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A Comparative Study between Laboratory Test and Ultrasound in Detecting Renal Infection

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Abstract: *The main objective of this study was to determine the characteristic of ultrasonography in detecting renal infections (glomerulonephritis and pyelonephritis) versus laboratory tests. This study was done on A total of 234 patients were included in this study (106 were normal cases (22.6% male and 77.4% female), 128 patients had renal infections; 68 diagnosed with glomerulonephritis (38.2% males and 61.8% females) 60 with pyelonephritis (33.3% males and 66.7 females). The study was done on Khartoum hospital and Madanihospital the important results of this study were female was mostly affected by glomerulonephritis and pyelonephritis rather than the male with male to female ratio of 1:1.6 and 1:2 respectively. loin pain found in 82.4% associated with glomerulonephritis while 75% of pyelonephritis showed ill-defined corticomedullary differentiation. Similarly, laboratory investigation revealed significant differences (at p = 0.05) between the patient with normal kidneys and infected one concerning RBC, WBC, Protein, and Pus cells where all these tests give significantly higher values.*

Keywords: *glomerulonephritis, pyelonephritis, ultrasound, Creatinine level.*

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I. Introduction

Glomerulonephritis is an inflammatory process affecting primarily the glomerulus, with infiltration and proliferation of acute inflammatory cells. [1]

Acute pyelonephritis is an infection of the renal pelvis, calyces, and parenchyma. This i/s most often (85%) caused by an ascending Escherichia coli (E. coli) infection; both inflammations are the most common renal infection in the world. [2]

Ultrasound continues to be one of the most important diagnostic tools used by a wide range of healthcare professionals across many applications. Ultrasounds not only complement the more traditional approaches such as X-Ray, but also possess unique characteristics that are an advantage in comparison to other competing modalities such as X-Ray, computed Tomography (CT), Radionuclide emission tomography, and Magnetic Resonance Imaging.[3,4]

Some advantages of choosing ultrasound as baseline investigation for the renal disease are a real-time image produced, a very cheap examination,- ionizing radiation form, safe examination, and high-resolution images.

Another advantage is Doppler protocol to best visualization blood flow and vasculature anatomy, and the portable machine can transport beside to patient's bed.[5]

Ultrasound limitations such as bony and gasses organs cannot be adequately visualized, only an imitated window is available for ultrasonic examination such as the cardiac and neonatal brain, not give an adequate image in obese patients and also ultrasound is operator experience independent.

The urinary system is the excretory system of the human body. The primary function is production, storage, and elimination of urine. Because urine contains nitrogenous wastes must be eliminated and excreted outside the body to maintain homeostasis. [6, 7] for that the kidney character is important for the clinical assessment of renal disease. This study was performed to detect renal infection (glomerulonephritis and pyelonephritis). Also to know how an increase of Serum Creatinin Level (SrCr) and urea are an indicator of renal disease. [8]

Laboratory investigation included:
• Urine protein—a few different tests may be used to screen for protein in the urine.
• Urine albumin—this test may be done on a 24-hour urine sample, or both urine albumin and creatinine can be measured in a random urine sample and the albumin/creatinine ratio (ACR) can be calculated. The American

Diabetes Association recommends ACR as the preferred test for screening for albumin in the urine (microalbuminuria).[9]

• Urinalysis—this is a routine test that can detect protein in the urine as well as red blood cells and white blood cells. These are not normally found in the urine and, if present, may indicate kidney disease.

• Urine total protein or urine protein to creatinine ratio (UP/CR)—detects not just albumin, but all types of proteins that may be present in the urine.[9,10]

While urinalysis and urine total protein is not as sensitive as urine albumin for detecting kidney damage, these tests give fewer false signals of kidney damage.[11]

• Estimated glomerular filtration rate (eGFR)—a blood creatinine test or possibly a cystatin C test is performed to calculate the eGFR. The glomerular filtration rate refers to the amount of blood that is filtered by the glomeruli per minute. As a person's kidney function declines due to damage or disease, the filtration rate decreases and waste products begin to accumulate in the blood.[11,12,13]

