Volume 3, Issue 5, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

ASSOCIATION BETWEEN METABOLIC SYNDROME AND CT KUB FINDINGS: A CROSS-SECTIONAL STUDY

Mahnoor Malik[*1], Fareed AaLam[2], Fatima Nazair[3], Bakhtawar Aslam[4], Maryam Zaheer[5], Areeba Liaquat[6], Hira Fazal[7]

[*1](Sharif Medical Complex Lahore
[2](Dhq Hospital Okara)
[3](Children Hospital Lahore)
[4]Zia Hospital and Maternity Complex Lahore)
[5]Farooq Hospital Dha Lahore)
[6]Farooq Hospital Burewala)
[7]Dhq South City Okara)

[*1]mahnoormalik990@gmail.com, [2]alamfarid068@gmail.com, [3]fatimanazir2709@gmail.com, [4]bakhtawaraslam75@gmail.com, [5]zaheermaryam0055@gmail.com, [6]areebaliaqat730@gmail.com, [7]hira.fazal.okara@gmail.com

DOI: https://doi.org/10.5281/zenodo.15798454

Keywords
Metabolic Syndrome, CT KUB, Renal Calculi, Nephrocalcinosis, Urolithiasis, Obesity, Cross-Sectional Study.

Article History
Received on 27 May 2025
Accepted on 27 June 2025
Published on 03 July 2025

Corresponding Author: *
Mahnoor Malik

Abstract

Background: *Metabolic Syndrome (MetS) is a cluster of interrelated conditions, including central obesity, hypertension, dyslipidemia, and impaired glucose tolerance, which together increase the risk of cardiovascular disease, diabetes mellitus, and renal complications. In recent years, research has highlighted the growing incidence of MetS and its potential impact on renal health. Computed Tomography of Kidneys, Ureters, and Bladder (CT KUB) is a commonly employed imaging modality to evaluate patients with flank pain, hematuria, and suspected urolithiasis. This study explores the potential link between MetS and radiological abnormalities detected on CT KUB.*

Objective: *To evaluate the association between Metabolic Syndrome and findings on CT KUB, and to determine whether individuals with MetS are more likely to exhibit renal abnormalities such as calculi, nephrocalcinosis, or other structural pathologies.*

Methodology: *This cross-sectional study was carried out at a tertiary care hospital. A total of 150 adult patients referred for CT KUB due to urinary complaints were included. Relevant clinical and biochemical parameters such as waist circumference, blood pressure, fasting blood glucose, triglycerides, and HDL cholesterol levels were recorded. Diagnosis of MetS was based on the International Diabetes Federation (IDF) criteria. CT KUB findings were reviewed for the presence of renal calculi, hydronephrosis, nephrocalcinosis, and other abnormalities. Data were statistically analyzed to compare CT findings between MetS and non-MetS groups.*

Results: *Of the 150 patients enrolled, 72 (48%) met the diagnostic criteria for Metabolic Syndrome. Among these, 60% had abnormal CT KUB findings, primarily renal calculi and nephrocalcinosis. In comparison, only 35% of patients without MetS demonstrated similar findings. A significant statistical correlation*

Volume 3, Issue 5, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

(p < 0.05) was observed between the presence of MetS and the likelihood of abnormal CT KUB findings. The association was particularly strong in patients with elevated triglycerides and increased waist circumference.

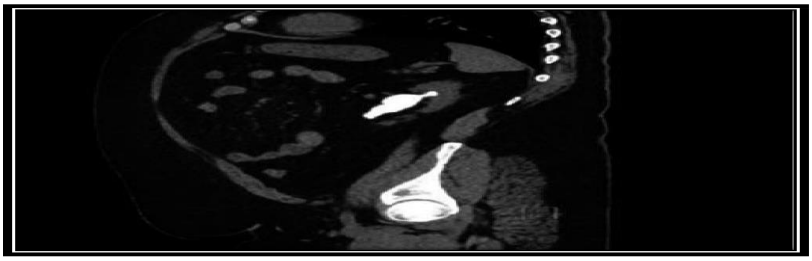
Conclusion: *This study demonstrates a significant association between Metabolic Syndrome and abnormal findings on CT KUB. Patients with MetS are more prone to developing renal pathologies, most notably nephrolithiasis. These findings emphasize the need for early detection and management of MetS to prevent complications related to renal health. Routine metabolic screening in patients with urinary complaints may be beneficial in clinical practice.*

