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A case-control study of hypertension and associated risk factor on kidney Volume

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Abstract: ***Introduction:*** Hypertension (or HTN) or high blood pressure is defined as abnormally high arterial blood pressure. According to the Joint National Committee 8 (JNC8), normal blood pressure is a systolic BP < 120 mmHg and diastolic BP < 80 mm Hg. Hypertension is defined as systolic BP level of ≥140 mmHg and/or diastolic BP level ≥ 90 mmHg. ***Material and Methods:*** This is a prospective, descriptive, cross sectional and observational study conducted at Department of Physiology, General Medicine and Radiology, Index Medical College, Hospital and Research center Indore. Period of the study from January 2020 December 2021. Using ultrasonographic methods, absolute renal size, relative renal size (renal length/body length), renal volume (length × width × depth × 0.52), and renal shape (width/length) were calculated. ***Results:*** The case group Mean Systolic Blood Pressure is 147.45 ± 5.87 mm of Hg (Mean±SD) and control group Mean Systolic Blood Pressure of 117.35 ± 5.67 mm of Hg (Mean±SD). However, this reduction in Systolic Blood Pressure is statistically significant. (P value < 0.05). The case group Mean Diastolic Blood Pressure is 97.03 ± 5.824 mm of Hg (Mean±SD) and Mean Diastolic Blood Pressure is 76.93 ± 5.688 mm of Hg (Mean±SD). This reduction in Diastolic Blood Pressure is however statistically significant. (P value < 0.05). ***Conclusion:*** The data presented in this work showed that renal size and volume were more than in hypertensive than normotensive subjects. The cortical size for both kidneys was greater in our study group compared to cortical size in normotensive subjects.

Keywords: Hypertension, Kidney Volume, Kidney Size.

INTRODUCTION

Hypertension (or HTN) or high blood pressure is defined as abnormally high arterial blood pressure. According to the Joint National Committee 8 (JNC8), normal blood pressure is a systolic BP < 120 mmHg and diastolic BP < 80 mm Hg. Hypertension is defined as systolic BP level of ≥140 mmHg and/or diastolic BP level ≥ 90 mmHg. [1] Primary HTN prevention strategies have been targeted to people with CVD risk factors such as behavioural or metabolic factors. [2] Population-based interventions often focus on behavioural risk factors such as smoking, excessive alcohol intake, unhealthy diet, physical inactivity or having stress. Individual-based interventions commonly comprise screening and treatment focussing on metabolic CVD risk factors such as hypertension, diabetes, obesity and dyslipidaemia. [3]

Renal ultrasound scan is a simple non-invasive method for estimating the kidney size *in vivo* and has many advantages over other imaging methods. These include use of non-ionising radiation, little or no patient preparation and no need for medication or injection of contrast media. [4] It is also readily available, cheap and easily reproducible to a large extent. Renal length and volume are important parameters in clinical settings, such as the evaluation and follow up of patients with kidney transplants, renal artery stenosis, recurrent urinary tract infection and vesico ureteral reflux. [5]

Where the facility is available, Doppler ultrasound scan of the renal vessels can also be important in the diagnosis of renal artery stenosis and renovascular disease. It is also useful in assessment of intra renal haemodynamics in different pathological conditions such as essential hypertension, acute and chronic renal failure (CRF). [6] Kidney length is the most easily reproducible parameter in assessing kidney size. However, renal volume is a better approximation of size than length because the shape of the kidney varies considerably. It has also been shown that renal volume correlates well with kidney weight. [7]

On sonographic evaluation, a change in renal volume (reduction or increase) from one examination to the next may be an important indicator of the presence or progression of disease. [8-13] Of several indices of kidney size, kidney length was traditionally used because it can conveniently be measured using US but when the complexity of the kidney shape is considered, length cannot appropriately represent kidney mass. It is also prone to interobserver variability and poor repeatability. [14-20]

A very few studies have been done in India on renal size, but most of them used renal length and width as the determinant parameters. No studies have been done on renal volume in India, either in healthy people or in those with conditions such as hypertension.

