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RESEARCH ARTICLE

US EVALUATION IN PATIENT WITH RENAL FAILURE IN DIGNOSTIC RADIOLOGY

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ABSTRACT

Objective: to analyze patients with renal failure and show the most encounter Complication in patients in our locality. **Design:** prospective study in US evaluation of patients with renal failure. Setting: the study was conducted in the radiological unit, Ibn Senate aching hospital, over the period from October 2005 – October 2006 **Methods':** all patients were examined by US (3.5 MHZ probe). **Main result:** A- 34 case (56.7%) male and 26 case (43.3%) female. B- 1case (1.7%) is due obtrusive causes and 59 cases (98.3%) are duetonon -obtrusive causes C- 5 case (8.3%) are acute renal failure and 55case (91.7%) are chronic renal failure. **Conclusion:** US is of great value in the diagnosis of renal failure and insufficiency and provide Complete information no need for preparing patients therefore it is considered an optional method in diagnosis of renal insufficiency and failure.

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INTRODUCTION

Renal failure is accumulations of nitrogenous west product in body due to deterioration of renal failure. Renal insufficiency and failure can result from a variety of congenital, developmental, and acquired conditions (Maria Gisela Mercado deane, 2002). A sudden and usually changefulloss of renal function which develops over a period of days or week mean acute renal impairment. An elevation in plasma creatinineconcentration to > 1.1 gm \ dl are often used as the biochemical definition. Decrease urine out put can occurs but not always. Chronic renal impairment mean a permanentdecline in kidneys function which classically occurs over a period of year (Christopher Haslett, 2002).

Aim of study: To evaluate role of ultrasound in patient with acute and chronic renal.

Anatomy of kidney: The functional unit of the kidney is called nephron, and consists of a glomerulus in the cortexand tubule in themedulla. The kidney has approximately1million nephron (Stephanie Rayan, 2004). The kidney are a pair of fist sized organs located in the back behind the peritoneum. Each kidney weighs about 115 – 170g and has the following approximate dimensions: 11cm long,6cm wide,3cm thick

Normal kidney appearance in ultrasound: The kidney in US normally appears as pear shape, with varying length according to egg,but in adults 10 - 12±2cm

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The normal renal parenchyma is homogenous echogenicity. It is 4- 6 cm wide (at level of hilum). Renal parenchymal is 2-3 cm thick. There is a marked corticalmedullaryline. Renal pelvis is echo free structure in the middle of the kidney. Renal pyramid appears as multiple small echo free area specially in children (Carol a.mittelstedt, 1992)

Function of the kidneys: Healthy kidneys' function is to remove extra water and wastes, helps to control blood pressure,keeps the body's chemicals in balance, keeps bones strong, tells your body to make red blood cells and helps children to grow normally (http://www.kidney.org./ provfessional/ dogi/kdogi/ toc.htm)

A etiology of renal failure

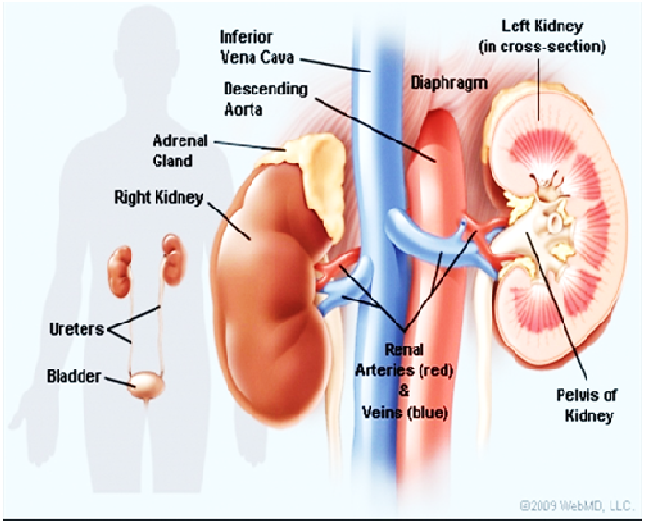
Acute renal failure (ARF)

Systemic: Heart failure, blood or fluid loss

Locality: Renal artery occlusion \ stenosis diseases affecting arterioles Under-perfusion initially causes reversible changes. Subsequently, acute tubular necrosis or other changes cause longer-lasting, but usually temporary, intrinsic renal failure

Renal causes: Intrinsic renal disease Acute tubular necrosis \toxic\septic renal failure Glomerular disease Primary Component of systemic disease Interstitial disease (Stephanie Rayan, 2004).