INTRODUCTION

Metabolic syndrome is a chronic health problem associated with high mortality, which is with composition of abdominal obesity, hypertension, dyslipidemia, and diabetes mellitus.Recently, metabolic syndrome has received attention due to its association with a significantly increased risk of kidney stone development.[1]The metabolic syndrome (MetS) is a cluster of cardiovascular risk factors including insulin resistance (IR), dyslipidemia, and hypertension.This may also foster development of chronic kidney disease.[2]The mechanisms of MetS-induced kidney disease are not fully understood. The metabolic syndrome (MetS) refers to a complex entity consisting of multiple interrelated factors including insulin resistance (IR), central obesity, dyslipidemia, and atherosclerotic disease, appearing to affect approximately 10–40% of adult population's worldwide.[3]

The left kidney is positioned more superior than the right (due to presence of liver).[4] Kidneys are bean-shaped organs each weighing between 130 and 150 g.Approximately 25 to 30cm long, it has a diameter of about 3mm. It has three natural constrictions.[5]The first at the pelvi-ureteric junction, the second at the pelvic brim where it crosses the iliac vessels, and finally at the uretero-vesical junction.The bladder is a distensible organ and is typically able to hold up to 500 milliliters of urine.[6]Kidney stone disease, also known as nephrolithiasis or urolithiasis, is a disorder in which urinary solutes precipitate to form aggregates of crystalline material in the urinary space.[7]

Kidney stones are frequently manifestations of underlying systemic medical conditions such as the metabolic syndrome, genetic disorders, or endocrinopathies.[8]. Analysis of urine chemistries and stone composition provide a window into pathogenesis and direct ancillary studies to uncover underlying diseases.[9]The male to-female ratio has decreased from 3:1 to about 2:1 in the past 2 decades, attributed to an increasing prevalence of obesity.[10]Although some of these conditions have a well-defined role in the etiologic pathway, the causative mechanisms for most patients with kidney stone are multifactorial and are poorly understood.[11] However, much like MetS, the prevalence of kidney stone is increasing throughout the world.[12]



Similarity with a previous episode should increase confidence in the diagnosis, although the value of personal or family history during an episode of renal colic is not known.[13] Patients with newly diagnosed kidney stones should receive a basic evaluation consisting of a detailed medical history, serum chemistry, and urinalysis/urine culture.[14] The medical history should review the stone history (including family history of kidney stones), diet, current medications, and conditions associated with

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

an increased risk of kidney stones.[15] A diagnosis of metabolic syndrome is made if any three of these five measurements show clearly established abnormalities. In both clinical practice and epidemiological research, the ATP III criteria for the metabolic syndrome have been extensively utilized.[16] High blood pressure of 130/80 mm Hg (millimeters of mercury) or higher. Normal blood pressure is defined as less than 120 mm Hg for systolic pressure (the top number), and less than 80 mm Hg for diastolic pressure (the bottom number).[17] Most people who have metabolic syndrome have insulin resistance. The body makes insulin to move glucose (sugar) into cells for use as energy.[18] It is a well -established diagnostic imaging modality that has been in clinical use in medicine for several decades but only recently has become commonly used in veterinary medicine.[19] Modern CT system that begun as Head-only scanners can now perform whole body scans in a uniform resolution in a matter of seconds.[20]

OBJECTIVE

To determine the association between metabolic syndrome and radiological findings found on CT KUB.

METHODOLOGY

Research Design: Cross sectional, analytical study design

Clinical Settings: Ranger teaching hospital Lahore, DHQ Hospital Pakpattan.

Sample Size: n= 109

Sampling Technique: Convenient sampling technique was used.

Duration of Study: 3 months after the approval of synopsis.

Selection Criteria

Inclusion Criteria:

Patients who underwent CT KUB scans for clinical purposes, such as suspected renal stones or urinary tract symptoms, hydronephrosis.

Patients reported with metabolic syndrome. (Hypertension, obesity, diabetes)

Exclusion Criteria:

Uncooperative patients.

Patients who can't have a CT scan safely, like pregnant women or those allergic to contrast.

