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Role of Renal Doppler Flowmetry in Patients with Altered Renal Function Tests

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ABSTRACT

Objectives: *(i) Study was done to know the sensitivity of renal ultrasound with Doppler studies in patient with altered renal function test.*
(ii) To study the sonomorphological characteristics in grayscale ultrasound and renal Doppler flowmetry in altered renal function test.
***Material and Methods**: A hospital based cross sectional study of 83 patients were conducted over a period of 1 year from June 2013 to May 2014 in the Deptt. Radio Daignosis, Assam Medical College & Hospital Dibrugarh. Approved was obtained from Institutional ethics review committees, AMCH, Dibrugarh.*
All the patients are subjected to grey scale USG of abdomen and Renal Doppler study. Grey scale USG done with 2.5-5 MHz curvilinear transducer and 10 MHz linear transducer.
Both colour Doppler and pulsed wave Doppler mode were done by using 2.5-5 MHz convex array probe.
Result: *For the analysis of the study, group is subdivided into four subgroups e.g. (i) Chronic kidney disease (CKD) (ii) Acute kidney Injury (AKI)*
(iii) Glomerular dieases – Nephritic Syndrome (NeS) & Nephrotic Syndrome (NS) (iv) Lupus Nephritis (LN). Among the 93 patients CKD 68 (73%), AKI – 13(12.9%) Nes- 3(3.2%), NS- 6 (6.4%), LN – 4 (4.3%).
Renal length are reduced 19%, increased in 16%. Renal cortical echoes are increased in 66.6%. In Renal Doppler RIm is increased 72 (77%) patients. PSVa were normal in 82.7% and increased 17% patients.
Conclusion: *Renal Doppler USG can delineate altered renal function tests in medical renal disease. USG features like increased renal cortical echotexture, increased and decreased renal size, irregular renal surface are the useful indicators for altered renal function.*
Keyword: *USG, Renal Doppler flowmetry, altered Renal Function.*

INTRODUCTION

Grey scale sonography is routinely performed during initial evaluation of both native and transplant renal dysfunction. Basic anatomic information is obtained with USG modality: renal length, cortical thickness, and grade of collecting system dilatation . Although these findings may help in evaluating disease chronicity, often the finding of sonography are normal despite severe renal dysfunction. Grey scale sonography is still routinely performed during initial evaluation of both native and transplant renal dysfunction.[1]

A series of articles published during the past decade indicated the potential of Doppler sonography for improving the sonographic assessment of renal dysfunction. Changes in intrarenal Doppler waveforms were shown to be

associated with urinary obstruction, several types of intrinsic renal disorders and renal vascular disease. The Doppler resistive index (RI) = (peak systolic velocity-end diastolic velocity)/ peak systolic velocity, is a useful parameter for quantifying the alterations in renal blood flow that may occur with renal disease.[1]

The Resistive index (RI) is commonly used as an index of intrarenal arterial resistance. RI increases in various kindey diseases and previous studies have shown the associations of RI with renal function and patient prognosis.[2] Certain renal disease produces increased renal vascular resistance and significant Doppler changes.[3]

Ikee et al. showed that RI correlated well with renal arteriosclerosis. Boddi et al. showed that RI allowed the early identification of patients with chronic tubulointerstitial nephritis. Interstitial fibrosis, accompanied by the loss of tubules and capillaries, is a common findings in essentially all progressive renal Diseases. Tubulointerstitial lesions proved to be the best in histologic correlation of renal function and for long-term prognosis. Doppler Ultrasonography, providing information about tubuointerstitial and vascular lesions, could predict renal prognosis.[4]

The current study to assesses and compares the sensitivity of transabdominal and Doppler sonography as a diagnostic modality to evaluate medical renal diseases with altered renal function tests.

MATERIALS AND METHODS

All 93 patients referred to the Department of Radio-diagnosis, Assam Medical College and Hospital for Renal Doppler having altered function tests.

SELECTION CRITERIA

Inclusion Criteria:

All the patients with altered renal function tests.

(b) Age > 20 years

Exclusion Criteria :

Age < 20 years (b) Patient with cardiac failure (c) Renal artery stenosis including fibromuscular dysplasia (d) Renal artery thrombosis (e) Renal vein thrombosis (f) Polycystic kidney diseases and other inherited tubular disorder (g) Obstructive nephropathy (h) Vascular injury to kidney except systemic hypertension (i) Nephronophthiasis (j) Pre renal and post renal causes of acute kidney injury.

Informed consent of patient is obtained and confidentiality of patient is maintained.

Techniques:

Transabdominal Sonography:

Ultrasonography was carried out with 2.5-5 MHz curvilinear probe and 10 MHz linear transducer by PHILIPS P-600.

