Physical Education, Health and Social Sciences

https://journal-of-social-education.org

E-ISSN: 2958-5996
P-ISSN: 2958-5988

Does BMI Influence the Sensitivity of CT in Ureteric Stone Diagnosis

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DOI: https://doi.org/10.63163/jpehss.v3i2.471

Abstract

Background: Ureteric colic is an important and frequent emergency in medical practice. It is most commonly caused by the obstruction of the urinary tract by calculi. The body mass index is a person's weight in kilograms divided by the square of height in meters. BMI is an inexpensive and easy screening method for weight categories—obese and non-obese.

Methodology: It was cross sectional analytical Study will be conducted at the Department of Radiology, DHQ Hospital Muzaffargarh. The duration of the study is 4 months at DHQ Hospital Muzaffargarh. In this study, we collected the 50 patients of ureteric colic disease from the DHQ Hospital Muzaffargarh during 2025. Patients presenting with Pain, changes in urine output, difficulty in urinating, hematuria, Urinary tract infections (UTI)

Results: The study revealed a correlation between obesity in ureteric colic patients. The study calculated the frequency of ureteric colic in different junctions, including the uretero-pelvic junction, ureterovesical junction and pelvi-ureteric junction categorized based on BMI criteria (obese and non-obese). This study showed that obese patients should relate with ureteric stones

Conclusion: This study was conducted in relation to BMI criteria and urolithiasis patients. patients who were obese, and diagnosed with ureteric colic at various junctions.

Keywords: BMI criteria, PUJ, VUJ, Obesity, Urolithiasis

Introduction

Ureteric colic, a common medical emergency, is caused mostly by urinary tract blockage owing to calculi, with 5-12% of the population having a urinary tract stone at some time in their lives. The recurrence rate for this illness is high. (M Masarani et al, 2007).

The purpose of this review is to shed light on the usefulness of plain kidney ureters-bladder (KUB) radiography in identifying urinary tract stones, since traditional teaching predicts 90% visibility. It will also go through the CT techniques used and the best image analysis approaches for assisting with interpretation. Non-radiologists will obtain a better grasp of the appropriate use of CT KUB, taking into account the radiology department's radiation safety requirements."

The secondary indicators of ureteric blockage that may help in the diagnosis include hydronephrosis and perinephric stranding. This article examines the diagnostic importance of these symptoms and

offers a checklist to help with their interpretation. The article also discusses unexpected alternative radiological diagnosis that may necessitate expert referral due to their considerable therapeutic implications."

Traditional signs and symptoms of calculus ureteric blockage include microscopic hematuria, severe colicky flank discomfort that spreads to the groin, and vomiting. Additionally, patients may exhibit anxiety and agitation. However, these symptoms might vary, making a definitive clinical diagnosis difficult (Steven J Kennish at el, 2010).

The diagnosis of ureteric colic has changed as a result of the development of new radiological imaging methods including non-contrast CT. Increased urine salt levels and a drop in pH in men's urine, as well as increased urine uric acid and sodium levels, as well as decreased urine citrate in women's urine, are risk factors for urinary stone disease, according to studies.

In this investigation, a connection was shown between increased BMI and numerous risk factors for urinary stone disease. Men had a rise in urine salt levels and a drop in pH, whereas women had an increase in urine uric acid and sodium levels and a decrease in urine citrate. Weight loss may be recommended as part of stone-former counseling, in addition to typical recommendations of high voided volumes, low dietary salt, and reduced animal protein consumption. (Brian H. Eisner at el, 2010)

" Urolithiasis is a worldwide health problem that affects people of all ages and is a primary source of morbidity. Urolithiasis is becoming more common with time, with a considerable lifetime risk. Approximately 50% of individuals with a past history of urinary stones are predicted to develop a second stone during the following ten years, according to publications. Also recognized to have a role in the formation of ureteric stones in both adults and children include socioeconomic level, stone size and position within the urinary system, anomalies in the structure and function of the kidneys, climate, and other components. These elements can greatly affect the course of treatment and the choice of action.

