



STUDY ON USEFULNESS OF AMBULATORY BLOOD PRESSURE MONITORING IN CONTROLLED OFFICE BLOOD PRESSURE RECORDING IN DIABETIC PATIENTS

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ABSTRACT

BACKGROUND - Microvascular and macrovascular complication in diabetes due to hypertension needs strict blood pressure control. Office Blood Pressure (BP) measurements may be regarded as a surrogate measure for the "true BP" of the patient. Ambulatory blood pressure monitoring (ABPM) is a fully automated technique in which BP is recorded typically over 24 hours.

AIM - To evaluate the role of ABPM for assessing the frequency of masked hypertension in diabetic patients and the presence of control blood pressure in diabetic patients on hypertensive medication.

MATERIALS AND METHODS - A Prospective study on 90 in/out patients was conducted.

OBSERVATION AND RESULTS - masked hypertension - 32.2%, antihypertensive medication need or adjustment of dose - 41%, non dipping-53.3%

CONCLUSION - ABPM is a useful tool and superior to office BP reading in diabetic patients.

KEYWORDS : Ambulatory blood pressure monitoring, diabetic patients, masked hypertension.

BACKGROUND

Diabetes mellitus and hypertension are among the most common diseases and worldwide cardiovascular risks are on a rise as the age advances. Elevated blood pressure (BP) readings are a common finding in patients with type 2 diabetes mellitus.⁽¹⁾

The increasing incidence of both microvascular and macrovascular complication in diabetes due to hypertension needs strict blood pressure control. Traditionally, office blood pressure measurements have consisted of using a sphygmomanometer in a clinic or hospital. But any clinical measurement of BP may be regarded as a surrogate measure for the "true BP" of the patient. ABPM is a non-invasive, fully automated technique in which BP is recorded over an extended period of time, typically 24 hours.

A key advantage of ABPM over other methods is its ability to identify BP patterns (i.e. sustained, white-coat, masked, and nocturnal hypertension, and non-dipping or reverse-dipping BP) that cannot be detected with office BP alone. ABPM is particularly important for the management of hypertension in diabetic patients, since hypertension is a major risk factor for cardiovascular disease in these patients. Diabetic patients are more likely to be non-dippers, and therefore office BP measurements do not portray the real cardiovascular risk.⁽²⁾ White coat hypertension seems to be less frequent, and masked hypertension is more frequent in diabetic patients and is associated with increased organ damage.⁽³⁾

AIM AND OBJECTIVES

To evaluate the role of ambulatory blood pressure monitoring for:

- 1) To assess the frequency of masked hypertension in diabetic patients.
- 2) To evaluate the presence of control blood pressure in diabetic patients on hypertensive medication.

MATERIALS AND METHODS

A Prospective study was conducted on 90 patients seeking treatment as in-patients & out-patients units of Department of General Medicine and cardiology, Geetanjali Medical College and Hospital, Udaipur from April 2018 to October 2019.

Statistical Analysis was done using Chi Square Test and P value was derived for $P < 0.05$ we reject the null hypothesis that there is no difference between the means/parameters and conclude that a significant difference does exist.

INCLUSION CRITERIA:

- Normotensive diabetic patients (Blood pressure by sphygmomanometer less than 140/90mm Hg)
- Diabetic patient on hypertensive medication who are normotensive.
- Subjects providing written consent.

EXCLUSION CRITERIA:

- Age less than 18 years.
- Pregnant female
- Night worker

STUDY METHODS:

A detailed clinical and past history was taken. Demographic data such as age and sex were noted. Blood pressure recording was done as per JNC VIII recommendation. LED blood pressure machine used for office blood pressure measurement, which is properly calibrated and validated. An appropriately sized cuff is used. These patients underwent a thorough general physical examination and systemic examination. Laboratory investigations like fasting blood sugar, post prandial blood sugar, random blood sugar and HbA_{1c} were done. Continuous blood pressure monitoring was done by Ambulatory Blood Pressure Monitoring machine. The findings were noted on a predesigned and pretested proforma.

- The ambulatory blood pressure was monitored by using the ambulatory blood pressure monitor of Meditech Company of model ABPM-05.
- Patients are instructed to

- a) keep their arm steady during measurement,
- b) keep their arm at heart level during measurement,
- c) engage in normal activities between measurements,
- d) keep the monitor attached at night to place the monitor under a pillow or on the bed at night.

