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RENAL CORTICAL THICKNESS IN ADULT WITH NORMAL RENAL FUNCTION MEASURED BY ULTRASONOGRAPHY

Dambar Sah[1]*, MD. Kalim Akhtar[1], Akhilesh Kumar Jha[1], Shashi Shekhar Prasad Shah[1], Rajan Kumar Mahato[1], Bikranta Rimal[1], Chandan Chaurasiya[1], Rakesh Kumar Jha[1], Trayush Adhikari[1], Ajay Kumar Gupta[2]

[1] Department of Radiodiagnosis, National Medical College Teaching Hospital, Birgunj, Parsa, Nepal.
[2] Department of Internal Medicine, National Medical College Teaching Hospital, Birgunj, Parsa, Nepal.

ABSTRACT

Introduction: Renal cortical thickness is an important parameter for many renal pathologies. Ultrasonography has been an efficient tool for the measurement of different renal parameters. The objective of this study was to determine the renal cortical thickness in healthy adults without any renal impairments and to correlate it with age, sex, height, weight, BMI and side of the body.

Materials and Methods: A total of 150 healthy adults with normal renal function were included in this study. A detailed clinical history of all the patients were taken. Basic investigations, clinical and ultrasonography examination were performed. Informed written consent and ethical approval were taken.

Result: The study included 150 participants (67 male & 83 female) with mean age of the participants 33.0±9.5 years. The mean renal cortical thickness was found to be 8.3±0.69mm. There was significant correlation between RCT and gender (p=0.013). However, no such correlation was observed between (renal cortical thickness) RCT and age, height, weight and BMI of the participants.

Conclusion: Ultrasonographic measurement of renal cortical thickness plays a vital role in identification of many renal diseases. Thus, the result of this study can be used for evaluation of renal cortical thickness to determine abnormal renal conditions.

Keywords: Renal cortical thickness, Renal function, Ultrasonography.

INTRODUCTION

Chronic Kidney Disease (CKD) is a common disease with an increasing incidence worldwide. Clinical symptoms and laboratory findings are used to diagnose CKD along with radiological examinations.[1] For renal imaging ultrasonography is a simple, cost-effective and non-invasive procedure.[2] In addition, ultrasonography has been shown to be a good method for studying acute rejection of transplanted kidneys, renal collagen-vascular diseases and renal cystic lesions.[3]

Ultrasonographic diagnosis of CKD depends on length, volume, echogenicity and cortical thickness of kidney.[4]

Renal cortical thickness (RCT) measurement is used to differentiate between acute and chronic renal failure.[5] As the disease progresses, RCT decreases and echogenicity increases. Echogenicity is, however primarily determined by an observer, so it may be subjective. In various references different measures have been reported for normal RCT, just like other body sizes that depends on weight and race.

Although renal length can be assessed, it is not usually diagnostic because it is related to body size and is not always measured using a standardized approach.[6] In a

study conducted by Beland et al., it was found that in patients with CKD the ultrasonographic measurement of RCT was more significantly related to eGFR than was renal length.[7]

There hasn't been much studies to establish the RCT measurement based on the demographics of our population. The aim of this study is to determine the sonographic values of renal cortical thickness in healthy adults with normal renal function and to correlate it with other variables such as age, gender, height, weight and BMI.

MATERIALS AND METHODS

This is a prospective hospital based cross-sectional study conducted in the Department of Radio-Diagnosis in collaboration with Department of Internal Medicine, National Medical College and Teaching Hospital, Birgunj, Nepal from November 2021-May 2022. Ethical approval was taken from Institutional Review Committee (Ref. F-NMC/548/078-079). Subject with known renal diseases were excluded from the study and inform consent was obtain from all the participants. A total of 150 participants with normal renal function were recruited. All the subjects were apparently healthy at the time of the study. Personal information including age and gender were taken. Height and weight of each participant were measured to calculate the BMI. All participants were examined by a physician and detailed history regarding previous or present renal disease were taken. Participants with abnormal physical examination, abnormal laboratory test history of renal pathologies, hypertension, diabetes mellitus or any systemic disease affecting the kidney were excluded from the study.

