

# Comparison of Kidney-Ureter-Bladder Radiography with Computed Tomography Scout Film for the Diagnosis of Renal Calculi Taking Axial Computed Tomography as Gold Standard

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## Authors' Contributions

1 Data Collection & Processing, Data Analysis and/or Interpretation, Drafting of Manuscript.

2 Conception & Study Design, Data Analysis and/or Interpretation, Critical Review.

3 Conception & Study Design, Data Collection & Processing

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## ABSTRACT

**Background:** Nephrolithiasis is a widespread disease with an incidence of 17-13 in North American, 5-9% in Europe, and 1-5% in the Asian continent. Plain abdominal radiography is used to visualize renal stones, but the cysteine stones are often poorly visible, uric acid and mixed stones are not visible at all. The second diagnostic tool for the diagnosis of renal calculus is computed tomography. The CT scout film is often overlooked and did not use for the diagnostic purpose.

**Objective:** To compare Kidney-ureter-bladder radiography with computed tomography scout film for the diagnosis of renal calculi taking axial computed tomography as a gold standard.

**Materials and Methods:** It was a cross-sectional analytical study design conducted on 57 patients presenting with acute flank pain in Faisal Hospital Faisalabad. Patients having ages between 18-60 were included in the study. Pregnant patients and patients with Indinavir therapy were excluded from the study.

**Results:** The sensitivity recorded for CT scout film was 66.7% and for the plain abdominal radiography was 80.7%. The calculus carrying Hounsfield unit less than 200 HU were not visualized on both the modalities x-ray and plain abdominal radiography. However, the calculus greater than 5mm in size has a sensitivity of 73% on CT scout film.

**Conclusion:** The sensitivity recorded for CT scout film was 66.7% and for the plain abdominal radiography was 80.7%. The calculus carrying Hounsfield unit less than 200 HU were not visualized on both the modalities x-ray and plain abdominal radiography. However, the calculus greater than 5mm in size has a sensitivity of 73% on CT scout film.

**Keywords:** CT scout, CT scan, x-ray KU.

## INTRODUCTION

Renal stone mostly present as acute renal colic from loin to groin pain. Sometimes stone size and its location enables the easy removal of stones from the body without any surgical intervention. To make a diagnosis alone based on physical examination and clinical manifestations is difficult [1]. Initial diagnosis for nephrolithiasis includes plain KUB x-ray [2]. It requires x-rays with anterior-posterior orientation of the body starting from xiphisternum to symphysis pubis [3], [4]. It uses the same fundamental concept as Computed tomography but in a single plane. Because this imaging method visualizes calculus from only one direction so its accuracy is reduced, which results in a decrease specificity and sensitivity. Plain abdominal radiography is used to visualize many stones but cysteine stones are often poorly visible as compared to uric acid and mixed stones are not visible at all [5]. To solve this problem, usually the plain abdominal radiography is joined with ultrasonography to detect the renal stones, however overlying bowel gas and fecal material can easily hide the calculus. Furthermore, the radiography of Kidney-Ureter- Bladder cannot visualize the radiolucent stones thus limiting the diagnostic value of plain x-ray. However, in some patients, a KUB x-ray is enough for diagnosing the exact shape, location, and size of the calculus. The main advantage of KUB x-ray is that it is a useful examination for the follow-up of known radiopaque calculus and requires less time to perform KUB even for the ambulant patients [6].

## OBJECTIVE(S)

To compare Kidney-ureter-bladder radiography with computed tomography scout film for the diagnosis of renal calculi taking axial computed tomography as gold standard.

## METHODOLOGY

### Study Design

It was a cross-sectional study and the sample size was 57 patients.

### Study Location

After taking informed consent, data were collected from patients presenting with renal pain in the Urology

diagnostic section of Faisal hospital Faisalabad Pakistan through developed questionnaire and compiled data collection sheets according to the questionnaire variables (age, gender, occupation, side, location, x-ray findings, CT scout findings, CT axial findings, stone size in mm, house field unit).

### Duration of Study

It was a 9<sup>th</sup>-month study.

### Statistical Analysis

Collected data was analyzed through spss version 23. Inclusion criteria were both genders presenting with clinical suspicion of renal stones and between the ages of 18-60 years. Exclusion criteria included pregnant patients and patients on Indinavir therapy. Ethical approval of the study was taken from the ethical review board University of Lahore.

## RESULTS

A total of 57 patients who visited Faisal Hospital Faisalabad and meeting the inclusion and exclusion criteria were included in this study. Out of 57 patients, 36(63.2%) were male and 21(36.8%) were female patients with a mean age of 42 (Table 1). Altogether 57 stones were detected by CT scan with a mean stone size of 7.9mm. The study showed that the male gender was predominant in the case of urolithiasis as shown in the table. All the stones appeared positive on CT axial images which were already taken as gold standard.

Table 1. Showing Ratio of Male and Female.