- The frequency of measurement was set to 30 minutes

inactive phase(during day time) and 1 hour during passive phase (during night time). The machine is removed after 24 hours.

- Number of measurements necessary: Day: > 14 systolic and diastolic blood pressure measurements. Night: > 7 systolic and diastolic blood pressure measurements.
- The measured values from the instrument were interpreted in the computer by Easy ABPM 1.1.1.5 software in which following data was analysed-

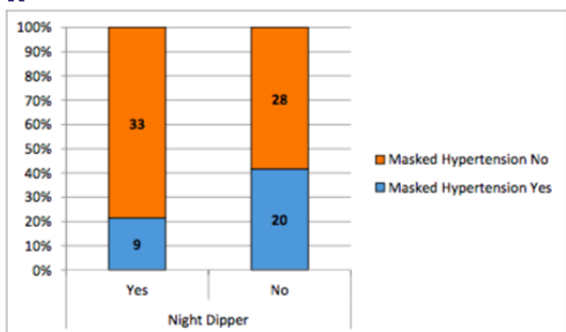
- Mean 24 hours blood pressure
- Mean day time systolic and diastolic blood pressure (active phase)
- Mean night time systolic and diastolic blood pressure (passive phase)
- Nocturnal dipping of blood pressure.
- Morning surge of blood pressure.
- Masked hypertension

RESULTS:

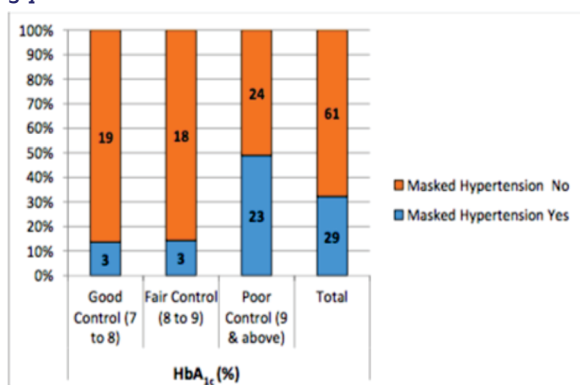
Table 1: Frequency of masked hypertension, nocturnal dipping and non dippers.

	Percentage (%)
Masked hypertension	32.2
Nocturnal dipping	46.7
Non dipper	53.3

Graph 1 : Correlation between night dipper and masked hypertension



Graph 2 : Correlation between masked hypertension and glycemic control



In the present study, we found 41% patients started on antihypertensive medication or adjustment of antihypertensive dosage and timing. Poor glycemic control were maximum (67.5%) among them.

DISCUSSION

Eguchiet al.⁽⁴⁾ conducted the study with mean age group of 67.8 with standard deviation of 9.6 years. Najafi et al.⁽⁵⁾ conducted the study which had mean age group of 58.1. In our study, the mean age is 54.12 with standard deviation of 14.456 years. The most common age group came to be between 40 – 54 years among male and 55 – 70 years among female patients.

In our study, 32.2% showed masked hypertension. Kaul et al.⁽⁶⁾ study conducted and showed 19.3% of masked hypertension. This variation could be because of larger study size conducted by Kaul et al.⁽⁶⁾ and one more explanation can be given that our study included only diabetic patients and Kaul et al.⁽⁶⁾ conducted cross sectional study included both non diabetic and diabetic patients.

Leitao CB et al.⁽⁷⁾ conducted the study on diabetic patients and showed correlation between glycemic control in diabetic patients and masked hypertension. 30 % of diabetic patients had masked hypertension and among non diabetic 10-20 % had masked hypertension. In our study, we found that 79.3% of total masked hypertension patients had poor glycemic control, which is statistically significant (p value =0.034). this higher value may be because we have taken diabetic patients only and poor glycemic patients are more to develop cardiovascular and micro-vascular complications, so these masked hypertension patients to be picked up by using ambulatory blood pressure monitoring for further management. Further more studies need to be done to validate this result.

In our study, we found that between non dippers, masked hypertension was found to be in 41.7 % as compared to 58.3 % among night dipping population. This result was found to be statistically significant after applying Pearson chi square formula which results into significant p value (0.04). It can be explained by the fact that if non dipping pattern present during night than patient tends to have raised blood pressure during the active phase and can cause cardiovascular complications. More studies needed on this correlation to validate this result.

