

SphygmoCor and Pregnancy

During pregnancy, women undergo major physical changes, not least of which are those that occur within the cardiovascular system. Hypertension in pregnancy can cause serious complications for both mother and child and a more serious problem is encountered when pre-eclampsia develops.

Hypertension disorders in pregnancy can be split into (a) chronic hypertension which predates the pregnancy or has an onset before 20 weeks gestation, and (b) hypertension developing after 20 weeks gestation, which can result in hypertension alone (gestational hypertension) through proteinuria and multi-organ dysfunction (pre-eclampsia) to seizures (eclampsia)¹. Chronic hypertension can also progress to pre-eclampsia¹. The presence of mild pre-existing hypertension approximately doubles the risk of pre-eclampsia but also doubles the risk of other complications such as placental abruption and growth restriction². When chronic hypertension is severe the risk of pre-eclampsia is as high as 46% resulting in increased maternal and fetal risks².

Prevalence and Survival

In the United States and the United Kingdom approximately 5% of pregnancies are complicated by pre-eclampsia and of these patients, 1–2% progress to eclampsia^{2,3}. The incidence is increased in women of low socioeconomic status, extremes of age, and primigravid state³. An estimated 50,000 women die annually from pre-eclampsia worldwide and maternal morbidity includes permanent CNS damage from recurrent seizures or intracranial bleeds and renal insufficiency. Although pre-eclampsia is not preventable, early diagnosis, careful monitoring and aggressive treatment is crucial in preventing mortality^{3,4}. The risks to the fetus from preeclampsia include prematurity, placental infarcts, intrauterine growth retardation, abruptio placentae, and fetal hypoxia³.

A large cross-sectional study observing more than 250,000 women and their infants showed that women with gestational hypertension were at a 30% greater risk and women with pre-eclampsia were at 400% greater risk of death or major morbidity¹, compared to women without hypertension. In addition, babies of women with hypertensive disorders during pregnancy are more likely to suffer adverse outcomes than those of women without hypertension¹.

Brachial blood pressure is routinely monitored throughout pregnancy, but is not a sensitive enough measure to distinguish pre-eclampsia from other types of hypertension or to predict pre-eclampsia in those at risk¹. The ability to distinguish between hypertensive disorders and identify those women who have an increased risk of pre-eclampsia can lead to better management of hypertensive disorders during pregnancy and therefore better outcomes for both mother and child.

Arterial Stiffening

There is a large body of evidence showing that increased arterial stiffness is a basic cause of hypertension⁵. Increased arterial stiffness is observed as an increase in aortic pulse wave velocity (PWV) and an increased aortic augmentation index (AIx) caused, in turn, by the early return of the reflected pressure wave in the stiffer arteries. The effect of changes in arterial stiffness during pregnancy has recently been the subject of several studies^{6,7,8,9}. A normal cardiovascular response to pregnancy is seen as an increased heart rate, lower brachial blood pressures primarily due to vasodilation of peripheral vessels and the expansion of blood volume during pregnancy². Elevated endothelial release of nitric oxide is also thought to be a central factor in this haemodynamic alteration during pregnancy⁶. In addition, aortic AIx has been shown to be significantly lower in pregnant women, in each of the three stages of pregnancy, compared to non-pregnant women. The aortic systolic pressure (during the 1st and 2nd trimesters) and aortic augmentation pressure (during the 2nd and 3rd trimesters) were also significantly lower compared to non-pregnant women⁸. The SphygmoCor[®] system measures the changes in aortic AIx during pregnancy, and therefore provides a key insight into whether observed changes in aortic AIx are consistent with normal pregnancy.

Women with gestational hypertension have been shown, in the third trimester, to have higher values of aortic AIx compared to women with normal pregnancy, and these values are markedly higher in women with pre-eclampsia^{6,7,9}. Notably, after 6 weeks post-partum, the aortic AIx values in women with gestational hypertension and pre-eclampsia had returned to normal non-pregnant levels, suggesting that these women do not have an underlying abnormality of arterial stiffness. Similarly, aortic stiffness (aortic PWV) has been shown to be significantly higher in the presence of gestational hypertension and pre-eclampsia⁷. These studies suggest that measures of arterial stiffness, such as aortic AIx and aortic PWV which are easily measured with the SphygmoCor[®] system may provide a clear distinction between those women with uncomplicated gestational hypertension and those who progress to pre-eclampsia.

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Interestingly, in normotensive pregnancies, maternal aortic PWV has also been found to be significantly associated with lower birth weight independent of mean blood pressure¹⁰. An increase of 1 m/s in aortic PWV was associated with a decrease in birth weight centiles of 17%. Fetal growth is a principal issue in antenatal observations and birth weight centiles are regarded as important measures of pregnancy outcome. Potentially, higher arterial stiffness, even in normotensive pregnancies, may reflect inadequate plasma volume expansion, that in turn impedes optimal fetal growth¹⁰.

Recent studies indicate that the extent to which women successfully adapt to vascular changes during pregnancy and the ability to distinguish between those women with gestational hypertension and those with pre-eclampsia can be identified through measurements of arterial stiffness and wave reflection. Such measurements are easily and non-invasively accessible through the use of the SphygmoCor[®] System and may provide better risk stratification and management of women during pregnancy.

References

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