

Original Research Article

Sonographic Evaluation of Hydronephrosis and the Prevalence of Leading Causes in Adults

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Abstract: Background: One of the most common complications of renal obstructive disease is hydronephrosis. It can lead to serious complications, including acute and chronic renal failure, if left untreated. **Objective(s):** To recognise factors overlooked in mild hydronephrosis. To demonstrate changes in ultrasound among patients with hydronephrosis. To ensure prompt ultrasound diagnosis leading to acute and chronic renal failure. **Material and method:** This is a descriptive cross-sectional study. The participants in this sample were 56 females and 44 males who went to the ultrasound department. Patients gave their informed consent to be scanned for trans-abdominal ultrasound. A specially crafted data collection sheet was developed to contain the patient's demographic statistics. Renal ultrasound has been the gold standard for kidney imaging. It is possible to picture and evaluate renal pelvic-calyceal system. A real-time machine with a 3.5 MHz, TA, convex transducer was used to conduct the ultrasound test. The renal pelvis and calyces were seen during longitudinal and transverse sections through the kidneys. When the renal pelvis and calyces dilate, it is easy to diagnose hydronephrosis. Statistical analysis was done for windows using version 22 of the standard social sciences statistical package (SPSS). **Results:** Hydronephrosis was categorised into mild, moderate, medium, and serious hydronephrosis based on its sonographic appearance. Mild hydronephrosis is the most common (56%), followed by moderate (25%), serious (13%), and extreme (6%). Ureteric stone, kidney stone, pregnancy, and benign prostatic hypertrophy were among the causes of hydronephrosis. **Conclusion:** The sensitivity of ultrasound is high to rule out grades of hydronephrosis and determining the root causes. The purpose of study is to have the information about neglected variables in mild state, so that exact causes of its prevalence can be timely sorted.

Key words: Hydronephrosis, Sonography, Prevalence, Causes, Renal failure.

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INTRODUCTION

Hydronephrosis, despite health advancements, is a major concern. It is a typical health disorder not only faced by urologists but also by experts in emergency medicine and primary care doctors. Hydronephrosis relates most typically to the dilation of renal collecting system due to partial or total obstruction. Obstruction results in elevated tension within the urinary tract, contributing to biochemical and anatomical changes. The normal operation of the kidney requires the removal of final metabolic products and an unnecessary volume of water. In certain instances, the urinary outflow is either blocked or there is backward

movement of urine still in the bladder which may escalate to swollen renal pelvis [1, 2].

An underlying medical condition or potential risk tends to cause hydronephrosis is that includes acute unilateral obstructive uropathy, congenital blockage, blood clots, nerve or muscle problems, kidney stones, urinary tract infection, tissue scarring, tumor or cancer (examples include bladder, colon, vaginal or prostate), prostate enlargement and pregnancy [3, 4]. According to some authors hydronephrosis or hydroureter is the most common disease while ureteral and renal pelvic dilatation is more pronounced on right and is observed in 80 to 90 percent pregnant females. Maternal

hydronephrosis is most often seen at initial of third trimester on ultrasound, which analysts say is due to effects of progesterone on the ureters which reduce their tone. Various hydronephrosis factors classified on the basis of swelling origin and whether source is found within or outside the collection system, or due to a difference in the operation of components in urinary system. Hydronephrosis can be acute or chronic, partial or complete, unilateral affecting one kidney, or bilateral affecting both, depending on the degree of cause [5, 6].

Generally, hydronephrosis growing progressively will cause no discomfort. Urethral or bladder outlet obstruction may trigger discomfort or pressure resulting from bladder distention [6]. A total blockage of blood supply to the kidney will lead to irreversible failure of the kidney. Blood tests can indicate compromised renal function or electrolyte imbalances. Due to the secondary degradation of nephrons within the affected kidney, urinalysis may suggest an increased PH [7]. Hydronephrosis or hydroureter exact cause and appearance differs in adults as compared to neonates and children. Ureteropelvic junction obstruction and vesico-ureteral reflex are the most common of all birth defects that causes hydronephrosis in fetuses and new-borns [8]. In young adults, a kidney stone is the most typical reason for this blockage followed by the tumours while neurogenic bladder, inflammatory ureteral strictures and bladder outlet obstruction are not common causes as bladder outlet obstruction is more common in older men. The leading causes in older patients are benign prostatic hyperplasia or carcinoma, pelvic neoplasm and calculi [9, 10].

Flank pain is the main symptom of hydronephrosis, in contrast to conditions such as urinary tract inflammation, acute and persistent renal dysfunction, gross or microscopic haematuria [11]. Other indications include decreased urination, incontinence, urinary pain, increased urge or frequency, fever and nausea. These signs depend on the cause and severity of urinary blockage. A detectable abdominal or flank mass caused by the swollen kidney can be identified by physical examination [12, 13]. Hydronephrosis is graded into five categories by the society of foetal urology (SFU) classification system. Grade 0 = hydronephrosis not present. Grade 1 = only renal pelvis dilatation. Grade 2 = grade 1 + some calyces are dilated. Grade 3 = grade 2 + all calyces are dilated. Grade 4 = grade 3 + renal parenchyma thinning. [14, 15].

