Peripartum and Long-Term Maternal Cardiovascular Health After Preeclampsia

Hypertension

REVIEW

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ABSTRACT: There is widespread acceptance of the increased prevalence of cardiovascular diseases occurring within 1 to 2 decades in women following a preeclamptic pregnancy. More recent evidence suggests that the deranged biochemical and echocardiographic findings in women do not resolve in the majority of preeclamptic women following giving birth. Many women continue to be hypertensive in the immediate postnatal period with some exhibiting occult signs of cardiac dysfunction. There is now promising evidence that with close monitoring and effective control of blood pressure control in the immediate postnatal period, women may have persistently lower blood pressures many years after stopping their medication. This review highlights the evidence that delivering effective medical care in the fourth trimester of pregnancy can improve the long-term cardiovascular health after a preeclamptic birth.

Key Words: blood pressure ■ cardiovascular diseases ■ cardiovascular risk ■ hypertension ■ pre-eclampsia ■ pregnancy

PERIPARTUM CARDIOVASCULAR HEALTH

Magnitude and Time Course of Postnatal Hypertension

The development of chronic hypertension after pregnancies complicated by hypertensive disorders of pregnancies (HDP) explains most of the increased risk of developing cardiovascular diseases (CVD), especially coronary artery disease and heart failure in this cohort of women.[1] This makes the prompt diagnosis and treatment of hypertension in women with a history of HDP a clinical priority. The increased risk of developing chronic hypertension is substantial and occurs much earlier after pregnancies complicated by HDP.[2,3] In a Danish registry-based cohort study that included 1.5 million primiparous women, the adjusted risk of hypertension was 4 to 10× in women with HDP compared with women with a normotensive pregnancy in the first five years after pregnancy. Notably, the cumulative incidence of hypertension at ten years postpartum was 10% in women aged 20 to 29 years with a previous HDP, which is higher than in women aged 40 to 49 years with previous normotensive pregnancies.[3] Furthermore, the earlier the onset and more severe the HDP, the higher the risk of developing postpartum hypertension.[3,4]

Recent evidence has shown that the risk of having persistent hypertension is exceptionally high shortly after giving birth with HDP, with about two-thirds of women with a pregnancy complicated by HDP remaining hypertensive at 6 months postpartum.[5,6] A meta-analysis of postnatal hypertension showed that the odds ratio of postpartum hypertension was 5.42 (95% CI, 3.12–9.41) in the period up to one year and 7.24 (95% CI, 4.44–11.80) between 1 to 2 years after HDP (Figure 1).[6] Similarly, a recent French National Health Data study demonstrated that the risk for hypertension 3 years following birth was higher after any HDP, even after adjusting for certain pre-existing cardiovascular risk factors, such as age, social deprivation, smoking, etc.[4] The mechanisms underlying the association between HDP and subsequent development of CVD are highly debated. Preeclampsia and other HDP might contribute independently to the development of postpartum CVD by causing persistent endothelial damage, dysregulation of the renin-angiotensin-aldosterone system, or an enduring high inflammatory state.[7,8] However, an impaired cardiovascular system might be

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REVIEW

Nonstandard Abbreviations and Acronyms

ACE	angiotensin-converting enzyme
BP	blood pressure
CVD	cardiovascular diseases
DBP	diastolic BP
HDP	hypertensive disorders of pregnancies
SBP	systolic BP

unmasked by the increased cardiovascular demands required during pregnancy, which functions as a cardiovascular stress test.[9]

Peripartum and Postpartum Echocardiographic Assessment

Profound echocardiographic changes are evident in the majority of pregnant women affected by HDP, and these persist in the postpartum period in a significant proportion of these women (Figure 2). Maternal echocardiography can detect HDP-associated increased left ventricle mass, cardiac remodeling, and diastolic dysfunction.[5,10–12] Patients with severe or preterm preeclampsia, particularly if they present with dyspnea or signs of volume overload, would probably benefit from an echocardiographic evaluation in the peripartum period to evaluate systodiastolic function. HDP is also the major risk factor for peripartum cardiomyopathy, where women with peripartum cardiomyopathy and preeclampsia exhibit more severe symptoms and signs of heart failure compared to peripartum cardiomyopathy without hypertension.[13] Also, Vaught et al[12] reported that all women with severe preeclampsia who developed pulmonary edema (10%) had high left ventricular filling pressures assessed by an elevated E/E′ (the ratio of E-wave mitral inflow velocity to early diastolic mitral annular velocity) ratio.

