ORIGINAL RESEARCH PAPER

Radiodiagnosis

STUDYASSESSING THE SEVERITY OF DIABETES ON RENAL MORPHOLOGY USING ULTRASOUND

KEY WORDS: Ultrasound, Kidneys, Morphology, Diabetes, Impacts.

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ABSTRACT

INTRODUCTION: Ultrasound reveals that the diabetes has direct impact on kidney morphology.
AIM AND OBJECTIVES: To study with aid of ultrasonography, the impact of Diabetes on Renal morphology.
METHODS: This is a prospective analysis of diabetic patients using ultrasonography who were been treated at our institution from December 2018 to January 2019.
RESULTS: In early Diabetes cortex enlargement and atrophied medulla and the renal enlargement was noted. In late Diabetes the kidney is more echogenic with loss of corticomedullary differentiation, the patient requiring dialysis or kidney transplantation.
DISCUSSION: The early and timely diagnosis of the impact of diabetes on Renal morphology by ultrasonography has substantial impact over instituting appropriate treatment and timely surgical intervention.
CONCLUSION: The ultrasound scanning has been the best choice for abdominal diagnosis of diabetes impact on kidneys and disease assessment.

INTRODUCTION

Diabetes mellitus is a syndrome of impaired carbohydrates, fat and protein metabolism caused by either lack of insulin secretion or decreased sensitivity of the tissue to insulin. There are two general types of diabetes mellitus.

Type 1 diabetes, also called Non-Insulin Dependent Diabetes Mellitus (NIDDM), is caused by lack of insulin secretion. Type 2 Diabetes, also called Insulin Dependent Diabetes Mellitus (IDDM), is caused by decreased sensitivity of target tissue to metabolic effect of insulin. This reduced sensitivity to insulin is called insulin resistance. In both types of diabetes mellitus, metabolism of all foodstuffs is altered. Basic effect of insulin lack or insulin resistance on glucose metabolism is to prevent the efficient uptake and utilization of glucose by most cells of the body, except those of the brain. As a result, blood glucose concentration increases, cell utilization of glucose falls increasingly lower, and utilization of fats and proteins increases. [1]

Also the chronic hyperglycaemia of diabetes is associated with long-term damage, dysfunction and failure of different organs, especiallythe eyes, kidneys, nerves, heart and blood vessels. [2]

The detection of diabetes could be carried out by different methods, such as creatinine level in blood and sugar level, in addition to ultrasound as non-invasive tool. In the assessment of diabetes impact on kidney'smorphology using ultrasound, Saddig *et al*. [3] showed that there was abnormal renal echogenicity with nephropathy Grade 1 which was so greater than Grade 2 that showed decreased renal size among diabetic patients.

Also, the utilization of ultrasound to evaluate the presence of nephropathy, due to diabetes, has been highlighted by Hricak *et al*. [4] and Fiorini and Barozzi [5] in which they evaluate it by comparing the echogenicity of the renal cortex, medulla and pelvic sinus with that of the adjacent liver and spleen (assuming that the liver and spleen present normal echogenicity). Echogenicity is divided into four different grades from 0 to 3: a) parenchyma appears hypoechoic when compared with the liver parenchyma; b) parenchyma appears isoechoic when compared with the liver parenchyma; c) parenchyma appears hyperechoic when compared with the liver parenchyma.

A renal ultrasound is typically obtained to measure the renal size and echogenicity. Renal enlargement may be seen early in diabetes due to hyper filtration, while in late stages the kidneys diminish in size from glomerulosclerosis. In addition, renal cortical hyper echogenicity is seen suggesting deteriorated renal function. Ultrasound also used to exclude non diabetes-related renal disorders, e.g. renal stones, masses or hydronephrosis [3] [6].

Renal length and volume measurements are clinically relevant, serving as surrogates for renal functional reserve, and are used frequently as the basis for making clinical decisions. Serial measurements can also provide information regarding disease progression or stability. A number of reports have described ultrasonography measurement of renal length and volume in the healthy Western population [7] [8], but there are scant data regarding MR measurement of renal dimensions in adults.

The kidney size of a patient is a valuable diagnostic parameter in urological and nephrologic practice, while the leading anatomy text describes the adult kidney as 12 cm long, 6 cm wide and 3 cm deep [9]. Further review of the literature shows that the renal size varies with age, gender, body mass index, pregnancy and concomitant conditions. Renal size may be an indicator for the state kidney and therefore, kidney function or physiology[10] [11], and it is valuable in monitoring unilateral kidney disease through comparison with the other, uninvolved *i.e.*, the healthy kidney [12]. Also, an increased BMI (25 kg/m2) has been associated with increased prevalence of diabetes mellitus, hypertension and dyslipidaemia [10]. The impact of diabetes in renal system canal so appear as a change in cortical echogenicity and thickness in case of diabetic nephropathy relative to normal ones that have been mentioned by Benjamin *et al*. [13] in which they found that the kidney lengths were 12.4 ±0.9 cm for men and 11.6 ± 1.1 cm for women, and that kidney volumes were 202 ± 36 ml for men and 154 ± 33ml for women.

AIM AND OBJECTIVES

- To study with aid of ultrasonography, the impact of Diabetes on Renal morphology.
- To establish that ultrasonography has significant role in assessing the diabetes severity.

MATERIALS AND METHODS

- Over a period of 3 months, 50 diabetic patients referred

for ultrasonography of abdomen to M.G.M hospital were evaluated.
- This is an analysis of diabetic patients using ultrasonography who were been treated at our institution from December 2018 to January 2019.
- The collected data was patient age, height, weight, kidneys size, ultrasound findings of involved kidneys, duration of diabetes and residence region.

