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TRANSABDOMINAL SONOGRAPHIC ASSESSMENT OF RENAL CORTICAL CYSTS AMONG PATIENTS PRESENTING WITH ACUTE ABDOMINAL PAIN

Zoha Ali[1], Yaseer Khan[1], Zobia Saleem[1], Asim Raza[1], Khazina Urfan[1], Izza Naeem[1], Tashfeen Eman[1]

[1]**School of Allied Health Sciences,** Combined Military Hospital, Lahore Medical College & Institute of Dentistry, Lahore, Pakistan

***Correspondence author:** Zobia Saleem. E. mail: zobiasaleem95.work@gmail.com

Abstract

Background: *Assessment of renal cortical cysts in patients presenting with acute abdominal pain can help identify individuals at increased risk for significant renal pathology. This evaluation provides valuable insights, aiding clinicians in making informed decisions and implementing timely management strategies.*

Objective: *The primary objective of this study was to assess renal cortical cysts among patients presenting with acute abdominal pain at a Tertiary Care Hospital, Lahore. The secondary objective of this study was to find the association of pattern of pain with clinical symptoms (fever, nausea, vomiting) and sonographic features of cysts (Number, type, texture, margins, echogenicity and posterior enhancement).*

Methodology: *An Analytical cross-sectional study was conducted at a Tertiary Care Hospital, Lahore from September to December 2024. All the patients who fulfilled the inclusion/exclusion criteria were enrolled. Detailed history was taken from all the patients, including age, gender, pattern of pain and any other pathologic condition. IBM Statistical Package for Social Science (SPSS) version 26 was used to enter and analyze the data. Data analysis included frequencies and percentages for qualitative data. Outcomes were reported with 95%confidence intervals, and p-values < 0.05 were considered statistically significant. Data were collected using a structured proforma and patient sonographic reports.*

Results: *Analytical cross-sectional study of 288 individuals with renal cortical cysts found that most patients were male (77.8%) and aged 36-60 (49.0%). Radiating pain was associated with multiple cysts (18.8%), complex cysts (2.8%), and heterogenous texture (2.1%), while non-radiating pain was more likely linked to single cysts (81.3%), simple cysts (97.2%), and homogenous texture (97.9%).*

Conclusion: *A study on renal cortical cysts found most patients were middle-aged males, with common symptoms including nausea, fever, and vomiting, and risk factors such as smoking, diabetes, and hypertension. Radiating pain was linked to multiple, complex, and heterogeneous cysts, while non-radiating pain was associated with simple, single, and homogeneous cysts.*

Keywords: *Abdominal pain, Cyst, Pain, Renal, Ultrasound*

INTRODUCTION

A renal cortical cyst is a frequently occurring type of kidney cyst (1) found in the outer layer of the kidney called the renal cortex where most of the filtration (2) and urine production occurs (3). These cysts are typically small and contain fluid. Many simple cysts likely maintain their size and characteristics and typically show no symptoms, but in some cases, they can grow large enough to trigger slight abdominal discomfort, which appear as dull aching in lumbar region (4).

The research findings indicate that simple renal cysts were more commonly found originating in the kidney's cortex compared to the pelvis (5), with a distribution of approximately 73% versus 17%. Additionally, the study revealed a higher prevalence of cysts in the right kidney (49%) than in the left kidney (37%). Furthermore, unilateral cysts were significantly more frequent than bilateral cases, with occurrences of 86% and 14%. Importantly, simple renal cysts are associated with a fatality proportion of zero. Most cases, 70-80% involves a single cyst on one side of the kidney, typically in the outer layer (6). Frequent occurrence of simple cysts accompanied by high blood pressure, diabetes mellitus, (7) atherosclerosis, serum creatinine

(8), smoking, and impaired kidney function (9). Advancing age and an individual's gender are considered other important contributory factors that increase the likelihood of developing renal cysts (10).