In the investigation of kidneys, renal imaging is the traditional approach. It demonstrates size, thickness, and presentation of parenchyma in the kidneys (echogenicity, corticomedullary distinction, identify focal lesions such as cancers, renal stones and cysts), hydronephrosis severity, ureteral dilation, and anatomy of the bladder [16, 17]. Conventional

ultrasound plays an important role in kidney evaluation and is susceptible for diagnosing pelvic calyceal dilatation. Ultrasound can diagnose the causes of hydronephrosis, such as pelvic abscesses or tumours, benign prostatic hypertrophy, bladder or ureteral calculi. If hydronephrosis source is at the outlet of bladder, the absence of urinary tract dilatation or massive accumulation of urine can be shown by post-void inspection [18, 19].

The importance of urodynamics and presence of hydronephrosis can be found on ultrasound. Clear parameters and harmful findings that are indicative of renal injury must be identified timely to develop clinical strategy to avoid complications. This study will help us to diagnose and treat hydronephrosis on a mild stage rather than its evolution towards acute and chronic renal failure.

MATERIAL AND METHOD

This is a descriptive cross-sectional study conducted at Allama Iqbal Memorial Teaching Hospital and Govt. Sardar Begum Teaching Hospital Sialkot, Punjab, Pakistan. This study is conducted over period of July 2020 to January 2021. All patients who were diagnosed with hydronephrosis during an ultrasound scan investigation presented at the study area within the period of the study are included. Patients gave their informed consent to be scanned for trans-abdominal ultrasound. A specially crafted data collection sheet was developed to contain the patient's demographic statistics.

Protocol of Renal Ultrasonography

Renal ultrasound has been the gold standard for kidney imaging. It is possible to picture and evaluate renal pelvic-calyceal system. A real-time machine with a 3.5 MHz, TA, and convex transducer was used to conduct the ultrasound test. XU Aplio and Toshiba SSA-770A ultrasound machines were included, with a Sony ultrasound printer recording system.

Scan was performed in dim light to avoid any artifact, and patient privacy was intended. Patient was positioned in supine and then ultrasound gel was applied over the area of interest and then transducer was placed to start examination. The renal pelvis and calyces were seen during longitudinal and transverse sections through the kidneys. When the renal pelvis and calyces dilate, it is easy to diagnose hydronephrosis. Every patient was scanned using the same ultrasound technique and the same kind of transducer to avoid bias.

RESULTS

In this sample, people who attended radiology department for ultrasound screening were examined and based on that the cause of hydronephrosis was noted. In table (1) according to age distribution in this study population were observed, in the age group of 25-50

years 56% patients presented with hydronephrosis. The participants in this sample were 56 females and 44 males who went to the ultrasound department for ultrasound exam (Figure 1). Table (2) shows the grouping of participants based on their experience of chronic medical conditions. Table (3) shows the general classification of subjects based on renal symptoms, in which pain being most common (28%). Table (4) shows right sided hydronephrosis was most common in this study population (44%). (Figure 2) depicted the sample population's hydroureter background, which showed that 55 percent had never had a stone. Table (5) shows how participants were classified according to the severity of their hydronephrosis, revealing that mild hydronephrosis was the most common (56%). (Figure 3) shows the distribution of the causes of hydronephrosis with ureteric and kidney stones being

the most common causes (29%) and (23%), respectively.

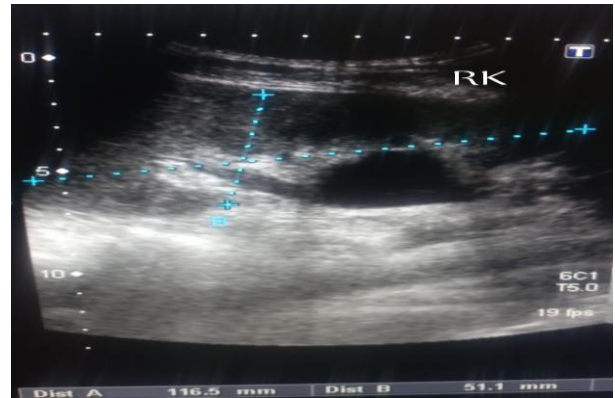


Image (a) sonogram reveals mild hydronephrosis and hydroureter on the right side of the kidney



