Clinical application of ambulatory blood pressure measurement in pregnancy

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Eclampsia and pre-eclampsia are the most important obstetric causes of maternal mortality in the Western world. The current definitions of hypertensive disorders in pregnancy rely on arbitrary blood pressure limits based on intermittent clinic readings which are subject to bias and error. Twenty-four-hour ambulatory blood pressure monitoring can overcome many of these deficiencies but has only recently been introduced into antenatal care. Five pregnancy studies using ambulatory blood pressure monitoring are currently underway in Birmingham, Glasgow, Grenoble, Oxford and Dublin. The results so far indicate that ambulatory blood pressure monitoring is an acceptable method of measuring blood pressure in pregnancy. It is also concluded that ambulatory blood pressure monitoring may have several roles in the future antenatal management of hypertension, including modification of existing classification systems, a clinical confirmatory role and a possible predictive role for pre-eclampsia.

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Introduction

Eclampsia and pre-eclampsia are the most important obstetric causes of maternal mortality in the Western world [1–3]. There are approximately 180 cases of eclampsia every year in Britain [4]. For this reason, the conventional technique of blood pressure measurement in the antenatal clinic or doctor's surgery is one of the most frequently used screening tests in pregnancy [5].

The successful diagnosis of hypertension in pregnancy, and the decisions arising from it regarding investigation, treatment prognosis and epidemiological conclusions depend on accurate measurements. Inadequate knowledge about blood pressure and its behaviour or a poor understanding of measurement techniques may lead to major errors in practice. This, in turn, may influence obstetric management and subsequent maternal and fetal progress [6]. To compound the problem of measurement even further, obstetricians are guided mainly by diastolic blood pressure in the diagnosis and management of hypertension in pregnancy [7], yet there has been confusion about how diastolic pressure should be measured in pregnancy, whether it should be recorded when Korotkoff sounds are muffled (phase IV) or at the point of disappearance (phase V) [8].

Current definitions of hypertension in pregnancy give an illusion of precision where none exists. What is pre-eclampsia? Hypertension is categorized by either an absolute threshold or by a blood pressure increase from baseline in the first half of pregnancy. Since blood pressure is very variable, any one reading, however carefully and accurately taken, may deviate significantly from the representative level for that patient. Definitions that depend on a numeric threshold arbitrarily imposed on a continuous spectrum of change create artefacts around the chosen threshold.

What then, is the normal blood pressure in pregnancy? Ambulatory blood pressure readings may help to answer this question, as the technique uses the average of a large number of readings taken under standard conditions. Besides correcting for observer variability and bias, ambulatory blood pressure measurement also reduces white-coat hypertension.

Review of current studies

Five centres in Western Europe are currently investigating the application of 24-h non-invasive automatic ambulatory blood pressure monitoring in pregnancy.

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These include units in Birmingham [9], Glasgow [10], Grenoble [11], Oxford [12] and Dublin [13].

The Birmingham study [9] is a cross-sectional study involving 12 patients, nine normotensives, one woman with pre-eclampsia, one with gestational hypertension and one with gestational proteinuria. The SpaceLabs 90207 monitor (Redmond, Washington, USA) was used to perform ambulatory blood pressure measurements. Two patients defaulted during the study. In the patient with pre-eclampsia the diurnal variation was reversed, and both the other patients with abnormal pregnancies showed a reduced and briefer nocturnal fall in blood pressure. The technique of ambulatory blood pressure monitoring was shown to be an acceptable method of measuring blood pressure in pregnancy, and an extensive longitudinal study of 24-h ambulatory monitoring in pregnancy is now underway.