The right kidney was examined in supine position through liver. The transducer was angled obliquely if liver is small, coronal or lateral approach is used. With patients in left side up position with arm extended overhead and using coronal approach the left kidney is visualized through the spleen.[8]

Renal Doppler:

Both colour coded Doppler and pulsed Doppler modes was used for the study. 2.5-5 MHz convex array probe of PHILIPS machine. Grey scale and colour Doppler parameters were optimized. Adjustments of colour Doppler parameters including PRF (pulse repetition frequency), colour gain and wall filters was performed in areas of laminar flow in aorta and renal artery. Supramesentric Abdominal aorta was visualised through anterior abdominal approach in sagittal plane. Origin renal arteries was located by using transverse approach through anterior abdominal wall. First the superior mesenteric artery or celiac artery is located because they are easy to locate and probe moved slightly caudally along aorta until origin of each of renal artery was visualized. Sample volumes were taken positioning cursor of the pulsed Doppler in each renal arteries. Intrarenal vascular structures was visualized using colour coded Doppler. Sample volumes were taken positioning cursor of the pulsed Doppler mode at the mid-portion of the interlobar arteries with flow along the renal pyramids with angle adjusted less than 60 degrees. Spectral tracings were taken at upper middle and lower interlobar arteries of each kidneys. Doppler waveforms were

obtained at pulse repetition frequency possible without aliasing. The lowest possible wall filter for ultrasound scanner was used. The velocity measurements of peak systolic velocity and end diastolic velocity were automatically calculated from the spectral waveforms.

Biochemical Parameters:

Proteinuria: Urinary dipsticks were used for protein urine.

Renal Function Test: Blood urea and Serum creatinine estimation was done by Beckman Coulter AU400 analyzer. Blood Urea was measured by Modified Berthelot method. Serum Creatinine was measured by Modified Jaffe's method.

Statistics

All the statistical calculation were done using Microsoft Excel, 2010. Graph Pad Software. 2014 and Online Statistics Calculator Version 3 Beta (http://www.danielsoper.com).

RESULTS AND OBSERVATIONS

The present study carried out in the Department of Radio-diagnosis, Assam Medical College & Hospital, Dibrugarh. A total of 93 patients were taken up for the study having altered renal function tests on serum creatinine and urea, for the period of one year from June 2013 to may 2014. US abdomen and Doppler sonography were done in these cases. US characteristics and Doppler waveforms were assessed in these patients.

Based on clinical features and laboratory finding for purpose of analysis the study group is subdivided into four subgroups:

Group – I : Chronic Kidney Disease (CKD)
Group – II : Acute Kidney Injury (AKI)
Group – III : Glomerular Diseases [Nephritic Syndrome (NeS) & Nephrotic Syndrome (NS)]
Group – IV : Lupus Nephritis (LN).

Age and Sex Distribution of the study Population:

Among 93 patients, there were 60 (62.37%) and 33(37.63%) females with definite female preponderance with the male: female ratio of 1.81:1. Patients having age more than 20 years were included in the study with a mean age of presentation of 51.98 years (Mean $\pm$ SD = 52.28 $\pm$ 16.13). The mean age of presentation of males and females were 54.71 years for males and 47.03 years for female. Majority of the cases were in the 6^{th} and 4^{th} decade.

Disease wise Distributions of the Study Population:

Among 93 patients, there were 68 CKD (73.12%), 13 AKI (12.90), 3 NeS (3.23%), 6 NS (6.45%) & 4 LN (4.3%) patient's. Most patients have CKD followed by AKI.

Age and Sex Distribution of Chronic Kidney Disease:

Among 93 patients, there were 58 patients were having CKD, 48 (70.58%) males and 38 (29.42%) females with definite male preponderance with the male : female ratio of 2.4 : 1. Patients having age more than 20 years were included in the study with a mean age of presentation of 52.28 years (Mean $\pm$ SD = 52.28 + 15.78) The mean age of presentation of males and females were 55.48 years for males and 46.97 years for females. Majority of the cases were in the 7^{th} decade.

Age and Sex Distribution of Acute Kidney Injury:

Among 93 patients, there were 12 patients with AKI 7 (58.33%) females and 5 (41.66%) males with definite female preponderance with the female: male ratio of 1.4:1. Patients having age more than 20 years were included in the study with a mean age of presentation of 42 years (Mean + SD = 42 + 14.5) The mean age of presentation of males and females were 38.8 years for males and 44.29 years for females. Majority of the cases were in the 4^{th} decade.

Age and Sec Distributions of Glomerular Diseases:

Among 93 patients, there were 8 patients with glomerular diseases. Of these 6 was Nes & 2 were NS, with definite male preponderance with the male: female ratio of 2:1. Patients having age more than 20 years were included in the study with a mean age of presentation of 41.23 years (Mean + SD = 52.28 + 14.15). The mean age of

presentation was 43 years for NeS and 34.5 years for NS. Majority of the cases were in the 4th decade.

Age Distribution of LN (n=4):

Among 93 patients, there were 4 patients with LN, 48 (80%) females and 38(20%) males with only female distribution with the male: female ratio of 1.65:1. Patents having age more than 20 years were included in the study with a mean age of presentation of 35.25 years (Mean + SD = 35.25 +7.41)

Disease wise Distribution of Renal Length:

Among 93 patients, there were 18 patients with reduced renal size, 60 patients with normal renal size and 15 patients with increased renal size on left side.

Disease wise Distribution of Renal Cortical Thickness

Among 93 patients, there were 18 patients with reduced 60 patients with normal and 15 patients with increased cortical thickness on left side whereas on right side 17 patients with reduced, 60 patients with normal size and 15 patients with increased cortical thickness.

