Ambulatory monitoring of blood pressure and pregnancy outcome in pregnant women with white coat hypertension in the third trimester of pregnancy

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ABSTRACT

Introduction: If the blood pressure of a pregnant woman is ≥140/90 mmHg at the clinic, but her ambulatory blood pressure is less <135/85 mmHg at daytime and <125/75 at night and her average ambulatory in 24 hours is <130/80 mmHg, her high blood pressure at clinic is considered white coat hypertension.
Objectives: To evaluate the value of ambulatory blood pressure monitoring in pregnant women.
Patients and Methods: This prospective cohort study was conducted in Imam-Khomeini hospital of Ahwaz, Iran between 2011 to 2012. A total of 105 pregnant women who had blood pressure of higher than 140/90 mmHg during the third trimester of pregnancy were monitored. Thirty five women with white coat hypertension, 35 women with gestational hypertension and 35 women with normal blood pressure were followed. The data were analyzed using the Kolmogorov-Smirnov test, Pearson correlation coefficient and Chi-square tests.
Results: The prevalence of white coat hypertension was 31.3%. The maternal and neonatal outcomes and laboratory examinations in white coat hypertension were similar to the normal blood pressure, but the frequency of caesarean section was more than the other two groups.
Conclusion: The findings of the study indicate the efficacy of 24 hour holter monitoring of blood pressure and using it more comprehensively , compared to the limited visits.

Implication for health policy/practice/research/medical education:
Prospective cohort study indicated the efficacy of 24-hour holter monitoring of blood pressure and using it in a more comprehensive way compared to the limited visits.

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Introduction

Hypertension (HTN) occurs in approximately 5-10% of all pregnancies. Among a wide variety of the causes of high blood pressure (BP) in pregnancy, preeclampsia syndrome, whether alone or in the form of added on the chronic hypertension, is considered as the most hazardous condition (1).
In developed countries, hypertensive disorders are responsible for around 16% of maternal deaths, and the important concern is that more than half of these deaths are associated with high BP that can be prevented (2-4). Gestational HTN is defined when BP of ≥140/90 mmHg is detected for the first time during pregnancy (5).

All current clinical criteria are usually based on the mean of at least two seated BP measurements during two outpatient visits. Generally, the results of home monitoring or 24-hour ambulatory BP measurements are lower than the clinical measurements (6-8). Since the mobile devices measure BP several times during the day and at night, these devices are considered as more comprehensive assessment tools compared with limited visits (9-14).
A growing body of evidence suggests that, the home monitoring, during work hours at office or ambulatory BP measurements have a better relationship with the end-organ damages compared to the measurements of the physicians'

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office or clinics (15-17).

If the BP of a pregnant woman is ≥140/90 mmHg, but the ambulatory measured value during the day is lower than 135/85 mmHg, less than 125/75 mmHg at night, and during the first 24-hour is less than 130/80 mmHg, this BP is considered as white coat or office only HTN. White coat HTN happens due to the adrenergic transient response to the stressful condition of measuring the BP in the physician's office (18-20).

One of the key variables that often remains far from the mind is the used method of the study and the necessity to standardize the measurements. White coat or office only HTN occurs in about 30% of the patients (21-26). Household tools or 24-hour ambulatory monitoring devices are often proper tools for those patients that have normal BP out of the physician's office or clinic (15,27-29).

In the study conducted by Bellomo et al, it was found that, the prevalence of white coat hypertension was 29.2% (20). In another study conducted by Mc Grath et al, the outpatient monitoring of blood pressure in predicting the pregnancy outcome was evaluated. Adverse pregnancy outcomes, including the incidence of preeclampsia, intrauterine growth retardation (IUGR) and preterm delivery were compared between two groups of with white coat hypertension and those with gestational hypertension. Undesirable consequences were significantly more common in the gestational hypertension group (30).

Objectives
The present study aimed to evaluate 24-hour ambulatory monitoring of blood pressure by holter monitoring devices in patients with white coat hypertension and also to evaluate the prevalence of white coat hypertension among the pregnant women and its effect on pregnancy outcomes.