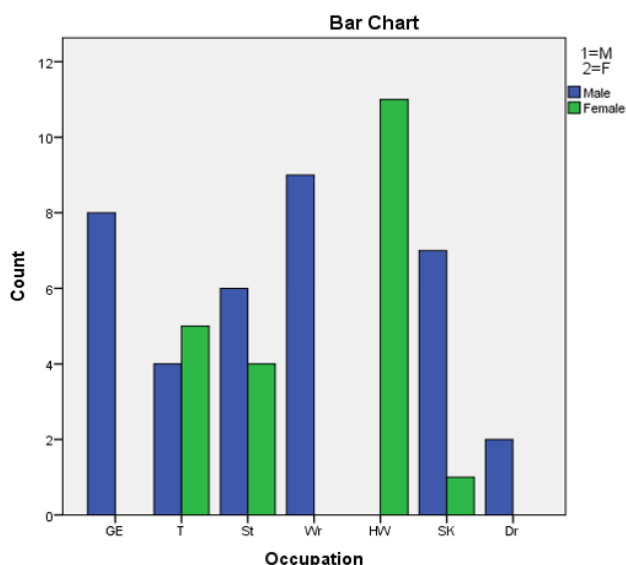
	Frequency	Percent
Male	36	63.2
Female	21	36.8
Total	57	100.0

### Prevalence of Renal Calculus Among Different Occupations

From these 57 patients, different occupation was analyzed for renal stones and it has been noted that house wives have a greater ratio of renal stones as compared to other professions. The least no of renal stones were noted in medical professionals. The following table and graph shows the prevalence of urolithiasis among different occupations (Table 2, Figure 1).

**Table 2. Showing Prevalence of Renal Calculus Among Different Occupation.**

Name of occupations	Frequency	Percent	Valid Percent
Govt Employ	8	14.0	14.0
Teacher	9	15.8	15.8
Student	10	17.5	17.5
Worker	9	15.8	15.8
House Wife	11	19.3	19.3
Shop Keeper	8	14.0	14.0
Dr	2	3.5	3.5
<b>Total</b>	<b>57</b>	<b>100.0</b>	<b>100.0</b>



**Figure 1.** Showing prevalence of renal calculus among different Occupations.

**Sensitivity of Abdominal Radiography at Different Locations in the Renal System**

Cross Tabulation of the results between plain x-ray findings with the location of calculus in the renal system showed that the stones which were present in proximal ureter, were seen positive on plain abdominal radiography with a sensitivity of 19.3%. Ureterovesical junction encountered 5 stones, out of which 4 (7.0%) stones were positive on plain abdominal x-ray and 1 (1.8%) stones appeared negative on plain abdominal x-ray. Mid ureter had 2 stones and both appeared positive on plain abdominal x-ray with a sensitivity of 3.5%. In Kidneys 28 (49.1%) were seen positive on plain abdominal x-ray while 7 (12.3%) stones were negative on plain abdominal x-ray. Distal ureter encountered 11(19.3%) stones, out of which 8 (14.0%) stones were X-ray positive and 3(5.3%) stones were x-ray negative. The detail of stone visibility on plain abdominal x-ray is shown below (Table 3).

**Table 3. Showing Sensitivity of X-ray Abdominal Radiography at Different Locations in the Renal system**

Location of the renal stone			Xray Finding		Total		
			Positive	Negative			
Location	PU	Count	11	0	11		
		% of Total	19.3%	0.0%	19.3%		
	UVJ	Count	4	1	5		
		% of Total	7.0%	1.8%	8.8%		
	MidU	Count	2	0	2		
		% of Total	3.5%	0.0%	3.5%		
	Kidney	Count	21	7	28		
		% of Total	36.8%	12.3%	49.1%		
	DU	Count	8	3	11		
		% of Total	14.0%	5.3%	19.3%		
	Total			Count	46	11	57
				% of Total	80.7%	19.3%	100.0%

**Sensitivity of CT Scout Film at Different Locations in the Renal System**

At the proximal ureter, 8 out of 11 stones with a sensitivity of (14.0%) were seen as positive and 3 out of 11 (5.3%) stones appeared negative on CT scout film. At mid ureter 2 stones were noted, 1 (1.8%) appeared positive on CT scout film and 1 (1.8%) appeared negative on CT scout film. Kidneys had a total of 28 stones, out of which 18 (31.6%) stoned

appeared positive on CT scout film and 10 (17.5%) appeared negative on CT scout film. Ureterovesical junction had 5(8.8%) stones, out of which 4 (7.0) stones appeared positive on CT scout film and 1 (1.8%) stone appeared negative on CT scout film. The distal ureter had 11 stones, out of which 7 (12.3%) stones appeared positive on CT scout film and 4 (7.0%) stones appeared negative on CT scout film (Table 4).