Disease wise Distribution of Renal Echo texture

Among 93 patients, there were 31 normal and 62 patients with increased renal cortical echo texture in both the kidneys were noted. Majority of them were noted in CKD.

Among 68 patients of CKD, there were 17 normal and 51 patients with increased renal cortical echotexture in both the kidneys were noted. Of these 51 patients 24 had grade I, 17 grade II, 6 grade III and 4 grade IV.

Among the 12 AKI patients 9 patients noted with increased echotexture. Of these 12 patients 2 had grade I and 7 grade II. In LN all patient had normal echotexture.

Among the 9 glomerular diseases 7 patients noted with increased echotexture. Of these 7 patients 2 had grade I and 5 grade II.

Disease wise Distribution of RIm:

Among 93 patients, there were 21 normal and 72 patients with increased resistivity index in both the kidneys were noted. Majority of them were noted in CKD.

Disease wise Distribution of PIm:

Among 93 patients, there were 21 normal and 72 patients with increased Pulsatality index in both the kidneys were noted. Majority of them were noted in CKD.

Disease wise Distribution of PSVa:

Among 93 patients, there were 77 normal and 16 patients with increased Peak systolic velocity in Aorta (PSVa) is noted. Majority of them were noted in CKD.

Miscellaneous:

Among 93 patients, 8 patients (7 CKD) & 1 NS) had ascites, 2 pericardial effusions (CKD) and 9 pleural effusions (CKD).

DISCUSSION

The present study out in the Department of Radio-diagnosis, Assam Medical College & Hospital, Dibrugarh. A total of 93 patients were taken up for study having altered renal function tests incresed serum creatinine and urea, for the period of one year from June 2013 to May 2014. US abdomen and Doppler sonography were done in these cases. US characteristics and Doppler waveforms were assessed in these patients.

Age and sex distribution:

Patients having age more than 20 years we included in the study with a mean age of presentation of 51.98 years (Mean + SD = 51.98 + 16.13) The mean age of presentation of males and females were 54.71 years for males and 47.03 years for females. Majority of the cases were in the 7th and 4th decade. The mean age of presentation in CKD was 52.24. Rajiv Agarwal et al (2011)[5] & Gautam Vishwnathan et al[6] series that the mean age of presentation for CKD was 67 & 51 years, which correlated with our study. In our study the male to female ratio in CKD was 2.4:1 which correlate with study done by Olivier et al[8] it was 2.22:1. The mean age of presentation for LN was 28.25 years. Varun et el[7] shown in their study that mean age of presentation for LN was 23.6 years with male : female ratio of 11:1 which correlated with our study there are only female patient in our study it s due to small sample size. In our study the male to female ratio

for glomerular diseases was 3.5:1 whereas it was 3.2:1 in study done by Pointer and Patel[10] (1994). In our study mean age of presentation for AKI was 41.23 whereas it was 63 years in study done by Liano et al[9] (1996) the variation in age of incidence may be due to the regional variation.

Among 93 patients, renal size and cortical thickness was reduced in 18 patients, normal in 43 patients and increased in 7 patients on left side. Whereas on right side, renal size and cortical thickness reduced in 17 patients, normal in 44 patients and increased in 7 patients. The increased kidney size and cortical thickness in NS, Nes and AKI correlated with text given in textbook of pathology[11]. 31.2% of the CKD in India is caused due to diabetic nephropathy[12]. In asymptomatic diabetic nephropathy kidney size and cortical thickness is increased as concluded by Soldo et al[14] which correlated with increased renal size and cortical thickness in CKD in our study. Small kidneys denotes advanced stage of chronic kidney disease as the study done by Khati et al[15] which correlates with our study.

Platt et al[13] concluded that renal echogenicity equal to the liver is not good criteria for diagnosis of renal parenchymal disease. In renal echogenicity greater than liver specificity (96%) and positive predictive value (67%). However sensitivity was only 20%. Hricak et al[16] concluded that the while there was overall significant correlation between the degree of cortical echogenicity and blood urea nitrogen and creatinine concentrations in each group of renal medical disorders, a wide range of variance was present. It is not currently feasible to distinguish different types of renal medical disorders using diagnostic ultrasound.

Among 68 patients of CKD, there were 17 normal and 51 patients with increased renal cortical echotexture in both the kidneys were noted. Of these 51 patients 24 had grade I, 17 grade II, 6 grade III and 4 grade IV. By using one way Analysis of Variance test the p value is found to be 0.001 which is significant suggestive of statistical correlation between and serum creatinine and grading based on cortical echogenicity. The results are correlated well with study done by Jagdish et al[17] with slight variation in which mean serum creatinine was 2.80 mg/dl for Grade 1 (range: 0.9-9.2 mg/dl), 3.69 mg/dl for Grade 2 (range: 1.2-10.3 mg/dl). 3.86 mg/dl for Grade 3 (range: 1.1-6.5 mg/dl). and 7.90 mg/dl for Grade 4 (range: 3.1-11.4 mg/dl). A statistically significant, positive correlation was observed between serum creatinine and grading based on cortical echogenicity (p=0.004)

Among the 9 glomerular diseases patients, 7 patients had increased echotexture, Of these 7 patients 2 had grade I and 5 grade II. By using one way Analysis of Variance test the p value is found to be 0.032 which is significant suggesting that serum creatinine is statistically related to grading based on cortical echogenicity in glomerular diseases which correlates with study done by Tsau et al[18].