Disorder in renal parenchyma: Renal Hypo perfusion (leading to acute tubular necrosis) .



Pre-renal causes

Drug nephrotoxicity: Direct (e.g. aminoglycosides, amphotericin B Renal tubular obstruction (e.g. caused by sulphadiazin methotrexate, oxalate in prolonged

Methoxyfluraneanesthesia or ethylene glycol poisoning)

Acute interstitial nephrites (e.g. caused by penicillin thiazide diuretic furosemide, sulphaonamidesprostaglandinsynthetize inhibitors).
Acute cortical necrosis (e.g. caused by snake venom) (ADU, 2005)

Post-renal causes: Stones, inflammation, tumor, obstruction-Fig (2,3)

Chronic renal failure (CRF): CRF may be due to a disease which destroys the kidneys parenchyma and function Such as:

Factors that predispose to chronic renal failure

Disease Comments

- Autosomal kidney disease. e.g. polycystic kidney Fig 4
- Alpert disease.
- Impairment in blood supply.
- Blood pressure elevation.
- Unknown.
- Systemic inflammatory disease as SLE.
- Diabetes mellitus.

Pathogenesis of renal failure:

The kidney can regulate its own blood flow and GFR over a wide range of perfusion pressures. Marked under-perfusion of the renal system may lead to impairment of these compensatory mechanisms and GFR decline s.[2]

Obstructive renal failure: In a normally functioning kidney, urine formed within the tubular system empties into the calyces,where pacemaker sites generate peristaltic activity to propel urine into the pelvis. Acute obstruction also produces alterations in blood flow, leading to ischemia. The renal capsule is a fixed container, and only with longstanding obstruction will the kidney significantly enlarge.

Angiography may reveal slight splaying apart and compression of arteries. However, there is a marked compression of the intracranial veins giving them a spidery appearance (Sameet, 2006)

Dialysis in renal failure: Dialysis may be usedto remove excesswaste and fluid. Commonsymptoms that require the use of dialysis include decreasedmental status, pericarditis, increased potassium level, total lack of urine production, fluid overload, and uncontrolled accumulation of nitrogen west products (serum creatinine> 10mg\dl and BUN > 120mg\dl).[7] Chronic renal impairment (CRF) dialysis or transplantation is required in end-stage renal disease (ESRD). the complication of renal failure are include hypertension, diabetes mellitus and other metabolic disease.

Complications noted in patient with ESRD on dialysis

Medical complication

- A life-threatening hyperkalemia which is usually asymptomatic.
- Pericardial effusion and pericarditis
- Decrease blood pressure with syncope may happened as a problem of electrolyte depletions from dialysis.
- Ischemic heart disease is more frequent in patient with End stage renal disease.
- A disequilibrium syndrome which is common neurological problem seen in patient with dialysis.
- Peritonitis is common in patients with ESRD. Vascular access problems include infections.

Sonographer complications

Cystic change: This change is noted after dialysis in patient with CRF. It's not related to disease process but due to effect of dialysis (27).

Patients and method: This study was done in the department of radiology in Ibinsena teaching hospital, Mosul City-between October 2005 and October 2006. All patients were examined by Ultrasound, using 3.5 MHZ prop. Patients were examined in supine position, lateral decubitus and prone position. the examination was done on established renal failure patient (high blood urea and serumcreatinine).

RESULTS

The number of cases are 60 (34 male and 26 female) as shown in Table (1).

Table 1. Renal failure in relation to sex of patient

Sex	Number of patient	%
Male	34	56.7%
Female	26	43.3%
Total	60	100%

Their age group varies from (10 to 79) year as shown in the below histogram. (this histogram demonstrates age in year and the percentage patients) Renal failure is either acute or chronic as shown in Table 2. Our cases show 1case obstructive, 59 non obstructive for their renal failure as shown in Table (3).

