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Original Research Article

Patterns of aldosterone, renin level and aldosterone/renin ratio in young hypertensive patients

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ABSTRACT

Background: Hypertension is a common disease that affects a vast and diverse patient group. Aldosterone, the primary human mineralocorticoid, is increasingly recognized as playing a key role in cardiovascular morbidity, and its involvement in hypertension has lately been evaluated by studies. It is estimated that it accounts for up to 13% of all hypertension patients and 20% of resistant hypertension cases. This study aimed to observe the patterns of aldosterone, renin level, and aldosterone/ renin ratio in young hypertensive patients.
Methods: This was a retrospective observational study and was conducted in the Department of Medicine Popular Medical College Hospital, Dhaka, Bangladesh during the period from June, 2023 to December, 2023. In our study, we included 124 hypertensive patients who visited the outdoor department of medicine of our hospital.
Results: In our study, we found mean age was 33.38±4.49 years. The majority (75%) of our patients were male. The mean SBP and DBP were 136.77±17.54 and 88.58±10.72 mmHg respectively. The mean aldosterone level was 148.74±125.91 pmol/L. The mean plasma renin activity and aldosterone to renin ratio were 10.03±12.04 ng/mL/hr and 22.98±28.66 respectively.
Conclusions: In our study, we aimed to determine the pattern of ARR ratio in young hypertensive patients. We found that aldosterone renin ratio (ARR) levels play a crucial role in identifying the etiological patterns of young hypertensive patients e.g. Conn's syndrome, Liddle's syndrome, etc.

Keywords: Aldosterone, Renin level, Aldosterone/renin ratio, Hypertension

INTRODUCTION

Hypertension is one of the most significant risk factors for cardiovascular diseases and the leading contributor to disability-adjusted life years globally, mostly by raising the risk of major cardiovascular events such as congestive heart failure, myocardial infarction, and stroke.[1-5] Secondary hypertension is known to be caused by primary hyperaldosteronism. It is estimated that it accounts for up to 13% of all hypertension patients and 20% of resistant hypertension cases.[6,7]

Since the 1950s, primary aldosteronism (PA) has been identified as a cause of hypertension. The existence of a severe hypertensive profile accompanied with hypokalemia was one of the most notable aspects when the first case was reported.[8] The relevance of identifying PA has been obvious in recent years due to the way it can cause hypertension as well as the harmful effects of aldosterone in numerous organs, including effects on the heart and blood vessels via nonepithelial receptors, independent of changes in blood pressure (BP).[9,10] In 1976, Dunn and Espiner suggested the first simultaneous measurements of serum aldosterone (SA) concentration, plasma renin activity (PRA), and the aldosterone/renin ratio (ARR) as a potentially viable screening test for PA.[11] The ARR is regarded to be an effective method for screening for PA.[12-14] The ARR is thought to be a good

technique for screening for PA.[12-14] The prevalence of PA increased from 1% when hypokalemia was used for screening to nearly 10% when the ARR was used for screening, and this figure was significantly greater in patients with severe or resistant hypertension.[6,7,15] The ARR, on the other hand, does not result in a clear diagnosis of PA. A confirmation test is required, and 30 to 50% of individuals with a positive ARR may exhibit aldosterone levels that are routinely lowered after confirmatory testing.[16]

Previous research has indicated that many people with essential hypertension have an active renin-angiotensin system (RAS).[17-19] However, the timing of RAS activation is unknown because limited evidence is available in young and healthy adults. If present, this suggests that RAS activation is a very early phase in hypertension development and might be used as a screening tool to identify persons at high risk for early-onset hypertension or as a target for preventive treatment. Furthermore, there is a scarcity of data linking RAS activation to ambulatory blood pressure (BP) indices or distinct hypertension classifications, which have been demonstrated to have varying correlations with cardiovascular outcomes. Some of these discrepancies could be explained by distinct RAS activation patterns.[20,21]

It has been shown that combined evaluation of renin and aldosterone levels ("RAAS-profiling") allows the detection of specific patterns, which can suggest the presence of specific forms of secondary hypertension.[22,23]

About thirty percent of hypertensive individuals have low-renin hypertension, which is characterized by multiple secondary causes of hypertension. So far, all monogenic types of hereditary hypertension that cause suppression of renin levels are associated with renal electrolyte management and excessive salt reabsorption. It has also been recognized that the most common type of secondary hypertension is primary aldosteronism, the classic case of low-renin hypertension.[24] As far as our knowledge no literature has been done to determine the pattern of aldosterone, renin, and ARR in hypertensive patients.

To address some of these issues, we aimed to observe the patterns of aldosterone, renin level, and aldosterone-to-renin ratio (ARR) in young hypertensive patients.