Patients and Methods
Patients
This was a prospective cohort study. A total of 105 pregnant women, who had BP of more than 140/90 mmHg during the prenatal visits in the third trimester of pregnancy in two visits and at least two times with a time interval of five minutes, were studied.

The total number of samples was 105 women: thirty five pregnant women with white coat hypertension, 35 pregnant women with gestational hypertension and 35 pregnant women with normal blood pressure.

Measurement of blood pressure
After explaining the objectives and details of the study, if the patients agreed to take part, the consent forms were obtained and they were enrolled. The BP measuring method included measuring twice with a five minute interval while the patient seated upright in a chair and t her arm kep at heart level. An adult size of BP cuff was used to measure blood pressure. The patient's right arm was used to measure BP. Then these patients underwent the 24-hour ambulatory monitoring of blood pressure with a Holter monitoring device (Agillis, Australia). Holter monitoring device was comprised of a small and special pressure gauge, which at first was programmed and set by a computer and then it was connected to the patient. In the specified intervals while the patient was busy with everyday activities, every half hour during the day and every two hours

during the night for 24 hours, the device was set to measure the blood pressure.

Out of the 105 pregnant women, who were undergoing Holter monitoring device, 47 people had negative holter results and 103 people had positive Holter results. Out of the 47 people with negative Holter results, 35 women who had blood pressure less than 125/75, 135/85 and 130/80 mmHg during the day, night, and 24 hours, respectively, entered the study as group of white coat hypertension (negative Holter group). Also, out of 103 patients with positive results during the outpatient monitoring, 35 patients, who had blood pressure higher than the above mentioned values, entered the study as gestational hypertension (positive Holter group). Furthermore, 35 pregnant women who were diagnosed with normal blood pressure alone, entered the study as the control group.

Laboratory tests
To compare the outcomes of pregnancy, up to the end of the pregnancy, these three groups were followed every two weeks and their blood pressure, complete blood count (CBC), liver enzymes, creatinine and proteinuria were assessed.

Finally, duration of pregnancy, the rout of delivery (cesarean section, normal vaginal delivery with or without induction), the incidence of preeclampsia and eclampsia, the preterm labor, duration of maternal and neonatal hospitalization, the weight of the their babies, intrauterine fetal death and laboratory examinations among three groups were studied and compared among the studied groups.

Definition of preeclampsia and eclampsia
Preeclampsia was defined as blood pressure of equal to or more than 140/90 mmHg after 20 weeks of gestation along with proteinuria equal to or more than 300 mg in 24 hours. Eclampsia was defined as having a seizure episode non-attributable to other causes in women with preeclampsia. Preterm labor was defined as the baby's birth before 37 weeks of the pregnancy; intrauterine fetal death was defined as fetal death after 20 weeks of gestation; and low birth weight (LBW) was defined as birth weight between 500 and 2500 g.

Ethical issues
The research followed the tenets of the Declaration of Helsinki. Written informed consent was obtained from all patients. This study was approved by ethical committee of Ahvaz Jundishapur University of Medical Science.

Statistical analysis
The Kolmogorov-Smirnov test was used to identify the normal distribution of variables and ANOVA test was used to compare the means of the three groups. Furthermore, Pearson correlation coefficient and Chi-square tests were used for comparing qualitative variables between the three groups. Data analysis was performed using SPSS version 19.0 software and the P-values ≤ 0.05 were considered statistically significant.

Results
In our study the prevalence of white coat hypertension was 31.3%. Among the variables investigated, the time of termination of pregnancy, the baby's weight at birth, the number of babies and maternal hospitalization days (Table 1).

