thin tubule like structure, it is very much common for a stone to get lodged within it easily and causing abrasion, renal colic and obstructive uropathy. Hence it become important to diagnose it in less with most effective diagnosing tool that is UECT scan. This analysis has been supported by a study done by Sommer et al, which showed 34 patients with renal colic, out of which 18 were depicted by UECT and 16 cases were true positive on basis of documented passage of stone. Out of those confirmed 16 cases, 13 cases were proved to be positive on other imaging tools including X- ray and ultrasonography. Hence, non UECT was found rapid and more accurate for determining presence of ureteral calculi[17]. Another prospective studies by Yilmaz et al are giving similar sensitivity for UECT in comparison with other modalities[18].

**Table-III: Size of single calculus in the given sites as measured on Unenhanced computed tomography (UECT) (n=244)**

| Size of Single Calculus | | 0.3 CM | 0.4 CM | 0.5 CM | 0.6 CM | 0.7 CM | 0.8 CM | 1.0 CM | Multiple Size Calculi |
|---|---|---|---|---|---|---|---|---|---|
| Site of Calculus | Kidney (n=82) (21.24%) | 0 | 0 | 0 | 3 | 5 | 8 | 19 | 47 |
| | Ureter (n=136) (35.23%) | 20 | 36 | 36 | 13 | 9 | 12 | 10 | 0 |
| | Urinary Bladder (n=26) (6.74%) | 2 | 1 | 5 | 3 | 2 | 4 | 6 | 3 |
| Total (N=244) | | 22 | 37 | 41 | 19 | 16 | 24 | 35 | 50 |

Another parameter is transverse size of the calculus. Through our study, the most commonly recorded transverse diameter of the stone in combine results as well as ureter was 0.4 to 0.5cm (9.6% to 10.6%). Other studies done by Kishore[19] shows mean actual transverse size of ureteric stone of about 0.4 to 0.6 cm. The justification behind these similar findings is that normal diameter of ureter is 3 to 4 mm, hence stone of 0.4 to 0.6 cm can cause obstruction and colic pain while passing through the ureter.

Regarding age group studied in our patients, it can vary demographically. Most of them were young age males with age between 20 to 31 years. Study done by Imran et al[(12)] and Sarla and colleagues[20] show more older age group of 35 to 45 years and 31 to 40 years respectively. During the study we also evaluated background histories, and durations of symptoms. We found most of patients being reluctant in their diet habits and were lacking in consumption of clean and proper fluid intake according to their body mean index. Hence it can vary in perspective of location, environment and habitats.

After comparable analysis with national and international studies, it can be clearly stated that UECT scanning is quick and straight forward procedure for depicting the accurate location, size and composition of stones. Apart from these, it can also depict degree of urinary obstruction and evaluation of renal anomalies. It provides protection from high risk of contrast reactions. On the contrary, IVP include time taking procedure, low detection and poor distinguishing of radiolucent stone, carrying the chance of adverse effects of contrast and still ending into the doubtful diagnosis.

After analyzing our data and literature review, we found that the UECT is highly sensitive for the detection of stones of all sizes, having several advantages as it is performed rapidly, does not require the administration of contrast material and detects almost all urinary stones, even it identifies renal micro-calculi which are not detectable by plain film. Moreover, it is a time saving procedure, causes less discomfort and can also detect other unsuspected extra-urinary and urinary tract abnormalities as well. It also shows composition of the stones by using CT house fields units which helps the urologist in selection of treatment options[14,18]. We consider that unenhanced CT is adequate and more efficient in providing information about the urolithiasis. It has significantly higher rate of diagnosing urolithiasis in comparison with intravenous pyelogram. It can replace IVP as the first-line diagnostic tool for early diagnosis and treatment to decrease the burden of suffering, misdiagnosis, risk of drastic contrast reactions and cost from an individual in our society.

## CONCLUSION

Unenhanced CT Scan KUB provides more efficient information in patients, presenting with acute renal colic. It has significantly higher rate of diagnosing urolithiasis in comparison with intravenous pyelogram.

## AUTHOR'S CONTRIBUTION

**Asma J:** Conceived idea, Designed research methodology, Data collection, Data analysis, Literature search, Manuscript writing.
**Adnan A:** Data compilation, Literature review, Data interpretation, Statistical analysis, Manuscript final approval.
**Ghazala S:** Data compilation, Literature review, Data interpretation, Statistical analysis

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