Hiregoudaret al.⁽⁸⁾ study showed 47.1% non-dipping pattern. Najafi et al.⁽⁵⁾ also had 54.2% of non-dipping nocturnal pattern. We can conclude that approximately 50 % diabetic patients shows non dipping pattern, which is very significant finding. In our study, 46.7% showed normal dipping and 53.3% shows non-dipping pattern. Sleep and inactivity are the two common factors responsible for normal nocturnal dipping of blood pressure. Decrease in cardiac output, heart rate during sleep and unchanged or increase in systemic vascular resistance during sleep compared to day time results in nocturnal dipping. So, non dipping phenomenon can be explained if any alteration occurs in above mentioned variables i.e. diminished decrease in cardiac output in night, increase systemic vascular resistance or combination of both. One more reason for non dipping in diabetic patients can be given by autonomic dysfunctions.

E Nelajet al.⁽⁹⁾ conducted the study which also had significant correlation of night dipping with glycemic control. Duggal et al.⁽¹⁰⁾ conducted the study in type 2 diabetic patients and hypertensive patients and had 46% - non dipping, 45 % normal dipping, 3% - reverse dipping, 6% extreme dipping and found significant correlation of dipping with glycemic control (p value <0.01). In our study, when night dipping present in 46.7% and non dipping in 53.3% patients and when dipping compared with the glycemic control, we found that poorly controlled glycemic patients have significantly showed non dipping pattern and was statistically significant (p-value < 0.05). Our study correlates with the above studies. Nocturnal non dipping antedates the development of microalbuminuria and nephropathy and this finding can be used as a potential marker of impending nephropathy. It is also important to have strict glycemic control in diabetic patients and hypertension to reduce the associated morbidities and mortalities. More studies needed to be done to make proper conclusion.

Nuthalapatiet al.⁽¹¹⁾ conducted study among 122 diabetic patients had 88.52% of morning surge. Lyhne JM et al.⁽¹²⁾

conducted the study and found no correlation between diabetic and morning surge ($27.5 \pm 11.2\%$) when compared to non diabetic patients ($24.6 \pm 12.2\%$). Afsaret al.⁽¹³⁾ Conducted the study and found higher morning blood pressure surge in type2 diabetic patients compared to non diabetic patients (p value <0.0001). In our study, morning surge found to be in about 17.8% among diabetic patients. This result does not correlates with above studies. The background for these diversifying results are unclear, but one can relate to difference in age, HbA1c levels, antihypertensive medication (both number and type) and duration of diabetes. The usefulness of ambulatory blood pressure monitoring, which accurately detects the risk of morning surge, are needed in the future to cut down cardiovascular risk. More studies need to be done and more number of patients to be taken to make proper conclusion.

V Manea et al.⁽¹⁴⁾ concluded in his study that among non dipper increase risk of atherosclerosis and impairment of renal function is present, so best anti-hypertensive treatment should be given among diabetics. Cicek Y et al.⁽¹⁵⁾ conducted a cross sectional observational study of 84 untreated hypertensive patients showed higher pulse wave velocity among non dippers, suggesting that increase in the arterial stiffness in non dippers. So usefulness of ambulatory blood pressure monitoring in commencement of antihypertensive medication and change of timing of antihypertensive medication can be done and effect of medication can be reassessed. In our study, we found that 27 patients who showed non dipping pattern needed to review anti-hypertensive treatment or alteration in the treatment dose or timing, which is statistically significant (p value =0.002). More number of studies need to be done to make proper conclusion.

CONCLUSION

Diabetic patients are more prone to develop hypertension in long term. For this ABPM used to detect masked hypertension, non dipping pattern, morning surge, and early risk of hypertension and dose and timing adjustment of antihypertensive therapy.

Our study demonstrates convincing evidences regarding the usefulness of ABPM in diabetic patients over office blood pressure recordings. 32.2% patients who were under diagnosed among diabetic patients were successfully diagnosed hypertension (masked hypertension). ABPM is the only tool for assessing night dipping pattern which is associated with increased cardiovascular risk in diabetic patients. Our study had 53.3% patients of non dipping nocturnal blood pressure. ABPM is a valuable tool for assessing antihypertensive treatment and used to adjust the dosage and timing of antihypertensive therapy. So ABPM should be used more widely to detect and manage hypertension and prevent end organ damage.