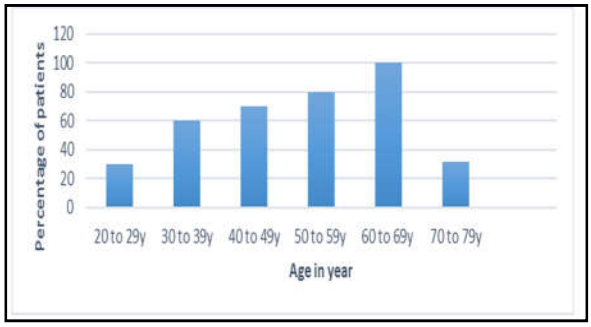


Table 2. Type of renal failure

Type of renal failure	Number of patients	%
Acute renal failure	5	8.3%
Chronic renal failure	55	91.7%
Total	60	100%

Table 3. Obstructive and non-obstructive causes

Causes of renal failure	Number of patients	%
Obstructive causes	1	1.7%
Non Obstructive causes	59	98.3%
Total	60	100%

Table 4. Causes of chronic renal failure

Causes of chronic renal failure	Number of patients	%
Diabetes Mellitus	19	34.54%
Hypertension	13	23.63%
Chronic infection, nephritis	7	12.72%
Glumerulonephritis	4	7.27%
Collagen disease (SLE)	2	3.63%
Polycystic kidney disease	3	5.45%
Unilateral agenesis failure	1	1.81%
Unknown cause	6	10.9%
Total	55	100%

Table 5. No. of patients on dialysis and patients without dialysis

Chronic renal failure	Number of patients	%
Number of patients on dialysis	39	70.9%
Number of patients without dialysis	16	29.1%
Total	55	100%

Table 6. Patients with different causes of ARF

Causes of ARF	Number of patients	%
Glumerulonephritis	1	20%
Thyrotoxicosis + heart failure	1	20%
Hypovolemic shock (postpartum hemorrhage)	2	40%
Hypertension +history of renal artery stenosis	1	20%
Total	5	100%

Table 7. Complications of dialysis in chronic renal failure

Type of complications	Period on dialysis	Number of patients	%
Multiple small parenchymal cystic change	2 – 3 year	21	53.8%
Electrolyte disturbance (hyperkalemia) +hypotension	Early month	6	15.3%
Neurological Complications	1 year	4	10.2%
Causes without complications	3 – 4 year	8	20.5%
Total		39	100%

Chronic renal failure in our series includes a lot of causes as show in Table. Some patients examined in our series have dialysis, (39) 70.9% and others have no dialysis. (16)19.1% as show in Table 5. In this study, we encountered (5) causes with acute renal failure of variable cause as shown in Table (6). Dialysis caries with a lot of complications as shown in Table (7). The mean-length width parenchymal thickness was measured in both acute and chronic renal failure patients as shown in Table (8).