The mean weight of babies, born in the gestational hypertension group was significantly less than the other two groups (p= 0.004). The neonatal hospitalization duration (Table 1) in the gestational hypertension group was significantly more than the other two groups (p= 0.01). As shown in Table 2, the Cesarean section procedure in the white coat hypertension group was significantly more common than the other two groups. There was no significant difference in the average proportion of the incidence of intrauterine death (Table 3; p= 0.13) among the groups. The average incidence of preeclampsia and eclampsia (Table 3) in the gestational hypertension group were significantly more than the other two groups (p= 0.01, p= 0.0003, p= 0.012, and p= 0.005, respectively). Normal vaginal delivery was significantly more common in the normal pregnancy group. Induction procedure was significantly more common in the gestational hypertension group (p= 0.012). The average ratio of occurrence of reducing the number of platelets, increased creatinine, the incidence of abnormal liver function test and albumin in the random urine (Table 3) in the gestational hypertension group was significantly higher than the other two groups (p= 0.005, p= 0.0001, p= 0.0001, and p= 0.0001, respectively).

Discussion

This study showed that, the prevalence of white coat hypertension in pregnant women was 31.3%. That mentioned prevalence was slightly more than non-pregnant population

(20). Only in the study conducted by Parati *et al*., prevalence of white coat hypertension was more common than our study (24). However, the frequency of caesarean of pregnants with white coat hypertension was more often than pregnants with normal blood pressure and the those with high blood pressure of pregnancy. The cause of an increase in the caesarean section in the group of white coat hypertension was hard to interpret, although in the group of white coat hypertension may be due to the decision on how to end a pregnancy based on the measurement of blood pressure in the physician's office or clinic. Another cause for it, is the common and a normal blood pressure increase in passing of blood pressure around the pregnancy term.

In the study conducted by Bellomo *et al.* on how to end a pregnancy in the white coat hypertension, it was shown that the frequency of the termination of the pregnancy using the cesarean section technique in the group of the white coat hypertension was more than the gestational hypertension and normal blood pressure groups (20). In the study by Mc Grath *et al.* the consequences of prenatal in white coat hypertension was desirable, and undesirable outcomes such as low birth weight, IUGR and premature pregnancy in the gestational hypertension group were more common (30). In Parati *et al.* study of pregnancy outcomes in white coat hypertension, adverse outcomes such as prematurity and preterm labor and intrauterine fetal death (IUFD) in white coat hypertension were not observed (24).

Table 1. Mean ± SD duration of gestation, birth weight and infant and maternal hospital stay in the pregnant women studied

Group	Duration of gestation (Week and day)		Birth weight (Gram)		Length of infant 's hospital stay (Day)		Length of mother 's hospital stay (Day)	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
White coat hypertension	39w+4d	0.382	3300	1.987	1.7	1.481	1.5	1.912
Gestational hypertension	3d38+w	1.281	2900	1.754	4.2	1.658	5.9	2.156
Normal blood pressure	39w+3d	0.3101	3350	1.645	1.2	2.893	1.2	2.893
P-value		0.01		0.004		0.01		0.0003

Table 2. Comparison of the rout of delivery in pregnant women

Group	Cesarean (%)	Normal vaginal delivery	Inductive	P-value
White coat HTN	45.7	48.6	5.7	
Gestational HTN	40	48.6	11.4	0.012
Normal blood pressure	11.4	82.9	5.7	

Table 3. Comparison of the incidence of pre eclampsia, eclampsia, preterm labor, low birth weight, intrauterine fetal death, reduced platelet, increased Keratin abnormal liver function test, urinary aluminum and preterm delivery in pregnant women studied

Group	Pre-eclampsia (%)	Eclampsia (%)	Preterm labor	Low birth weight	Intrauterine fetal death	Reduced platelet	Increased Keratin	Abnormal liver test	Urinary aluminum
White coat HTN	5.7	0	0	0	0	0	0	0	0
Gestational HTN	60	2.9	14.3	14.3	5.7	14.3	25.7	60	57.1
Normal blood pressure	8.5	0	0	0	0	0	0	0	0
P-value	0.0001	0.0001	0.005	0.005	0.13	0.005	0.0001	0.0001	0.0001

In our study, the abnormal laboratory results, including reducing the number of platelets, increased creatinine, the abnormal liver function tests and albumin in the random urine of pregnant women with gestational hypertension were observed, however, the impaired laboratory results were not observed in people with white coat hypertension and the pregnant women with normal blood pressure. Similar results were also obtained in other studies, including the study of Bellomo et al. (20). Also abnormal results were not observed in the laboratory examinations of white coat hypertension in the study conducted by Hodgkinson et al. (7).

