

Assessment of Renal Artery Doppler Index in Young Adult Hypertension

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Abstract

Background: Hypertension is a chronic elevation in blood pressure (BP) 140/90. It is subjected to various disorders which produce alterations in the morphology of kidneys with renal artery blood flow. Doppler ultrasound (US) of the renal artery is sensitive for evaluating the kidneys and provides the accurate diagnosis of early kidney function, morphology, and blood flow effects. The aim of this study is to determine whether there were different renal artery Doppler indices in young adult hypertension with control group. **Methods:** This is a cross-sectional study conducted from October 2019 to October 2021 and this study make in Khartoum Sudan The Health Ministry of Khartoum Hajj AlmardiMohiuddin Teaching Hospital. A total of 100 patients with hypertension and 100 as control group were examined using the Doppler ultrasonography for renal artery. Measurement of the renal artery Doppler index was performed on young adult essential hypertension patients and control group. criteria were all young adult patients with essential hypertensive equal 140/90mm HG or above, also all patients came to the ultrasound department after sudden hypertension, all patients did not take any medication agent and exclusion criteria were excluded from the study; Pregnant patients because elevated blood pressure in some patients during pregnancy were also excluded patients with diabetes and patients took hypertension medications agent. The cases were selected using the convenient sampling method.

control group is young adult with normal blood pressure less than 140/90 mmHG and exclusion criteria were excluded from the control group; Pregnant patients were also excluded patients with diabetes and patients took hypertension medications agent. The cases were selected using the convenient sampling method

Results: There were significant different in right kidney volume in adult hypertension 149 cm^3 and 123.9 cm^3 in control group at $P= 0.01$ and also there were significant different in left kidney volume in adult hypertension 153.8 cm^3 and 137 cm^3 in control group at $P= 0.04$. There were significant different between mean right kidney Doppler indices in adult hypertension group (EDV= 15, RI=0.72, PI=1.43, AT=50.19) versus control group of right kidney right (EDV=23.4, RI=0.58, PI=0.94, AT 42.6) at P value respectively (<0.001 , <0.001 , <0.001 , 0.006). There were significant different between mean left kidney Doppler indices in adult hypertension group (EDV=15, RI=0.71, PI=1.4, AT=48.7) versus control group of left kidney (EDV=22.2, RI=0.57, PI=0.93, AT=43.9), at P value respectively (<0.001 , <0.001 , <0.001 , 0.07).

Keywords: renal artery Doppler, adult hypertension, Doppler index.

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I. Introduction

Hypertension is a chronic elevation in blood pressure (BP) 140/90; etiology unknown in 90–95% of patients (“essential hypertension”). Always consider a secondary correctable form of hypertension, especially in patients under age 30 or those who become hypertensive after 55. Isolated systolic hypertension (systolic 160, diastolic 90) is most common in elderly patients, due to reduced vascular compliance⁽¹⁾. Secondary hypertension may be a result of renal artery stenosis due either to atherosclerosis (older men) or fibromuscular dysplasia (young women). Presents with sudden onset of hypertension, refractory to usual antihypertensive therapy. Abdominal bruit is often audible; mild hypokalemia due to activation of the renin-angiotensin-aldosterone system may be present⁽¹⁾. Young adults are defined as people between 18 and 40 years of age⁽²⁾. Laboratory workup screening tests for secondary hypertension should be carried out on all patients with documented hypertension: serum creatinine, blood urea nitrogen (BUN), and urinalysis (renal parenchymal disease); serum potassium (K) measured off diuretics (hypokalemia prompts workup for hyperaldosteronism or renal artery stenosis)⁽¹⁾.

Renal artery stenosis, main cause of renovascular hypertension; due to atherosclerosis (two-thirds of cases; usually men aged 60 years, advanced retinopathy) or fibromuscular dysplasia⁽¹⁾. The intrarenal RIs were lower in normotensives when compared with the hypertensive participants, which were statistically significant.

These showed that hypertension has significant effects on the kidneys, and with early detection and intervention, irreversible renal damage may be prevented⁽³⁾. In this study I was evaluate renal artery in young adult hypertensive patients using Doppler ultrasonography to detect the early effect of hypertensive on renal .