Some additional tests that may be ordered to evaluate for kidney disease include:

Urea (urea nitrogen or BUN)—the level of this waste product in the blood increases as kidney filtration declines. Increased BUN levels suggest impaired kidney function, although they can also be elevated due to a condition that results in decreased blood flow to the kidneys, such as congestive heart failure, heart attack, or shock.[13]

Creatinine clearance—this test measures creatinine levels in both a sample of blood and a sample of urine from a 24-hour urine collection. The results are used to calculate the amount of creatinine that has been cleared from the blood and passed into the urine. This calculation allows for a general evaluation of the amount of blood that is being filtered by the kidneys in 24 hours. [13]

Urinary tract infections (UTIs) are a common clinical problem, especially among women.

Ultrasound assessment is indicated in the case of complicated UTIs, in particular in children, pregnant women, and patients with chronic kidney disease. [14]

The frequency of urinary tract infections (UTIs) is second only to that of respiratory tract infections in the pediatric population. UTIs often are separated into infections of the lower urinary tract that involve the bladder and urethra and those of the upper tract that involve the kidneys, renal pelvis, and ureters. Infections of the upper tract are designated pyelonephritis. [14]

II. Materials And Methods

2.1Material

2.1.1Area and duration

This study was carried out in the period from January2014to August 2016 in Khartoum hospital, Madani hospital, Elmanagil hospital, and Elkramit family health center.

2.1.2 Sample study

This study consisted of 234 patients who were included in this study having an ultrasound examination, referred to the urology department for investigation. Patients were selected conveniently. The study includes both genders with their ages ranged from 11 years to 80years old. A laboratory test was included in the study for all patients.

Inclusion criteria: patient with loin pain and had urinary tract infection (UTI) signs and symptoms and patient age between 11-80 years.

Exclusion criteria: patient less than 11 years and over 80 years.

2.1.3 Machine used

Renal ultrasound examination was performed with Mindary DC-7and my lab 60ultrasound machines with 3.5-5 MHz probes are typically used to scan the kidney. For urine analyzer, Clinitek Atlas Automated Urine Chemistry Analyzer (Carousel) from Siemens was used.

2-2 Methods

2-2-1 Technique

2-2-1-1 Sonographic technique

There are different optimal patient positioning, supine and lateral decubitus positions often suffice, to assessed kidney in transverse and coronal sections. For obese patients, oblique and occasionally prone positioning may be recommended. Because of the upper pole of the left kidney may be particularly difficult to image, combinations of subcostal and intercostal approaches are required to evaluate all kidney parts.

The patient position is in the supine position. By using the liver and spleen as acoustic windows Scans are performed in the Sagittal and transverse planes from the anterior approach. Then, left lateral decubitus or

lateral oblique positions for the right kidney and right lateral decubitus or lateral oblique positions for the left kidney.

For hydronephrotic patients, coronal longitudinal and transverse scans may also be obtained and are recommended for evaluating the renal pelvis and proximal Ureter. [15]

The highest frequency transducer permitting adequate penetration is used. Usually, 3 to 5 MHz ranges are best. A phased array sector probe with its small footprint permits subcostal and intercostal scanning.[15,16]

2-2-1-2 urinalysis technique

A urinalysis is a urine test by a laboratory device. A urinalysis is used to detect and manage a wide range of diseases and pathology, such as urinary tract infections, kidney disease, and diabetes.

A urinalysis involves checking the appearance, concentration, and content of urine. Abnormal urinalysis results may point to an infection, disease or illness. [17, 18]

For a urinalysis, your urine sample is evaluated in three ways: visual exam, dipstick test, and microscopic exam.

2-2-1-2-1 Visual exam

A visual exam is a lab technician who examines the urine's appearance. Urine is typically clear. Cloudiness or any change in urine color may indicate a problem, such as an infection. For example, Blood in the urine may make it look red or brown.This one indicator of renal infection. [18]

2-2-1-2-2 A dipstick

It is a thin, plastic stick with strips of chemicals on it, and is placed in the urine to detect abnormalities. The chemical strips change color if certain substances are present or if their levels are above normal. A dipstick test usually checks the following:

Acidity (pH): is means the amount of acid in urine. Abnormal pH levels may indicate a kidney or urinary tract diseases

Concentration: it shows how concentrated particles are in your urine. A higher than normal concentration often is results in dehydration or less fluid intake.