Urine analysis, BUN and creatinine were performed and a serum creatinine > 1.2mg/dL and BUN > 20 mg/dL were considered abnormal. The participants then underwent ultrasonography of the kidney which were performed by a single radiologist using a 3.5-5 MHz curvilinear probe (Canon Aplio 300). Patients were scanned in supine and oblique positions. The renal cortical thickness of both kidneys was measured as distance between external capsule and external margin of hypoechoic medulla. Three measurements were taken from each kidney viz.

upper pole, interpolar region and lower pole. The mean of the three measurements of each kidney was reported as the RCT. Data analysis were done by using SPSS version 25. Data of both kidneys were compared using Student's t test. Pearson's correlation coefficient was used to determine correlation between RCT and other variables. The data was presented as mean (CI 95%) and mean ± SD and a p-value <0.05 was considered statistically significant.
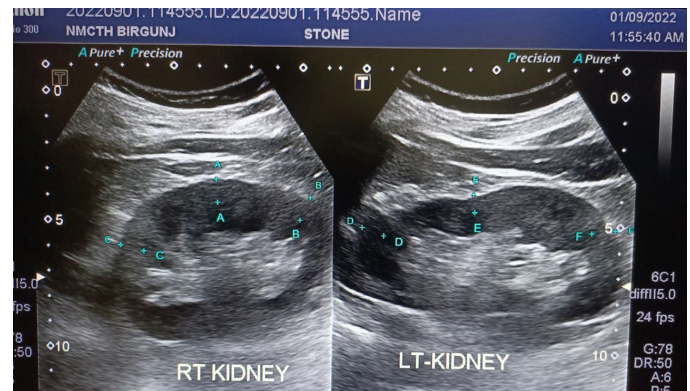

Figure 1: Sonographic measurement of RCT of right and left kidney at three points.

RESULTS

A total of 150 participants were included in this study. Of 150 participants, 67 were male and 83 were female. The mean age of the participants was 33.0 ± 9.5 years (range: 20-50 years). The mean height was 1.57±0.98m (range: 1.24-1.83 m) with mean weight 58.3±10.9 kg (range: 35-88 kg) and mean BMI 23.6±4.29 kg/m^2 (range: 15.0-38.4 kg/m^2).

The mean RCT was 8.3 mm (CI 95%: 8.2-8.4 mm). The mean RCT was 8.2 mm (CI 95%: 8.1-8.4 mm) for the right kidney and 8.4mm (CI 95%: 8.3-8.5 mm) for the left kidney (p=0.869). The mean RCT was 8.5 mm (CI 95%: 8.3-8.7mm) in men and 8.2 mm (CI 95%: 8.0-8.3mm) in women (p=0.013).

In men, the mean RCT of the right and left kidneys were 8.4mm (95% CI: 8.2-8.6) and 8.5mm (95% CI: 8.3-8.6) mm, respectively. In women, the mean RCT of the right and left kidneys were 8.1mm (95% CI: 7.9-8.2) and 8.2mm (95% CI: 8.1-8.4) mm, respectively.

No significant correlation was found between age of the participants and RCT (p=0.073).

There was no significant correlation between BMI and RCT (p=0.093). Also, no significant correlation was observed between mean height of the participants and RCT (p= 0.439) as well as weight of the participants and RCT (p= 0.410).
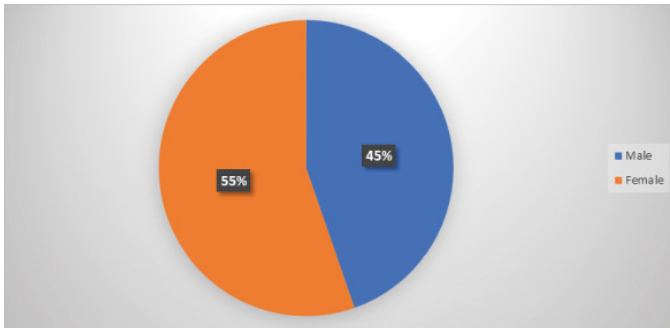

Figure 2: Study population distribution according to sex

Above chart shows distribution of the total subjects (150) according to gender with male participant-67 (44.7%) & female participant-83 (55.3%).