There are a number of technical variables that need to be properly taken into account. These include the practitioner's endourologic expertise, the kind, size, and position of the stone, the existence of a urinary tract infection (UTI), the frequency of pulses, and their prior ESWL experience. (Hamid Shafi at el, 2016)

Urolithiasis is currently thought to be a disease that is changing for a variety of causes. There have been changes in epidemiology, improvements in diagnostic and therapeutic techniques, and ongoing research into preventative interventions for groups thought to be at risk for developing stone disease.

After presenting with unrelated symptoms, a lot of individuals are eventually identified with stone disease after an abdominal ultrasound exam. It is crucial to remember that stone disease is continually changing due to a variety of variables, including as changes in epidemiology, improvements in diagnostic and therapeutic approaches, and ongoing initiatives to provide preventative measures for groups thought to be at risk for the illness.

Stone disease is a complicated disorder that necessitates a detailed knowledge of the mechanisms involved in its origin and progression. Several factors contribute to its incidence, including genetic, anatomic, dietary, and environmental variables, as well as the existence of associated disorders. Furthermore, new studies has emphasized the impact of dietary variables, such as greater consumption of animal protein and daily calorie intake, in increasing the risk of stone development. (M. Rizzo at el, 2007)

Due to increased picture noise, low-dose CT imaging frequently has difficulties for overweight and obese patients with high BMI scores. It can be difficult to accurately diagnose urolithiasis in these individuals, even with the use of high radiation doses.

In many industrialized countries, the prevalence of urolithiasis has been rising significantly over the past few decades. This growth has coincided with a sharp rise in the proportion of overweight and obese people, which has now reached epidemic levels.

The rising frequency of the CT protocol being used on overweight and obese individuals can be linked to the rise in the incidence and recurrence of urolithiasis in these patients. (Jan Herden at el, 2022)

The body mass index (BMI), which is determined by multiplying a person's weight by 703 and dividing by twice their height in inches, has been included in more recent recommendations for treating obesity. With a BMI of 25.9 to 29 is defined as overweight and a BMI >30 as obese, this number is now used to assess the level of overweight or obesity. The World Health Organization (WHO) estimated that 1.6 billion persons over the age of 15 were overweight in 2005. Out of them, more than 20 million children under the age of five were overweight, with at least 400 million being categorized as obese.

Some stones might not show up on plain radiography; in these situations, CT scout views may be used to establish whether a follow-up plain radiograph is viable based on the stone's visibility on the initial scout view on the CT KUB. However, the follow-up imaging strategy is equally important, especially for patients who are treated conservatively, that is, waiting for the stone to pass naturally. Finding the stone, especially if it is in the ureter, in the emergency setting is essential to ensure that patients are referred for timely clinical management. The methods used to follow up with these patients, however, have varied widely up to this point. To enable appropriate triaging for their care, proper imaging can aid in differentiating between the various soft and hard stones.

Because of metabolic syndrome, the prevalence of urolithiasis in women has risen. Plain radiography, intravenous urography, ultrasonography, computed tomography (CT), and nuclear medicine can all be used to diagnose urolithiasis.

Men who weigh more than 100 kg are at a greater relative risk (RR) (1.44) of developing ureter stones than men who weigh less than 68.2 kg. The RR was considerably higher in women, both older and younger, with values of 1.89 and 1.92, respectively. Furthermore, both men and women have a higher chance of developing kidney stones if they gain weight in their early adult years.

Urolithiasis must be diagnosed by imaging investigations, and a variety of methods are available to do so. They are magnetic resonance imaging (MRI), computed tomography (CT) (single- or multi-detector row helical), nuclear medicine, intravenous urography (IVU), ultrasonography (US), and traditional radiography (plain KUB).

A plain kidney, ureter, and bladder (KUB) radiograph is a straightforward and often used imaging method for detecting urinary calculi, although its accuracy is constrained. Although it has greater expenses and exposure to radiation, non-enhanced computed tomography (CT) is a quick, precise, and focused imaging technique for evaluating urolithiasis.