II. Materials And Methods

This is a cross-sectional study conducted during the period of October 2019 to October 2021. The study targeted on assessment of 100 cases confirmed the diagnosis of young adult essential hypertension and 100 cases control group adult normotensive. The data of this study was to be collected using an ultrasound Doppler Machine with a curve linear low frequency transducer (3.5-5 MHz). Inclusion criteria was all young adult patients with hypertensive equal 140/90mm HG or above and exclusion criteria were Excluded from the study ; pregnant patients because elevated blood pressure in some patients during pregnancy also excluded patients with diabetic .The cases were selected using the convenient sampling method. control group is young adult with normal blood pressure less than 140/90 mmHG and exclusion criteria were excluded from the control group; Pregnant patients were also excluded patients with diabetes and patients took hypertension medications agent. The study was approved by the Ethical Committee of karary University college of Graduate Studies and The Health Ministry of Khartoum Hajj AlmaridiMohiuddin Teaching Hospital . Special consideration was given to the right confidentiality and anonymity of all research participants. Anonymity was achieved by using numbers for each research participant that would provide a link between the information collected and the participants. In addition, confidentiality was ensured by making the collected data accessible only to the researcher and the sonographer. Justice and human dignity were observed by treating selected patients equally when telling them to participate in the research as a sample of this study. The patients were free to decide whether to participate or not. Patient's data sheets were kept in a locked cabinet, and the data were stored on a personal computer .The sonographic procedures were all patients underwent duplex and grey scale ultrasonography for estimation of arterial Doppler index. The patients were examined in supine, right decubitus, and left decubitus positions. A low-frequency (3.5 MHz) was used. Then, colour Doppler followed by pulse wave Doppler. (PW) modes were applied for the spectral analysis and determination of arterial Doppler index which obtained from kidneys shown in figures(1,2).The data were analyzed using the SPSS software program (version 23, Chicago, IL, USA, IMB). Data were presented as mean \pm standard deviation, independent *t*-test was.



figure (1) female, 30 years age, hypertensive right renal artery Doppler index(RI =0.69 , PI = 1.4, AT = 52.7 ms , PSV =41 cm/s , EDV = 12.7 cm/s)



figure (2) female, 30 years age, hypertensive left renal artery Doppler index(RI =0.7 , PI = 1.2, AT = 62.3 ms , PSV =36.5 cm/s , EDV = 11 cm/s.

III. The Results

A total of 100 young adult Sudanese affected with hypertension and 100 normal as control group were examined by Doppler ultrasound. The patients were female 46.8 % and male 53.2% , as showed in table(1).Mean age in young adult hypertension 34.5 years ,age range 17-40 years. Mean age in normal young adults 27 years ,age range 19-40 years showed in table(2). Mean body mass index(BMI) in young adult hypertension was 25 kg/cm², range 18-44 kg/cm² and 24 kg/cm² in normal with range from 13.7 to 91 kg/cm². There were significant different in right kidney volume in adult hypertension 149 cm³ and 123.9 cm³ in control group at P= 0.01 and also there were significant different in left kidney volume in adult hypertension 153.8 cm³ and 137 cm³ in control group at P= 0.04 shown in table (3).There were significant different between mean right kidney Doppler indices in adult hypertension group (,EDV= 15 , RI=0.72 ,PI=1.43 ,AT=50.19)versus control group of right kidney (EDV=23.4, RI=0.58 ,PI=0.94,AT 42.6) at P value respectively (<0.001 , <0.001 , <0.001 , 0.006).There were significant different between mean left kidney Doppler indices in adult hypertension group (EDV=15 ,RI=0.71 ,PI=1.4 ,AT=48.7) versus control group of left kidney (EDV=22.2 ,RI=0.57 ,PI=0.93 ,AT=43.9) ,at P value respectively (<0.001 , <0.001 , <0.001 , 0.07) showed in table (4).

Table (1): frequency distribution of gender:

Gender	Frequency	Percent
Female	46	46.80%
Male	54	53.20%
Total	100	100.00%

Table (2): Comparison between means of Age (years), BMI (kg/m2), Waist to hips ratio among study groups.

General Characteristics	Case Mean +SD (n=100)	Control Mean +SD (n=103)	P. Value
Age (year)	34.51 ± 6.322 (17 – 40 years)	27.95 ± 6.260 (19 – 40 years)	0.000
BMI (kg/cm2)	25.95 ± 5.49 (18 – 44.0 kg/cm2)	24.140 ± 8.019 (13.7 – 91.0 kg/cm2)	0.061

- independent sample t-test was used to compare between means.
 - P values considered significant at 0.05.