As age increases, the likelihood of developing renal cysts also rises, with almost 40% of all individuals assessed through ultrasound examinations presenting with these cysts, indicating a significant association with advanced age (11). The earlier studies suggested that more than half of the patients above the age of 50 must have at least one renal cortical cyst (12). Earlier studies have revealed that the incidence of renal cysts among elderly patients about 50 years of age is 7.7%. However, for patients under the age of 40 years, the incidence rate is significantly lower at 2.7%. The highest incidence of renal cysts is observed in patients older than 60 years, with a staggering 23.9% of this age group affected. Interestingly, male patients seem to be more susceptible to renal cysts, with 94.8% of the cysts occurring in men (13). Further investigation into sex disparity has confirmed that cortical cysts show a distinct prevalence among men compared to women. However, for medullary cysts, the gender discrepancy is less pronounced or less evident (14). Furthermore, approximately 63.6 percent of these cysts are solitary (15).

The passage highlights the lack of comprehensive research on patients visiting tertiary care hospitals in Pakistan, particularly regarding the management of renal cortical cysts. While some cysts may cause symptoms such as pain, hematuria, or urinary obstruction, prompting timely treatment, others remain asymptomatic. The principal objective of this study is to examine how the assessment of renal cortical cysts in patients presenting with abdominal pain can aid in assessing individuals at heightened risk of developing significant renal diseases. By Investigating the assessment of renal cortical cysts in specific patient population will provide physicians valuable insights for informed clinical decision-making and prompt management strategies. Some images showing renal cortical cysts are representing in Fig. 1.