Different junctions of ureteric colic are followings;

VESIOURETERIC CALCULUS

FIGURE 1.1

Figure 1.1 shows: calculus sitting at the left vesicoureteric junction with associated mild hydro-ureter and hydronephrosis. (Morgan M at el,2023)

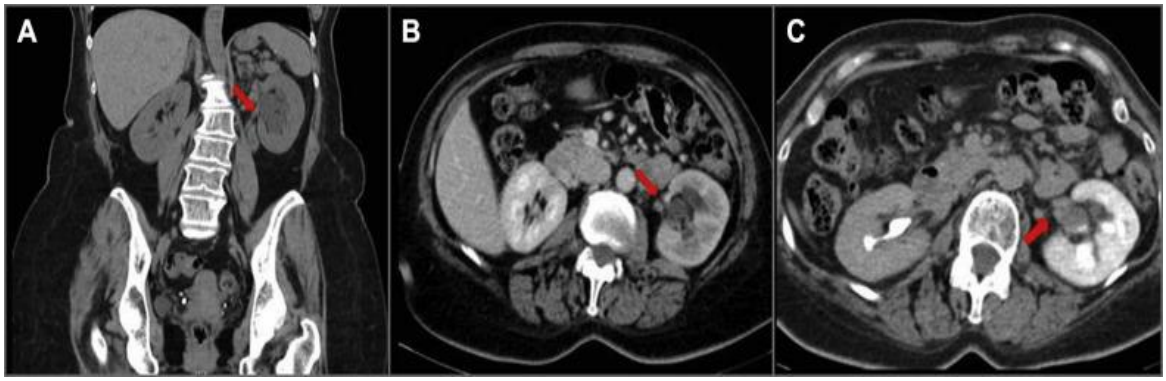


Figure 1.2

PELVIURETERIC CALCULUS

Figure 1.3

Figure 1.3 shows **Left hydronephrosis with severe pelvic dilatation and normal caliber ureter suggesting stenosis of the ureteropelvic junction. (**Di Muzio B at el,2023)

MATERIAL AND METHOD:

It was Cross- sectional analytical study**.** Study was conducted at the Department of Radiology, DHQ Muzaffargarh. The duration of this study 4 months. Sample size was 50 patients utilizing a convenient sampling technique for sample collection. Inclusion criteria encompassed patients presenting with abdominal pain, changes in how much urine you produce (urine output), difficulty urinating, blood in urine and urinary tract infections. Exclusion criteria encompassed patients with previous any surgery, asking the patient if they have any medical problem, patients with ongoing treatment. All patients underwent scanning using a Philips Computer tomography with 128 slices.

DATA ANALYSIS PROCEDURE:

Data was analyzed with statistical procedures. Data was collected according to the data collection sheet. Data was analyzed using SPSS version 27. Frequencies and percentages was calculated for qualitative/quantitative variables. Mean ± SD ratio was calculated for qualitative variables. Histogram and pie-chart was constructed. T-test is run between obese and non- obese ureteric stones.

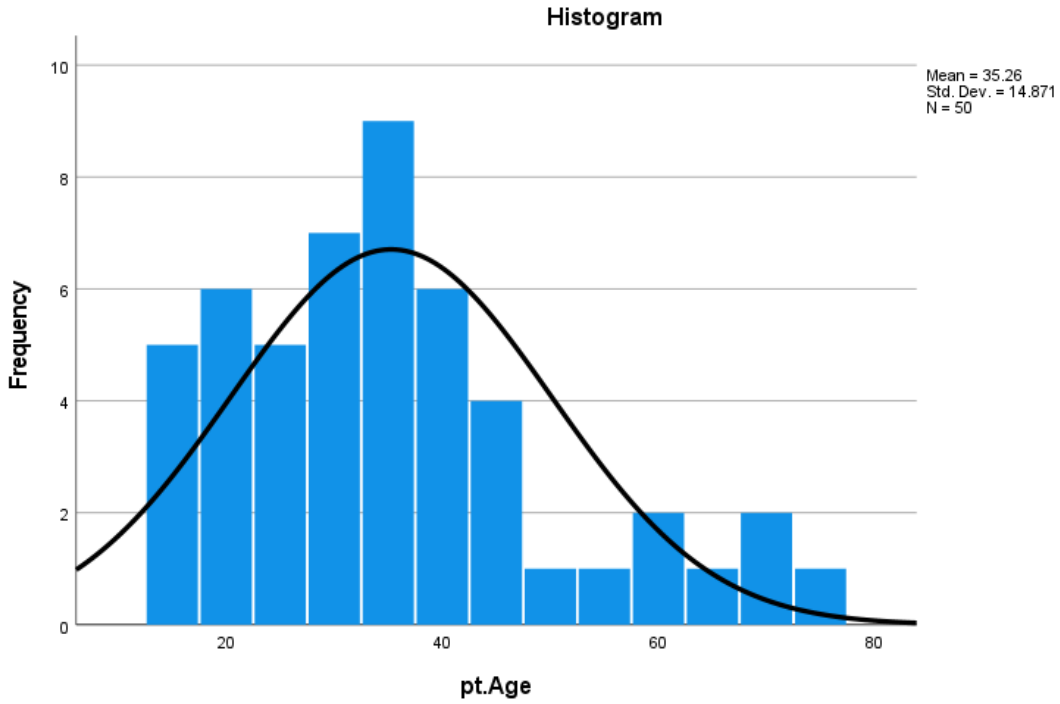
RESULTS:

Statistics

pt.Age

N	Valid	50
	Missing	0

Figure 1.4



The histogram shows that the mean, standard deviation, and number of participants who take part in study the mean is 35.26, the Standard deviation is 14.871 and number of participant is 50 respectively.

Frequencies

Statistics

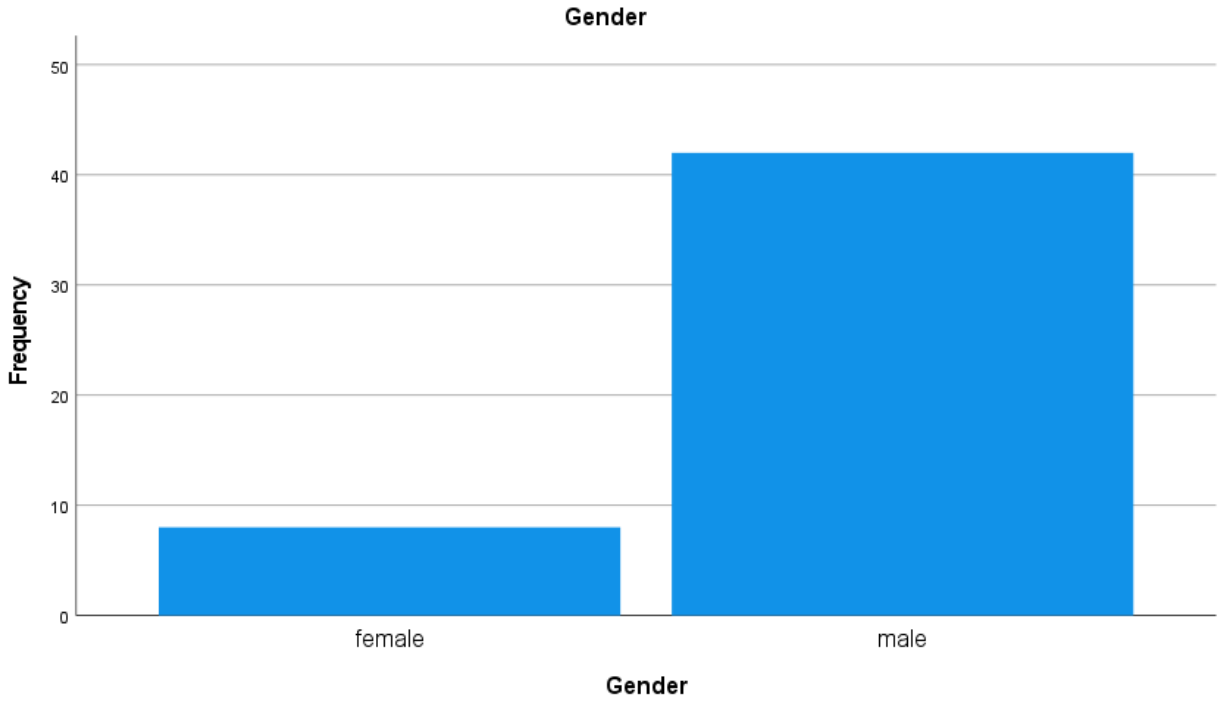
Gender

N	Valid	50
	Missing	0

Gender

	N	%
female	8	16.0%
male	42	84.0%

Figure 1.5



The male participant who were found to have the disease were 42 in number. The percentage of this group of the population having the disease is 84%. The female participant was found to have the disease were 8 in number. the percentage of this group of the population having the disease 16%. The total number of participant who took part in the study was 50giving the percentage of 100%respectively.