Although removal of the placenta at birth is said to cure HDP, the impact of HDP extends well beyond birth, with persistent cardiac remodeling and dysfunction detectable by postpartum trans-thoracic echocardiography.[14] In a multicenter observational study of 321 women with preterm preeclampsia, 10% of women had a left ventricle ejection fraction <55% or diastolic dysfunction at 6 months postpartum.[5] Melchiorre et al[15] demonstrated in preeclampsia patients with normal blood pressure (BP) at 1 year after delivery that those with moderate-severe echocardiographic left ventricle anomalies were more likely to develop hypertension at 2 years postpartum (50% risk) in comparison to those with normal or mild left ventricle alterations (3.5% risk). Women with a history of preeclampsia have altered cardiac structure and evidence of diastolic and myocardial dysfunction in the first years after delivery, which may then translate to a trend toward long-term CVD.[14,16] In preeclampsia, subclinical signs of myocardial dysfunction, such as abnormal global longitudinal strain, might be present long before the onset of the overt cardiac condition after HDP.[17–20] Women with HDP who develop chronic hypertension within a decade, have shown the most pronounced echocardiographic differences in left ventricular remodeling and diastolic function indices compared with women with only hypertension without previous HDP.[21] Despite this evidence, there are no recommendations on whether, when, or how often a cardiac evaluation should be carried out after HDP.

New-Onset Postpartum Preeclampsia

A poorly studied complication is new-onset postpartum preeclampsia, defined as new-onset hypertension (systolic BP [SBP] ≥140 mm Hg or diastolic BP [DBP] ≥90 mm Hg) and end-organ involvement or severe new-onset hypertension (SBP≥160 mm Hg or DBP≥110 mm Hg) 48 hours to 6 weeks after delivery in the absence of other identifiable causes.[22] Its incidence varies considerably among studies (0.3%–27.5%) and only in 40% of cases there is a diagnosis of HDP.[23,24] Preexisting maternal cardiovascular risk factors for postpartum preeclampsia are similar to those for antepartum preeclampsia and both conditions share the finding of an

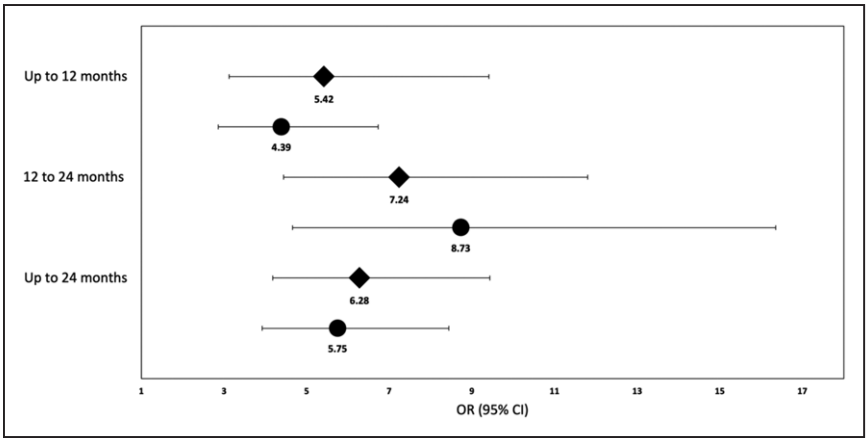

Figure 1. Risk of postnatal hypertension within 2 years of delivery after hypertensive disorders of pregnancy including (♦) or excluding (●) women with preexisting chronic hypertension.
OR indicates odds ratio. Adapted from Giorgione et al.[6]

