

Possible Renal Damage and Its Relation with Cholesterol Level Among the Hypertensive and Non-Hypertensive Patients by Using Ultrasonographic Parameters

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Abstract: *Background:* Renal disease is a leading cause of death and morbidity in Bangladesh, and hypertension and dyslipidemia are important risk factors for this condition. *Objective:* The objective of this study was to find out the possible renal damage and its relation with cholesterol level among the hypertensive and non-hypertensive patients by using ultrasonographic parameters. *Methods:* This was a case control study. The sample size was 135 in each group (Hypertensive and normotensive) which was selected purposively. Data were collected on different renal parameters, blood pressure, smoking status, and lipid profile, including total cholesterol (TC), triglyceride (TG), low-density lipoprotein (LDL), and high-density lipoprotein (HDL). *Results:* Relationship between TC, TAG, HDL, LDL and different renal parameters (Renal bipolar length, Renal anterior-posterior diameter, Renal cortical thickness, Renal cortical echogenicity, Corticomedullary differentiation) were found statistically significant. This indicates that increased cholesterol levels among the hypertensive patients there were possibility of renal damage. We need to identify it earlier and protecting the renal conditions. This finding provides more evidence that hypertension patients with high cholesterol levels are at increased risk for developing kidney impairment down the road. Ultrasonographic parameters showed the variations between the two groups. *Conclusion:* Patients with hypertension in Bangladesh should undergo routine blood pressure and ultrasonography examinations of renal parameters and lipid profiles to detect and prevent renal disease, which is frequently associated with high cholesterol.

Keywords: Renal Damage, Cholesterol Level, Hypertensive, Non-Hypertensive, Ultrasonographic Parameters

1. Introduction

Around the world, hypertension is the most significant risk factor for developing chronic diseases [1]. Myocardial infarction, stroke, heart failure, and renal failure are all conditions that are more likely to occur in individuals who have hypertension [2]. Although hypertension is a risk factor for the advancement of kidney disease in people who have

chronic kidney disease (CKD) [3], there have been relatively few studies that have investigated the connection between hypertension and the possibility of renal injury in patients who have high cholesterol levels. When assessing patients who may have renal illness, it is crucial to measure the size of the kidneys using ultrasound. The use of radiographs is also essential in making a differential diagnosis. For imaging the kidneys, ultrasonography provides a straightforward,

easy-to-use, non-invasive, and cheap option. Ultrasound diagnostics rely on four key parameters: volume, length, echogenicity, and cortical thickness [4]. The bilateral renal length is typically reported in the US since renal length has been extensively utilized as a predictor of CKD [5]. Although assessing renal volume is challenging and demands expertise, it has been utilized in prior research as a direct indication of kidney size, bypassing the need to measure kidney length. Additional tools for the identification of chronic kidney disease (CKD) include renal cortical thickness (RCT) and echogenicity. Echogenicity rises and RCT falls as the disease advances. In addition to the aforementioned measures, laboratory assays are useful for monitoring the disease's course throughout follow-up [6, 7]. On the other hand, specialist judgment is key when it comes to echogenicity, which can lead to subjective findings. What's more, there aren't any set normal range values for echogenicity just yet, and a normal result for renal echogenicity doesn't rule out the chance that the patient has kidney damage [8]. There is a correlation between dyslipidemia (high triglycerides, low HDL-cholesterol, and changed lipoprotein composition) and chronic kidney disease (CKD). The incidence of hypertension was positively and strongly correlated with renal alterations. One way to assess the severity of renal illness in hypertensive patients with high cholesterol is through sonographic examination of renal parameters.

2. Methods

The current time frame for this case-control observational study is from January 2018 through December 2020. The study population included all male and female patients with hypertension or normotension who visited the Hypertension

and Research Center or the Institute of Nuclear Medicine and Allied Sciences in Rangpur, Bangladesh, throughout the study period. After calculating, the sample took into consideration 135 people from the case group and 135 people from the control group. This research made use of a purposive sampling technique.

Inclusion & Exclusion Criteria

Adults (i.e., those above the age of 18) with hypertension or normotension visited the research centers. Inclusion in the trial was contingent upon the absence of patients with haemoglobinopathies, diabetes mellitus, liver disease, or renal illness. Also not included were those who had clear renal abnormalities detected by ultrasound, such as polycystic kidney disease, renal tumors, or hydronephrosis.