Statistics

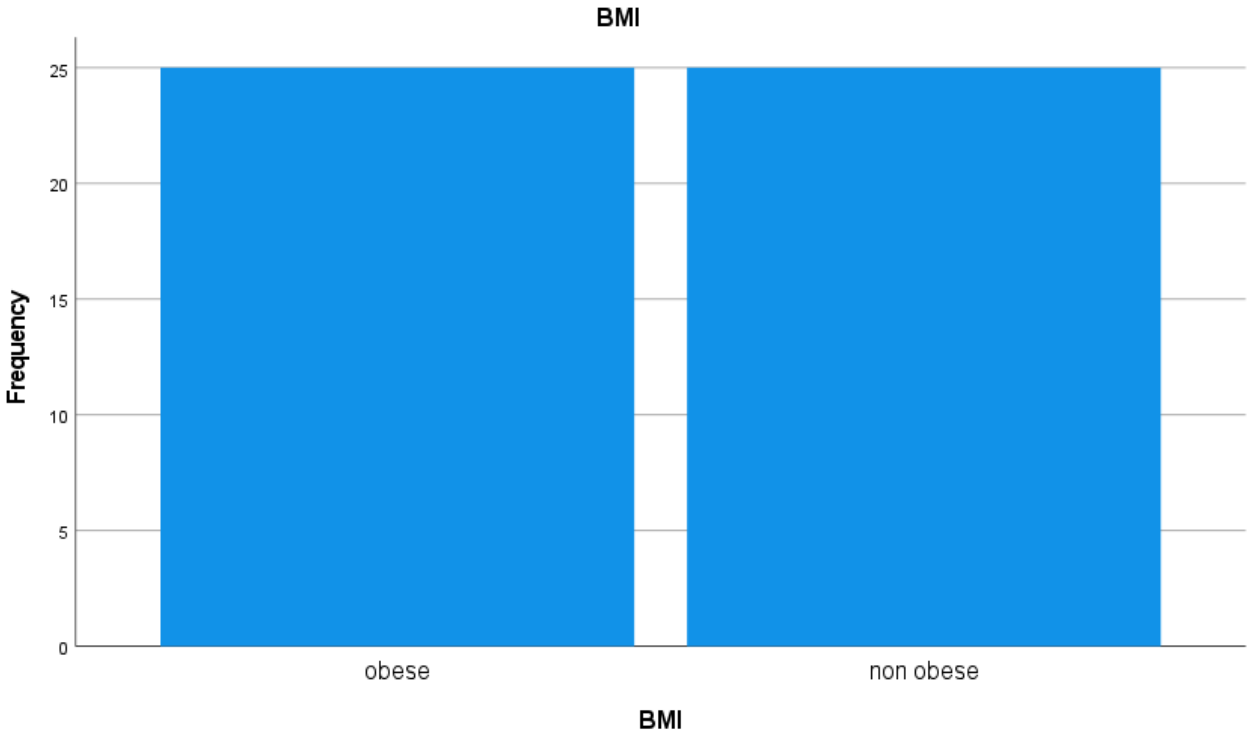
BMI

N	Valid	50
	Missing	0

BMI

	N	%
Obese	25	50.0%
non obese	25	50.0%

Figure 1.6



This Graph represents the number of obese and non obese patients who take part in study. The number of obese patients are 25 giving out percentage 50%. The number of non obese patients are 25 giving out percentage 50% respectively.

