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ORIGINAL ARTICLE

Comparison of Renal Segmental Artery Blood Flow on Doppler in Young Obese & Non Obese Individuals

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ABSTRACT
Aim: To compare renal segmental artery blood flow on Doppler in young obese & non-obese individuals.
Methodology: In University Ultrasound Clinic Green Town, Lahore, Pakistan, a comparative study was conducted. 180 patients of age group 16 to 25 were enrolled in this study with convenient sampling technique. All the obese & non-obese patients having no history of renal disease were included in this study. Hypertensive and diabetic patients were also included. Pregnant females having any renal parenchymal disease were excluded.
Results: In 90 non-obese individuals the average mean of PI was .989±.249 while in 90 obese individuals the average mean of PI was .985±.338. No statistical difference between the two averages as p-value 0.928> α=0.05.
Conclusion: Study concluded that no statistically significant difference between the average PI in non-obese individuals compared to the average of PI in obese individuals.
Keywords: Obese, Renal segmental artery, Pulsatility Index (PI), Ultrasonography.

INTRODUCTION

The kidneys are paired, bean-shaped excretory organs located in the retroperitoneum in the posterior region of the abdomen on either side of the spinal cord, completely hidden by the costal margin. The right kidney is pushed down by the liver and is slightly lower than the left kidney. The superficial cortex, which includes the renal corpuscles, the conical medullary pyramids, which are further split into outer medulla and inner medulla; the renal papilla and renal pelvis make up the kidney parenchyma. The cortex makes up the majority of the kidney and gets a disproportionately greater amount of blood flow (90%) than the medulla or papilla.[1] Each kidney is formed of 3 fascial layers: the capsule, perinephric fat; and renal fascia, which clings to structures near the hilum.[2] In adults, the kidney is around ten to twelve centimeters long by six centimeters wide by three centimeters in depth. Compared to women, a single male adult kidney weighs roughly 135g.[3]

Renal artery stenosis (RAS) is the single most common cause of secondary hypertension, impacting 25% to 35% of people with the condition.[4] In obese individuals the causes of hypertension are complex and it is likely to be a major factor in renal impairment.[5] According to World Health Organization (WHO), BMI between 18.5 and 25 kg/m^2 is considered by the to be normal weight, a BMI between 25 and 30 kg/m^2 as overweight, and a BMI of more than 30 kg/m^2 as obese.[6] About 30 to 35 percent of American adults are overweight, and more than half of those over 50 are overweight. Among African-American women over 50, obesity rates can reach 70-80 percent, along with hypertension rates of 70 percent or higher. Framingham Heart Study suggests that around 78 percent of males and 65 percent of female hypertension cases can be directly linked to fat. Obesity-related kidney adipose tissue is mostly found in the renal sinuses that ring the renal medulla, thus fat accumulation around the renal capsule and in these sinuses might cause compression. As a result of this long-term increase in renal capsular pressure, arterial pressure continues to grow.[7]

Atherosclerosis is responsible for roughly 90% of the flow-limiting lesions in the renal arteries.[8] A one-month high-fat diet increases extracellular fluid and induces a sodium balance shift and increases blood pressure. This increase in long-term arterial pressure, glomerular hyperfiltration, neurohumoral factors, and metabolic alterations may result in renal injury, renal-pressure natriuresis, and more severe hypertension. The three mechanisms responsible for this are: 1) increased sympathetic activity, 2) activation of the renin-angiotensin system, and 3) altered intrarenal physical forces due to compression of the kidneys.[9] Atherosclerotic renal artery stenosis is a symptom of systemic atherosclerosis rather than a separate disease entity. Its frequency rises with age, and it affects 30% of individuals with coronary artery disease and up to 50% of those with peripheral artery disease.[10] A sub-study of the Cardiovascular Health Study in the United States discovered that up to 6.8 percent of healthy adults above 65 years of age had clinically asymptomatic atherosclerotic renal artery stenosis.[11] The prevalence of atherosclerotic renovascular disease found by the Medicare population in the United States was estimated to be 0.5 percent overall while in chronic renal disease individuals it was 5.5 percent.[12]

RAS detection is critical since it is a potentially treatable cause of hypertension. RAS may be detected using a wide range of diagnostic tools for example, Duplex Ultrasound, MRA, contrast-enhanced helical CT, and traditional angiography. The gold standard for detecting renal artery stenosis is conventional angiography. Consequentially, invasive, costly contrast angiography carries with it the potential of consequences. However, conventional contrast angiography can identify the existence of RAS but it does not offer data on its physiologic, hemodynamic, or clinical relevance.[13] Doppler ultrasound is routinely used as a screening test for renal artery stenosis since it is a non-invasive, widely available, reasonably affordable and can be utilized in patients with renal insufficiency or contrast allergy.[14] The Renal Artery Doppler ultrasonography accurately identifies velocity variations associated with vascular narrowing. It necessitates meticulous attention to detail especially in terms of operator competence, patient preparation, and the time allotted for acceptable research. Prospective studies indicate that sensitivity and specificity are more than 90%. Others have found sensitivity in the 60 percent range with more than 20% of trials being technically insufficient, typically owing to obesity or poor preparation. Although duplex ultrasonography seldom causes "false positives," it might miss significant vascular abnormalities, giving "false negatives." It can be beneficial to monitor the development of illness in previously recognized lesions.[15]