We used IBM's SPSS program, version 21.0, to do the statistical analysis.

3. Results

According to our findings, people with high cholesterol levels are more likely to experience kidney impairment. Ultrasound has the ability to identify specific indicators of kidney disease. Over time, renal health may be affected by atherosclerosis and other disorders caused by elevated cholesterol levels. Atherosclerosis affects blood arteries. Hypertensive individuals may be at a higher risk of developing kidney damage and high cholesterol. Relationship between TC, TAG, HLD, LDL and different renal parameter (Renal bipolar length, Renal anterior-posterior diameter, Renal cortical thickness, Renal cortical echogenicity, Corticomedullary differentiation) were found statistically significant (Tables 1-4).

Table 1. Relationship with TC and different renal conditions.

TC	No	df	Case		t value	Sig.	Control		t value	Sig.
			Mean	SD			Mean	SD		
TC	135	134	184.62	43.89	13.705	0.000	170.18	15.63381	38.328	0.000
Blood Pressure	135	134	130.76	20.96			114.23	7.82300		
TC	135	134	184.62	43.89	48.374	0.000	170.18	15.63381	125.021	0.000
Smoking status	135	134	1.73	0.44386			1.7259	0.44771		
TC	135	134	184.62	43.89	45.818	0.000	-	-	-	-
Duration of hypertension	135	134	10.2963	10.29496			-	-		
TC	135	134	184.62	43.88602	46.294	0.000	170.18	15.63381	117.891	0.000
Renal bipolar length (Right)	135	134	9.4164	.91748			9.4761	1.23087		
TC	135	134	184.62	43.88602	46.218	0.000	170.18	15.63381	119.397	0.000
Renal bipolar length (Left)	135	134	9.7201	.85299			9.8364	0.60506		
TC	135	134	184.62	43.88602	47.764	0.000	170.18	15.63381	122.970	0.000
Renal anterior-posterior diameter (Right)	135	134	3.9376	.66267			3.7312	0.65692		
TC	135	134	184.62	43.88602	47.695	0.000	170.18	15.63381	123.254	0.000
Renal anterior-posterior diameter (Left)	135	134	4.1768	.75772			3.8270	0.55550		
TC	135	134	184.62	43.88602	48.639	0.000	170.18	15.63381	125.738	0.000
Renal cortical thickness (Right)	135	134	.7668	.18597			1.0220	0.12976		
TC	135	134	184.62	43.88602	48.641	0.000	170.18	15.63381	125.757	0.000
Renal cortical thickness (Left)	135	134	.8016	.17924			1.0649	0.16566		
TC	135	134	184.62	43.88602	48.938	0.000	170.18	15.63381	126.194	0.000
Right renal cortical echogenicity	135	134	1.3778	.72139			1.0370	0.22551		
TC	135	134	184.62	43.88602	48.945	0.000	170.18	15.63381	126.194	0.000
Left renal cortical chogenicity	135	134	1.3778	.71097			1.0370	0.22551		
TC	135	134	184.62	43.88602	48.754	0.000	170.18	15.63381	125.732	0.000
Right corticomedullary differentiation	135	134	1.1704	0.41503			1.0000	0.00000		

TC	No	df	Case		t value	Sig.	Control		t value	Sig.
			Mean	SD			Mean	SD		
TC	135	134	184.62	43.88602	48.761	0.000	170.18	15.63381	125.732	0.000
Left corticomedullary differentiation	135	134	1.1704	0.41503			1.0000	0.00000		
TC	135	134	184.62	43.88602	48.204	0.000	170.18	15.63381	123.502	0.000
Presence or absence of other renal pathology	135	134	3.1852	1.05226			4.0000	0.00000		

Table 2. Relationship with TAG and different renal conditions.