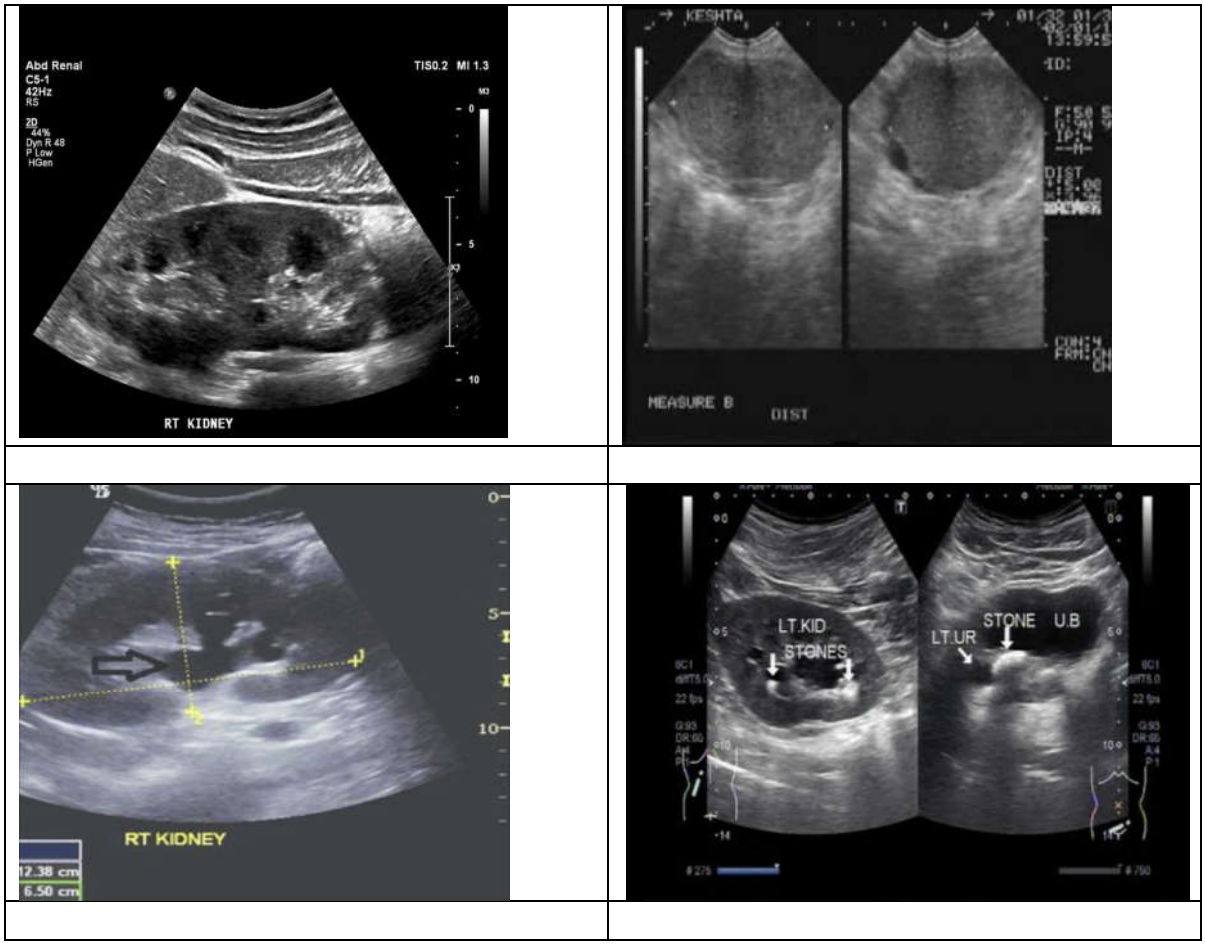
DISCUSSION

In this study, an attempt was made to evaluate the kidneys pathologies which could be diagnosed by ultrasound and are considered to be a main cause of renal failure. In this today, we depended on certain parameter which includes renal length, width, cortical thickness and parenchymal echogenicity as indicator for the renal insufficiency and failure. In this study, it was found that 43.3% of causes were females and 56.3% were males. The collecting cases are from different age groups ranging from (10-75)years with a higher percentage of (60–69)years patients and lower a percentage in (10 – 20)years old patients. This high percentage in elderly group is because the majority of cases in CRF due to diabetes mellitus is found in elderly people. Only 1.7% of causes of chronic renal failure were found to be due to obstructive causes, while 98.3% of chronic renal failures were due to non-obstructive causes. This low percentage of obstructive CRF is because most of causes have under gone surgical operation before reaching the stage of failure.

Obstructive causes can be easily diagnosed clinically by US before changing to CRF. 91.7%of causes in CRF were due to non-obstructive causes because most of renal insufficiency is due to parenchymal affection. In our study, 8.3% of causes show that their kidneys have normal length, width, cortical thickness and parenchymal echogenicity, but the patient is clinically in failure and shows high blood urea and serum creatinine, so ultrasonography is not a sensitive tool in detecting patients with ARF. We found the total mean of renal length, width, and cortical thickness was equal to 11.5cm,4.44cm,1.85cm respectively, but ultrasound can exclude other causes of CRF. While 91.7% of causes have chronic renal failure. Most of causes show a small size kidney. The total mean of right renal length, width and cortical thickness was equal to 8.2cm, 3.0cm, and 0.9cmrespectively. The total mean of left renal length, width and cortical thickness is equal to 6.9cm, 3.0cm, 0.8cm. In this study, we found 35.1% of patient in CRF is caused by diabetes mellitus which is agreement with Christopher Haslett (20 – 40%) (Christopher, 2002). In this series, 24.1% of causes in CRF is due to hypertension which is in agreement with Christopher Haslett (5 – 25%)[(2)]. Also, we found that 13% of causes in CRF is due to interstitial disease which is in agreement with Christopher Haslett (5 – 15%) (Christopher, 2002). In this series, 7.4% of causes in CRF is caused by glomerulonephritis, while Christopher Haslett (Christopher, 2002) study shows (10–20%) possibly because some of glomerulonephritis patients are mostly children treated in the pediatric hospital. In this study, we found 3.7% of causes in CRF is due to systemic inflammatory disease like SLE, while Christopher Haslett found 5% of causes in CRF due to systemic inflammatory disease.