Equipment: Computed Tomography Machine HITACHI 16 Slices

Data Collection Procedure

This study was conducted by developing a standardized data collection form including demographic details, medical history and participating centers on the study protocol and data collection procedures. We obtained informed consent from all eligible participants, after explaining the study's purpose and potential risks and it was ensured that participants were aware of the procedure. After that we screened patients who underwent KUB CT scans for eligibility to Identify and exclude individuals based on predefined exclusion criteria. After procedure we took an Interview of participants to gather information. Assessed for CT KUB findings such as any stones, blockage and obstruction. Size and location of stone and obstruction. We tried to find if there is any correlation between metabolic syndrome and the CT KUB findings. We used standardized terminology to classify and document observed findings. After this we included details on the mechanisms of correlation. We ensured secure storage and confidentiality of collected data. We conducted statistical analysis to determine the overall incidence and characteristics of metabolic syndrome relating to CT findings. After this we prepared a comprehensive report summarizing the study findings.

Data Analysis

Data was evaluated and analyzed with statistical package for social sciences (SPSS) 25 and Microsoft excel of 2016.A descriptive analysis was performed to investigate the distribution data. Mean and standard deviation (SD) were calculated for continuous variables. Frequency and percentage were calculated for categorical variables. Collected data was stored in Microsoft office.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

RESULTS

Total of 109 patients were studied age ranging 1-79 years. The mean age group was 3.27 means ranging from 30 years to 39 years with standard deviation 1.379. Out of these 109 patients, 64 were male (58.7%) and 45 were female (41.3%). They presented with different symptoms, among these patients, 63 patients (57.8%) were presented with history of pain, Vomiting accounted in 48 patients (44%), Fever was reported in 55 patients (50.5%), Anuria was reported in 22 patients (20.2%), 57 patients (52.3%) were reported with history of Dysuria, 16 patients (14.7%) were accounted with history of Hematuria and history of Oligouria was accounted in 43 patients (39.4%). On the basis of results of Renal function tests, out of 109 patients Low Serum Urea level (<10 mg/dL) was reported in 47 patients (43.1%). Normal Serum Urea level (10-50 mg/dL) was reported in 40 patients (36.7%) and High serum Urea level (>50mg/dL) was reported in 22 patients (20.2%). Serum Creatinine level having low value (<0.55 mg/dL) was reported in 50 patients (45.9 %), Serum Creatinine level having normal value (<0.55-1.02 mg/dL) was reported in 38 patients (34.9%). Serum Creatinine level having high value (>1.02 mg/dL) was reported in 21 patients (19.3%). eGFR's normal value (>60 ml/min/1.73m^2) was reported 52 patients (47.7%) while 57 patients (52.3%) were reported with low eGFR value (<60 ml/min/1.73m^2).Urinalysis was also performed and 56 patients (51.4%) were reported with abnormal reports. 37 patients (33.9%) were reported with calculus upon radiological examination. Upon CT examination 29 patients (26.6 %) were reported with no sign of hydronephrosis, 35 patients (32.1%) were reported with mild hydronephrosis, 29 patients (26.6%) were reported with moderate hydronephrosis and 16 patients (14.7%) were reported with severe hydronephrosis.

TABLE 1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
GENDER	109	0	1	.59	.495
AGE GROUP	109	1	7	3.27	1.379
H/O PAIN	109	0	1	.58	.496
H/O VOMITING	109	0	1	.44	.499
H/O FEVER	109	0	1	.50	.502
H/O ANUREA	109	0	1	.51	.502
H/O DYSURIA	109	0	1	.52	.502
H/O HEMATURIA	109	0	1	.51	.502
H/O OLIGOURIA	109	0	1	.51	.502
SERUM UREA	109	0	2	.77	.765
SERUM CREATININE	109	0	2	.73	.765
eGFR	109	0	1	.52	.502
URINALYSIS	109	0	1	.51	.502
CALCULUS REPORTED	109	0	1	.66	.476
HYDRONEPHROSIS REPORTED	109	0	3	1.71	1.021
OTHER FINDINGS	109	0	1	.80	.403
Valid N (listwise)	109				

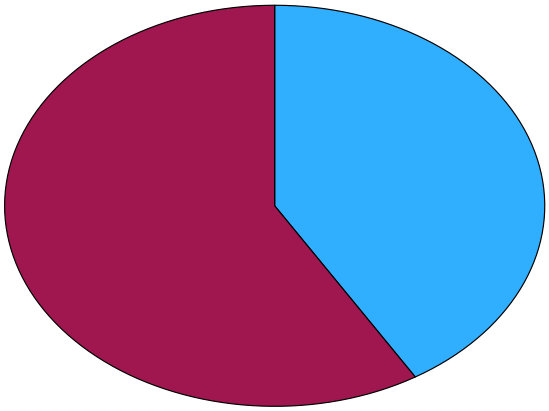
TABLE: 2 GENDER

Frequency			Percent	Valid Percent	Cumulative Percent
Valid	Female	45	41.3	41.3	41.3
	Male	64	58.7	58.7	100.0
	Total	109	100.0	100.0	