Protein: Low levels of protein in urine are normal. Small increases in protein in the urine usually aren't a cause for disease or illness, but larger amounts of protein may indicate a kidney problem.

Sugar and Ketones: Normally the amount of sugar (glucose) in urine is too low. If there is a high level of sugar on this test usually calls for follow-up testing for diabetes mellitus. [18]

Bilirubin: is a product of red blood cell breakdown. Bilirubin in your urine may indicate liver damage or disease.[18]

Evidence of infection: If either nitrites or leukocyte esterase in the urine, it may be a sign of a urinary tract infection.

Blood in your urine requires additional testing .blood in urine can be a sign of kidney damage, infection, renal stones, or kidney or bladder cancer. [18]

2-2-1-2-3 Microscopic exam

During this exam, several drops of urine are viewed with a microscope. If there any of the White blood cells, red blood cells, bacteria and crystals in urine above-average levels, additional testing may be necessary because all those are a sign of renal infection.[18, 19]

2.2.2 Statistical analyses

By using SPSS program version16 all data and variables are analyzed. Descriptive statistics, including frequency and percentages, were calculated. ANOVA test was applied to test the significance, the *p*-value of less than 0.005 was considered to be statistically significant.

III. Results

All collected data analyzed and tabulated in tables and graphs as follows:

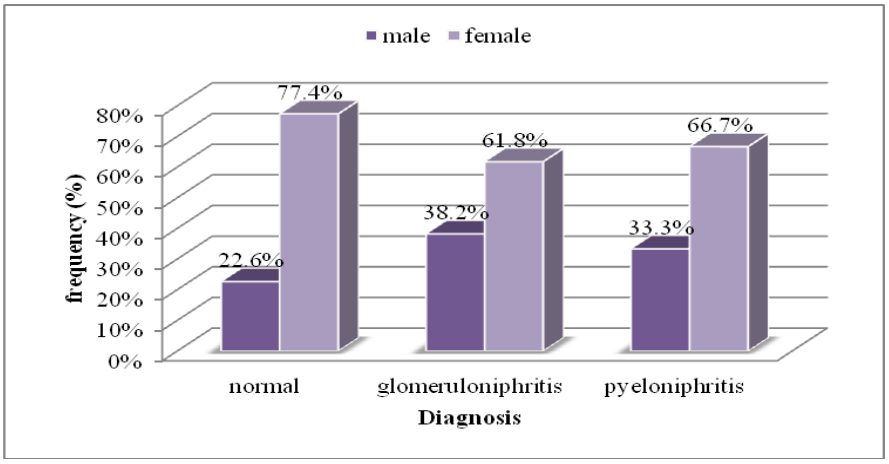

Figure no 1: a bar graph illustrating the % frequency distribution of diagnosis according to their gender