Image (b) sonogram reveals grades of hydronephrosis

Table-1: Age group Distribution of study population

	Frequency	Percent	Valid Percent	Cumulative Percent
<25	10	10.0	10.0	10.0
25-50	56	56.0	56.0	66.0
51-70	22	22.0	22.0	88.0
>70	12	12.0	12.0	100.0
Total	100	100.0	100.0	

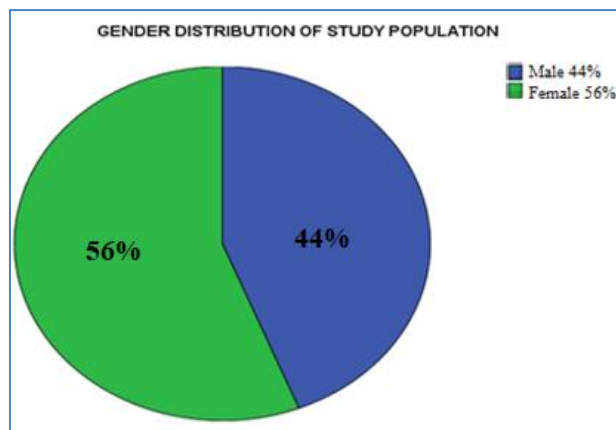


Fig-1: The gender distribution of study population is shown (44% male and 56% females)

Table-2: Classification by history of chronic medical condition

	Frequency	Percent	Valid Percent	Cumulative Percent
No history	42	42.0	42.0	42.0
Gout	17	17.0	17.0	59.0
DM	22	22.0	22.0	81.0
HTN	19	19.0	19.0	100.0
Total	100	100.0	100.0	

DM: Diabetes mellitus, HTN: Hypertension

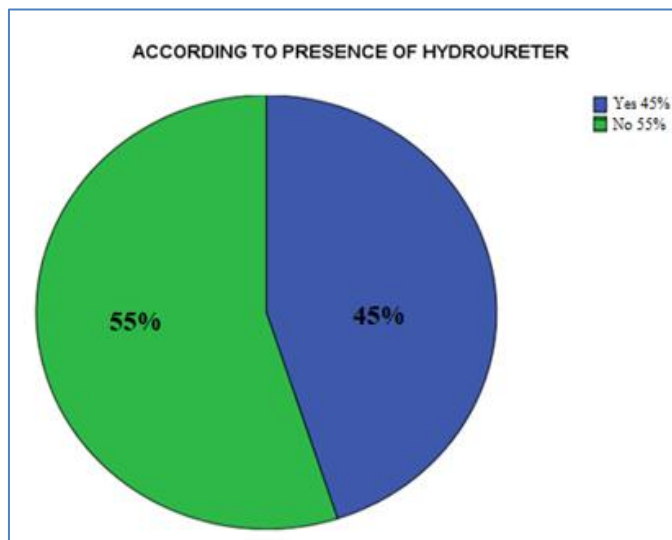


Fig-2: The hydroureter presence is shown in this chart (45% yes and 55% no)

Table-3: Classification of subject according to renal characteristics

	Frequency	Percent	Valid Percent	Cumulative Percent
Pain	28	28.0	28.0	28.0
UTI	15	15.0	15.0	43.0
Haematuria	20	20.0	20.0	63.0
U. Retention	17	17.0	17.0	80.0
Pyelonephritis	8	8.0	8.0	88.0
Renal Colic	12	12.0	12.0	100.0
Total	100	100.0	100.0	

Table-4: Most common type of hydronephrosis in study

	Frequency	Percent	Valid Percent	Cumulative Percent
Left HN	34	34.0	34.0	34.0
Right HN	44	44.0	44.0	78.0
Bilateral HN	22	22.0	22.0	100.0
Total	100	100.0	100.0	

Table-5: Classification of subject according to severity of hydronephrosis

	Frequency	Percent	Valid Percent	Cumulative Percent
Mild HN	56	56.0	56.0	56.0
Moderate HN	25	25.0	25.0	81.0
Severe HN	13	13.0	13.0	94.0
Extreme HN	6	6.0	6.0	100.0
Total	100	100.0	100.0	

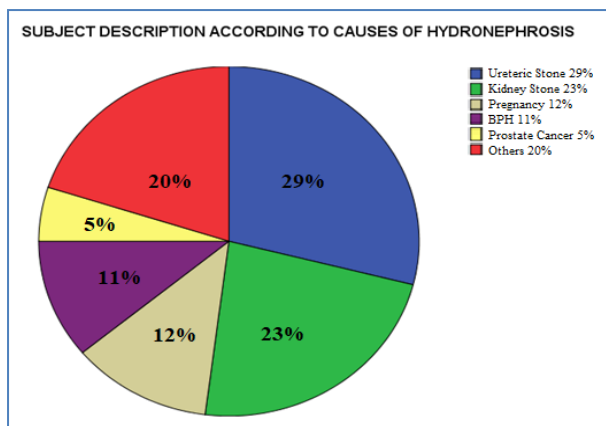


Fig-3: The pie chart shows the distribution of hydronephrosis causes

STATISTICAL ANALYSIS

Statistical analysis was done using version 22 of the standard social sciences statistical package (SPSS). For defining variables, descriptive statistics were used. The data was presented in the form of pie charts and tables.