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

FIGURE 1: GENDER



N	Valid	109
	Missing	0

Statistics

AGE GROUP

TABLE: 3 AGE GROUPS

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Age Group 10-19 Years	7	6.4	6.4	6.4
	Age Group 20-29 Years	25	22.9	22.9	29.4
	Age Group 30-39 Years	36	33.0	33.0	62.4
	Age Group 40-49 Years	28	25.7	25.7	88.1
	Age Group 50-59 Years	4	3.7	3.7	91.7
	Age Group 60-69 Years	4	3.7	3.7	95.4
	Age Group 70-79 Years	5	4.6	4.6	100.0
	Total	109	100.0	100.0	

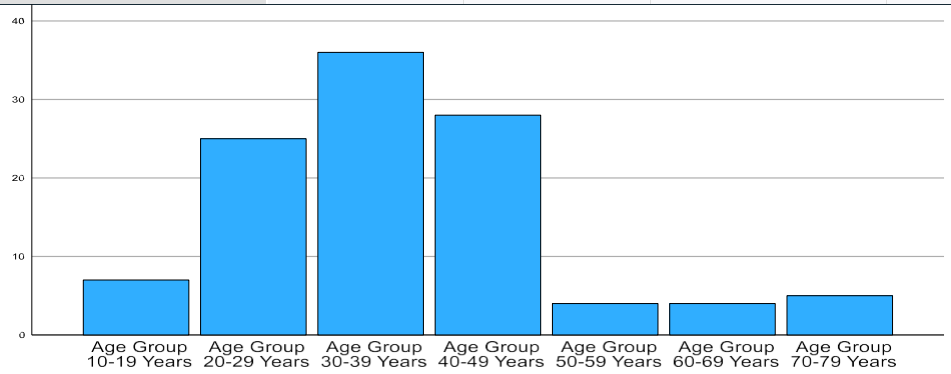


FIGURE 2: FREQUENCY OF AGE GROUPS

DISCUSSION

Liu J, et al, (2021) conducted a research and total of 151 patients were retrospectively analyzed and divided into 2 groups according to diagnosis of metabolic syndrome. Of these patients, 60 diagnosed with metabolic syndrome (group 1), and 91 did not

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

(group 2). Group 1 consisted of patients with metabolic syndrome, and group 2 contained patients without metabolic syndrome. They presented with different symptoms, among these patients, 63 patients (57.8%) were presented with history of pain, Vomiting accounted in 48 patients (44%), Fever was reported in 55 patients (50.5%), Anuria was reported in 22 patients (20.2%), 57 patients (52.3%) were reported with history of Dysuria, 16 patients (14.7%) were accounted with history of Hematuria and history of Oliguria was accounted in 43 patients (39.4%). Upon CT examination 29 patients (26.6 %) were reported with no sign of hydronephrosis, 35 patients (32.1%) were reported with mild hydronephrosis, 29 patients (26.6%) were reported with moderate hydronephrosis and 16 patients (14.7%) were reported with severe hydronephrosis. We analyzed this data by correlating different factors and a significant correlation was found between renal functioning test results and hydronephrosis reported in patients upon radiological examination.[21]

Iqbal MW, et.al (2017) Analyzed that patients with pure struvite calculi rarely have underlying metabolic abnormalities. Therefore, most of these patients do not undergo metabolic studies.75 patients treated with percutaneous nephrolithotomy for struvite stones were identified. Of these, 7 had pure struvite stones (Group 1), 32 had mixed struvite stones (Group 2), both with metabolic evaluation, and 17 had pure struvite stones without metabolic evaluation (Group 3). The frequency of metabolic abnormalities and stone activity (defined as stone growth or stone- related events) was compared between groups. The median age was 55 years and 64 % were female. No significant difference in race, infection history, family history, stone location volume existed between groups. Urinalysis was also performed and 56 patients (51.4%) were reported with abnormal reports. We analyzed this data by correlating different factors and a significant correlation was found between renal functioning test results and hydronephrosis reported in patients upon radiological examination.[22]

Abedinzadeh M, et.al (2021) Studied that the 146 patients with mean age of 45.3±15.1 years (ranging from 11 to 84 years) were enrolled. CT scan and ultrasound were diagnostic in 121 (82.9%) and 25 patients (17.1%) respectively.Upon CT examination 29 patients (26.6 %) were reported with no sign of hydronephrosis, 35 patients (32.1%) were reported with mild hydronephrosis, 29 patients (26.6%) were reported with moderate hydronephrosis and 16 patients (14.7%) were reported with severe hydronephrosis.[23]

CONCLUSION

The results of renal functioning tests suggesting metabolic syndrome has a significant correlation with radiological findings in patients undergone CT KUB.