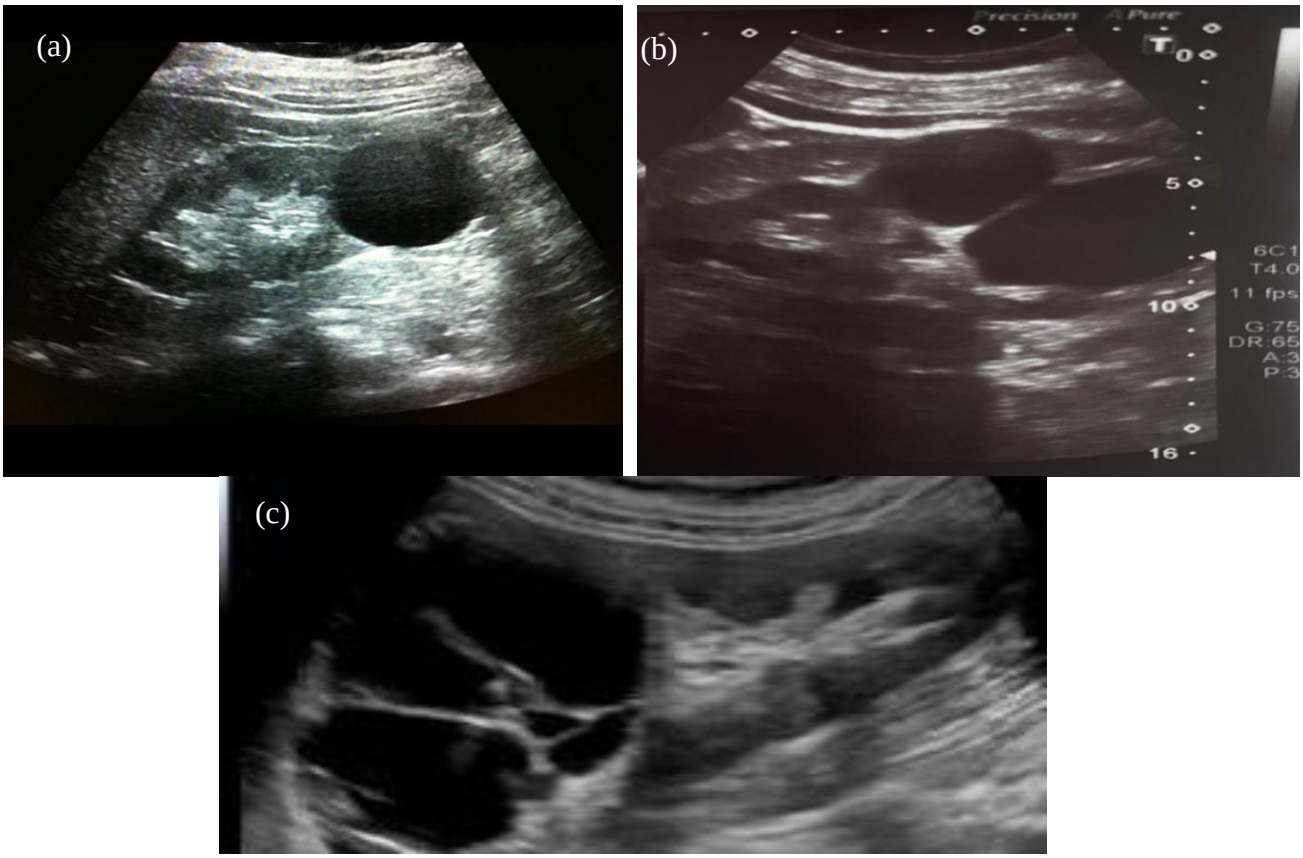

Fig. 1. (a). 1-A simple cortical cyst in lower pole of kidney; **(b).** Two large simple cysts in middle and lower pole of kidney; **(c).** Complex cyst with internal septations

MATERIALS AND METHODS

This Analytical cross-sectional study was conducted at Diagnostic center of Tertiary Care Hospital, Lahore between September and December 2024. Data were collected from 288 Patients presenting with acute abdominal pain and having renal cortical cyst. Sample size (16) was calculated from Cochran formula (17).

$$n = \frac{N}{1 + (N)(e)^2}$$

Estimated population (N)=750, Marginal error(e)=0.05 and sample size(n)=288. Data were collected from 288 patients who were selected through non-probability consecutive sampling technique. Symptomatic patients who presented with moderate to severe abdominal pain and patients diagnosed with renal cortical cyst were included in the study. However, Individuals with renal parenchymal disease and Congenital kidney deformity were excluded. Equipment that was used Ultrasound Toshiba Xario curvilinear transducer (5-12 MHz). Ultrasound examination was performed by radiologist or radiographer with the patient positioned in supine, prone and lateral decubitus positions. Data collection followed a predefined proforma, which included clinical variables such as pain pattern, fever, nausea, and vomiting, as well as medical history factors including smoking, hypertension, and diabetes, Ultrasound findings recorded the affected kidney, number and type of cysts, cyst texture, location, margins, internal echoes, and posterior enhancement.

Written and verbal consent were taken from eligible participants. All information and data collection were kept confidential. Participants remained anonymous throughout the study. This study was conducted in line with ethical standards set by the ethical committee of CMH LMC & IOD with (Ref Case#86/ERC/CMH/LMC, Dated: 23 September 2024). This study was conducted in accordance with the Declaration of Helsinki. IBM Statistical Package for Social Science (SPSS) version 26 was used to enter and analyze the data. For descriptive analysis, frequency and percentages were computed for the qualitative data, Chi square test was applied to find the association and a p value of ≤ 0.05 was regarded as significant. All the variables were computed using a 95% confidence interval.

RESULTS

This cross-sectional study, conducted at a tertiary care hospital, evaluated the sonographic characteristics and clinical correlations of renal cortical cysts in patients presenting with acute abdominal pain. The majority of the participants were middle-aged males, with 77.80% being male and 49.0% falling within the 36–60 years age group (Table I).

Table I. Frequency distribution of age (years) and gender

Variables	Categories	n (%)
Age groups (years)	0-14	1 (0.30)
	15-35	17 (5.90)
	36-60	141 (49.0)
	Above 60	129 (44.80)
Gender	Male	224 (77.80)
	Female	64 (22.20)
	Total	288 (100)

The most frequently reported clinical symptom was nausea, observed in 40.63% of the patients, followed by fever (33.70%) and vomiting (12.50%). Specifically, nausea was absent in 59.40%, fever in 66.30%, and vomiting in 87.50% of the patients (Table II). Analysis of potential risk factors revealed that 55.90% of participants were active smokers, while 44.10% were non-smokers. Diabetes mellitus was nearly evenly distributed, with 48.60% of patients diagnosed with the condition.