TAG	No	df	Case		t value	Sig.	Control		t value	Sig.
			Mean	SD			Mean	SD		
TAG	135	134	160.99	61.62900	5.713	0.000	137.13	25.738	9.860	0.000
Blood Pressure	135	134	1.3076E2	20.96051			1.1423E2	7.82300		
TAG	135	134	160.99	61.62900	29.971	0.000	137.13	25.738	61.125	0.000
Smoking status	135	134	1.7333	0.44386			1.7259	0.44771		
TAG	135	134	160.99	61.62900	28.706	0.000	-	-	-	-
Duration of hypertension	135	134	10.2963	10.29496			-	-		
TAG	135	134	160.99	61.62900	28.567	0.000	137.13	25.738	57.618	0.000
Renal bipolar length (Right)	135	134	9.4164	0.91748			9.4761	1.23087		
TAG	135	134	160.99	61.62900	28.545	0.000	137.13	25.738	57.738	0.000
Renal bipolar length (Left)	135	134	9.7201	0.85299			9.8364	0.60506		
TAG	135	134	160.99	61.62900	29.628	0.000	137.13	25.738	60.052	0.000
Renal anterior-posterior diameter (Right)	135	134	3.9376	0.66267			3.7312	0.65692		
TAG	135	134	160.99	61.62900	29.607	0.000	137.13	25.738	60.084	0.000
Renal anterior-posterior diameter (Left)	135	134	4.1768	0.75772			3.8270	0.55550		
TAG	135	134	160.99	61.62900	30.198	0.000	137.13	25.738	61.462	0.000
Renal cortical thickness (Right)	135	134	0.7668	0.18597			1.0220	0.12976		
TAG	135	134	160.99	61.62900	30.197	0.000	137.13	25.738	61.443	0.000
Renal cortical thickness (Left)	135	134	0.8016	0.17924			1.0649	0.16566		
TAG	135	134	160.99	61.62900	30.330	0.000	137.13	25.738	61.798	0.000
Right renal cortical echogenecity	135	134	1.3778	0.72139			1.0370	0.22551		
TAG	135	134	160.99	61.62900	30.316	0.000	137.13	25.738	61.798	0.000
Left renal cortical chogenecity	135	134	1.3778	0.71097			1.0370	0.22551		
TAG	135	134	160.99	61.62900	30.255	0.000	137.13	25.738	61.455	0.000
Right corticomedullary differentiation	135	134	1.1704	0.41503			1.0000	0.00000		
TAG	135	134	160.99	61.62900	30.241	0.000	137.13	25.738	61.455	0.000
Left corticomedullary differentiation	135	134	1.1704	0.41503			1.0000	0.00000		
TAG	135	134	160.99	61.62900	29.767	0.000	137.13	25.738	60.101	0.000
Presence or absence of other renal pathology	135	134	3.1852	1.05226			4.0000	0.00000		

Table 3. Relationship with HDL and different renal conditions.

HDL	No	df	Case		t value	Sig.	Control		t value	Sig.
			Mean	SD			Mean	SD		
HDL	135	134	36.6593	7.84187	-49.816	0.000	37.7852	5.75674	-84.801	0.000
Blood Pressure	135	134	130.76	20.96051			1.1423E2	7.82300		
HDL	135	134	36.6593	7.84187	50.828	0.000	37.7852	5.75674	72.094	0.000
Smoking status	135	134	1.7333	.44386			1.7259	0.44771		
HDL	135	134	36.6593	7.84187	24.347	0.000	-	-	-	-
Duration of hypertension	135	134	10.2963	10.29496			-	-		
HDL	135	134	36.6593	7.84187	39.194	0.000	37.7852	5.75674	55.125	0.000
Renal bipolar length (Right)	135	134	9.4164	0.91748			9.4761	1.23087		
HDL	135	134	36.6593	7.84187	39.054	0.000	37.7852	5.75674	55.606	0.000
Renal bipolar length (Left)	135	134	9.7201	0.85299			9.8364	0.60506		
HDL	135	134	36.6593	7.84187	48.299	0.000	37.7852	5.75674	68.610	0.000
Renal anterior-posterior diameter (Right)	135	134	3.9376	0.66267			3.7312	0.65692		
HDL	135	134	36.6593	7.84187	48.222	0.000	37.7852	5.75674	68.367	0.000
Renal anterior-posterior diameter (Left)	135	134	4.1768	0.75772			3.8270	0.55550		
HDL	135	134	36.6593	7.84187	52.985	0.000	37.7852	5.75674	74.260	0.000
Renal cortical thickness (Right)	135	134	0.7668	0.18597			1.0220	0.12976		
HDL	135	134	36.6593	7.84187	53.113	0.000	37.7852	5.75674	74.484	0.000
Renal cortical thickness (Left)	135	134	0.8016	0.17924			1.0649	0.16566		
HDL	135	134	36.6593	7.84187	52.272	0.000	37.7852	5.75674	74.281	0.000
Right renal cortical echogenecity	135	134	1.3778	0.72139			1.0370	0.22551		
HDL	135	134	36.6593	7.84187	52.285	0.000	37.7852	5.75674	74.281	0.000
Left renal cortical chogenecity	135	134	1.3778	0.71097			1.0370	0.22551		