We aimed to evaluate renal volume in patients with essential hypertension who have not developed chronic renal disease, and correlate it with age, somatic parameters and duration of hypertension. Restricting our studies toward the middle age group will provide better information relating to this age group. Therefore, this study was aimed to determine the prevalence of hypertension and its associated factors among middle aged adults in India.

MATERIALS AND METHODS:

This is a prospective, descriptive, cross sectional and observational study. Department of Physiology, Index Medical College, Hospital and Research center Indore. Department of General Medicine and Radiology, Index Medical College, Hospital and Research center Indore.

Inclusion criteria of cases:

- Age 41-60 years of either gender hypertensive subjects according to JNC VIII (Systolic BP >140mmHG and Diastolic BP >90 mmHg) was included.
- Persons willing to give consent.

Inclusion criteria of control:

- Age 41-60 years of either gender normotensive subjects according to JNC VIII and no renal diseases was included.
- Persons willing to give consent.

Exclusion criteria

- Persons not willing to give consent.
- Patients with renal tumours, kidney failure and hydronephrosis was excluded.
- Pregnant and lactating women was excluded.

A curvilinear probe with transducer frequency of 2–8 MHz of a Sonoace X6 ultrasound machine was used. Each individual was laid supine on the couch with the abdomen adequately exposed from upper abdomen to the symphysis pubis. Longitudinal, coronal, and transverse scans of the kidneys were obtained in the supine, supine-oblique, and prone positions.

Renal dimensions including length, width, anteroposterior thickness as well as renal cortical thickness and renal parenchymal volume/echogenicity/ echotexture was assessed.

Statistical Analysis:

The measurements data was statistically analyzed with the Statistical package for social sciences (SPSS) version 25th software was used. Data comparison (statistical test of significance) was done with Chi-square test for categorical data and t-test for continuous variables. At 95% interval, two-tailed P ≤ 0.05 was considered statistically significant.

RESULTS:

The study procedure was carried out on 131 cases and control aged between 41 to 60 years. Assessment of physiological and biochemical parameters were done among case and control group.

Table 1: Distribution of Gender

Gender	Case group n (%)	Control group n (%)
Male	**81 (62.3%)**	**86 (66.1%)**
Female	**49 (37.6%)**	**44 (33.8%)**
Total	**130 (100%)**	**130 (100%)**

In table 2, of the 130 samples, 81 were males and 49 females in case group, which correspond to 62.3% of male and the rest female. On the other hand, 86 were males and 44 females in case group, which correspond to 66.1% of male and the rest female.

Table 2: Case and Control Group of SBP Changes

Study Subjects	SBP (mm/Hg) Mean ±SD	p- Value
Case group	147.45 ± 5.87	<0.05
Control group	117.35 ± 5.67	

It is observed from Table 2 that; the case group Mean Systolic Blood Pressure is 147.45 ± 5.87 mm of Hg (Mean±SD) and control group Mean Systolic Blood Pressure of 117.35 ± 5.67 mm of Hg (Mean±SD). However, this difference in Systolic Blood Pressure is statistically not significant. (P value < 0.05).

Table 3: Case and Control Group of DBP Changes

Study Subjects	DBP (mm/Hg) Mean ±SD	p- Value
Case group	97.03 ± 5.82	<0.05
Control group	76.93 ± 5.68	

It is observed from Table 3 that; the case group Mean Diastolic Blood Pressure is 97.03 ± 5.824 mm of Hg (Mean±SD) and Mean Diastolic Blood Pressure is 76.93 ± 5.688 mm of Hg (Mean±SD). This difference in Systolic Blood Pressure is however statistically significant. (P value < 0.05).