Statistics

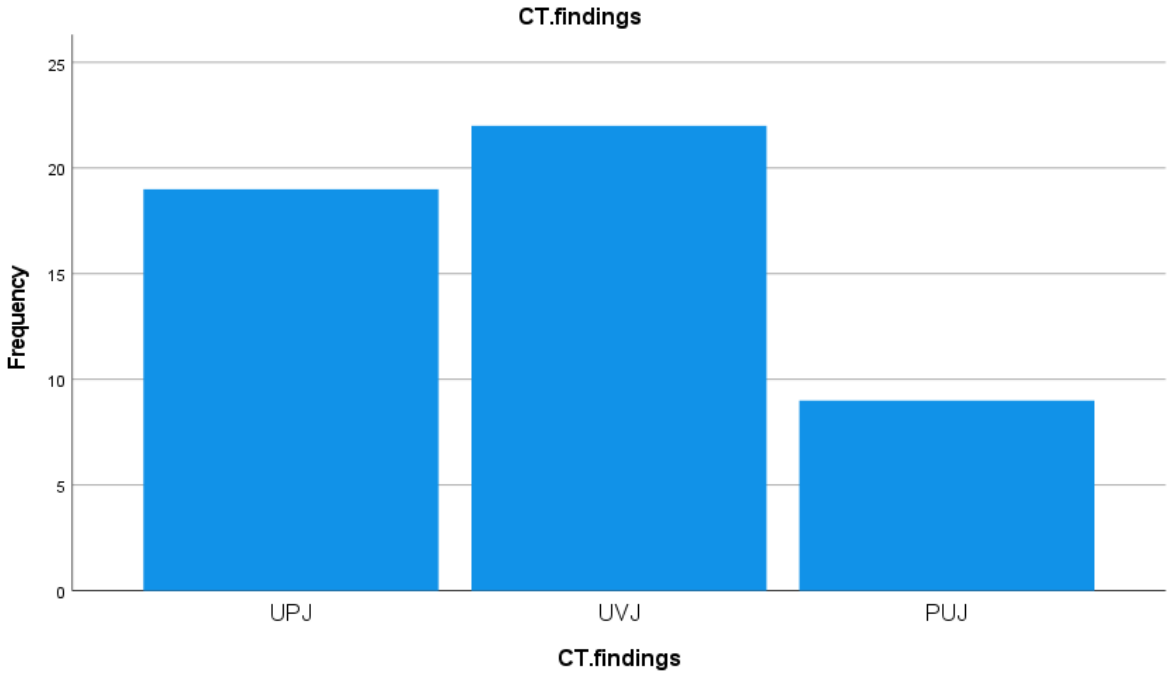
CT.findings

N	Valid	50
	Missing	0

CT findings

	N	%
UPJ	19	38.0%
UVJ	22	44.0%
PUJ	9	18.0%

Figure 1.7



The participants who take part is the study have undergone CT scan for their identification of problems. The CT findings show the patients have ureteric colic in ureteropelvic junction are 19 giving percentage 38%. The patients with ureteric colic in ureterovesical junction are 22 giving percentage 44%. The patients who have ureteric colic in pelvi-ureteric junction are 9 giving percentage 18% respectively.

Group Statistics

	BMI	N	Mean	Std. Deviation	Std. Error Mean
CT.findings_ureteric_stones	Obese	25	1.80	.764	.153
	non obese	25	1.80	.707	.141

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means
		F	Sig.	T
CT.findings_ureteric_stones	Equal variances assumed	.329	.569	.000
	Equal variances not assumed			.000

Independent Samples Test

		t-test for Equality of Means		
		df	Sig. (2-tailed)	Mean Difference
CT.findings_ureteric_stones	Equal variances assumed	48	1.000	.000
	Equal variances not assumed	47.718	1.000	.000

Independent Samples Test

		t-test for Equality of Means		
		Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
CT.findings_ureteric_stones	Equal variances assumed	.208	-.419	.419
	Equal variances not assumed	.208	-.419	.419

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval Lower
CT.findings_ureteric_stones	Cohen's d	.736	.000	-.554
	Hedges' correction	.748	.000	-.546
	Glass's delta	.707	.000	-.554

Independent Samples Effect Sizes

		95% Confidence Interval[a] Upper
CT.findings_ureteric_stones	Cohen's d	.554
	Hedges' correction	.546
	Glass's delta	.554

The statistical analysis compares CT findings of ureteric stones between obese and non-obese individuals, with both groups showing an identical mean value of 1.80. Levene's Test indicates no significant difference in variances ($p = 0.569$), allowing the assumption of equal variances for the t-test. The independent samples t-test reveals no significant difference between the two groups ($t = 0.000$, $p = 1.000$), with a mean difference of 0 and a 95% confidence interval ranging from -0.419 to 0.419). This suggest a moderate to large effect, the lack of statistical significance implies that any observed difference in CT findings is likely due to chance, and not a meaningful distinction between obese and non-obese patients in this sample.