Table (8): The mean of renal length, width and cortical thickness of right and left kidney in acute and chronic renal failure

	Right kidney			Left kidney		
Type of renal failure	Length	Width	Cortical thickness	Length	Width	Cortical thickness
ARF	11.5	4.4	1.8	11.1	4.6	1.6
CRF	8.2	3.04	0.9	6.7	3.04	0.8



In this study 5.5% of causes in CRF is due to congenital causes like polycystic kidney disease which is in agreement with Christopher Haslett. Moreover, 11% of causes in CRF is due to unknown etiology, which is in agreement with Christopher Haslett (5-20%). One patient out of 54 causes got CRF due to unilateral agenesis, and failure or insufficiency of the other kidney. Regarding ARF in this study, 40% of patients is due to pre-renal causes (under perfusion) like hypovolemic shock due to severe bleeding specially postpartum hemorrhage. While 60% of causes is due to acute renal causes like glomerulonephritis, complicated renal artery stenos is and Reno vascular hypertension, systemic disease like Thyrotoxicosis and heart failure. Christopher Haslett found that 85% of causes in ARF is due to Acute tubular necrosis\toxic\septic renal failure. 5% of causes are due to Glomerular diseases and interstitial diseases responsible for about 10% of causes in ARF. In this study, 70.9% of causes with CRF are on regular dialysis and 29.1% is on medical treatment without dialysis. We found that the kidney exposed to repeated dialysis will have multiple small parenchymal cystic change. This is known as acquired cystic disease of dialysis. 58% of patient on regular dialysis shows this condition in the second year of dialysis, while David Sutton found that after three years of dialysis. the native kidney shows usually small and multiple cysts renal cell carcinoma also be developed in 7% in patient after long term of dialysis.

In the majority of causes of chronic progressive kidney failure, a gradual decrease in kidney size closely correlated with loss of functioning nephrons. Thus most patients with chronic renal failure have atrophic kidneys. In contrast, most of those with acute renal failure have kidney of normal size. The important exception is in diabetic nephropathy because of the associated hyper filtration. The kidney is enlarged in the early stage of diabetic renal disease which is in indication for the need for dialysis approaches. By comparing the echogenicity of the kidney with the echogenicity of the liver, spleen and renal sinus can decide whether a kidney has increased echogenicity or not. Renal size or renal echogenicity or both are good indications of the chronicity of renal failure. Sub-acute glomerulonephritis may be diagnosed in the presence of markedly increased cortical echoes and prominent echo-poor pyramids. Cortical echogenicity may also be increased acutely in renal vein thrombosis and transplant rejection but not to the marked degree noted in sub-acute glomerulonephritis. Enlargement of the pyramids in the absence of a markedly echogenic cortex is a non-specific sign of parenchymal disease that may be seen with transplant rejection, renal vascular obstruction, acute pyelonephritis, and acute tubular necrosis (Mallet, 1999). Renal vascular disease may be another cause of small kidney. If the infarct is focal, areas of decreased echoes will be seen. Within the infraction small area, the kidney will

expand and contain fewer parenchymal echoes before shrinking to the echogenic (Arafa, 1999; Marangola, 1998)

Conclusion

Ultrasound is an integral part of the evaluation 0f renal insufficiency and failure. High-resolution Us allows improved characterization of the renal parenchyma and more precise description of renal architecture. Recognition of the Us appearance and characteristics different pathogeneses aids in the establishment of a differential diagnosis. A Prompt diagnosis permits earlier intervention and may prevent progression of renal insufficiency to renal failure in some patients. Ultrasound is non-invasive, harmless, easy to perform and quick. It should be the first procedure performed in the investigation of a patient in renal failure. Ultrasound needs no preparation except full bladder to check the bladder and prostate (Sanders, 2001). It is a traumatic which is an important consideration in these severely ill individuals. It provides diagnostic images regardless of the level of renal function. It's not like the contrastive studies, and it is quite sensitive in detecting ureteral obstruction (Kevin smith, 2005).

Ultrasound should be among the first diagnostic procedures in cause of acute unexplained renal failure it provides answers for urgent management. It can accurately measure renal size and echo texture. Renal length could be measured accurately by ultrasound and the value is slightly less than those by radiography because of the absence of magnification (Winston, 2002). CT scan is more sensitive than ultrasound in detection site of obstruction weather due to stone or mass lesion but it carry risk of high dose of radiation. Ultrasonography is the imaging method of choice to aid in the evaluation of acute obstructed renal failure. When dilatation of the renal collecting system is detected by means of this non-invasive technique. The physician can exclude the diagnosis of chronic renal failure and orient the diagnostic search toward a localized sobstruction (Mallet, 1999).

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