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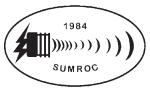

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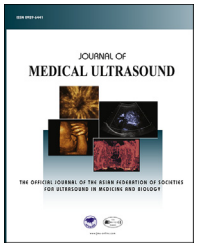

Original Article

Renal Cortical Elastography: Normal Values and Variations

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Abstract *Introduction:* Renal cortical elastography has shown conflicting but promising results in evaluation of chronic kidney disease and other renal disorders. The purpose of this study was to establish a normogram of renal cortical elasticity values and assess their variation between right and left kidney and their relation with age, gender, body mass index, renal dimensions and skin to cortex distance.

Methods: The study was a hospital based cross sectional study performed at Tribhuvan University Teaching Hospital, a tertiary care center in Kathmandu, Nepal. All individuals referred for Ultrasound from General Health Check up clinic were included in the study. Patient with abnormal ultrasound findings and abnormal renal function test were excluded from the study. Renal morphometry including length, cortical thickness, and skin to cortex distance were measured in B mode imaging and renal cortical elastography was measured with region of interest box of 1 × 0.5 cm. All analyses were done using Statistical Package for Social Sciences 20.0 soft ware.

Results: A total of 95 individuals who met the inclusion criteria were included in the study. The mean values of right and left renal cortical shear wave velocity were 1.49 ± 0.19 m/s and 1.54 ± 0.19 m/s respectively. Statistical significant difference was observed between the renal cortical shear wave velocity of right and left kidney. The renal shear wave velocity was seen to decrease with age, however the correlation was not statistically significant. No significant difference was also noted in renal shear wave velocity among various sex or Body mass index groups. Statistically significant negative correlation was noted between skin to cortex distance and renal cortical shear wave velocities. However no statistically significant correlation was noted between renal dimensions and renal cortical shear wave velocities.

Conflicts of Interest: None.

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Conclusions: The normal cortical elasticity values in terms of shear wave velocity of right and left kidney were established. Renal elasticity is independent of the age, gender, Body mass index and renal dimensions.

Introduction

Chronic kidney disease (CKD) is one of the common major public health problems in the world. Fibrosis of the renal parenchyma is the main pathologic process leading to progression of CKD. Renal fibrosis comprises of glomerulosclerosis, tubular atrophy, interstitial fibrosis and vascular changes [1,2]. Imaging of the kidney is mainly based on the morphologic evaluation of the parenchyma, excretory system and renal vasculature using Ultrasonography (USG), Computed Tomography (CT) and Magnetic Resonance Imaging (MRI). Renal length, parenchymal thickness and resistive index (RI) have showed significant correlation with renal fibrotic changes [3,4]. However these imaging parameters are not sensitive and specific in the evaluation of renal failure, as the renal morphology may still appear normal in early stages of CKD.

Elastography is a non-invasive technique that measures tissue elasticity, which is the capacity to deform and to return to the initial shape when a stress is applied. Most elastography techniques used today are ultrasound based, like shear wave elastography (SWE) using Acoustic Radiation Force Impulse (ARFI) quantification. Shear wave elastography is a technique that applies low frequency focused impulse to induce a shear wave in the tissue that is transmitted perpendicularly to the direction of applied impulse. The propagation speed of the shear wave, named shear wave velocity, is proportional to the tissue stiffness. Elastography quantification of shear wave velocity has been proposed as an alternative technique for assessing liver fibrosis and has shown promising results [5,6]. There are few studies conducted in determining the role of elastography in evaluation of renal parenchyma in CKD, Chronic Allograft Nephropathy (CAN), Vesico-ureteral reflux (VUR) and renal tumors which have shown although conflicting but still promising results [7—19]. Till date no such studies evaluating normal or abnormal renal cortical elasticity values has been done in Nepal.

So the purpose of this study was to establish a normogram of renal cortical elasticity values and assess their variation in between right and left kidney as well as with age, gender, BMI, renal dimensions and skin to cortex distance.

Methods

The study was a hospital based cross sectional study performed at Tribhuvan University Teaching Hospital (TUTH), a tertiary care center in Kathmandu performed as a Thesis, a partial requirement for the fulfillment of the degree of doctor of medicine (MD) in Radiodiagnosis. The study population was all individuals referred for USG from General Health Check up clinic. All individuals who came for routine ultrasound as a part of general health check up from (1st) October, 2014 to (30th) September, 2015 were included in the study after obtaining a written informed consent. Individuals unwilling to participate in the study; individuals with abnormal ultrasound like ascites, renal stone disease, hydronephrosis or any urinary tract pathology or deranged renal function or laboratory or clinical findings of urinary tract pathology were excluded from the study.

Renal ultrasound examinations and measurements were performed by a single observer on Philips iU22 Ultrasound machine, (Philips Medical System, Bothell, WA) using C5-1 (1—5 MHz) convex probe. All measurements were taken with electronic calipers in lateral decubitus position post micturition. All patients were screened in supine position for any residual urine before the scan.

Renal length was measured on coronal plane from superior pole to inferior pole of the kidney. Renal width was measured from the renal hilum to the renal capsule at mid pole on coronal plane. Parenchymal thickness was measured from the renal capsule at mid pole to the outer margin of the renal sinus on coronal plane. Cortical thickness was measured from the renal capsule at mid pole to base of the medullary pyramid. At last, the distance of skin to the outer margin of the renal cortex corresponding to renal capsule at mid pole was measured.

Subsequently point shear wave elastography (pSWE) was performed using ELAST PQ software based on ARFI technology maintaining the same lateral decubitus position and using the same C5-1 (1—5 MHz) convex probe. The probe was placed steadily with minimum compression and the person was asked to hold breath in full inspiration for a few seconds to minimize motion of the kidney with respiration. After that Region of interest (ROI) box of 1.0 × 0.5 cm (predefined by the manufacturer) was positioned in the renal cortex in the middle third of the kidney excluding the medulla as much as possible with the main axis of the ROI box lying as parallel as possible to the main axis of the medullary pyramids in the mid pole and the "Update" button was pressed for quantification and the renal cortical shear wave velocity was obtained in m/s (Fig. 1).

Five valid elasticity measurements in terms of shear wave velocity were made during separate breath holds for the particular kidney and then mean shear wave velocity value for that kidney was obtained. In case of invalid measurement the screen would display 0 m/s, and such measurements were repeated. Then the examination procedure was repeated for the contralateral kidney. Age, gender, height and weight of the subjects were also noted.

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