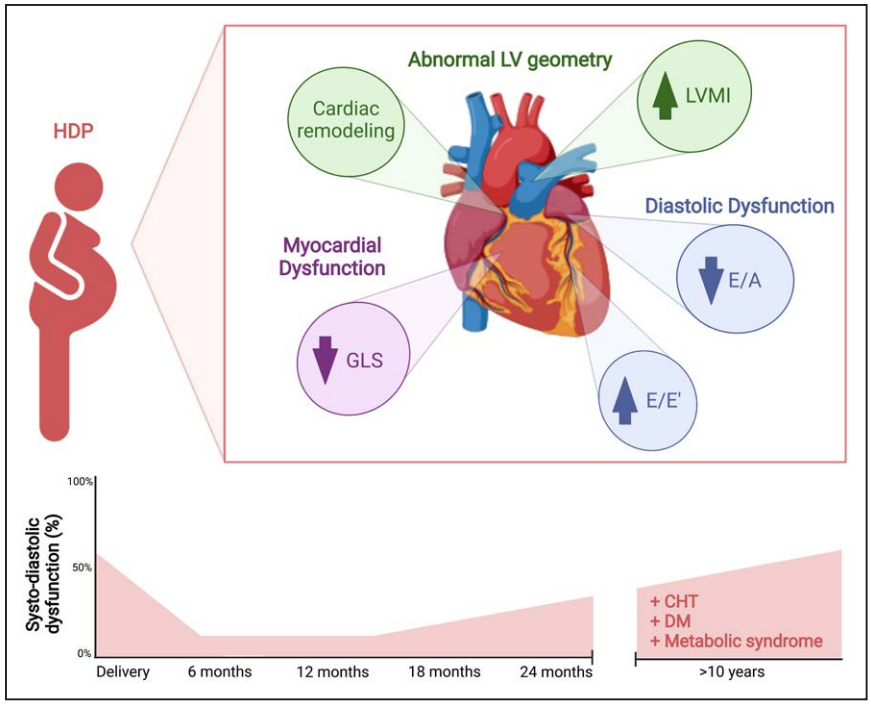

Figure 2. Cardiac changes in pregnancies complicated by hypertensive disorders of pregnancy during pregnancy and throughout the postpartum.
CHT indicates chronic hypertension; DM diabetes; E/E′, the ratio of E-wave mitral inflow velocity to early diastolic mitral annular velocity (E′); E/A, the ratio of E-wave mitral inflow velocity to A-wave mitral inflow velocity; GLS global longitudinal strain; LV left ventricle; and LVMI left ventricular mass index.

antiangiogenic imbalance in the maternal circulation.[25,26] Postpartum preeclampsia challenges the paradigm that removing the placenta at birth cures HDP and brings into question the role of the placenta as the undisputed trigger for HDP.[27] Postpartum preeclampsia is often underdiagnosed, as BP monitoring in the fourth trimester is not universally recommended for women without HDP and only infrequently undertaken after HDP.[28] The most common presenting symptoms of postpartum preeclampsia are neurological (eg, headache) or signs of volume overload.[22,28] Due to underdiagnosis, women who develop postpartum preeclampsia are at increased risk of severe maternal morbidity, particularly eclampsia and stroke.[29] Current studies on long-term cardiovascular risk after HDP have not reported the onset of postpartum preeclampsia, and as a result, there is a paucity of epidemiological data on new-onset postpartum preeclampsia and future risk of CVD.[22] After delivery, women should be informed on how to recognize symptoms of postpartum preeclampsia. Although risk factors for postpartum cardiovascular morbidity could be identified at the time of discharge, their effectiveness in identifying subsequent disease is unknown.[30] A predictive model based on these risk factors would be invaluable in tailoring postpartum follow-up for women at risk of severe maternal morbidities.

Factors That Influence Persistent Postpartum Cardiovascular Dysfunction

HDP and CVD share common pathophysiological pathways and processes which may explain their close and dose-dependent association.[31] These findings have led to the acknowledgment of HDP as a crucial female-specific risk factor for CVD later in life.[32–34] However, there is no consensus regarding optimal screening, prevention, and managing CVD risk after HDP.[35] In addition, not all women who experience HDP develop CVD in later life, indicating different levels of future risk.[36,37] Epidemiological studies have shown that the severity of HDP, the need for preterm birth for HDP, and other obstetric complications might help identify women at increased risk of CVD.[38,39] In addition, early-life factors of women with HDP, such as being born preterm or small-for-gestational-age themselves, are associated with increased cardiovascular risk, early-onset high BP, and cardiovascular dysfunction.[40]

Better cardiovascular health in early pregnancy, defined by markers such as BP, lipid profile, and glucose, has been associated with better pregnancy and postpartum cardiovascular outcomes in women with HDP.[41,42] Imbalances in circulating angiogenic factors, such as sFlt-1 (soluble fms-like tyrosine kinase 1) and its ligand placental growth factor (PlGF), are considered responsible for maternal signs and symptoms of preeclampsia as it induces microangiopathy in target organs and also vascular remodeling in coronary artery disease or heart failure.[43,44] Higher sFlt-1 levels are associated with cardiovascular dysfunction during pregnancy and increased sFlt-1/PlGF ratio in HDP was associated with postpartum hypertension.[25,45] Moreover, lower PlGF concentrations in HDP have been associated with worse cardiac structure, increased BP levels, and higher lipid levels in the postpartum follow-up.[46,47] In one small study of echocardiographic variables at the time of preeclampsia diagnosis, women who were hypertensive 4 years postpartum

had significantly thicker left ventricle posterior walls on their initial antenatal echocardiogram.[48]