The impaired liver enzymes, platelet count, and creatinine were not observed in the laboratory examinations in the study of Mark et al. on the white coat hypertension (15). Our study showed that, risks of preeclampsia and eclampsia were higher in pregnant women with gestational HTN than pregnant women with white coat hypertension or pregnant women with normal blood pressure. Additionally, the duration of the pregnancy and duration of the mother's hospitalization and preterm labor was more common in the gestational hypertension group than other groups. In the study of Bellomo et al. on maternal results of the white coat hypertension, the risks of preeclampsia and eclampsia in white coat hypertension group were significantly less than gestational hypertension group (20). Jose et al. studied the adverse maternal outcomes such as preeclampsia and eclampsia in white coat hypertension and observed that they were significantly lower in gestational hypertension group (11).

In analyzing the neonatal results in our study, low birth weight and the hospitalization duration of newborns in the hospital in the gestational hypertension group was more than the other two groups. In this study, we have shown that the weight of the baby has a direct relationship with the results of the monitoring Holter set. Therefore, in the positive Holter set group, the baby weight was less than the negative Holter set group. Bellomo et al, also considered the incidence of low birth weight and the lower Apgar of the minute one and more duration of hospitalization of baby in hospital in the white coat hypertension group. They found that, these were significantly less in the gestational hypertension group (20). In the study of Mark et al., adverse neonatal outcomes such as low weight at birth and the lesser duration of hospitalization in white coat hypertension group, were significantly lower than the gestational hypertension (15).

Conclusion
Our study showed the higher incidence of white coat hypertension and therefore the utility of ambulatory 24-hour blood pressure monitoring in its detection. In white coat hypertension, pregnancy outcome was similar to the pregnant women with normal blood pressure. The 24-hour ambulatory blood pressure monitoring will provide more comprehensive information and it will followed by ensuring the favorable outcome of pregnancy in women with white coat hypertension.

Limitations of the study
One of the limitations of the study was the limited number of visits of patients. Principally, it was due to the need for more visits to select the patients (for example, three visits instead of two visits on arrival to study). It was also necessary to educate

pregnant women and encourage them to come for more follow up visits during pregnancy.

References
1. Martin J, Thigpen B, Moore R, Rose C, Cushman J, May W. Stroke & severe preeclampsia and eclampsia, a paradigm shift focusing on systolic blood pressure. Obstet Gynecol 2005; 105: 246-54.
2. Khan K, Wojdyla D, Say L, Gulmezoglu M, Van Look P. WHO Analysis of causes of maternal death. Lancet 2006; 367: 1066-74.
3. Berg C, Chang J, Callaghan W, Whitehead S. Pregnancy related mortality in the united states. Obstet Gynecol 2003; 101: 289-96.
4. Berg C, Harper M, Atkinson S, Bell E, Brown H, Hage M, et al. Preventability of pregnancy related death. Obstet Gynecol 2005; 106: 1228-34.
5. National High Blood Pressure Education Program, Working Group report on high blood pressure in pregnancy. Obstet Gynecol 2000; 183: S1-S22.
6. Nasothimiou E, Tzamouranis D, Roussias L, Stergiou G. Home versus ambulatory blood pressure monitoring in the diagnosis of clinic resistant and true resistant hypertension. J Hum "Hypertens 2012; 26: 696-700.
7. Hodgkinson J, Mant J, Martin U, Guo B, Hobbs F, Deeks J, et al. Relative effectiveness of clinic and home blood pressure monitoring in diagnosis of hypertension: systemic review. BMJ 2011; 342: d3621.
8. Nimrta G, Patrick C, William B. Role of ambulatory and home blood pressure recording in clinical practice. Curr Cardiol Rep 2009; 11: 414-21.

9. Dianna E, Ramon C, Hermida R, Jose R, Ines S, Rafael U. Ambulatory blood pressure monitoring for early identification of hypertension in pregnancy. Chronobiol Int 2013; 30: 233-59.