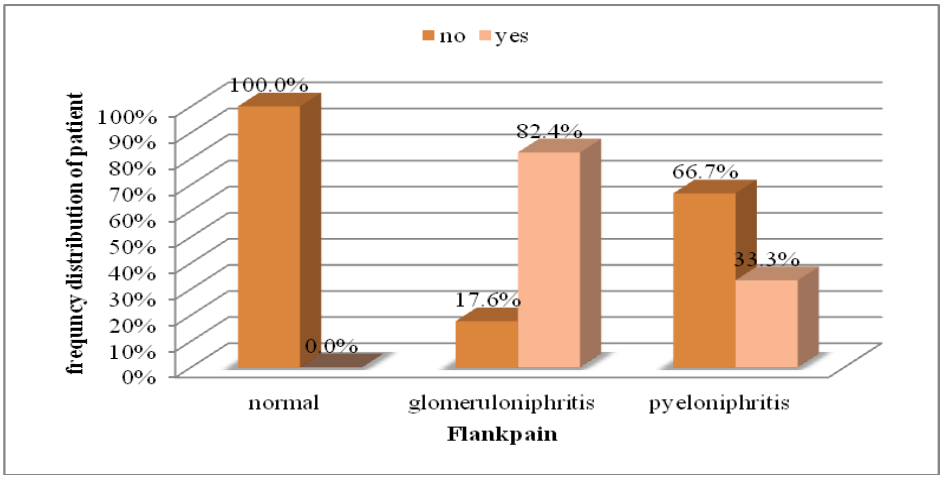

Figure no 2: a bar graph display the frequency distribution of flank pain

Table no 1.the mean ± Standard deviation of the laboratory and Sonographic measured variable included in the study including the t-test values and the probability level (significant < 0.05)

Variables		Mean	Std. Deviation	t	Sig. (2-tailed)
RBC	Normal	0.4	0.9	8.96	**0.000**
	Abnormal	24.5	19.4		
WBC	Normal	6230.8	1113.5	16.52	**0.000**
	Abnormal	13414.9	2908.6		
Protein	Normal	0.0	0.0	12.97	**0.000**
	Abnormal	1.7	0.9		
Urea	Normal	21.8	5.4	1.29	0.200
	Abnormal	24.0	10.6		
Pus cells	Normal	1.3	1.1	15.43	**0.000**
	Abnormal	50.1	22.8		
Keratin	Normal	0.9	0.2	7.109	**0.000**
	Abnormal	0.6	0.3		
Rt Kidney length	Normal	8.3	0.9	6.162	**0.000**
	Abnormal	9.6	1.3		
Rt kidney width	Normal	4.1	0.7	0.754	0.453
	Abnormal	4.0	0.6		
Rt kidney thickness	Normal	2.9	0.3	0.071	0.944
	Abnormal	2.9	0.4		
Rt Kidney size	Normal	98.7	30.0	2.033	0.045
	Abnormal	111.6	33.1		
Rt Cortical thickness	Normal	1.9	0.4	1.786	**0.001**
	Abnormal	1.6	0.2		
Lt Kidney length	Normal	8.6	0.9	4.714	**0.000**

	Abnormal	9.6	1.1		
Lt kidney width	Normal	4.6	0.7	1.185	0.239
	Abnormal	5.4	4.9		
Lt Kidney thickness	Normal	2.9	0.4	1.698	0.093
	Abnormal	2.8	0.3		
Lt Kidney size	Normal	115.1	31.0	1.544	0.129
	Abnormal	142.5	123.6		
Lt Cortical thickness	Normal	1.9	0.4	1.544	**0.002**
	Abnormal	1.7	0.3		

