Section: Radiology

Original Research Article

EVALUATION OF RENAL PARENCHYMAL STIFFNESS BY SHEAR WAVE ELASTOGRAPHY IN PATIENTS WITH DERANGED RFT

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ABSTRACT

Background: Non-invasive assessment of renal fibrosis by ultrasound and MR elastography is important because renal biopsy though considered gold standard cannot be performed in every patient because of its complications. Today, elastography techniques are used for the non-invasive assessment of tissue fibrosis. Shear wave elastography (SWE) is an emerging ultrasound technique used to measure tissue stiffness. Shear wave velocity increases in diseased tissues, which can be significantly stiffer than normal ones. The aim & objective are to evaluate the utility of ultrasound based shear wave elastography in the evaluation of renal parenchymal stiffness in patients with deranged RFT

Materials and Methods: Study design is case Control study. Study setting: Radiology department of MGM medical college, Chhatrapati Sambhajinagar. Study duration: From 1st April 2024 to 30th June 2024. The study population 25 chronic kidney disease patients and 20 controls subjects who had been referred to the Department of radiodiagnosis for Imaging in a MGM Medical College, Chhatrapati Sambhajinagar during study period. Sample Size is 25 cases and 20 controls.

Conclusion: On SWE, CKD patients show greater renal parenchymal stiffness than non-CKD patients. SWE assessment may help in early non-invasive detection and management of CKD.

Keywords: Thyroid, Thyroid Dysfunction, Hypertensive Disorders, Pregnancy.

INTRODUCTION

Chronic kidney disease (CKD) is a progressive loss of kidney function caused due to hypertension, diabetes and primary renal disorders. As CKD progress, it results in widespread tissue scarring, which subsequently leads to the destruction of kidney parenchyma and end-stage renal failure.[1]

The pathologic damage is irreversible and can lead to morbidity and mortality. The early detection of a kidney injury is essential to protect against the progression of kidney damage owing to the progressive nature of chronic kidney disease.[2]

Ultrasound elastography is a non-invasive technique for assessing tissue elasticity on the basis of the pathological and physiological principle that solid tumors or fibrotic tissues have different elasticities compared to normal tissues.[3]

Non-invasive assessment of renal fibrosis by ultrasound and MR elastography is important because renal biopsy though considered gold standard cannot be performed in every patient because of its complications. Today, elastography techniques are used for the non-invasive assessment of tissue fibrosis.

Shear wave elastography (SWE) is an emerging ultrasound technique used to measure tissue stiffness. Shear wave velocity increases in diseased tissues, which can be significantly stiffer than normal ones.

Aim and Objectives: To evaluate the utility of ultrasound based shear wave elastography in the evaluation of renal parenchymal stiffness in patients with deranged RFT

MATERIALS AND METHODS

Study Design: Case Control study
Study Setting: Radiology department of MGM medical college, Chhatrapati Sambhajinagar
Study Duration: From 1st April 2024 to 30th June 2024
Study Population: The study population 25 chronic kidney disease patients and 20 controls subjects who had been referred to the Department of radiodiagnosis for Imaging in a MGM Medical College, Chhatrapati Sambhajinagar during study period
Sample Size: 25 cases and 20 controls
Inclusion Criteria
The inclusion criteria for patients were as follows:

1. Those with abnormal eGFR (<90 ml/min/1.73 m2)
2. Deranged serum creatinine (>1.3 mg/dl)
3. Deranged serum urea (>40 mg/dl).

The inclusion criteria for comparison group were as follows:

1. Subjects with eGFR (>90 ml/min/1.73 m2)
2. Serum creatinine (<1.3 mg/dl)
3. Serum urea (<40 mg/dl).
4. No other comorbid conditions.

Exclusion Criteria

1. thin renal parenchymal thickness
2. renal cortex to skin surface depth of more than 8 cm
3. Those who could not control their breathing according to the sonographer's instructions during the SWE procedure.
4. Presence of abnormal findings in ultrasonography such as renal calculus, unilateral/bilateral Hydronephrosis, ascites and renal cyst.

Sampling Method: Simple random sampling method
Approval for the study: Written approval from Institutional Ethics committee was obtained beforehand. Written approval of Radiology department was obtained. After obtaining informed verbal consent from all patients coming to our institute during study period according to exclusion and inclusion criteria admitted in radiology department of MGM medical college, Chhatrapati Sambhajinagar such cases were included in the study.
Sampling technique: Simple random sampling technique used for data collection. All patients admitted in radiology department of MGM medical college, Chhatrapati Sambhajinagar such cases were included in the study.
Methods of Data Collection and Questionnaire: Predesigned and pretested questionnaire was used to record the necessary information. Questionnaires included general information, such as age, sex, Medical history- chief complain, past history, general examination, systemic examination. Shear wave Elastography findings.
Image Acquisition: Patients were placed in a lateral decubitus position. Conventional ultrasound was performed to measure kidney length and cortical thickness. SWE was performed to measure renal parenchymal stiffness. With the image stabilized, a region of interest (ROI) with a fixed diameter of 4 mm was placed in the renal cortex, excluding the renal medulla and sinus, to measure the SWE estimates of renal YM in kPa.
Data Entry and Analysis: The data collected was statistically analyzed using IBM.SPSS statistics software. To describe the descriptive statistics of the data, frequency analysis and percentage analysis were used for categorical variables and the S.D & mean were used for continuous variables. The one-way ANOVA test is used for the multivariate analysis. To assess the relationship between the variables Pearson's Correlation was used. In all of the above statistical analysis, the probability value .05 is considered as significant. SWE and conventional ultrasounds diagnostic performance were correlated with serum creatinine, urea and eGFR.