DISCUSSION

Hydronephrosis was observed in this study in patients who had come to the ultrasound department with kidney problems. It was observed that females are more likely than males to develop hydronephrosis (56%) because they have a lower threshold for renal effects (Figure 1). In literature, Suzan Omer Abdelmaboud et al. performed a study in Khartoum, he studied 53 females and 47 males and evaluated hydronephrosis on ultrasound in which (53%) had mild hydronephrosis, (30%) moderate hydronephrosis, severe hydronephrosis (13%). There were various causes in which most of the study population had history of renal stones (63%) and less than 50 years of age were more presented in this study of being diseased. In table (1), the cumulative percentage of hydronephrosis is 66% in patients who are less than 50 age group. Table (2) shows there was no history of illness associated with renal disorders in 42% of the cases. As seen in the table (2), diabetes accounts for 22%, hypertension accounts for 19%, and gout accounts for 17% of the cases. In 2015, AlsheikhBabiker Ahmed Hamid et al. researched the causes of obstructive uropathy in (100) patients. The findings revealed main causes as (75%) stones, (20%) mass, least infection (5%). Mild hydronephrosis (29%), moderate hydronephrosis (58%), severe hydronephrosis as (13%) [14, 20].

Sultan Abdulwadoud Alshoabi et al. conducted a study that included 210 ultrasound records of patients diagnosed with hydronephrosis between 2016-2017. Chi-square test and odd ratio were used to determine the relationship between parameters. He reported that hydronephrosis was 91.8% unilateral and 8.1%

bilateral. It was dispersed in patients as 58.7% (grade2), 20% (grade 3), 12.38% (grade 1) and 9.1% (grade 4). The urinary stone identification figure was 50%, 61% and 71.4% for hydronephrosis in grade 1, 2 and 3 accordingly. He concluded that in 60% of patient's, urinary stones were the cause of hydronephrosis and its identification improves as grade 1 to grade 3 and declines in grade 4 [15]. Table (3) indicates the classification of subjects based on symptoms. Pain is the most common symptom (28%) and (15%) of those afflicted with infection (UTI) [12]. As shown in Table (4) the most common type of hydronephrosis in the study is right sided hydronephrosis that is 44% along with 34% left sided and 22% bilateral hydronephrosis respectively. In (Figure 2) hydroureter is present in 45% of cases and is caused by ureteric obstruction in the lower ureter. Subject description according to causes of hydronephrosis are explained in (Figure 3) the most common cause is ureteric stone, which accounts for 29% of all cases [21]. The second factor is a kidney stone (23%), pregnancy is the second leading cause of hydronephrosis in women, accounting for 12% of cases, and benign prostatic hyperplasia is the second leading cause of hydronephrosis in men (11%). The best imaging modality for determining the size of the prostate gland is ultrasound. The dimensions are determined using the formula $(W \times D \times L)/2$, where W represents width, D represents depth, and L represents weight. If the calculated volume of the prostate exceeds 30 cc, there is usually a rise in volume. The central gland is swollen and hypoechoic or mixed echogenic in appearance. The calcification of the swollen gland can be observed. According to some authors hydronephrosis or hydroureter is the most common disease while ureteral and renal pelvic dilatation is more pronounced on right and is observed in 80 to 90 percent pregnant females. Maternal hydronephrosis is most often seen at initial of third trimester on ultrasound, which analysts say is due to effects of progesterone on the ureters which reduce their tone [5, 11].

CONCLUSION

The sensitivity of ultrasound is high to rule out grades of hydronephrosis and determining the root causes. The most frequent causes of hydronephrosis are ureteral and kidney stones. The results of the study suggests that in females, pregnancy and in male benign prostatic hypertrophy were the second and third most common causes of hydronephrosis, respectively. And it is mentioned that renal obstructive disorders are characterized by pain as the most frequent symptom. Therefore, the purpose of study is to have the information about neglected variables in mild state, so that exact causes of its prevalence can be timely sorted.

Ethical considerations

The rules and regulations set by the ethical committee of University of Lahore are followed while conducting the research and the rights of the research participants are respected.

Confidentiality of data

A written informed consent was taken from all the patients having flank pain. All collected data will be kept confidential for research purpose only.

Informed consent and right to privacy

Patients were given the right to withdraw their information in any step of data collection. Everything is in confidentiality and all the things that were mentioned in the article are with the permission of every single person which is considered in this article.

Financial support and conflict of interest

No financial support and we declared that there is no conflict of study in this research.

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