References

Liu J, Hong Y, Yang B, Wang W, Wang Y, Zhang X, et al. The impact of metabolic syndrome on the safety and efficacy of flexible ureterorenoscopy. Ann Palliat Med. 2021; 10(3):2776–80.

Moinuddin Z, Dhanda R. Anatomy of the kidney and ureter. Anaesth Intensive Care Med. 2015; 16(6):247–52.

Kulkarni R. Anatomy of the human ureter. In: Ureteric Stenting. Cham: Springer; 2017. p. 1–9.

Shermadou ES, Rahman S, Leslie SW. Anatomy, abdomen and pelvis, bladder. Treasure Island (FL): StatPearls Publishing; 2018.

Shastri S, Patel J, Sambandam KK, Lederer ED. Kidney stone pathophysiology, evaluation and management: core curriculum 2023. Am J Kidney Dis. 2023?

Sarofim M, Teo A, Wilson R. Management of alternative pathology detected using CT KUB in suspected ureteric colic. Int J Surg. 2016; 32:179–82.

Fontenelle LF, Sarti TD. Kidney stones: treatment and prevention. Am FAM Physician. 2019; 99(8):490–6.

Karimi YW. The prevalence and association of metabolic syndrome with benign prostatic enlargement among men treated at Kenyatta National Hospital [thesis]. Nairobi: University of Nairobi; 2021.

Türk C, Petřík A, Sarica K, Seitz C, Skolarikos A, Straub M, et al. EAU guidelines on diagnosis and conservative management of urolithiasis. Eur Urol. 2016; 69(3):468–74.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Lell MM, Wildberger JE, Alkadhi H, Damilakis J, Kachelriess M. Evolution in computed tomography: the battle for speed and dose. Investig Radiol. 2015; 50(9):629–44.

Klib M, Ghandour M, Wannous H. Urinary stone disease in Syrian children. Pediatr Nephrol. 2023.

Shen Z, Xie L, Luo D, Xie H, Chen H, Liu C. Metabolic syndrome differences between unilateral and bilateral staghorn renal stones and the impact on outcome of percutaneous nephrolithotomy. 2023.

Aziz A, Nawaz A, Sultan N. Frequency of different metabolic abnormalities in paediatric age group with renal stone diseases. Pak J Med Health Sci. 2023; 17(5):306.

Xia K, Xu Y, Qi Q, Zheng J, Zhang R, Li D, et al. Establishment of a new predictive model for the recurrence of upper urinary tract stones. Int Urol Nephrol. 2023; 55(10):2411–20.

Abedinzadeh M, Karami H, Gholami J, Maleki H. Investigation of factors affecting spontaneous ureteral stone excretion. J Renal Inj Prev. 2021.

Iqbal MW, Shin RH, Youssef RF, Scales CD, Preminger GM. Should metabolic evaluation be performed in patients with struvite stones? Urolithiasis. 2017; 45:185–92.

Ho LM, Samei E, Mazurowski MA, Merkle EM, Knelson LP, Marin D, et al. Can texture analysis be used to distinguish benign from malignant adrenal nodules on unenhanced CT, contrast-enhanced CT, or in-phase and opposed phase MRI? AJR Am J Roentgenol. 2019; 212(3):554–61.

Kjeldsen SE. Hypertension and cardiovascular risk: General aspects. Pharmacol Res. 2018; 129:95–9.

Chooi YC, Ding C, Magkos F. The epidemiology of obesity. Metabolism. 2019; 92:6–10.

Blair M. Diabetes mellitus review. Urol Nurs. 2016; 36(1).

Liu J, Hong Y, Yang B, et al. The impact of metabolic syndrome on the safety and efficacy of flexible ureterorenoscopy. Annals of Palliative Medicine. 2021; 10(3):2776-2780.

Iqbal MW, Shin RH, Youssef RF, et al. should metabolic evaluation be performed in patients with struvite stones? Urolithiasis. 2017; 45:185-192.

Abedinzadeh M, Karami H, Gholami J, Maleki H. Investigation of factors affecting spontaneous ureteral stone excretion. Journal of Renal Injury Prevention. 2021