In our study the sensitivity of RIm in CKD is 0.83 whereas it was 0.59 in study done by Sugiura and Wada[4] (181 out of 311 patients) the variation may be due to variation in study population. Study done by Sugiura and Wada[4] consists of CKD patients presented Outpatient Department of OSAKA National Hospital whereas our study consisted of CKD patients from both OPD and Wards from Assam Medical College and hospital. The sensitivity of RIm in AKI was 0.75 whereas it was 0.85 in study done by Bossard et al[19] which correlated well with our study with . In our study there is no increase in RIm in LN patients which correlated well with study done by Ozbek et al[20] in which they evaluated intrarenal arterial waveforms with Doppler ultrasonography in 21 patients with LN. Doppler parameters were in the normal ranges in all patients, they concluded that image-directed color Doppler ultrasonography is of no practical value in the evaluation of lupus nephritis during the early stages of the disease. In our study glomerular diseases (Nes & NS) the sensitivity is 55% (0.55) whereas in study done by Sugiura et al[21] it was 61.9% (0.619) which correlated with our study.

In our study in CKD, hypertension is noted in 16.11% patients whereas in study done by Srijeeth

et al[12] and Anees et al[6] were 9.7% and 12.8% respectively the slight difference of hypertension may be due to higher incidence of hypertension in north east as concluded by study done Lt Col VK Agrawal[22]. In NS the hypertension is noted in 16.6% whereas in study done by Prabhakar et al[23] it was 9 to 14% which is correlating with our study. In our study in LN hypertension is noted in 50% patients whereas it is 68.85% and 67% for male and female respectively in study done by Soni et al[24].

CONCLUSION

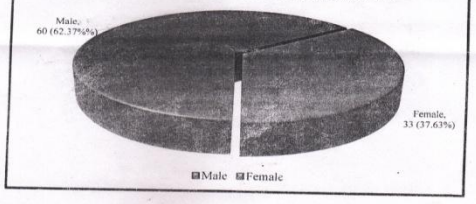
Doppler assessment of renal vascular waveforms could delineate altered renal function tests in certain medical renal diseases. However it is not currently feasible to distinguish different types of medical renal disorders and it's etiology by using renal colour Doppler ultrasound. Certain additional intrarenal USG features like increased echotexture, increased or decreased renal size and irregular renal surface are useful indicators for altered renal function. Certain associated extrarenal USG features like ascites, pleural effusion and pericardial effusion should raise the suspicion of altered renal function tests.

Table & Figure Legend

TABLE–1
SEX DISTRIBUTIONS OF THE STUDY POPULATION (n=93)

SEX	NUMBER (n)	PERCENTAGE (%)	RATIO (Male : Female)
Male	60	62.37	1.81 : 1
Female	33	37.63	
TOTAL	93	100.00	

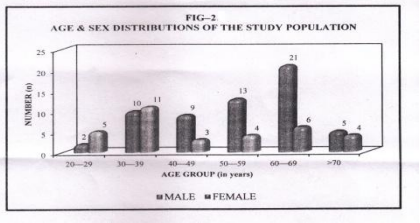
FIG–1
SEX DISTRIBUTIONS OF THE STUDY POPULATION



TABLE–2
AGE & SEX DISTRIBUTIONS OF THE STUDY POPULATION (n=93)

AGE GROUP (in years)	SEX		TOTAL	
	Male	Female	n	%
20—29	2	5	7	7.53
30—39	10	11	21	22.58
40—49	9	3	12	12.90
50—59	13	4	17	18.28
60—69	21	6	27	29.03
>70	5	4	9	9.68
TOTAL	60	33	93	100.00

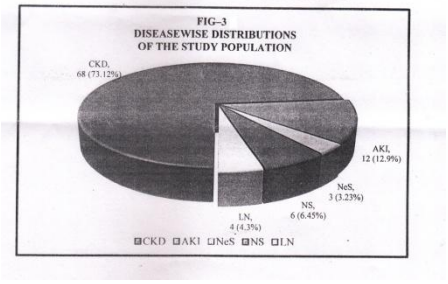
FIG–2
AGE & SEX DISTRIBUTIONS OF THE STUDY POPULATION



TABLE–3
DISEASEWISE DISTRIBUTIONS OF THE STUDY POPULATION (n=93)

SEX	NUMBER (n)	PERCENTAGE (%)
CKD	68	73.12
AKI	12	12.90
NeS	3	3.23
NS	6	6.45
LN	4	4.30
TOTAL	93	100.00

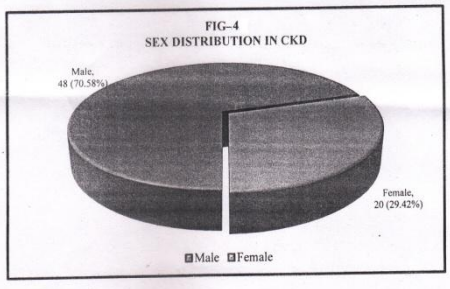
FIG–3
DISEASEWISE DISTRIBUTIONS OF THE STUDY POPULATION



TABLE–4
SEX DISTRIBUTION IN CKD

SEX	NUMBER (n)	PERCENTAGE (%)	RATIO (Male : Female)
Male	48	70.58	2.4 : 1
Female	20	29.42	
TOTAL	68	100	