However, a significantly higher prevalence of hypertension was noted, affecting 79.90% (n=230) of the study population compared to 20.10% (n=58) who were normotensive. In terms of anatomical distribution, the right kidney was more commonly affected, with 44.79% of renal cortical cysts localized there. Single cysts were the dominant presentation, identified in 81.25% of cases, while simple cysts constituted the overwhelming majority of morphological types at 97.22%.

A clear association was observed between pain characteristics and cyst morphology. Radiating pain was predominantly associated with multiple, complex, and heterogeneous cysts, whereas non-radiating pain correlated with single, simple, and homogeneous cysts.

Table III presents the frequency and percentage distribution of sonographic and clinical characteristics among patients with renal cortical cysts. A total of 43.10% of patients reported radiating pain,

while 56.90% experienced non-radiating pain. The right kidney was the most frequently affected site (44.80%), followed by the left kidney (39.60%), with bilateral involvement observed in 15.60% of cases

Table II. Frequency distribution of selected symptoms and comorbidities in a study population

Variables	Categories	n (%)
Fever	No	191 (66.30)
	Yes	97 (33.70)
Nausea	No	171 (59.40)
	Yes	117 (40.60)
Vomiting	No	252 (87.50)
	Yes	36 (12.50)
Smoking	No	127 (44.10)
	Yes	161 (55.90)
Diabetes mellitus	No	148 (51.40)
	Yes	140 (48.60)
Hypertension	No	58 (20.10)
	Yes	230 (79.90)
Total		288 (100)

Regarding cyst number, 81.30% of patients had a single cyst, whereas 18.80% presented with multiple cysts. Morphologically, simple cysts were predominant, accounting for 97.20%, while complex cysts were noted in 2.80% of cases. In terms of internal architecture, the majority of cysts displayed a homogeneous texture (97.90%), with heterogeneous cysts comprising 2.10%.

Cyst margins were predominantly regular (97.20%), and irregular margins were identified in 2.80% of the cases. Additionally, internal echoes were detected in 2.80% of cysts, while 97.20% appeared anechoic. Regarding posterior acoustic characteristics, 97.20% of cysts exhibited posterior enhancement, and 2.80% did not demonstrate this feature.

Table III. Characteristics of renal cysts and associated pain patterns in a study group

Variables	Categories	n (%)
Pattern of pain	Radiating	124 (43.10)
	Non-Radiating	164 (56.90)
Kidney involved	Right	129 (44.80)
	Left	114 (39.60)
	Both	45 (15.60)
No. of cyst	Single	234 (81.30)
	Multiple	54 (18.80)
Type of cyst	Simple	280 (97.2)
	Complex	8 (2.80)
Texture of cyst	Homogenous	282 (97.90)
	Heterogenous	6 (2.10)
Margins	Regular	280 (97.20)
	Irregular	8 (2.80)
Internal echoes	No	280 (97.20)
	Yes	8 (2.80)
Posterior enhancement	No	8 (2.80)
	Yes	280 (97.20)
Total		288 (100)

The frequency distribution of renal cortical cyst locations across various kidney regions in a cohort of 288 patients is indicated in Fig. 2. The Right Upper Pole emerged as the most commonly affected site, accounting for 18.75% of cases, followed by the Left Upper Pole (15.97%), Right Lower Pole (14.93%), and Left Lower Pole (13.19%). Involvement of the Middle Poles bilaterally was observed in 9.38% of cases. Less frequent were bilateral and complex multi-pole combinations, such as simultaneous involvement of the Right Upper Pole and Left Middle Pole.