**Table 4. Showing Sensitivity of CT Scout Film at Different Locations in the Renal System.**

Location Wise Distribution in a Urinary System			CT scout finding		Total	
			Positive	Negative		
Location	PU	Count	8	3	11	
		% of Total	14.0%	5.3%	19.3%	
	UVJ	Count	4	1	5	
		% of Total	7.0%	1.8%	8.8%	
	MidU	Count	1	1	2	
		% of Total	1.8%	1.8%	3.5%	
	Kidney	Count	18	10	28	
		% of Total	31.6%	17.5%	49.1%	
	DU	Count	7	4	11	
		% of Total	12.3%	7.0%	19.3%	
	Total		Count	38	19	57
			% of Total	66.7%	33.3%	100.0%

**Sensitivity of Abdominal Radiography with Respect to Stone Size**

In this study, 11 stones were noted having size less than 5mm and 46 stones were noted having size greater than 5mm. Out of these 11 smaller stones, 6 stones appeared positive on plain x-ray radiography and 5 become radiolucent (negative) shown in (Table 5).

**Table 5. Showing Sensitivity of X-Ray Abdominal Radiography with Respect to Stone Size.**

Stone Size	Xray Finding		Total
	Positive	Negative	
Less than 5	6 (54%)	5 (45%)	11
Greater than 5	40 (86.7%)	6 (13%)	46
Total	46	11	57

**Sensitivity of CT Scout Film with Respect to Stone Size**

Out of 11 stones which were noted less than 5mm in size, 4 appeared positive on CT scout film while 7 remained undetected on CT scout film (Table 6).

**Table 6. Showing Sensitivity of CT Scout Film with Respect to Stone Size.**

Stone Size	CT Scout Finding		Total
	Positive	Negative	
Less than 5	4 (36.3%)	7 (63.6%)	11
Greater than 5	34 (73%)	12 (26%)	46
Total	38	19	57

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## DISCUSSION

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Non-contrast Computed tomography now a days has been used widely for the diagnosis of renal calculi. When calculus is diagnosed, patient must be treated appropriately depending upon the calculus size and location and symptoms of the patient [7],[8]. If a patient will not recover from the symptoms, radiological evidence is necessary for the follow up which confirms the status of the kidneys and ensure that they are not at risk for further silent obstructions [9],[10]. So it is important that the radiological modality is reliable for the diagnosis and follow up scans. Ultrasound is a noninvasive radiological modality and can be used but its sensitivity is (10-50%) for the renal calculus which is low. Intravenous urography can be used but it has a disadvantage of a risk of allergy due to contrast media [11]. Conventional abdominal plain radiography has been used for many years for the diagnosis of renal calculi. However, bowel gases, bones, and costal cartilage may interfere with the diagnosis and obscure the margins of the kidney. In addition to all these many other structures such as arterial calcification, calcified lymph nodes, stool, abdominal and pelvic masses may also mimic the renal calculus for their location and appearance. Yap *et al* conducted a study and concludes that the sensitivity of plain film radiography is up to 73% [12]. As computed tomography has the advantage of its accuracy, speed, and safety. From the cases received while comparing the laterality noted right side of the patients contains 20 (40.4%) while the left side of the patient contains 34 (59.6%) no. of calculus. Calculus was also described based on their location that is the kidney, Proximal Ureter, Distal Ureter, and ureterovesical junction. Number of positive cases on plan abdominal radiography and CT scout film at proximal ureter were 19.3% and 14%, mid ureter were 3.5% and 1.8%, distal ureter were 14% and 12.3%, ureterovesical junction contains the same that is 7% and the kidney contain the positive cases of 36.8% and 31.6% respectively. Majority of the calculi were noted in the kidneys with a sensitivity of 48.1%. All the calculi which were positive on CT scout film were also seen positive on Plain abdominal radiography. My study showed that no. of positive cases on plain abdominal radiography and CT scout film were 46/57 (80.7%) and 38/57 (66.7%) respectively. No. of positive cases noticed on CT scout film also appeared positive on x-ray

radiography. The results noted in my study are closer to the results noted by Michael E. According to Michael E the sensitivity of plain radiography was 77.4% and for CT scout radiography was 58.06% with a sample size of 110[13]. My results are higher in percentage noted by Yap. According to his study, the no. of positive cases on plain abdominal radiography were 73% and for CT scout films were 52% [3]. Somehow little difference in study was due to the small sample size of my study. A total of 11 stones were noted whose size was less than 5mm. 4 stones from these were seen positive on CT scout films and 7 stones were seen negative on CT scout films. 46 Stones were detected larger than 5mm, out of which 34 stones were seen positive on CT scout film and 12 stones were seen negative on CT scout film. The sensitivity of stones less than 5mm on CT Scout film was 36.3% and for the stones greater than 5mm was 73%. These results are closer to the sensitivity measured by G.EGE *et al*. According to his study the sensitivity of CT scout film larger than 5mm were 66% [13]. Assi *et al* also supported my study in the case of stones greater than 3mm. According to his study number of positive cases on CT scout films for the stones larger than 3mm were 81% and for abdominal radiography were 86% [7].

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## CONCLUSION

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The CT scout radiography was found similar to plain radiography in the detection of renal calculi. However, the results indicated that CT scout radiography, carry significant potential to report calculi larger than 5mm, and its sensitivity for the calculus larger than 5mm was reported as 73%. CT scout radiograph should be considered as a baseline investigation for the diagnosis of renal calculus.

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## LIMITATION(S)

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Shortcomings of the study include small sample size and confinement to only one hospital of Faisalabad.

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