METHODS

This was a retrospective observational study and was conducted in the Department of Medicine, Popular Medical College Hospital, Dhaka, Bangladesh during the period from June, 2023 to December, 2023. In our study, we included 124 hypertensive patients who visited the outdoor department of medicine of our hospital.

Inclusion criteria

a) Patients aged between 21-40 years; b) Patients with hypertension; c) Patients with elevated aldosterone; d) Patients with higher plasma renin activity; e) Patients who were willing to participate were included in the study.

Exclusion criteria

a) Patients with uncontrolled DM and pregnancy; b) Patients with Coagulopathy; c) Patients with previous surgical history; d) Patients taking antihypertensive medications; e) Patients with any history acute illness (e.g., renal or pancreatic diseases, ischemic heart disease etc.) were excluded from our study.

Statistical analysis

All data were recorded systematically in preformed data collection form, and quantitative data was expressed as mean and standard deviation, and qualitative data was expressed as frequency distribution and percentage. Statistical analysis was performed by using SPSS (Statistical Package for Social Sciences) for windows version 10. A probability value <0.05 was considered as a level of significance. Ethical Review Committee of Popular Medical College Hospital, Dhaka, Bangladesh approved the study.

RESULTS

Figure 1 shows that the majority (38%) of our patients were aged between 36-40 years, followed by 34% and 21% of patients were 31-35 and 26-30 years old respectively. The least prevalence (7%) was found in patients aged between 21-25 years old.

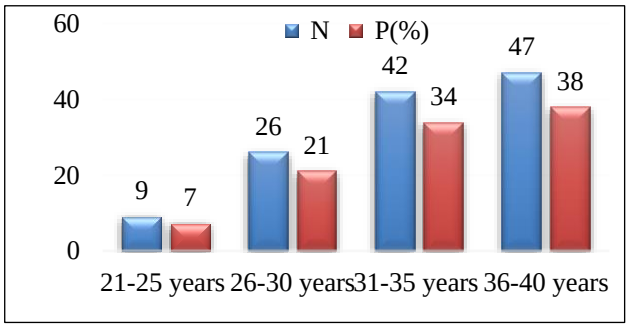

Figure 1: Age distribution of our study subjects.

In Figure 2 we showed the gender distribution of our study subjects. Most of our patients were male (75%) compared to female (25%). The male and female ratio was 3:1 in this study.

Table 1 shows the baseline characteristics of patients. We found the mean age was 33.38±4.49 years. The majority (62.90%) of our patients completed graduation. Among all patients 61.29% were smokers. The mean BMI was

26.36±3.95 kg/m^2. The mean SBP and DBP were 136.77±17.54 and 88.58±10.72 mmHg respectively. We found the mean heart rate 83±13 per minute. As a comorbidity, we found DM (33.87%), obesity (9.68%) and dyslipidaemia (29.03%).

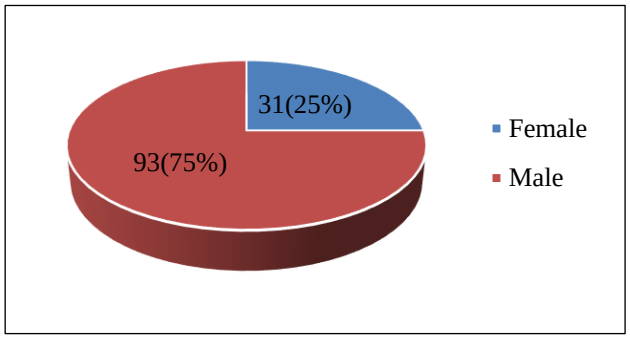

Figure 2: Gender distribution of our study participants.

Table 1: Baseline characteristics of our study subjects.

Baseline	N	P (%)
Mean age (years)	33.38±4.49	
Height (cm)	164.87±6.91	
Weight (kg)	73.33 ± 9.65	
BMI (kg/m^2)	26.36±3.95	
Education		
Illiterate	9	7.26
Primary education	13	10.48
Secondary education	24	19.35
Higher above	78	62.90
Smoking status		
Smoker	76	61.29
Non-smoker	48	38.71
Systolic blood pressure (mmHg)		
≥140	60	48.39
<140	64	51.61
Mean systolic blood pressure (mm Hg)	136.77±17.54	
Diastolic blood pressure (mmHg)		
≥ 80	116	93.55
<80	8	6.45
Mean diastolic blood pressure (mmHg)	88.58±10.72	
Heart rate (per minute)	83±13	
Comorbidities		
DM	42	33.87
Obesity	12	9.68
Dyslipidaemia	36	29.03

Table 2 shows the pattern of aldosterone level, renin level, and aldosterone renin ratio (ARR) among our study subjects. The mean aldosterone level was 148.74±125.91 pmol/L. The mean plasma renin activity was 10.03±12.04 ng/mL/hr. We found the mean aldosterone to renin ratio was 22.98±28.66 in our study.