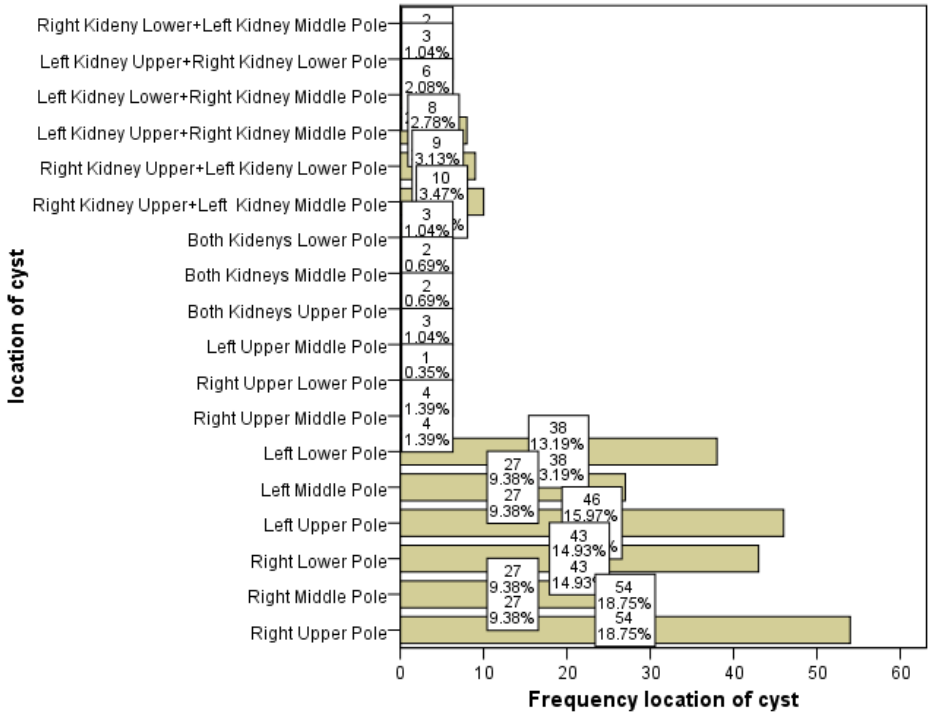

Fig. 2. Frequency distribution of location of renal cysts

The distribution of cyst diameters within the same population has been shown in Fig. 3. The majority of cysts (55.90%) measured 1–2 cm in diameter, followed by 3–4 cm (39.58%), 5–6 cm (3.13%), and greater than 6 cm (1.39%), indicating that smaller cysts are substantially more prevalent in this cohort.

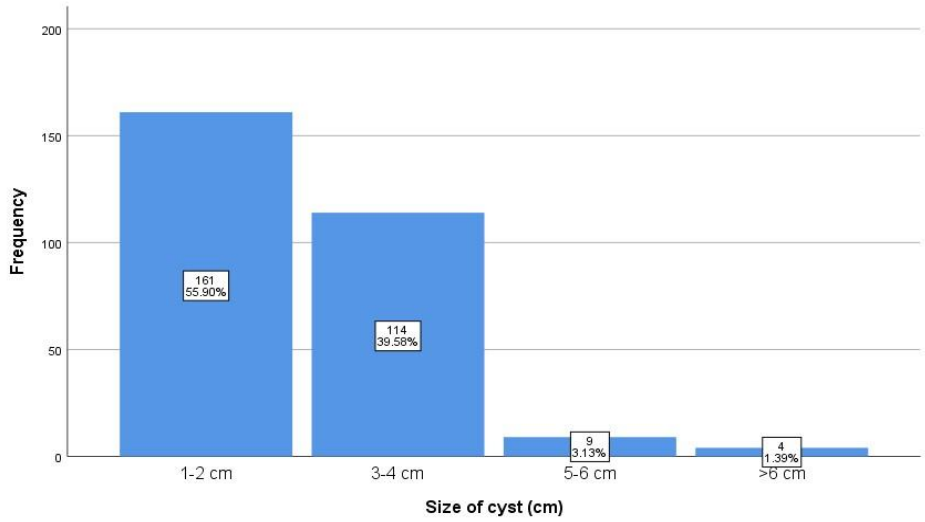

Fig. 3. Cyst size distribution in the sample population

Table IV explores the association between pain patterns (radiating vs. non-radiating) and various clinical and cyst-related characteristics. Statistically significant associations ($p < 0.001$) were identified between pain type and all three clinical symptoms: Fever and nausea were more frequently reported in patients experiencing radiating pain; Vomiting was more commonly observed in those with non-radiating pain.