Prediction Models for Postpartum Cardiovascular Dysfunction

Women with a history of preeclampsia, have an elevated Framingham risk score compared to those who experienced uncomplicated pregnancies.[37,49,50] However, adding pregnancy complication history, particularly HDP, in an established cardiovascular risk score did not substantially improve discrimination or reclassification.[51,52] The incremental information provided by adverse pregnancy outcomes may have been partly captured by any subsequent increases in hypertension, diabetes, and dyslipidemia. Current CVD risk calculators have not been designed to be used in women of reproductive age with a low overall CVD risk, highlighting the urgent need to develop models to assess long-term CVD risk which include sex-specific risk factors, such as HDP. To achieve this, it might be helpful to target prediction of cardiovascular risk factors such as hypertension, diabetes, and dyslipidemia instead of CVD that occurs several decades after HDP. Indeed, hypertension and obesity are essential targets for cardiovascular prevention in women after HDP because they explain most of the excess risk of CVD in women with a history of HDP.

LONG-TERM MATERNAL HEALTH AFTER PREECLAMPSIA

Cardiovascular Disease Mortality and Hospitalization

There is an abundance of evidence demonstrating the development of CVD and its risk factors after preeclampsia pregnancy (Table 1 and Table S1), and recent meta-analyses that suggest CVD morbidity and mortality increase throughout the lifetime.[53,54] The most recent meta-analysis of over 10 million women showed that the overall risk of composite adverse CVD outcomes in the decade after birth is 2-times higher for women who had experienced a preeclampsia pregnancy compared with those who had uncomplicated pregnancies.[53] Consistent with this association, Langlois et al[55] showed a 17% increased risk of hospitalization for CVD after preeclampsia compared to uncomplicated pregnancies and this finding seems to extend throughout lifetime and includes an increased risk of all-cause mortality. However, specific CVD mortality studies show that a history of preeclampsia increases risk of dying 2- to 5-fold from CVD regardless of follow-up time.[56–59] Preeclampsia appears to increase the long-term risk of cardiovascular morbidity and mortality throughout the lifetime.

Influence of Preeclampsia on the Future Development of Conventional CVD Risk Factors

Preeclampsia is associated with increased long-term development of conventional CVD risk factors with hypertension appearing to be most prominent.[60] At >10 years after a preeclampsia pregnancy, hypertension occurs roughly 2× to 4× more frequently than after uncomplicated pregnancies.[58,61] Ghossein-Doha et al[62] show that 8% of women who were normotensive at 6 weeks following a preeclampsia birth were hypertensive at 6 years and that most women who were hypertensive postpartum, remained hypertensive at 6 years. The average mean difference for total cholesterol is higher after preeclampsia but does not necessarily lead to dyslipidemia.[54,60] Dyslipidemia may occur 2× more frequently, but there is no apparent correlation with cholesterol level.[47,61,63] Although one study demonstrated a 15.6% prevalence of metabolic syndrome within 1 year following preeclampsia, this finding is not supported by subsequent smaller studies.[47,64,65] There is a mixed picture as to whether preeclampsia increases the risk of developing type 2 diabetes mellitus with increased risk being evident with longer-term follow-up up to 35 years.[53]

Atherosclerotic disease

Placental decidual vasculopathy in preeclampsia has a similar pathophysiological process to atherosclerosis—leading to the hypothesis that preeclampsia could induce development of systematic atherosclerosis at

Table 1. Table Summarizing the Most Recent Key Literature Indicating the Risk (Based on HRs) of Developing Various Types of CVD Split by Number of Years After Preeclampsia

Years after PE	CVD hospitalization	CVD mortality	All-cause mortality	Hypertension	Dyslipidemia	Metabolic syndrome	Type 2 diabetes mellitus	Ischemic heart disease	Stroke	Heart failure	Dysrhythmia	CKD	ESRD	Peripheral artery disease	Dementia
5–10		++	++	+++		+++		++	+	++	+	+		+	
10–20	+			+++		++		+	+	+/–	+/–	+	+++	+	
>20	++	++	+/–	+	+		+	+	+/–	+	+	+			++

Citations to support level of risk are shown in the Table S1. +/– denotes risk may not be raised. + denotes mildly increased risk (HR<2 in most studies). ++ denotes moderately increased risk (HR>2 in most studies). +++ denotes markedly increased risk (HR>3 in most studies). CKD indicates chronic kidney disease; CVD, cardiovascular disease; ESRD, end-stage renal disease; HR, hazard ratio; and PE, preeclampsia.