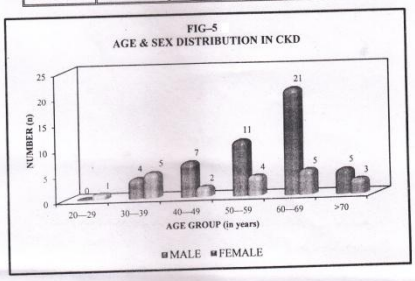
FIG–4
SEX DISTRIBUTION IN CKD



TABLE–5
AGE & SEX DISTRIBUTION IN CKD

AGE GROUP (in years)	SEX		TOTAL	
	Male	Female	n	%
20—29	0	1	1	1.47
30—39	4	5	9	13.24
40—49	7	2	9	13.24
50—59	11	4	15	22.06
60—69	21	5	26	38.24
>70	5	3	8	11.76
TOTAL	48	20	68	100.00

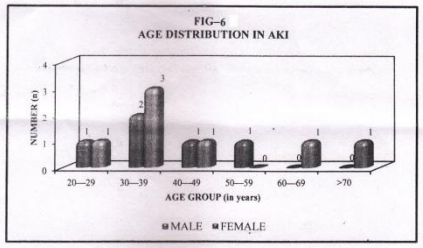
FIG–5
AGE & SEX DISTRIBUTION IN CKD



TABLE–6
AGE DISTRIBUTION IN AKI

AGE GROUP (in years)	SEX		TOTAL	
	Male	Female	n	%
20—29	1	1	2	16.67
30—39	2	3	5	41.67
40—49	1	1	2	16.67
50—59	1	0	1	8.33
60—69	0	1	1	8.33
>70	0	1	1	8.33
TOTAL	5	7	12	100.00

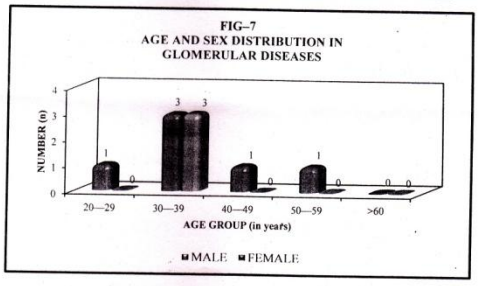
FIG–6
AGE DISTRIBUTION IN AKI



TABLE–7
AGE AND SEX DISTRIBUTION IN GLOMERULAR DISEASES (n=9)

AGE GROUP (in years)	SEX		TOTAL	
	Male	Female	n	%
20—29	1	0	1	11.11
30—39	3	3	6	66.67
40—49	1	0	1	11.11
50—59	1	0	1	11.11
> 60	0	0	0	0.00
TOTAL	6	3	9	100.00

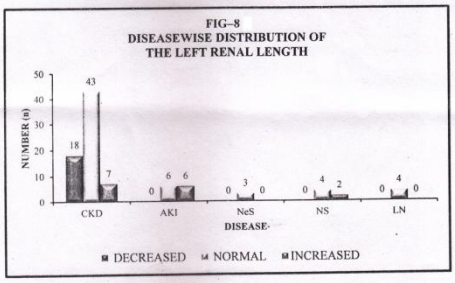
FIG–7
AGE AND SEX DISTRIBUTION IN GLOMERULAR DISEASES



TABLE–8
DISEASEWISE DISTRIBUTION OF THE LEFT RENAL LENGTH
(Normal Renal Length: 8-12 cm)

DISEASE	DECREASED (n)	NORMAL (n)	INCREASED (n)	MEAN LENGTH
CKD	18	43	7	9.34
AKI	0	6	6	12.41
NeS	0	3	0	10.25
NS	0	4	2	10.73
LN	0	4	0	11.11
TOTAL	18	60	15	9.79

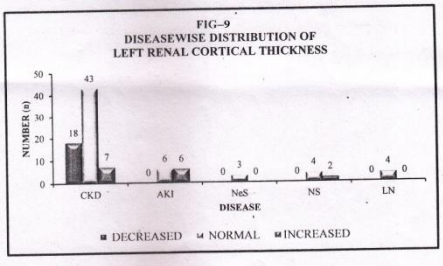
FIG–8
DISEASEWISE DISTRIBUTION OF THE LEFT RENAL LENGTH



TABLE–9
DISEASEWISE DISTRIBUTION OF LEFT RENAL CORTICAL THICKNESS
(Normal Renal Cortical Thickness: 1.5–3.0 cm)

DISEASE	DECREASED (n)	NORMAL (n)	INCREASED (n)	MEAN CORTICAL THICKNESS
CKD	18	43	7	2.13
AKI	0	6	6	3.11
NeS	0	3	0	2.36
NS	0	4	2	2.66
LN	0	4	0	2.93
TOTAL	17	60	15	2.10

