

## FREQUENCY OF MASKED HYPERTENSION IN DIABETIC PATIENTS BY USING AMBULATORY BLOOD PRESSURE MONITORING DEVICE

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### **Contribution**

All the authors contributed significantly to the research that resulted in the submitted manuscript.

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### **ABSTRACT**

**Objective:** To determine the frequency of masked hypertension in normotensive type 2 diabetic patients by means of ambulatory blood pressure monitoring.

**Methodology:** A cross-sectional study was conducted in 230 normotensive patients with type 2 diabetes mellitus. Patients underwent 24 hour ambulatory blood pressure monitoring (ABPM). Patients with increased daytime blood pressure levels ( $\geq 135/85$  mmHg) were classified as having masked hypertension.

**Results:** The prevalence of masked hypertension was 31.7% (n=73). Normotensive and masked hypertensive subjects, based on ambulatory blood pressure, were not different in terms of age and diabetes duration. The office systolic blood pressure was higher in those with masked hypertension than in the normotensive group ( $128.8 \pm 8.5$  vs.  $123.9 \pm 9.2$  mmHg,  $p = 0.003$ ).

**Conclusion:** Upto one third of normotensive type 2 diabetic patients have masked hypertension according to ABPM. Therefore, ABPM is important to identify this high-risk group so as to be able to take interventional measures early on.

**Key Words:** Blood Pressure, Hypertension, Diabetes, Ambulatory BP Monitoring

## INTRODUCTION

Diabetes Mellitus (DM) and hypertension are a critical combination for the development of both macro and micro vascular disease. In people with type 2 DM, the prevalence of hypertension is 50% at the time of diagnosis, increasing to 80% in the presence of microalbuminuria and to >90% with macroalbuminuria.<sup>1</sup> This association can be explained on the basis of commonly shared risk factors such as central obesity, sedentary life style and family history.<sup>2</sup> In addition, nephropathy, insulin resistance and high levels of Gamma-GT increase the likelihood of occurrence of both.<sup>3</sup> Concomitant hypertension triples the already high risk of coronary artery disease(CAD), doubles total mortality and stroke risk, and may be responsible for up to 75% of all cardiovascular disease (CVD) events in people with DM.<sup>4</sup>

Studies World over have clearly demonstrated the superior efficacy of ABPM over clinic BP measurement with respect, not only to accuracy of BP readings for diagnosis and better management of hypertension but also to reduction in overall morbidity and mortality in hypertensive patients, the latter owing to its better correlation with end organ damage.<sup>5-7</sup> Thirty percent of normotensive type 2 DM patients may have masked hypertension i.e. greater than that in individuals without DM (10%-20%).<sup>8</sup> In previous reports in non-diabetic patients, masked hypertension has been associated with diminished sensitivity of arterial baro-reflex, aortic stiffness, increased left ventricle mass index, and cardiovascular mortality.<sup>8</sup> Likewise, type 2 diabetic patients with masked hypertension have a higher prevalence of high-normalalbuminuria, micro- and macroalbuminuria, and increased left ventricular wall thickness in comparison with normotensive patients.<sup>8</sup>

Before the ambulatory blood pressure monitoring (ABPM) became available, these patients were not detected and were believed to have the same risk for cardiovascular events as the normotensive diabetic population. However, emerging evidence shows that masked hypertension is associated with greater left ventricle wall thickness and increased cardiovascular mortality in comparison with normotensive individuals.<sup>8</sup> The simple office blood pressure evaluation cannot identify patients with masked hypertension and thus cannot provide them with the potential benefits of anti hypertensive treatment.<sup>8</sup> Moreover, type 2 diabetic patients with masked hypertension would probably benefit from anti hypertensive interventions, in the same way as has been demonstrated in pre-hypertension non-diabetic subjects and normotensive type 2 diabetic patients.<sup>8</sup>

We conducted this study with the aim to determine the frequency of masked hypertension in normotensive type 2 diabetic patients by means of ambulatory blood pressure monitoring.

## METHODOLOGY

This descriptive cross-sectional study included 230 patients of both genders ranging 30 to 70 years of age and was conducted in Diabetic clinic of Sheikh Zayed Post graduate Medical Institute/Hospital Lahore over a period of six months. The sample size was 100 cases, with 6% margin of error, 95% confidence level, taking expected percentage of masked hypertension in type 2 diabetics of 30%. The study included type 2 diabetics (diabetes duration of more than 2 years), having office blood pressure levels of <140/90 mm Hg on two occasions, at least two weeks apart, and on the day of study. The study excluded individuals with serum creatinine of greater than 1.5 mg/dl, those taking any medication known to affect blood pressure and those having postural hypotension. The oscillometric ambulatory blood pressure device (Tonoport V/2 CE 0482, Ref. 2001589-038) was applied to the subjects for 24 hours. Waking hours were taken from 6 am to 10 pm while sleeping hours were from 10 pm to 6 am. The device was preset to take readings every 30 minutes during waking hours and hourly during sleeping hours. Patients with mean daytime ambulatory blood pressure of >135/85 mmHg were regarded to have masked hypertension and those with <135/85 as normotensives.

Statistical analysis was performed using SPSS version 16. Numerical Variables were presented as mean ± SD. Categorical variables were presented as frequencies and percentages. Comparison between categorical variables was performed using chi square test while numerical variables was performed using student t test. P-value ≤ 0.05 was taken as statistically significant.