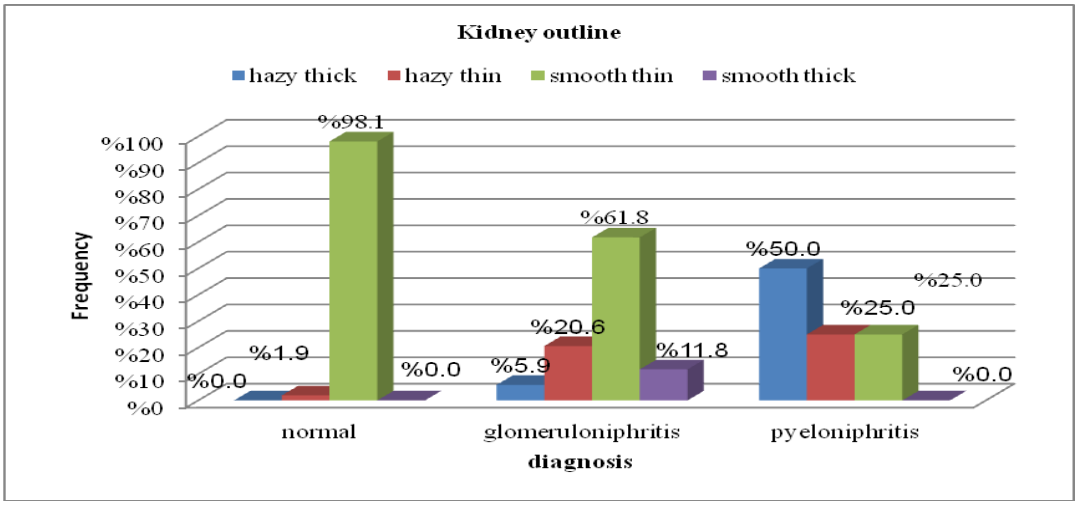

Figure no 3. Percentage distribution of ultrasound appearances of kidney outline for normal kidneys and infected one (glomerulonephritis and pyelonephritis).

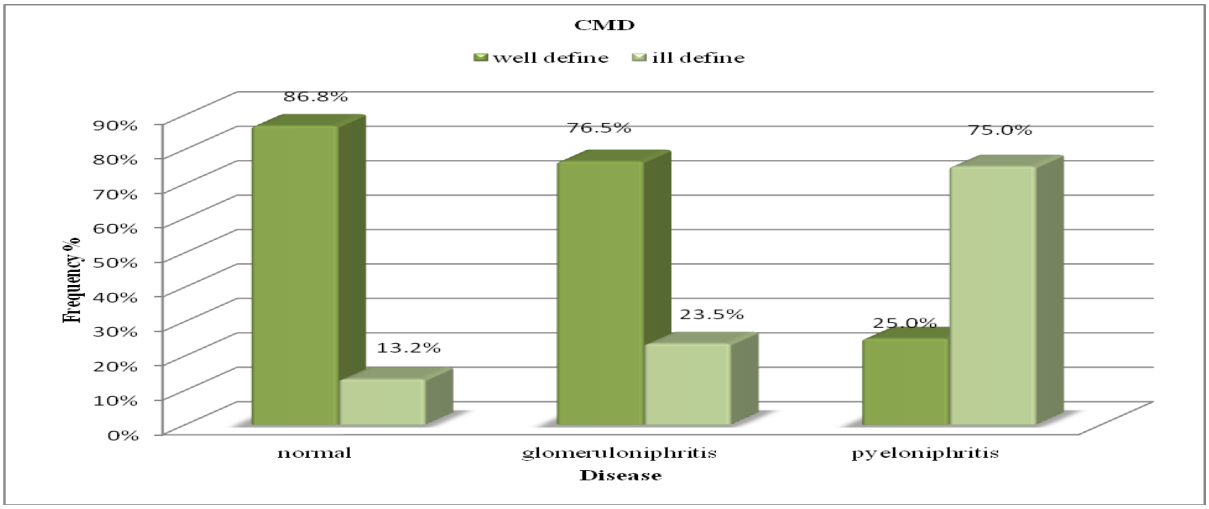

Figure no 4. Percentage distribution of ultrasonography appearance of corticomedullary differential of normal kidneys and the affected kidneys by glomerulonephritis and pyelonephritis

Table no 2. Classification score table related the accuracy of the predicted groups to the original group using the ultrasonography characteristics and laboratory tests result

Original group	**Predicted Group Membership**			
	Diagnosis	Normal	Glomerulonephritis	Pyelonephritis
	Normal	98.1%	1.9%	0%
	Glomerulonephritis	0%	94.1%	5.9%
	Pyelonephritis	0%	8.3%	91.7%

IV. Discussion

A total of 234 patients were included in this study 106 were normal cases (22.6% male and 77.4% female) 128 patients had renal infections; 68 diagnosed with glomerulonephritis (38.2% males and 61.8% females) 60 with pyelonephritis (33.3% males and 66.7 females); the number of females was higher than that of

male with a male to female ratio for glomerulonephritis and pyelonephritis of 1:1.6 and 1:2 respectively; which mean that females were more susceptible for renal infection than males (Figure 1). The patient's age ranged from 11 to 80 years also indicates that infection appears in a wide spectrum of ages which might be attributed to hygiene problems. The common presenting symptoms were flank pain which appears more in patients with glomerulonephritis (Figure 2).