HDL	No	df	Case		t value	Sig.	Control		t value	Sig.
			Mean	SD			Mean	SD		
HDL	135	134	36.6593	7.84187	52.514	0.000	37.7852	5.75674	74.244	0.000
Right corticomedullary differentiation	135	134	1.1704	0.41503			1.0000	0.00000		
HDL	135	134	36.6593	7.84187	52.520	0.000	37.7852	5.75674	74.244	0.000
Left corticomedullary differentiation	135	134	1.1704	0.41503			1.0000	0.00000		
HDL	135	134	36.6593	7.84187	48.794	0.000	37.7852	5.75674	68.189	0.000
Presence or absence of other renal pathology	135	134	3.1852	1.05226			4.0000	0.00000		

Table 4. Relationship with LDL and different renal conditions.

LDL	No	df	Case		t value	Sig.	Control		t value	Sig.
			Mean	SD			Mean	SD		
LDL	135	134	85.2889	16.31722	-20.953	0.000	80.3037	9.65778	-31.974	0.000
Blood Pressure	135	134	1.3076E2	20.96051			114.23	7.82300		
LDL	135	134	85.2889	16.31722	59.193	0.000	80.3037	9.65778	94.164	0.000
Smoking status	135	134	1.7333	.44386			1.7259	0.44771		
LDL	135	134	85.2889	16.31722	46.161	0.000	-	-	-	-
Duration of hypertension	135	134	10.2963	10.29496			-	-		
LDL	135	134	85.2889	16.31722	53.359	0.000	80.3037	9.65778	84.055	0.000
Renal bipolar length (Right)	135	134	9.4164	.91748			9.4761	1.23087		
LDL	135	134	85.2889	16.31722	53.255	0.000	80.3037	9.65778	84.401	0.000
Renal bipolar length (Left)	135	134	9.7201	.85299			9.8364	0.60506		
LDL	135	134	85.2889	16.31722	57.583	0.000	80.3037	9.65778	91.531	0.000
Renal anterior-posterior diameter (Right)	135	134	3.9376	.66267			3.7312	0.65692		
LDL	135	134	85.2889	16.31722	57.165	0.000	80.3037	9.65778	91.663	0.000
Renal anterior-posterior diameter (Left)	135	134	4.1768	.75772			3.8270	0.55550		
LDL	135	134	85.2889	16.31722	60.083	0.000	80.3037	9.65778	95.287	0.000
Renal cortical thickness (Right)	135	134	.7668	.18597			1.0220	0.12976		
LDL	135	134	85.2889	16.31722	60.110	0.000	80.3037	9.65778	95.584	0.000
Renal cortical thickness (Left)	135	134	.8016	.17924			1.0649	0.16566		
LDL	135	134	85.2889	16.31722	60.524	0.000	80.3037	9.65778	95.740	0.000
Right renal cortical echogenicity	135	134	1.3778	.72139			1.0370	0.22551		
LDL	135	134	85.2889	16.31722	60.530	0.000	80.3037	9.65778	95.740	0.000
Left renal cortical chogenicity	135	134	1.3778	.71097			1.0370	0.22551		
LDL	135	134	85.2889	16.31722	60.342	0.000	80.3037	9.65778	95.408	0.000
Right corticomedullary differentiation	135	134	1.1704	.41503			1.0000	0.00000		
LDL	135	134	85.2889	16.31722	60.346	0.000	80.3037	9.65778	95.408	0.000
Left corticomedullary differentiation	135	134	1.1704	.41503			1.0000	.00000		
LDL	135	134	85.2889	16.31722	58.634	0.000	80.3037	9.65778	91.798	0.000
Presence or absence of other renal pathology	135	134	3.1852	1.05226			4.0000	0.00000		