## RESULTS

Masked hypertension was found in 73 (31.7%) normotensive type 2 diabetic patients. Both groups (normotension and masked hypertension, based on ABPM) were not different regarding age and diabetes duration. There was an excess of male prevalence in the masked hypertension group (72% vs. 47%, p=0.005) (Table 1). The

**Table 1: Clinical Characteristics According to Blood Pressure Classification**

Variables	Normotension n = 157	Masked hypertension n = 73	P-value
Age (years)	55.2 ± 9.5	55.1 ± 8.7	0.941
Diabetes Duration (years)	8.5 ± 6.6	8.1 ± 5.2	0.762
Male subjects	32 (47%)	23 (72%)	0.005

office systolic blood pressure was higher in patients with masked hypertension ( $128.8 \pm 8.5$  vs.  $123.9 \pm 9.2$  mmHg,  $p=0.003$ ) (Table 2). The office diastolic blood pressure was comparable in the two groups. The day time blood pressure measurements were higher in the masked hypertension group ( $139.1 \pm 7.8$  vs.  $123.3 \pm 7.1$  mmHg,  $p<0.001$ ), as expected, because it was part of the definition of the group.

**Table 2: Blood Pressure Characteristics According to Blood Pressure Classification**

Variables	Normotension n = 68	Masked hypertension n = 32	P-value
<b>Office</b>			
Systolic Blood Pressure (mmHg)	123.9±9.2	128.8 ±8.5	0.003
Diastolic Blood Pressure (mmHg)	77.0±7.2	78.4 ±7.4	0.309
Pulse Pressure (mmHg)	46.9±9.2	50.4± 8.1	0.041
<b>24-hours</b>			
Systolic Blood Pressure (mmHg)	120.7± 7.3	135.8 ±9.5	< 0.001
Diastolic Blood Pressure (mmHg)	72.8±6.1	82.9±6.3	<0.001
Pulse Pressure (mmHg)	47.9±6.9	52.9±10.0	0.003
<b>Daytime</b>			
Systolic Blood Pressure (mmHg)	123.3 ±7.1	139.1±7.8	<0.001
Diastolic Blood Pressure (mmHg)	75.3 ±6.1	86.4±6.3	<0.001
Pulse Pressure (mmHg)	48.0 ±6.6	52.7±10.1	<0.001
<b>Night time</b>			
Systolic Blood Pressure (mmHg)	115.2±10.3	128.3± 14.3	<0.001
Diastolic Blood Pressure (mmHg)	66.5 ± 7.9	75.9 ± 9.5	<0.001
Pulse Pressure (mmHg)	48.7± 7.7	52.4 ±11.1	0.060

Masked hypertension group as compared to the normotension group also had significantly higher office pulse pressure, day time, night time and 24 hour systolic blood pressure, diastolic blood pressure, pulse pressure, systolic blood pressure load and diastolic blood pressure load ( $p<0.05$ ) (Table 2).

## DISCUSSION

Masked hypertension is reported to affect 10-20% of the population.<sup>9</sup> This large variation might be due to differences in the definition of normal ambulatory blood pressure levels as well as to variations in patient demographic characteristics, such as age and BMI.<sup>10</sup> The data from the Pressione Arteriose Monitorate e Loro Associazioni (PAMELA) study, a large cohort of individuals (n = 2,051) evaluated by ABPM showed a prevalence of 14.5% among normotensive non diabetic subjects.<sup>11</sup> The frequency of masked hypertension in the diabetic population was found to be much higher (30%) in Leitao et al, study.<sup>8</sup> In our study, the prevalence was even higher (32%) which can be explained by the higher prevalence of systemic hypertension in our general population.<sup>12</sup>

We obtained these results when we used 135/85 (mm Hg) as a cut off for the detection of hypertension, as in most studies using ABPM.<sup>9</sup> Had we used JNC VII criteria for diagnosis and treatment of hypertension in DM (130/80 mm Hg), the percentage would have been significantly higher, as was demonstrated in one of the study which showed a prevalence of 36.4%.<sup>13</sup> In previous reports in nondiabetic patients, masked hypertension has been associated with diminished sensitivity of arterial baroreflex, aortic stiffness (verified by carotid-femoral pulse wave velocity), increased left ventricle mass index, micro and macro albuminuria, and cardiovascular mortality.<sup>14</sup> Patients with masked hypertension have shown an adverse clinical and metabolic profile in some contexts.<sup>14</sup> In children and adolescents, the diagnosis of masked hypertension was associated with increased BMI and a parental history of hypertension.<sup>15</sup> In nondiabetic adults, there is a progressive increase in male sex prevalence, age, BMI, total cholesterol, and blood glucose throughout the spectrum of blood pressure abnormalities, from the truly normotensive group across the white-coat hypertensive, masked hypertensive, and truly hypertensive groups.<sup>11</sup> Moreover, most previous reports identified higher levels of office blood pressure in masked hypertension patients.<sup>11</sup> Based on this, it could be hypothesized that the worst outcomes found in the masked hypertension group are explained solely by higher office blood pressure levels because it is well known that there is no definite threshold for blood pressure and target-organ lesion, as the two variables have a continuous correlation.<sup>16</sup>

There are two practical implications of the present results. First, the simple office blood pressure evaluation cannot

identify patients with masked hypertension and thus cannot provide them with the potential benefits of anti-hypertensive treatment. Therefore, ABPM should be part of the initial evaluation of normotensive type 2 diabetic patients to identify those patients with masked hypertension. Second, type 2 diabetic patients with masked hypertension probably would benefit from anti-hypertensive interventions, in the same way as has been demonstrated in pre-hypertension nondiabetic subjects and normotensive type 2 diabetic patients in the Micro-Heart Outcomes Prevention Evaluation Study.<sup>17</sup>

## CONCLUSION

Upto one third of normotensive type 2 diabetic patients have masked hypertension according to ABPM. Therefore, ABPM is important to identify this high-risk group so as to be able to take interventional measures early on.

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