Table 4: Case and Control Group of Right renal length

Study Subjects	Right renal length (cm) Mean ±SD	p- Value
Case group	10.7 ± 0.82	<0.001
Control group	8.3 ± 0.51	

In our study, mean right renal length in case group 10.7±0.82 cm and in control group 8.3 ± 0.51 cm in table 4.

Table 5: Case and Control Group of left renal length

Study Subjects	Left renal length (cm) Mean ±SD	p- Value
Case group	11.1 ± 1.73	<0.001
Control group	8.9 ± 0.68	

On the other hand, left renal length in case group 11.1 ± 1.73 cm and in control group 8.9 ± 0.68 cm in table 6.

Table 6: Case and Control Group of Right renal width

Study Subjects	Right renal width (cm) Mean ±SD	p- Value
Case group	5.1 ± 0.81	<0.001
Control group	3.9 ± 0.67	

In addition, mean right renal width in case group 5.1±0.81 cm and in control group 3.9 ± 0.67 cm in table 6.

Table 7: Case and Control Group of Left renal width

Study Subjects	Left renal width (cm) Mean ±SD	p- Value
Case group	5.6 ± 0.73	<0.001
Control group	4.3 ± 0.38	

On the other hand, left renal width in case group 10.7±0.82 cm and in control group 8.9 ± 0.68 cm in table 7.

DISCUSSION:

Hypertension (HTN) is a prevalent disorder estimated to affect >25% of the world's adult population. [21] The incidence and prevalence of chronic kidney disease (CKD) is also on the rise with >20 million people being affected in the United States alone. Two of the major causes of CKD worldwide are HTN and diabetes mellitus (DM), particularly type 2 DM. [22] The frequent concurrence of HTN, type 2 DM, insulin resistance, dyslipidaemia, and CKD, all of which are also important cardiovascular risk factors, may reflect a common underlying mechanism. [23] One such mechanism that is becoming more and more recognized is the far-reaching impact of the fetal environment. [24]

Ultrasonography (US) has therefore become the standard imaging modality in the investigation of renal diseases because it is accurate, non-invasive, cost effective, easily available, convenient and provides excellent anatomical details. [25] Ultrasonography requires no special patient preparation neither does it require the use of X-radiation or contrast agents which are potentially harmful. [26]

In our study, mean right renal length in case group 10.7±0.82 cm and in control group 8.3 ± 0.51 cm. On the other hand, left renal length in case group 11.1 ± 1.73 cm and in control group 8.9 ± 0.68 cm. Similar result is reported by Mansi KSA (2007) [27] There is statistical significant difference between case and control group. The normal size of the kidney is variable and affected by age, gender, BMI as well as the side. The size provides a rough indication of the renal function. Decrease size and function are seen with chronic renal failure, renal arterial occlusion and late stage of renal venous thrombosis. Physiologically renal length decreases 0.5 cm per decade after middle age. On the other hand, there is an increase in kidney size in early stage renal thrombosis, early stage diabetes mellitus and renal inflammation. [28]

In addition, mean right renal width in case group 5.1±0.81 cm and in control group 3.9 ± 0.67 cm. On the other hand, On the other hand, left renal width in case group 5.6±0.73 cm and in control group 4.3 ± 0.38 cm. The result is similar to that observed by Saleh SM (2005). [29] The explanation is that the spleen is smaller than the liver, so the left kidney has more space to grow. Also, the left renal artery is shorter than the right one, so increased blood flow in the left renal artery may result in a relatively increase in volume of the left kidney. As the age has an important bearing on kidney volume, we found in our study, the volume remains with marked decreased. [30]

CONCLUSION:

The data presented in this work showed that renal size and volume were more than in hypertensive than normotensive subjects. The cortical size for both kidneys was greater in our study group compared to cortical size in normotensive subjects. In agreement with published studies, our study showed that renal

volume is higher in the left than in the right kidney for both sexes. The female patients have smaller kidney size compared to males.

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