4. Discussion

Renal parameters might be affected by hypertension. Renal artery constriction, decreased blood flow, and eventual injury can result from persistently high blood pressure. Proteinuria, a decrease in glomerular filtration rate (GFR), and changes in electrolytic levels are all potential effects of this strain on renal parameters. Preventing kidney damage and ensuring adequate renal function requires careful management of hypertension. The results showed a statistically significant correlation between TC and various renal parameters (Table 1). Despite the fact that the left kidney is larger than the right, there were substantially different renal volume metrics between the two kidneys in the cooperation study ($p < 0.01$) [9]. Researchers discovered that there was a statistically significant relationship between TAG, HDL, LDL and a variety of kidney parameters (Tables 2-4). In the group of people with normal blood pressure, the variance in the right and left renal sonographic parameters was statistically significant; however in the

group of people with hypertension, this was not the case. The incidence of hypertension, which is a well-known modifiable risk factor of renal failure in recent times, as well as the absolute burden of this risk factor, is rapidly increasing all over the world, particularly in countries with low and intermediate incomes. It is possible to indirectly evaluate renal function or status using renal sonographic measures, as hypertension can indirectly affect the kidneys. When it comes to assessing the kidneys, ultrasound is a safe and low-cost option. Statistical analysis revealed a notable difference in cortical echogenicity between the hypertensives and controls; although 74.0% of hypertensives and 75.3% of controls exhibited elevated cortical echogenicity on the right and left kidneys, respectively, normotensives exhibited 28.0% and 26.0% [10]. In another study, there was also a statistically significant positive correlation between hypertension and renal echogenicity ($P = 0.006$), parenchymal thickness, and renal echogenicity ($P = 0.009$), and cortical thickness and renal echogenicity ($P = 0.008$) [11]. In our study, most of the respondents from urban area with high BMI which is

similar with another study, the results showed that, whereas 52.6% of the case group lived in urban areas, 47.4% lived in rural areas. The control group consisted of 50.4% city dwellers and 49.6% country bumpkins. In this particular case group, it was discovered that 51.11 per cent of the participants had a body mass index (BMI) higher than 26, 36.26% had a BMI between 22 and 26, and 9.63 per cent had a BMI below 22. Between 84.44% and 15.56% of the individuals in the control group had a body mass index (BMI) ranging from 22 to 26 [12].

Worldwide, hypertension is acknowledged as a critical contributor to the development of cardiovascular disease, stroke, diabetes, and renal diseases [13]. Obesity, glucose intolerance, and abnormalities in lipid metabolism are among the comorbidities that around 80% of hypertension patients experience. A study conducted in northern Bangladesh compared the lipid profile status of hypertension patients to healthy normotensive controls. The results showed that all three lipids, TC, TG, and LDL, were also high in the former group [14]. There is a substantial correlation between hypertension and dyslipidemia in the Bangladeshi population, although very little research has assessed this. According to a study conducted in rural parts of Bangladesh, approximately 17% of the population has a "high" total cholesterol concentration (>240 mg/dL or >6.2 mmol/L), 2% have a "high" low-density lipoprotein concentration (≥ 160 mg/dL or ≥ 4.2 mmol/L), and 67% have a "low" HDL concentration (<40 mg/dL or <1.04 mmol/L) [15].

5. Conclusions

Here, the research has established baseline values for renal parenchymal volume and cortical thickness in both hypertensives and non-hypertensives. Renal characteristics including renal parenchymal volume, cortical thickness, and renal length were associated with significantly higher TC, TAG, HDL, and LDL levels. The cerebral echogenicity was noticeably greater in hypertensives as compared to normotensives. Results demonstrate that essential hypertension significantly alters both cortical thickness and cortical echogenicity. In conclusion, we advise hypertension individuals to coordinate their sonographic results and to manage and avoid the adverse effects of excessive cholesterol on their kidneys.

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Authors' Contribution

Taibatul Kubba, Narayan Roy, and Murshed Ali devised the concept, conducted the statistical analysis, and composed the text. Examined and revised by Tanvir Ahmed and Abdul Awal. Revised and materials provided by the teaching assistant. The final manuscript was read and approved by all writers.

Ethics Approval and Consent to Participate

The study got ethical clearance from the Ethical Review Board from Institute of Biological Sciences (IBSc), University of Rajshahi, Bangladesh.

Conflicts of Interest

The authors declare that they have no competing interests.

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