The result showed that there is a significant difference between patients with normal kidneys and those affected by glomerulonephritis and pyelonephritis in the case of medical laboratory tests, as well as Sonographic results at $p = 0.05$ using the t-test. Sonographic appearance that showed significant differences from the normal kidney appearance includes: kidney length, corticomedullary differentiation and cortical thickness for the right and left kidney; wherein case of length the infected kidney appears larger than the normal one mostly attributed to infection condition (increases of fluid content), on the other hand, cortical thickness appear significantly thinner than that of normal patient. The rest of the variable concerning the Sonographic measurement outcome showed inconclusive results they include kidney width, thickness, and size for both kidneys. Similarly, laboratory investigation revealed significant differences (at $p = 0.05$) between the patient with normal kidneys and infected one concerning RBC, WBC, Protein, and Pus cells where all these tests give significantly higher values than those reported for the patient with normal kidneys. (Table1)

Ultrasound scanning showed that kidneys outline of 50% of pyelonephritis were hazy thick and 25% were hazy thin, where for glomerulonephritis 61.8% were smooth thin similar to normal while 20.6% showed hazy thin outline; this means pyelonephritis affected the outline of the kidneys more than glomerulonephritis because the later one affected calyces rather than medulla area (Figure 3). While corticomedullary differentiation (CMD) effects appear mostly in the case of pyelonephritis in which 75% of the kidneys appear with ill-defined or poor differentiation between the medulla and the cortices. (Figure 4)

Similar to this study was done by A. Hassan et al(2014) intended to measure the ultrasound normative values of renal length and parenchymal thickness in the adult Sudanese population to establish their reference value for the Sudanese population while no recorded reference value in literature for them [1]. Ultrasonographic kidney measurements were performed on 77 adult patients without known kidney lesions. Measurements included the length and parenchymal thickness. The effect of age, gender, site (left and right side) and height were statistically analyzed. All normal patient was included in this study while any renal disease was excluded. This study was include (35) males and (42) females. The mean renal lengths were (10.15± 0.78) and (10.33± 0.80) cm for the right and left kidney respectively. The mean parenchymal thicknesses were (1.4714± 0.33cm) for the right kidney and (1.7169± 0.36cm) for the left kidney. They found there were correlated with age, gender, size, and height which showed that there is no significant difference between right and left renal length, but there was a significant difference between right and left parenchymal thicknesses. The significant effect of age was found only in the left renal length. The significant effect of gender was noted only in the right parenchymal thicknesses. No significant difference among height groups for renal length, but there was a significant difference in right parenchymal thickness. The study concluded that the normal value of left renal length was affected with age and normal parenchymal thickness was affected with the side (left or right). The right parenchymal thickness was affected by gender and height. The establishment of normal renal values of renal length and parenchymal thickness in the Sudanese population will help us in the evaluation of patients with chronic renal disease.

Brandt et al. (1982) assessed normal renal dimensions using Ultrasound. His result shows that the accuracy and reliability of sonographic assessment of renal dimensions when meticulous scanning techniques. Sonographically, with patients in the prone position, the mean right renal length was 10.74 cm (± 1.35 SD) and the mean left renal length was 11.10 cm (± 1.15 SD). A prospective sample demonstrated the mean depth (ventral-dorsal dimension) to be approximately 4.5 cm when the transducer was angulated for the lie of the kidney. [5]

V. Conclusion

Renal infections corresponding to glomerulonephritis and pyelonephritis can be diagnosed by ultrasonography according to it is manifestations which represented by CMD and outline of the kidney profile as well as kidney dimensions measurements like kidney length and cortical thickness, in addition to the medical laboratory test as an indicator for the presence of renal infection. The characteristics (presence of flank pain, RBC, WBC, CMD, kidney length and cortical thickness) that identify the renal infections type from the normal kidney

A urinalysis alone usually doesn't provide a definite diagnosis. Depending on the reason your doctor recommended this test, abnormal results may or may not require follow-up.

Your doctor may evaluate the urinalysis results along with those of other tests — or order additional tests — to determine the next steps.