REFERENCES:

1. Ferrannini E, Cushman WC. Diabetes and hypertension: the bad companions. *The Lancet*. 2012 Aug 11;380(9841):601-10.
2. Gorostidi M, de la Sierra A, González-Albarrán O, et al. Spanish Society of Hypertension ABPM Registry investigators Abnormalities in ambulatory blood pressure monitoring in hypertensive patients with diabetes. *Hypertens Res* 2011;34: 1185-189.
3. Pierdomenico SD, Cuccurullo F. Ambulatory blood pressure monitoring in type 2 diabetes and metabolic syndrome: a review. *Blood Press Monit* 2010;15:1-7.
4. Kazuo Eguchi, Joji Ishikawa, Satoshi Hoshida, Thomas G. Pickering, Joseph E. Schwartz, Kazuyuki Shimada et al. Nighttime Blood Pressure Variability is a Strong Predictor for Cardiovascular Events in Patients with Type 2 Diabetes. *Am J Hypertens*. 2009; Jan ; 22:1.
5. Mohammad Taghi Najafi, Pegah Khaloo, Hamid Alemi, Asma Jaafarinia, c Michael J. Blaha, Mohammad hassan Mirbolouk et al Ambulatory blood pressure monitoring and diabetes complications. Targeting morning blood pressure surge and nocturnal dipping. *Medicine*. 2018 ;97:38.
6. Kaul U1, Arambam P, Rao S, Kapoor S, Swahney JPS, Sharma K. Usefulness of ambulatory blood pressure measurement for hypertension management in India: the India ABPM study. *Journal of Human Hypertension*. 2019.
7. Cristiane Bauermann Leitão; Luis Henrique Canani; Sandra Pinho Silveiro;

- Jorge Luiz Gross. Ambulatory blood pressure monitoring and type 2 diabetes mellitus. *Arquivos Brasileiros de Cardiologia*. 2007;89:315-21
8. Narendra Hiregoudar, Uday ShubashBande, Basavraj Baligar, Abhishek M. Study On Ambulatory Blood Pressure Monitoring in Type 2 Diabetic Patients With Hypertension. *Journal Of Evidence Based Medicine And Healthcare*. 2017; 4:2507-10.
9. B. Bouhanick, V. Bongard, J. Amar, S. Bousquel, B. Chamontin. Prognostic value of nocturnal blood pressure and reverse-dipping status on the occurrence of cardiovascular events in hypertensive diabetic patients. *Diabetes & Metabolism* (2008) ; 34:560-67.
10. Duggal A, Bal BS, Navpretsingh. Stud of non dipping pattern in patients of type 2 diabetes mellitus with hypertension and its association with microalbuminuria. *Annals of international medical and dental research*, 2017 Jan; vol 3(2):20-4.
11. Nuthalapati RK, Indukuri BR. Indian. Association between glycemictrol and morning blood pressure surge with vascular endothelial dysfunction in type 2 diabetes mellitus patients. *Journal of Endocrinology and Metabolism*. 2016 Apr; 20(2): 182-8.
12. Lyhne JM, Laugesen E, Høyem P, Cichosz S, Christiansen JS, Knudsen ST, Hansen KW, Hansen TK, Poulsen PL. Morning blood pressure surge and target organ damage in newly diagnosed type 2 diabetic patients: a cross sectional study. *BMC endocrine disorders*. 2015 Dec; 15(1):77.
13. Afsar B, Elsurer R. The relationship between central hemodynamics, morning blood pressure surge, glycemic control and sodium intake in patients with type 2 diabetes and essential hypertension. *Diabetes research and clinical practice*. 2014 Jun 1; 104(3):420-6.
14. Manea V, Pop C, Pop L. High prevalence of non dippers hypertensive diabetic patients: The role of ambulatory blood pressure monitoring in effective treatment. *Atherosclerosis*. 2016 Sep 1; 252:e142.
15. Cicek Y, Durakoglugil ME, Kocaman SA, Cetin M, Erdogan T, Dogan S, Ugurlu Y, Canga A. Non-dipping pattern in untreated hypertensive patients is related to increased pulse wave velocity independent of raised nocturnal blood pressure. *Blood pressure*. 2013 Feb 1; 22(1):34-8.