Table (3): Comparison between means of kidney measurement (Length, AP, width, and volume) in right and left kidney among case group versus control group

Kidney measurement		Right kidney				Left kidney			
		Length	AP	Width	volume	Length	AP	Width	volume
Hypertensive(n=100)	Mean	10.22	4.7	5.53	149.0	10.37	4.9	5.34	153.8
	Std.D	1.44	0.8	0.96	64.13	1.51	1.1	0.96	72.78
Normal(n=103)	Mean	9.94	4.3	5.22	123.9	10.00	4.9	5.13	137.0
	Std.D	0.82	0.8	0.76	40.64	0.74	0.6	0.80	36.43
Total (n=203)	Mean	10.08	4.5	5.37	136.5	10.18	4.9	5.24	145.0
	Std.D	1.17	0.8	0.88	54.91	1.20	0.8	0.89	57.73
P value		0.09	0.0	0.01	0.01	0.02	0.4	0.09	0.04

- independent sample t-test was used to compare between means.
 - P value considered significant at 0.05

Table (4): Comparison between means of kidney Doppler indices (PSV, EDV, RI, PI, and AT) in right and left kidney among case group versus control group.

US Doppler findings		Group	Mean	Std. D	Std. Error Mean	P value
Right kidney	PSV	Hypertensive(n=100)	52.84	23.17	2.32	0.318
		Normal(n=100)	55.73	17.56	1.73	
	EDV	Hypertensive(n=100)	15.02	7.55	0.76	<0.001
		Normal(n=100)	23.45	7.33	0.72	
	RI	Hypertensive(n=100)	0.72	0.08	0.01	<0.001
		Normal(n=100)	0.58	0.04	0.00	
	PI	Hypertensive(n=100)	1.43	0.47	0.05	<0.001
		Normal(n=100)	0.94	0.15	0.01	
	AT	Hypertensive(n=100)	50.19	24.55	2.46	<0.006
		Normal(n=100)	42.61	12.41	1.22	
Left kidney	PSV	Hypertensive(n=100)	51.16	20.89	2.09	0.594
		Normal(n=103)	52.56	15.94	1.57	
	EDV	Hypertensive(n=100)	15.03	7.60	0.76	<0.001
		Normal(n=100)	22.27	6.33	0.62	
	RI	Hypertensive(n=100)	0.71	0.08	0.01	<0.001
		Normal(n=100)	0.57	0.04	0.00	
	PI	Hypertensive(n=100)	1.40	0.49	0.05	<0.001
		Normal(n=100)	0.93	0.13	0.01	
	AT	Hypertensive(n=100)	48.72	24.06	2.41	0.078
		Normal(n=100)	43.98	12.52	1.23	

IV. Discussion

Hypertension affects size and blood flow. The disease causes severe complications and affects patient's activities, especially when the disorder was not efficiently managed. Considering the effect of hypertension on the kidneys, the present study evaluated the alterations of the kidney size and renal blood flow using Doppler ultrasonography. In this study, the Doppler indices were measured for adult hypertension and compared with normal adults. Previous studies reported the intrarenal RIs were lower in normotensives when compared with the hypertensive participants, which were statistically significant. These showed that hypertension has significant effects on the kidneys study by George Madubueze⁽³⁾ this study agree with Omolola M. Atalabi showed Mean renal resistive index in the hypertensive patients was 0.60 ± 0.04 (\pm SD) and in the controls was 0.56 ± 0.04 (\pm SD) ($p = <0.001$)⁽⁶⁾. In addition, the current study showed Individuals with hypertension had a significant reduced blood flow in the renal artery at EDV compared with the control group and a significant increase in RI ,AT and PI for renal artery to hypertensive compared with control group. This strong indicator to reduced renal artery blood flow in young adult hypertension compared with the control group, this will effect on kidney function.

V. Conclusion:

Individuals with hypertension had a significant reduced blood flow in the renal artery at EDV compared with the control group and a significant increase in RI ,AT, and PI in renal artery in hypertensive compared with the control group. This powerful indicator to reduced renal artery blood flow in young adult hypertension compared to the control group, this will effect on kidney function.

Limitation of the study:

- The patients with overweight.
- The patients who inability to control our breathing.
- Patients with severe Abdominal gases.

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