RESULTS

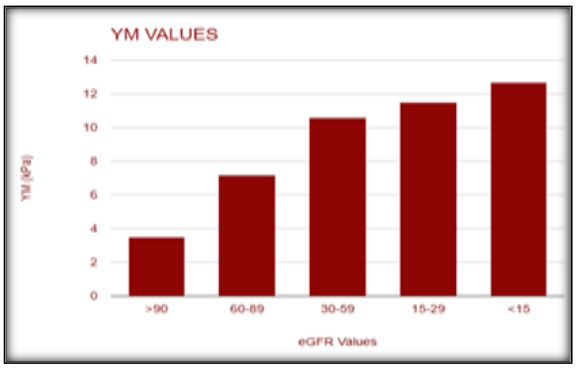

Figure 1

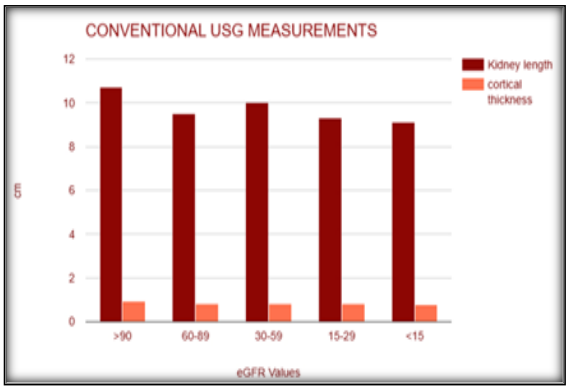

Figure 2

Pearson's correlation coefficient revealed a moderate negative linear correlation between YM measurements and Egfr. Positive linear correlations between YM measurements with age, serum creatinine and serum urea were observed. Kidney length and cortical thickness obtained by conventional USG showed no significant correlation with age, eGFR, serum creatinine or serum urea.
CASE 1: 50 years old male patient with weight 74 kg, Height 172 cm, BMI 25.
Urea 78 mg/dl; Creatinine 2.4 mg/dl.

Table 1

Length	7.3 cm
Width	3.6 cm
Cortical thickness	0.9 cm
Skin to cortex distance	4.2 cm

Table 2

Youngs Modulus (kPa)	Left kidney	Right kidney
	Inter pole	Inter pole
READING 1	10.4	7.1
READING 2	9.3	6.8
READING 3	9.5	8.7
READING 4	10.5	9
READING 5	9.7	7.4
MEAN YM	10.1	7.8

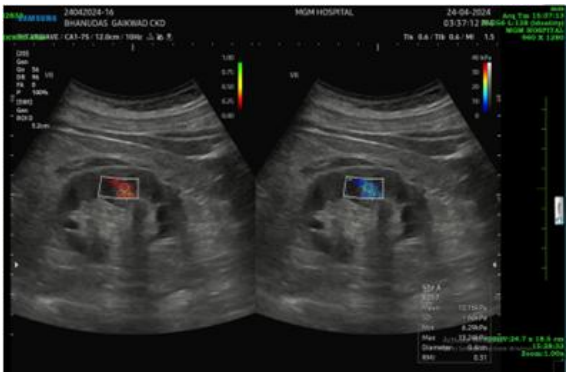

Figure 3: Shear Wave Elastography

Figure 4: Conventional USG Measurements

DISCUSSION

There was no significant difference in renal length or cortical thickness in the diseased and control groups, but a significant difference was found in young's modulus stiffness measurements. YM measurements had good interobserver reliability and intraobserver reliability. There was no significant difference in the YM measurement between a distended bladder and empty bladder. There was a significant correlation between shear wave elastography measurements and eGFR values.[4]

Progressive interstitial damage results in declining GFR, indicating an inverse correlation between serum creatinine and GFR. The GFR was inversely related to the degree of renal fibrosis, which in turn is directly related to the propagation of shear waves. Our results conclude that, YM measurements significantly correlated with eGFR, and serum creatinine and urea.[5]

CONCLUSION

In detecting CKD, SWE was better than conventional ultrasound.

- On SWE, CKD patients show greater renal parenchymal stiffness than non-CKD patients.
- SWE assessment may help in early non-invasive detection and management of CKD.
- SWE correlated well with eGFR values and in future it can be used as an alternative non invasive tool to renal biopsy.

Limitations

Although the results of SWE is encouraging, the limitations of this new technique should be taken into account,

1. The location of the ROI in SWE
2. Intra- and interobserver variation in the assessment of kidney stiffness.
3. Thin renal parenchymal thickness.
4. Sensitivity to breathing movement artifact Known reference standard of eGFR only to estimate CKD severity. No biopsy data for histological quantification was acquired. The sensitivity to breathing movement artefact was also one of the challenges encountered in obtaining reliable measurements.

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