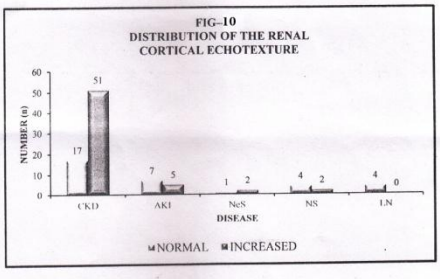
FIG–9
DISEASEWISE DISTRIBUTION OF LEFT RENAL CORTICAL THICKNESS



TABLE–10
DISTRIBUTION OF THE RENAL CORTICAL ECHOTEXTURE

DISEASE	NORMAL (n)	INCREASED (n)	TOTAL (n)
CKD	17	51	68
AKI	7	5	12
NeS	1	2	3
NS	4	2	6
LN	4	0	4
TOTAL	31	62	100

FIG–10
DISTRIBUTION OF THE RENAL CORTICAL ECHOTEXTURE



TABLE–11

DISTRIBUTION OF INCREASED ECHOTEXTURE IN RELATION TO SERUM CREATININE (S. Cr.) IN CKD

GRADE	NUMBER (n)	MEAN S. Cr. (mg/dl)	± SD (mg/dl)	RANGE (mg/dl)
I	24	2.73	1.96	1.2–5.8
II	17	3.69	1.87	1.3–4.5
III	6	3.88	3.24	1.4–10.3
IV	4	7.87	3.30	3.2–10.9

TABLE–11

DISTRIBUTION OF INCREASED ECHOTEXTURE IN RELATION TO SERUM CREATININE (S. Cr.) IN AKI

GRADE	NUMBER (n)	MEAN S. Cr. (mg/dl)	± SD (mg/dl)	RANGE (mg/dl)
I	2	1.75	0.07	1.7–1.8
II	7	2.47	0.40	2–3.1

TABLE–12

DISTRIBUTION OF INCREASED ECHOTEXTURE IN RELATION TO SERUM CREATININE IN GLOMERULAR DISEASE

GRADE	NUMBER (n)	MEAN S. Cr. (mg/dl)	± SD (mg/dl)	RANGE (mg/dl)
I	2	4.3	0.28	3.8–4.8
II	7	2.73	0.68	2.2–3.5

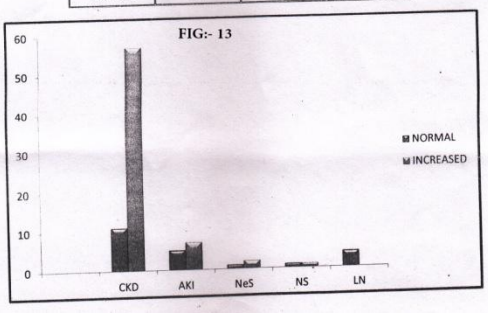
TABLE– 13

DISEASEWISE DISTRIBUTION RIm IN BOTH KIDNEYS

(Normal Rim : < 0.7 and Increased Rim : >/= 0.7)

DISEASE	NORMAL (n)	INCREASED (n)	MEAN
CKD	11	57	0.73
AKI	5	7	0.69
NeS	1	2	0.76
NS	1	1	0.72
LN	4	0	0.63
TOTAL	21	72	0.74

FIG:- 13

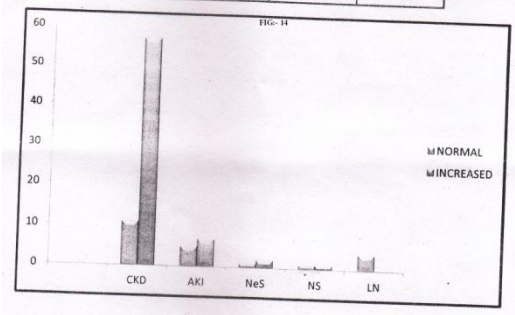


TABLE–14

DISEASEWISE DISTRIBUTION OF THE PIm

(Normal RIm : < 0.7 and Increased RIm : >/= 0.7)

DISEASE	NORMAL (n)	INCREASED (n)	MEAN
CKD	11	57	1.21
AKI	6	6	1.04
NeS	1	2	1.29
NS	1	1	2.51
LN	4	0	0.87
TOTAL	21	72	1.20



TABLE–15

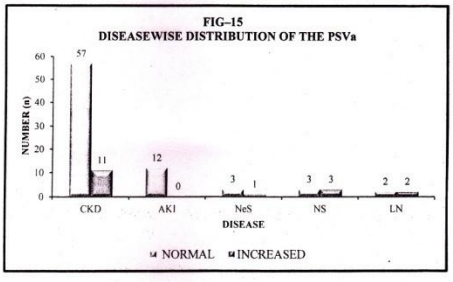
DISEASEWISE DISTRIBUTION OF THE PSVa

(Normal PSVa : 60–100 cm/s and Increased PSVa : >/= 100 cm/s)

DISEASE	NORMAL (n)	INCREASED (n)	MEAN
CKD	57	11	84.00
AKI	12	0	86.50
NeS	3	1	84.33
NS	3	3	6.00
LN	2	2	4.00
TOTAL	77	16	93.00