For example, if you are otherwise healthy and have no signs or symptoms of illness, results slightly above normal on a urinalysis may not be a cause for concern and follow-up may not be needed. However, if

you've been diagnosed with a kidney or urinary tract disease, elevated levels may indicate a need to change your treatment plan.

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References

[1]. Abdelrahman H A. B., Adil A. Mansour, M. E. M. Gar-elnabi,Elsir Ali Saeed, Ultrasonographic Renal Length and Parenchymal Thickness in Normal Sudanese Population, International Journal of Science and Research (IJSR) ISSN
[2]. KEMP., W., BURNS., D. & BROWN., T. 2008. Pathology: The Big Picture, McGraw-Hill Companies
[3]. Jan A. Bates; MPH;L DMU ;DCR;abdominal Ultrasound. 2nd Edition 2004; P .1.
[4]. Al-KhaderAA,Tamim H, SulaimanMH,JondebyMS,TaherS,Hejaili FF, et al.what is the most appropriate formula to use in estimating glomerular filtration rate in adult Arabs without kidney disease? Ren Fail 2008;30:205-8.
[5]. Brandt TD,NeimanHL,DragowskiMJ,Bulawa W ,ClaykampGUltrasound assessment of normal renal dimensions Journal Ultrasound Med.1982 Mar,L(2):49-52.
[6]. Carol et aL; Diagnostic ultrasound imaging .sonographic technique 2011,4th edi,9-321.
[7]. D.Miletic ,Z.Fuckar, A.Sustic,V.Mozetic,D.Stimac, G.Zauhar: Sonographic measurement of absolute and relative renal length in adults. JClinUltrasound26 : 185-189,1998.
[8]. Brown, P. (2003) Ultrasound in Diffuse Renal Disease. British Medical Ultrasound Society Bulletin, 11, 30-35.http://ult.sagepub.com/content/11/4/30.full.pdf
[9]. Kfar Saba. Isr Med Assoc J. 2007 Oct;9(10):729-31 Rathaus V(1), Werner Medical Imaging, Acute focal nephritis
[10]. S.A Emamian, M.B Nielsen, J.F Pedersen, L. Yite:Kidney dimensions at sonography:Correlation with age, sex, and habitus in 665 adult volunteers. AJR Am J Roentgenol1601 :83-86,1993.
[11]. Beers M,D Robert Barkow, MD ., Mark H .MARK MANUAL of medical information 2009.
[12]. Omar Khan, William V. Raszka, Jr, MD Sonographic assessment of pyelonephritis MD October 2005
[13]. Kfar Saba. Isr Med Assoc J. 2007 Oct;9(10):729-31 Rathaus V(1), Werner Medical Imaging, Acute focal nephritis
[14]. G ItalNefrol. Ultrasound assessment in renal infections, 2012 Nov-Dec;29Suppl 57:S47-57.
[15]. Tempkin, B. B. 1999. Ultrasound scanning : principles and protocols, Philadelphia, W.B. Saunders Co.
[16]. Tortora, G. J. &B et al. Principles of ANATOMY & PHYSIOLOGY, USA, Biological Science Textbooks.2012
[17]. B. Johonsson, S .Troell, U. Berg ,,I .Wikstad.Ultrasonographic renal parenchymal volume related to kidney function and renal parenchmal area in children with recurrent urinary tract infections and asymptomatic bacteriuria. ActaRadiol 1984:25:411-416.
[18]. Anderson, N.G., Anderson, N.L., Tollaksen, S.L., Hahn, H., Giere, F., and Edwards, J. Analytical techniques for cell fractions. XXV. Concentration and two-dimensional electrophoretic analysis of human urinary proteins. United States: N. p., 1979. Web. doi:10.1016/0003-2697(79)90184-2
[19]. Evann E. Hilt, Kathleen McKinley, et al Urine Is Not Sterile: Use of Enhanced Urine Culture Techniques To Detect Resident Bacterial Flora in the Adult Female Bladder 10.1128/JCM.02876-13,2013

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