A highly significant association ($p < 0.001$) was also observed between pain type and cyst number. Patients with radiating pain exhibited a greater tendency to have multiple cysts, whereas those with non-radiating pain predominantly had single cysts. Similarly, a significant correlation ($p < 0.010$) was found between pain type and cyst classification, with complex cysts being more prevalent among patients reporting radiating pain, and simple cysts being predominantly associated with non-radiating pain.
Furthermore, a statistically significant association was noted between pain pattern and cyst texture ($p < 0.044$), with heterogeneous cysts more commonly observed in cases of radiating pain. In contrast, no

statistically significant relationships were observed between pain pattern and other sonographic features such as cyst margins, posterior acoustic enhancement, or the presence of internal echoes ($p > 0.05$).

Table IV. Association between pattern of pain and selected clinical and cyst characteristics

Variable	Categories	Pattern of pain n (%)		Total	Chi Square	*p*-value
		Radiating	Non-Radiating			
Fever	No	44(35.50)	147(89.60)	191(66.30)	92.695	<0.001*
	Yes	80(64.50)	17(10.40)	97(33.70)		
Vomiting	No	96(77.40)	156(95.10)	252(87.50)	20.232	<0.001*
	Yes	28(22.60)	8(4.90)	36(12.50)		
Nausea	No	36(29.00)	135(82.30)	171(59.40)	83.116	<0.001*
	Yes	88(71.00)	29(17.70)	117(40.60)		
No. of cyst	Single	79(63.70)	155(94.50)	234(81.30)	43.979	<0.001*
	Multiple	45(36.30)	9(5.50)	54(18.80)		
Type of cyst	Simple	117(94.40)	163(99.40)	280(97.20)	6.629	<0.010*
	Complex	7(5.60)	1(0.60)	8(2.80)		
Texture of Cyst	Homogenous	119(96.00)	163(99.40)	282(97.90)	4.055	<0.044*
	Heterogenous	5(4.00)	1(0.60)	6(2.10)		
Margins	Regular	117(94.40)	163(99.40)	280(97.20)	6.629	0.1
	Irregular	7(5.60)	1(0.60)	8(2.80)		
Posterior Enhancement	No	7(5.60)	1(0.60)	8(2.80)	6.629	0.1
	Yes	117(94.40)	163(99.40)	280(97.20)		
Internal Echoes	No	117(94.40)	163(99.40)	280(97.20)	6.629	0.1
	Yes	7(5.60)	1(0.60)	8(2.80)		
Total		124(100)	164(100)	288(100)		

DISCUSSION

The present study identifies a significant correlation between age, gender, and the prevalence of renal cortical cysts. A notable proportion (49%) of renal cyst cases were observed in individuals aged between 36 and 60 years, which corroborates findings by Gameraddin (2016), who reported an 89% prevalence among individuals above 50 years in Sudan (6). Similarly, Ozveren's 2016 study in Turkey also demonstrated increased cyst prevalence with advancing age, particularly among older males (13). The gender disparity was also evident in our cohort, where 77.8% of cyst-positive individuals were male and only 22.2% were female. These observations align with Chang CC's 2005 study in China, which reported prevalence rates of 15.14% in males and 5.38% in females (18), as well as with Ozveren's findings.

Laterality analysis revealed a higher incidence of cysts in the right kidney (44.8%) compared to the left kidney (39.6%), consistent with the results of Attia Ashraf (2023), who documented 32.5% of cysts on the right and 17.5% on the left (19). These results are further supported by Gameraddin's data (6). Unilateral cysts were predominant (84.4%) in our study, with bilateral involvement observed in only 15.6% of cases, this pattern parallels findings by Gameraddin & Babiker, 2016 and Attia A *et al.*, 2022 (6, 19).