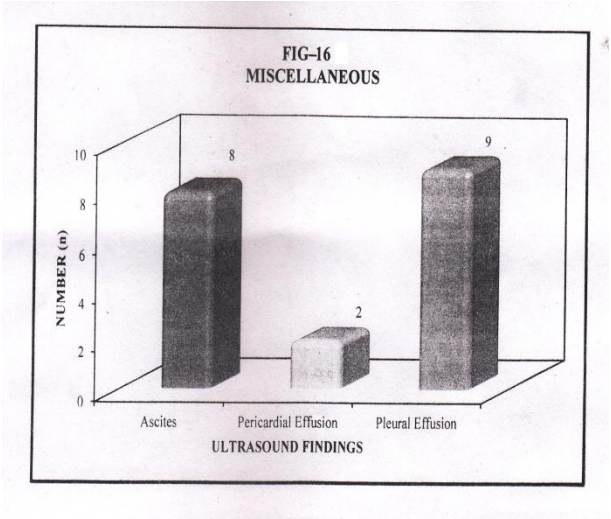
FIG–15

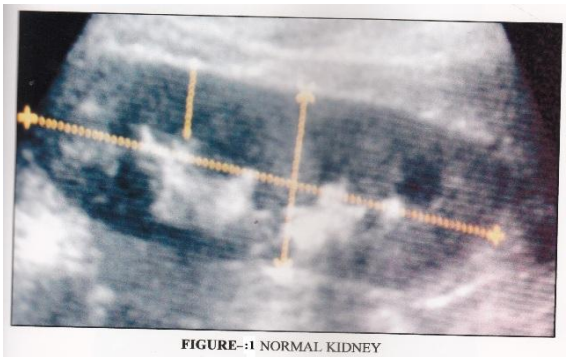
DISEASEWISE DISTRIBUTION OF THE PSVa



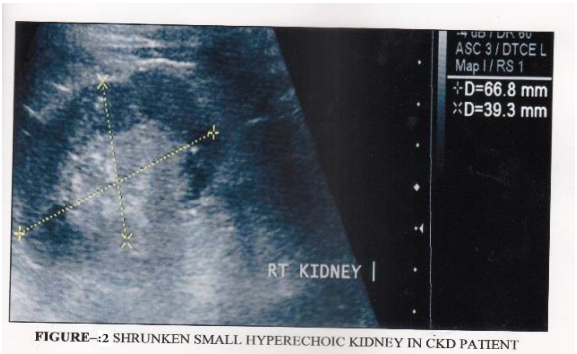
FIG–16

MISCELLANEOUS

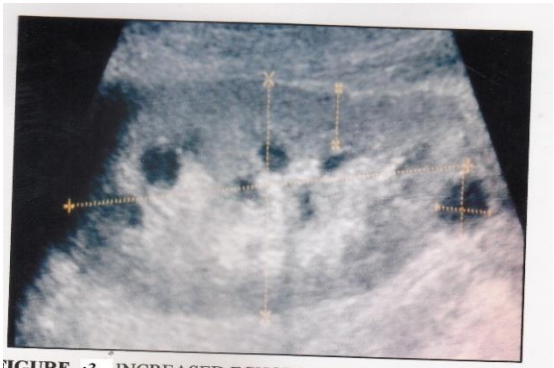




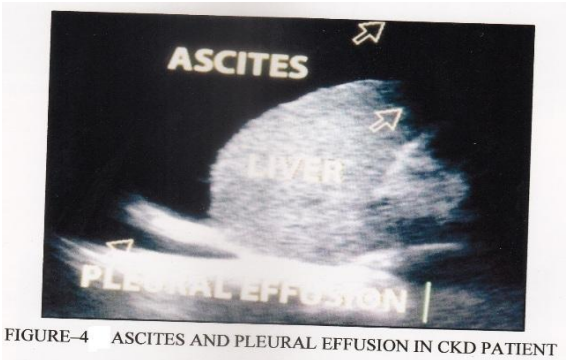
FIGURE–:1 NORMAL KIDNEY



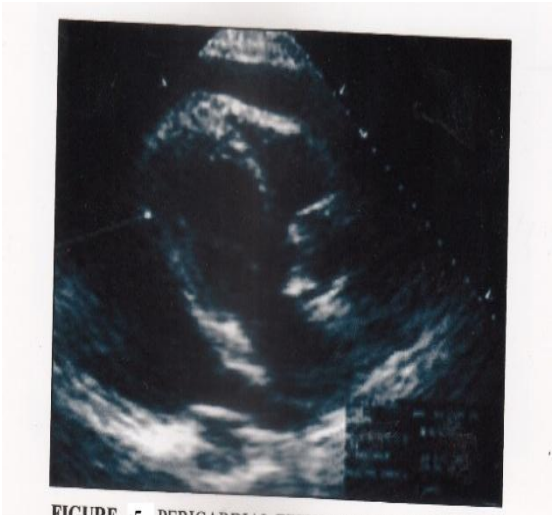
FIGURE–:2 SHRUNKEN SMALL HYPERECHOIC KIDNEY IN CKD PATIENT



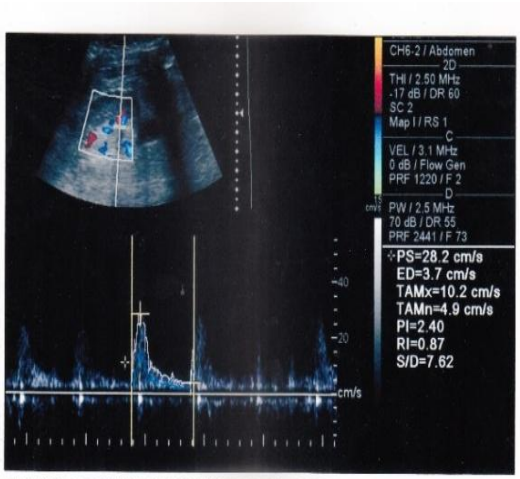
IGURE–:3 INCREASED ECHOTEXTURE IN CKD PATIENT



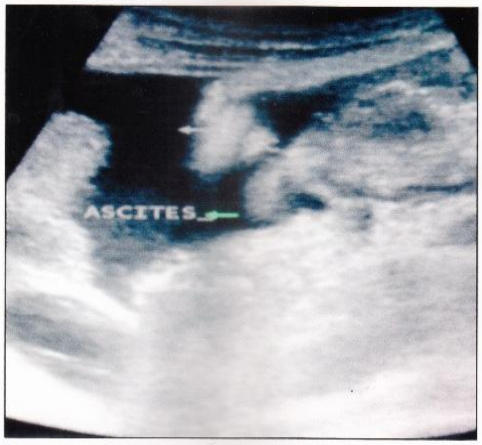