Preparation of Patients:
No preparation was required since only plain study was indicated in patients.

Plan of study:
Details were recorded on data sheet immediately before or after the sonography of the patient.

Equipment:
- The examinations were done using PHILIPS HD 15 ultrasound machine.
- Gray-scale B-mode imaging with curvilinear transducer 3 MHz for the patients who have been referred for renal system scanning was used.
- Their average age was 46.9 ± 8.8 years old.

Ultrasound Technique:
- The scanning was performed from posterior-lateral direction for obese patient.
- Anterior-lateral direction for thin patients.
- The kidneys sizes were calculated from the multiplication of width and length.

INCLUSION CRITERIA
- Adults aged >= 18 yrs.
- Patients with diagnosed Diabetes Type II.

EXCLUSION CRITERIA
- Paediatric cases
- Type 1 diabetes patients.

OBSERVATIONS AND RESULTS
Average age was 46.9 ± 8.8 years old.

Correlation between age in yeas and BMI in (Kg/m2) was calculated, it revealed that the BMI decreased in a linear form following the ageing among diabetic patients.

Correlation between BMI in (Kg/m2) and kidney size in cm was studied, it showed that the Kidneys size increases following the BMI increment among diabetic patients in a linear form.

Correlation between duration of diabetes in years and kidney size in cm was also studied. It revealed that the kidneys size had decreased following the duration of the disease (diabetes) in a linear form.

Sonographic appearance of diabetes impact in renal morphology, which was studied showed the mean kidney length was 14.5 cm, an enlarged renal cortex in the range of 2 - 2.3 cm and atrophied medulla.

In late cases in which the kidney was more echogenic with loss of corticomedullary differentiation, the patient requiring dialysis or kidney transplantation.

Such results are relative to common normal cases that showed a renal cortex thickness of 1.0 - 1.6 cm and a kidney length of 9.2 - 10.8 cm.

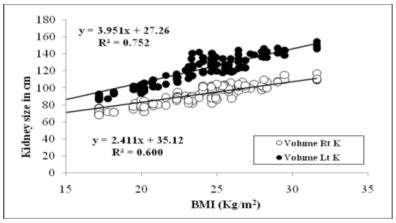

CHART 1: CHART SHOWINGCORELATION BETWEEN BMI in (Kg/m2) ANDKIDNEY SIZE IN CM.

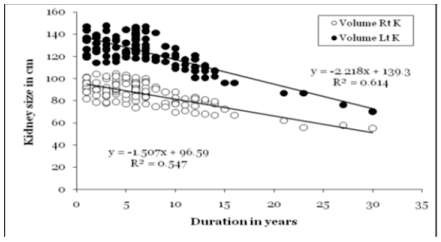

CHART 2: CHART SHOWINGCORELATION BETWEENDURATION INYEARSANDKIDNEY SIZE IN CM.

ILLUSTRATIVE CASES

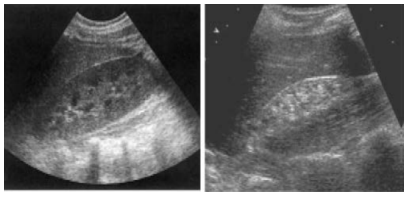

FIG. 1:The abnormal renal parenchymal echogenicity: (a) Grade 1 nephropathy high echogenicity; (b) Grade 3 nephropathy (also notice the small renal size in (a) due to chronic nephropathy)

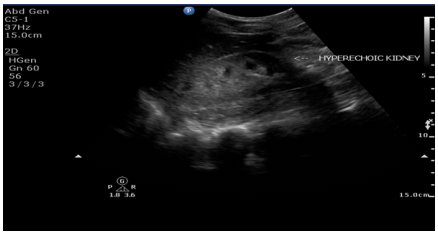

FIG. 2: Hyperechoic kidney.

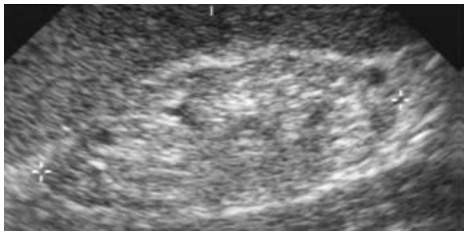

FIG. 3:Late case in which the kidney is more echogenic with loss of corticomedullary differentiation.

DISCUSSION
BMI decreases in a linear form following the aging among diabetic patients.

Such correlation is significant as, the decreasing phenomena could be ascribed to the decreasing of function which in turn influenced by a reduction in nitric oxide production (a potent vasodilator) in tissues.

In addition, there is a reduction in beta adrenergic receptor sensitivity associated with the aging process which in turn reducing the ability of the sympathetic nervous system to

respond to stress.

Kidneys size has been decreases following the duration of the disease (diabetes) in a linear form. However, the renal hypertrophy has been observed during the early stage only and gradual reduction in size following the long duration.

In this realm, Inomata stated that in humans' diabetic renal hypertrophy can persist for several years despite good glucose control, which could be ascribed to the compensation of the kidney to clear threefold incidence of micro-albumin urea and almost threefold faster decline in GFR during the years.

Other investigators have related an increase in kidney size with an increased glomerular filtration rate in early stage diabetes mellitus while size shrinking occur in late stages which is consider as a main mark for renal failure.

CONCLUSION

The ultrasound scanning has been the best choice for abdominal diagnosis and diseases assessment. It reveals that the diabetes has direct impact on kidney morphology in view of renal volume enlargement and cortical thickening in early stage, then atrophied and echogenic in late stage. Such finding could be utilized successfully to assess the diabetes severity and stage as well as to determine the treatment model.

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