10. Head G, McGrath B, Mihailidou A, Nelson M, Schlaich M, Stowasser M, et al. Ambulatory blood pressure monitoring in Australia. J Hypertens 2012; 30: 253-66.

11. Boggia J, Hansen T, Asayama K, Luzardo L, Staessen J. White coat hypertension on automated blood pressure measurement. J Hypertens 2011; 1: 17-21.

12. Jose B, Tine W, Kei A, Leonell L, Yan L. White coat hypertension & home blood pressure monitoring. Eur J Cardiovasc Med 2001; 301-15.

13. Bar J, Maymon R, Padoa A, Wittenberg C, Boner G, Ben Z, et al. White coat hypertension and pregnancy outcome. J Hum Hypertens 1999; 13(8): 541-5.

14. Brown M, Robinson A, Jones M. The white coat effect in hypertensive pregnancy, much ado about nothing. Br J Obstet Gynaecol 1999; 106: 474-80.

15. Mark A, Lee G, Tine W, Martin C. Ambulatory blood pressure monitoring. JAMA 2001; 64: 263-71.

16. Head G, Mihailidok A, Duggan K, Beilin L, Berry N, Brown M, et al. Definition of ambulatory blood pressure target for diagnosis and treatment of hypertension in relation to clinic blood pressure, prospective cohort study. BMJ 2010; 340: c1104.

17. Gaboriean V, Delarche N, Gosse P. Ambulatory blood pressure at home, correlation with target organ damage. J Hypertens 2008; 26: 1919-27.

18. Carney S, Gillis A, Garvey L, Smith A. Direct comparison of repeated same day self and ambulatory blood pressure monitoring. Chronobiol Int 2005; 10: 151-6.

19. Hermida R, Ayala D. Prognostic value of ambulatory blood pressure monitoring for diagnosis of hypertension in pregnancy. Chronobiol Int 2004; 2: 375-91.

20. Bellomo G, Narducci P, Rondoni F, Pastorelli G, Stangoni G, Angeli G, et al. prognostic value of 24 hour blood pressure in pregnancy. JAMA 1999; 282: 1447-52.

21. Abir S, Zainis S, Tazi M, Bendahmane S, Bensaoud O, Benomar M. Prevalence and predictors of white coat hypertension in large database of ambulatory blood pressure monitoring. East Meditter Health J 2009; 15: 400-7.

22. Pickering T, White W, Giles T, Black H, Izzo J, Materson B, et al. Home and ambulatory blood pressure monitoring, when and how to use self and ambulatory blood pressure monitoring. J Am Soc Hypertens 2008; 2: 119-24.

23. Brown M, Mangos G, Davis G, Homer C. The natural history of white coat hypertension during pregnancy. BJOG 2005; 112: 601-6.

24. Parati G, Bilo G, Mancia G, Asmar R, Mallion J, Mengden T. Prognostic and diagnostic value of ambulatory blood pressure monitoring in hypertension. Elsevier Inc 2005: 305-17.

25. Dolan E, Stanton A, Thijs L, Hinedi K, Atkins N, McClory S, et al. Superiority of ambulatory over clinic blood pressure measurement in predicting mortality. J Hypertens 2005; 46: 156-61.

26. Tice J, Dolan E. Utility of ambulatory blood pressure monitoring. California Tech assessment 2004;19:28-47.

27. Marchiando R, Pharm D, Elston M. Automated ambulatory blood pressure monitoring. Am Fam Physician 2003; 67: 2343-51.

28. O'Brien E, Asmar R, Beilin L, Mancia G, Imai Y, Mallion J, et al. European Society of Hypertension recommendations for conventional, ambulatory and home blood pressure measurement. J Hypertens 2003; 21: 821-48.

29. O'Brien E. Ambulatory blood pressure monitoring in the management of hypertension. Heart 2003; 89: 571-6.

30. Mc grath B, Mark A, Robinson M, Sutton K. Ambulatory blood pressure monitoring. Med J 2002; 176: 588-92.