Discussion

In this study, data collected the 50 patients of ureteric colic disease from the DHQ Hospital Muzaffargarh during 2025. During this study, we known that, patients that have obese have ureteric colic in different junctions. This study was correlated with past studies which showed that ureteric colic has been associated with an increase in metabolic syndrome. in particular, associations with high BMI criteria. . This study evaluated Ureteric colic-related acute flank discomfort that regularly sends patients to the emergency room. Males between the ages of 30 and 60 are most typically affected by this illness, which has a 12% lifetime incidence rate. More than half of these patients experience repeated episodes of ureteric colic the underlying illness that causes severe pain. This study calculated the frequency of ureteric colic in different junctions like ureterovesical junction, pelvi-ureteric junction, and vesicoureteral junction in BMI criteria (obese and non obese) by using CT scan technique. CT scan is the best modality that combines a series of X-ray images taken from different angles around the body and uses computer processing to create image slices of the bones, blood vessels, and soft tissue inside the body. This study elevated that patients with different radiological findings are shown to have a higher risk of needing to be admitted after visiting the emergency room. Following the initial evaluation, the most frequently requested imaging study is a renal tract ultrasound, followed by abdominal ultrasound and CT scans. there was no statistically significant variation in imaging study rates between gender groups. This study found out the frequency of ureteric calculus in relation to BMI criteria. Our study showed that obese patients mostly in men. Due to high calcium and salt dietary food intake have risk of ureteric stone. As the previous study determined that urine calcium levels are directly correlated with blood pressure and salt intake in adults. Additionally, recent epidemiologic studies have demonstrated an independent association of urolithiasis in adults. (Lane S. Palmer at el, 2017)

Cross-section studies have shown that urolithiasis is more frequently found in obese. Cross-section studies have shown that urolithiasis is more frequently found in obese. Borghi et al. demonstrated a greater risk of stone formation in subjects with obese associated with excess body weight. Higher oxaluria and calciuria as well as super-saturation of calcium oxalate and uric acid appear to be the most important factors. Excess body weight and consumption of salt and animal proteins may also play important roles. (F. Travaglini at el, 2007)

Increasing body mass index (BMI**)** was related to several risk factors for urinary stone disease including an increase in urine sodium and decrease in pH in men and increasing uric acid and sodium and decreasing urine citrate in women. (Brian H. Eisner at el, 2010)

Conclusion

The use of non-contrast-enhanced computed tomography (NCCT) has become the gold standard for the diagnosis of ureteric stones due to its high sensitivity and specificity. One area of ongoing research has been the influence of patient body mass index (BMI) on the diagnostic accuracy of CT imaging. The findings from current literature and clinical studies suggest that although higher BMI can affect certain imaging parameters—such as increased image noise and the need for higher radiation dose—these changes do not significantly compromise the sensitivity or diagnostic accuracy of NCCT in detecting ureteric stones.

Several studies, including those by Katz et al. and Liu et al., have demonstrated that NCCT maintains a sensitivity and specificity greater than 95% even in obese and morbidly obese patients. While image quality may be subjectively perceived as poorer in individuals with elevated BMI due to increased tissue attenuation and scattering, modern CT scanners equipped with dose modulation and iterative reconstruction techniques compensate for these challenges effectively. Furthermore, diagnostic confidence remains high across BMI categories, as ureteric stones typically have high intrinsic contrast compared to surrounding tissues, making them readily detectable.

Therefore, it can be concluded that although increased BMI can pose technical imaging challenges, these do not translate into a meaningful reduction in the diagnostic performance of CT for ureteric stones. The reliability of NCCT in this context remains robust across the BMI spectrum. Clinicians can confidently utilize CT imaging for suspected ureterolithiasis in patients of all body sizes, with appropriate protocol adjustments made for radiation dose optimization and image quality enhancement.

Recommendations for further investigations:

Conduct studies with a larger sample size to enhance the statistical power and generalizability of the findings. Including a diverse range of BMI categories can provide more comprehensive insights into the relationship between CT imaging and BMI in the context of ureteric colic.

Undertake longitudinal studies to assess the long-term impact of BMI on the incidence, recurrence, and management of ureteric colic.

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