Table 2: The pattern of aldosterone level, renin level, and ARR.

Variables	N	P (%)	P value
Aldosterone level (pmol/L)			
<200	107	86.29	
200-800	17	13.71	
>800	0	0	
Mean aldosterone level	148.74±125.91		>0.05
Plasma renin activity (ng/mL/hr)			
<0.7	9	7.26	
0.7-3.3	28	22.58	
>3.3	87	70.16	
Mean plasma renin activity	10.03±12.04		>0.05
ARR (ng/dL per ng/hour)			
<23.6	84	67.74	
>23.6	40	32.26	
Mean ARR	22.98±28.66		>0.05

DISCUSSION

Aldosterone is a steroid hormone that regulates sodium reabsorption, water retention, and blood pressure management.[25] Secondary hypertension is commonly caused by primary aldosteronism, which is characterized by increased aldosterone levels and reduced renin activity.[26]

The etiology of hypertension is unknown, but hereditary effects have been linked to 30 to 60% of cases.[27,28] Furthermore, among non-hypertensive offspring, a positive family history is a key risk factor for future hypertension, and the parental hypertensive antecedent predicts changes in offspring SBP during follow-up.[29,30] In our study, the majority (38%) of our patients were aged between 36-40 years. We found the majority (86.29%) of our patients had less than 200 pmol/L Aldosterone levels. In the present study, aldosterone levels decreased over age.

According to Alvarez-Madrazo et al the ARR is impacted by genetic and environmental factors, and the ethnic background of the group investigated should be taken into account.[31] Other research with other ethnicities should be conducted to establish applicable particular reference ranges for ARR.[32]

Renin is the first and crucial phase in the RAAS, and numerous experimental and clinical studies show that the RAAS can stimulate atherosclerosis by triggering basic reactions, ultimately leading to the growth, instability, and rupture of atherosclerotic plaques and the facilitation of thrombosis.[33,34] Excessive RAAS activation is widely known to cause organ damage, mostly through elevated Ang II and aldosterone levels.[35] The renin-aldosterone system alterations with age in normal persons are extensively known. The most noticeable alterations are witnessed at life's extremes.[36] In our study, plasma renin

activity was found more than 3.3 (ng/mL/hr) in most patients. There was an increased relationship between age and renin activity. Martinez-Aguayo discovered a negative relationship between age and PRA.[32] Wilson et al. observed similar findings, namely that PRA and active renin concentrations were inversely linked with age.[37] Furthermore, Fiselier et al evaluated basal PRA and active and inactive plasma renin concentrations in 89 healthy recumbent children aged 1 week to 16 years and discovered that active, inactive, and total renin concentrations decreased with age.[38] In terms of aldosterone, our findings are consistent with earlier studies that show a reduction in aldosterone levels with age.[39] However, in the NH group, aldosterone did not show a significant connection with age, which was likely due to family antecedents of hypertension or other factors that could influence aldosterone levels. Although the NN group showed a trend toward a positive association, the link between age and ARR did not achieve statistical significance. The small age range (4 to 16 years) and small number of patients were most likely insufficient to reveal a significant connection. Martinez-Aguayo's study discovered that high blood pressure was not substantially linked with ARR, which was consistent with recent findings by Li et al.[32,40]

Martinez-Aguayo also discovered that the percentage of body fat mass was inversely related to aldosterone and PRA. This was not detected with body mass index. The association was lost when the percentage of body fat mass was controlled by age. These findings show that changes in body composition were not a significant predictor of aldosterone or renin levels during childhood.[32]

No other literature reviews showed the patterns of aldosterone or renin levels in young hypertensive patients, so in our study, we aimed to do that. We found aldosterone levels and ARR ratio decreased over age while renin levels increased over age in our hypertensive patients.

This study has few limitations. Our study was a single-center study. We took a small sample size due to our short study period. We didn't find a pattern of ARR ratio in older patients and patients with a long history of hypertension. After evaluating those patients we did not follow up on them for the long term and do not know other possible interference that may happen in the long term with these patients.

CONCLUSION

In our study, we aimed to determine the pattern of ARR ratio in young hypertensive patients. We found that Aldosterone Renin Ratio (ARR) levels play a crucial role in identifying the etiological patterns of young hypertensive patients e.g. Conn's syndrome, Liddle's syndrome, etc.

Recommendations

We need to do further studies with a prospective and longitudinal study design including larger sample size to verify and evaluate the findings of our study.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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