In terms of morphology, simple renal cysts were overwhelmingly more common (97.2%) than complex cysts (2.8%). This observation aligns with the findings of Sunaina Ali (2023), who reported 78% of

cases as simple cysts and 3.7% as complex. These data underscore the predominance of benign, non-complicated renal cysts in patients presenting with acute abdominal pain.

Regarding cyst size, the most frequently encountered dimension was 1–2 cm (55.9%), followed by 3–4 cm (39.6%), 5–6 cm (3.1%), and >6 cm (1.4%). These results are in line with those of Erhan Tatar (2017), who described renal cysts within a size range of 0.8–6 cm.

Localization analysis showed that the right upper pole of the kidney was the most common site of cyst development (18.75%), followed by the left upper pole (15.97%), right lower pole (14.93%), left lower pole (13.19%), and the middle poles bilaterally (9.38%). These findings align with McHugh K.'s research, which reported 43% of renal cysts occurring in the right upper pole (20). Bilateral and multiple pole involvements were found to be relatively rare.

A strong association was observed between renal cysts and hypertension (79.9%), diabetes mellitus (48.6%), and smoking (55.9%). These findings corroborate previous studies: Choi JD (2016) in Korea reported similar associations with hypertension, while Wei L and Ozveren (2016) established links between diabetes and renal cyst formation. Terada N's 2000 study also highlighted smoking as a contributory factor in renal cyst development.

This study also demonstrated a statistically significant association ($p < 0.001$) between pain type and clinical presentation. Among patients with radiating pain, 64.5% reported fever, and 22.6% experienced nausea and vomiting, in contrast to 10.4% and 4.9%, respectively, in patients with non-radiating pain. These results are consistent with the findings of Bajwa (2001) and Bevers. Furthermore, among those experiencing radiating pain, 36.3% had multiple cysts, and 5.6% had complex cysts, while patients with non-radiating pain primarily had single (94.4%) and simple (99.4%) cysts. These patterns support previous observations made by Bisceglia (21).

A significant relationship ($p = 0.044$) was also found between pain pattern and cyst texture. Among patients with radiating pain, 4% exhibited heterogeneous cysts, whereas 99.4% of patients with non-radiating pain had homogeneous cysts. This observation, though lacking comprehensive precedent in the literature, warrants further investigation.

Additional associations were examined between pain type and sonographic features including cyst margins, posterior acoustic enhancement, and internal echoes. Although trends suggested that radiating pain was more commonly linked to irregular margins, absence of posterior enhancement, and presence of internal echoes, these differences did not reach statistical significance ($p = 0.10$). Nonetheless, similar qualitative patterns were noted in Karen Garfield's 2023 study, wherein non-radiating pain was generally associated with regular margins, posterior enhancement, and absence of internal echoes (22).

CONCLUSION

Recent study found common risk factors (smoking, diabetes, hypertension) and symptom (nausea, fever, vomiting) can guide targeted screening, particularly in middle-aged males. The association of radiating pain with complex, multiple cysts and non-radiating pain with simple, single cysts may aid in early differentiation between benign and potentially problematic cysts. Recognizing The consistent finding of right-sided, small (1–2 cm), simple cysts supports the use of ultrasound imaging for non-invasive monitoring. These insights emphasize the importance of incorporating cyst characteristics into routine assessments to inform management strategies and predict complications.

Further longitudinal study needed for identify whether early identification of cyst in acute abdominal pain can alter patient's outcomes. Pain intensity scale recommended for better assessment. Include asymptomatic patients for a comprehensive understanding.

Limitations:

This study has certain limitations. The sample was derived from a tertiary care hospital in Lahore, which may not be representative of the broader population, particularly those residing in rural areas. Furthermore, the cross-sectional design restricts the ability to determine causality or long-term outcomes. Ultrasonography, while widely used for renal imaging, is operator-dependent and subject to technical

limitations such as interference from bowel gas, potentially affecting diagnostic accuracy for renal cortical cysts.

Authors' contribution:

YK and ZS Conceptualization & supervision; ZA Research work, writing initial manuscript & data acquisition; AR, KU, IN and TE Data analysis, statistical analysis & editing of manuscript.

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