The Glasgow study [10] is a cross-sectional study comparing 24-h and daytime ambulatory measurements by the SpaceLabs 90207 recorder with standard measurements taken in the clinic. This study also compared daytime and night-time averages in hypertensive pregnancy with those in non-pregnant women. In nine hypertensive pregnant women the clinic readings were significantly higher than the 24-h ambulatory blood pressure averages. The nocturnal falls in blood pressure were not significantly different between the pregnant and non-pregnant women. The ambulatory blood pressure monitors were well tolerated. The Glasgow group now propose to define a normal range of ambulatory blood pressure in pregnancy and to evaluate its use in the management of pregnancy associated with hypertension.

The French study [11] is a longitudinal multicentre study involving a cohort of 49 women who underwent three ambulatory blood pressure monitoring events during the third, sixth and eighth months of pregnancy. The recorders used were SpaceLabs 90207 and the Novacor Diasys 200 (Malmaison, France). The purpose of the study was to provide a statistical interpretation of ambulatory blood pressure in pregnancy. The reference data are presented as the mean, standard deviation, one-tail 95% confidence intervals and 90th percentile of data distribution by month of pregnancy. No patient in the cohort developed pre-eclampsia and accordingly it was not possible to assess the prognostic value of ambulatory blood pressure monitoring.

The Oxford/Queen Charlotte study [12] is a longitudinal study with ambulatory blood pressure monitoring at 18 and 28 weeks of gestation. The recording monitor used is the Takeda-2420 (Tokyo, Japan) [14]. The study is still underway, with the aim of recruiting 150 women with no history of hypertension, renal disease or diabetes who are not taking any medication. So far 140 women have been recruited, 72 of whom have now delivered including 53 with a normal pregnancy who underwent both blood pressure recordings. Analysis of these 53 patients has shown a small but significant rise in mean waking systolic and diastolic blood pressure and the heart rate between 18 and 28 weeks. Sleeping blood pressure and the pulse rate were significantly lower than waking values in both the monitoring sessions. There was no significant difference in the degree of fall on the two gestational dates.

The Dublin Rotunda/Beaumont Hospital Study [13] is a continuing longitudinal investigation of 100 pregnant patients who undergo 24-h ambulatory blood pressure monitoring on five separate occasions throughout the three trimesters and the puerperium. The objective of the study is to determine the normal range and pattern of non-invasive ambulatory blood pressure in primiparous patients. So far 100 patients have been recruited between 9 and 16 weeks of gestation. Since recruitment all have undergone the second monitoring event at 18–24 weeks of gestation. Ninety-three patients have undergone the third monitoring event at 26–32 weeks of gestation. Seventy-seven have completed the fourth monitoring event at 33–40 weeks of gestation and 20 have been monitored 6 weeks postpartum. The compliance of patients over these five monitoring events indicates that the technique is an acceptable method of measuring blood pressure in pregnancy.

Conclusions

Some evidence has been provided to suggest that ambulatory blood pressure monitoring is useful in antenatal care. The inherent variability of blood pressure readings and the limitations of clinical measurement have long been recognized [15,16]. There is an increasing awareness of the inadequacy of single readings of blood pressure, taken on different occasions, in the diagnosis of hypertension [17]. Ambulatory blood pressure monitoring appears to be a very satisfactory way of overcoming the large sampling and measurement errors associated with the commonly used method of casual blood pressure determination. As well as these sources of error, white-coat hypertension is also reduced. In particular, ambulatory blood pressure measurement has confirmed the presence of nocturnal hypertension that appears to have special significance in pre-eclampsia. What is becoming clear is that routine measurements taken during the day may miss these most relevant changes. It may be necessary to modify the existing pregnancy classifications of hypertension for ambulatory monitoring. Absolute values may be replaced by blood pressure behavioural patterns, both over a 24-h period and with longitudinal follow-up. Further, ambulatory monitoring of blood pressure in the non-clinical setting may help to predict pre-eclampsia from the blood pressures measured in the early stages of pregnancy.

By providing an assessment of blood pressure behaviour over time in the patient's normal environment, ambulatory blood pressure monitoring in pregnancy may lead to a reappraisal of the clinical management of hypertension, which is currently based on conventional measurement techniques.

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