Table 1. Descriptive statistics table

Parameters	Age (years)	Height (m)	Weight (kg)	BMI (kg/m²)	RCT (Com-bined)	RCT (Men)	RCT (Wom-en)
Total No.	150	150	150	150	150	67	83
Mean	33.05	1.57	58.35	23.64	8.34	8.51	8.21
Std. Dev.	9.52	0.98	10.93	4.29	0.69	0.80	0.55
Minimum	20	1.24	35	15.07	7.15	7.15	7.40
Maximum	50	1.83	88	38.43	10.70	10.70	9.13

Table.2. Correlation between RCT and other variables

Variables	P-value
Age	0.073
Height	0.439
Weight	0.410
BMI	0.093
RCT in Men and Women	0.013

p value <0.05 is considered to be significant

Significant correlation observed between mean RCT in men and women.

DISCUSSION

Ultrasonography is a common examination used to assess renal anatomy. Ultrasound is useful for diagnostic and prognostic purposes in chronic kidney disease. As the disease progresses, there is decrease in size of kidney and thinning of renal cortex.[6] The majority of earlier studies have examined kidney length and its relationship with other variables. Only limited research has assessed the RCT and its relation with other variables such as age, gender, weight, height and BMI.

We calculated the RCT and its correlation with several parameters to establish some preliminary statistics on our population. We conducted a hospital based cross-sectional prospective study which included 150 participants (67 male & 83 female) with mean age of the participants 33.0±9.5 years. The mean renal cortical thickness was found to be 8.3±0.69mm. Our study found significant correlation between RCT and gender (p=0.013).

In a study conducted by Adibi et al. reported the mean RCT as 9.1±1.0mm which was close to our result (mean± RCT 8.3±0.69mm).[8] Another study conducted by Khademi et al. found that the normal RCT was 5-12mm as well [9], which is in agreement with our findings.

A study using Doppler ultrasonography has reported the normal RCT to be 10-15 mm [10], which is slightly higher than our findings. It is possible to expect different results from RCT calculations based on two measurements in the upper and lower poles of the kidney.

Buchholz et al, have reported a mean ± SD RCT of 16±2 mm at Karachi University, Pakistan,[11] which is significantly different from our results. However, it may be a result of the measurement of mean parenchymal thickness. It would be warranted to conduct more regional studies if it was the mean RCT as Pakistan is our neighbor country. Variation in renal cortical thickness reflects wide range of renal size and configuration of the collecting system. In kidneys with short and stocky infundibula, the cortex appears thicker than in kidneys with elongated, spiderly infundibula.[9]

Significant difference between the mean RCT in men and women (P=0.013) was found in our study. The difference might be due to the different built and body metabolism in men and women. While some references report that renal length decreases with aging [12] and we expect RCT to decrease with age, we did not observe a significant correlation between age and RCT. This lack of correlation might be attributed to the age of our subjects (20-50

years).

The correlation between BMI and RCT was not significant. Neither was the correlation between the mean height of the subjects and RCT significant. Considering that body fat content has no effect on body metabolism and that weight and BMI are affected by body fat content, these results are expected. It is likely that a significant result would have been found if we had studied the correlation between RCT and lean body mass. Finally, it seems that to establish the local references values, more population-based studies with a larger sample size are needed to establish the normal values of the Nepalese population.

CONCLUSION

As it is common for chronic renal failures to present with renal cortical thinning, the RCT is mainly used to differentiate between these two conditions. However, in acute renal failure, a decrease in the RCT is not expected.

CONFLICT OF INTEREST: None

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