When it comes to segmental branch RAS, Doppler US diagnosis might be considerably more complex and challenging. A localized stenosis of an segmental renal artery can potentially induce renovascular hypertension. 11 percent of patients in a large angiographic series had segmental branch RAS. The Doppler signal produced by non-stenotic branches will provide a false-negative result if stenosis is in a segmental artery. Since it is possible for RAS in an accessory or segmental renal artery to be missed in the process of the study, spectral analysis should include various locations, such as the upper, the middle, and lower pole of each kidney. There is a good chance that a segmentally separated tardus-parvus waveform indicates a severe stenosis of a segmental or accessory renal artery[16].

It is postulated that fat deposits in the renal sinuses of the obese individual which can cause changes in the renal hemodynamics. Doppler ultrasound is the first line modality to evaluate the segmental artery blood flow.

MATERIAL AND METHODS

This comparative analysis comprised of individuals between the ages of 16 and 25 who underwent a renal ultrasound. All the obese and non-obese, hypertensive and diabetic individuals having no history of renal disease were included in the study. Pregnant females and patient having any renal parenchymal disease were excluded. Data were collected with help of convenient sampling technique according to the age, gender, obese or non-obese, Pulsatility Index (PI). 180 participants including 103 females and 77 males were preferred during suitable sample procedure. SPSS version 24.0 was used to analyze data.

RESULTS

In this comparative study, we enrolled 180 individuals from both genders with age group between 16 to 25 years. Out of them 103(57.2%) individuals were females while 77(42.8%) individuals were males.

Table 1: Descriptive Statistics of PI in obese and non-obese.

		PI (n=90)
NN	Mean±SD	.99±.249
Obese	Mean±SD	.99±.337

In 90 non-obese individuals the average mean of PI was .989±.249 while in 90 obese individuals the average mean of PI was .985±.338. No statistical difference between the two averages as p-value 0.928> α=0.05.

Table 2: Comparison of Average of PI in Obese and Non-Obese.

	PI in Non-Obese	PI in Obese
N	90	90
Mean±SD	.989±.249	.985±.338
Mean Difference	.004	
T	-1.297	
Sig.	.196	

DISCUSSION

In our study, an attempt was made to compare the renal segmental artery blood flow in obese with the renal segmental artery blood flow in non-obese individuals. Data was collected according to the variables i.e. age, gender, obese or non-obese, and Pulsatility Index (PI). Patient were asked to lie supine or decubitus (left & right) for respective kidneys. Doppler ultrasonography of renal arteries was performed on these 180 individuals. Radermacher J, et al. did a research that showed that Hypertension and renal failure are both symptoms of renal artery disease, and Renal Doppler sonography may be an effective screening tool. Because it provides reliable and quick diagnosis of stenosis in all patients, regardless of renal function, Doppler sonography, which evaluates both major renal and intrarenal arteries, is an appropriate screening tool for detecting a RAS of 50% or more. As compared to angiography, 96.7 and 98.0 percent sensitivity and specificity, respectively, were found for identification of a severe stenosis.[17]

In our study average of PI were compared in the both obese and non-obese individuals. In 90 non-obese individuals the average mean of PI was .989±.249 while in 90 obese individuals the average mean of PI was .985±.338. Among 90 non-obese individuals the mean RI was .660±.280 while in 90 obese individuals the mean RI was 1.128±3.396. Average of PI and RI in obese was equal to the average PI in non-obese individuals. No statistical difference between the two averages as p-value 0.928> α=0.05 for average of PI and p-value 0.192> α=0.05 for average of RI. A study was conducted by Sidi M, et al on the topic, “Renal Doppler Indices of Normal Adult Individuals and their Correlation with Anthropometric Variables in Kano, Nigeria.” The study compromises of 384 participants; 192 males and 192 females. The mean and the standard deviation of the right and left RI and PI for the males’ participants were 0.60±0.02, 0.59±0.02, 1.26±0.15 and 1.25±0.14. For females’ participants it was 0.59±0.25, 0.59±0.03, 1.17±0.16 and 1.16±0.16. In terms of age, RI and PI showed a statistically significant positive relation (r>6, p=0), and with weight and BMI (r>4, p=0).[19]

CONCLUSION

Study concluded that no statistically significant difference between the average of PI in non-obese individuals compared to the average of PI in obese individuals.

Recommendation: A large sample size with proper supervision would give more accurate results.

Limitation: The Doppler ultrasonography data collected by various examiners may be different.

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