FIGURE–4 ASCITES AND PLEURAL EFFUSION IN CKD PATIENT



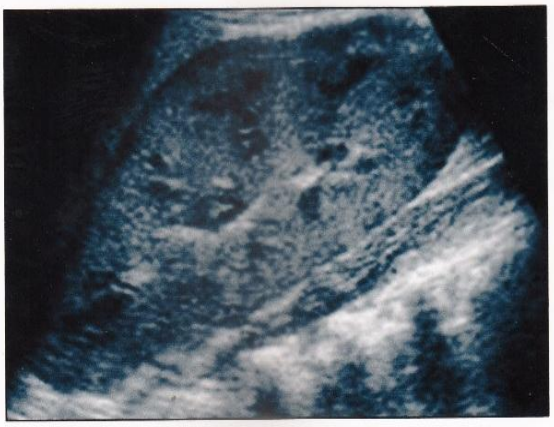
FIGURE–:5 PERICARDIAL EFFUSION IN CKD PATIENT



FIGURE–:6 INCREASED RESISTIVE (RI) AND PULSATILITY (PI) INDEX IN CKD



FIGURE– :7 ASCITES IN NS PATIENT



FIGURE–:8 BULKY & HYPERECHOIC KIDNEY IN NS PATIENT

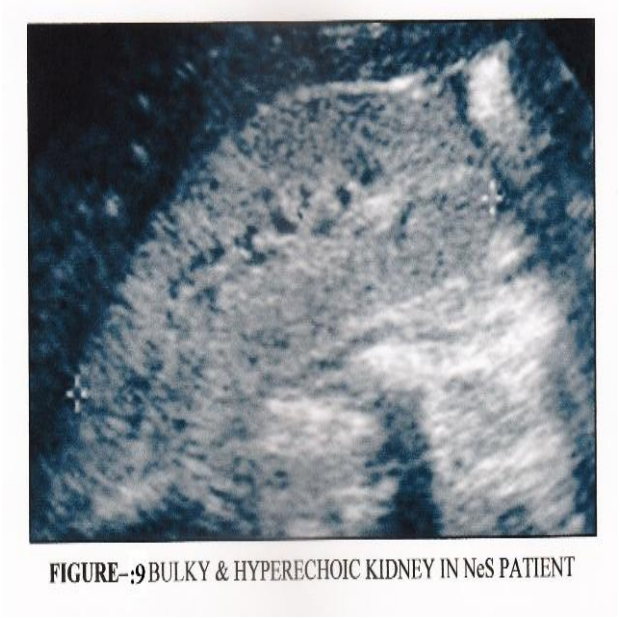


FIGURE-:9 BULKY & HYPERECHOIC KIDNEY IN NeS PATIENT

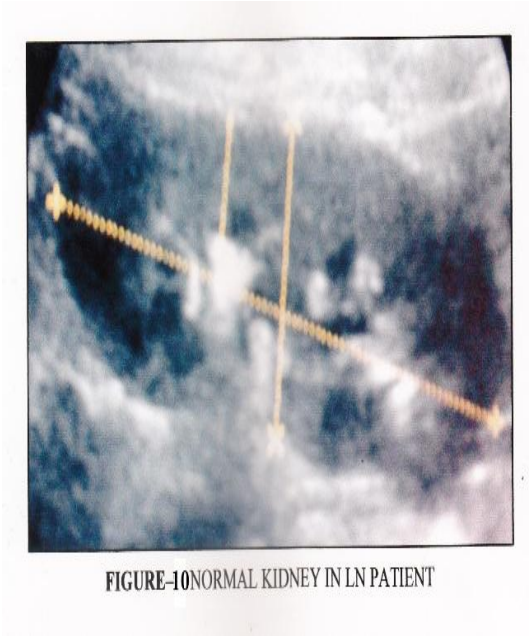


FIGURE-10 NORMAL KIDNEY IN LN PATIENT

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