an accelerated rate leading to an increased incidence of CVD.[66] This is supported by a national registry study with 50-year follow-up showing a 50% increase in risk of atherosclerotic events after preeclampsia.[67] Computed tomography angiography has also demonstrated subclinical coronary atherosclerosis in 30% of 45- to 55-year-old women consistent with a systematic review of 7 studies showing a 50% increase in coronary artery disease.[38,68] In addition to coronary events, a meta-analysis including nine studies demonstrated a 40% increased risk of developing a stroke after preeclampsia. Preeclampsia may also affect cerebral microvasculature with evidence at 5 to 10 years that cerebral white matter lesions related to microvascular disease occur more frequently.[69,70] Although most long-term studies did not demonstrate an increased risk of developing dementia, the largest study with 283 902 participants showed a significant 6-fold increased risk for vascular dementia specifically.[71]

Heart Failure and Arrhythmia

Heart failure and related hospital admissions are increased 2-fold after preeclampsia pregnancy, with hypertension being the key determinant driving cardiac dysfunction.[17,64] This finding is echoed in a study of 1 303 365 women followed up for an average of 10 years with a 2-fold hazard ratio.[58] There is also an increased risk of dysrhythmias after preeclampsia, but this relationship is no longer evident when adjusted for confounding factors such as diabetes, hypertension, and renal disease.[55]

Renal Dysfunction

There is robust evidence of a 5-fold increase in the risk of developing end-stage renal disease after preeclampsia.[72] In contrast, there is a fewer data on the development of chronic kidney disease with one study showing a 4-fold increase in risk for hypertensive and diabetic chronic kidney disease and a 2-fold increase for glomerular/proteinuric chronic kidney disease at 20 years following a preeclampsia pregnancy.[73]

POSTPARTUM MONITORING AND MANAGEMENT

BP Pattern During Pregnancy and the Puerperium

Identifying these longitudinal BP patterns is vital to our understanding of maternal cardiovascular adaptation in HDP and to shaping postpartum treatments to reduce cardiovascular morbidity. A recent retrospective cohort study of almost 1000 women with HDP[74] showed a decrease of 3.5 mm Hg in SBP and 4.4 mm Hg in DBP during the first trimester so that BP was below preconception levels, with a very small drop from 1st to 2nd trimester similar to a normal pregnancy.[75] SBP subsequently peaks on the day of the delivery and then reached similar highs up to day 5, whereas DBP peaks later at 5 to 7 days postpartum. SBP gradually decreased and fell below the preconception level by day 15 postpartum, but DBP falls more gradually not reaching preconception level until 6 weeks postpartum. Therefore, before the typical 7- to 10-day routine postpartum medical check, BP varies significantly, and this is when cardiovascular morbidities typically occur.

What Is the Long-Term BP Course Following Hypertensive Pregnancy?

Many argue that HDP is not causal in accelerating cardiovascular risks but, rather is a marker of a preexisting subclinical disease. These conclusions are supported by the longitudinal follow-up of the Trøndelag Health Study (HUNT) 1, 2, and 3, population-based, open cohort studies from 21 years before pregnancy up to 41 years after a women's first delivery. This cohort contains 22,308 normotensive women, 1092 of whom developed preeclampsia and 478 of whom developed gestational hypertension.[76] The HUNT studies demonstrate that BP trajectories remain higher in the HDP cohort compared to normotensive women, and that progression of cardiovascular risk factors to 60 years of age occurs in parallel for women with and without a history of HDP, with greater increases in systolic BP and adiposity in HDP women. However, the data does highlight that the diastolic BP does not return to 'normal' postpartum in the HDP cohort—a finding not explained by differences before pregnancy. Without intervention, BP can remain unstable for up to 50% of women for several months after HDP, and it may well be that uncontrolled BP in the puerperium directly affects cardiac and vascular remodeling, known to occur in the weeks after a hypertensive pregnancy in both mother and child.[77]

Optimal Measurement of BP

Hypertension is largely identified during routine annual checks or opportunistically assessing BP in a primary care setting. However, between 1 out of 3 and 1 out of 2 of hypertensive patients remain undiagnosed, indicating the need for better screening.[78] UK guidance for hypertension in pregnancy makes no specific recommendation, but the general adult guidance[79] recognizes the value of home BP monitoring and 24-hour ambulatory BP monitoring.[80] Trials of self-monitoring outside of pregnancy, repeatedly show it can improve BP control, and it is an increasingly common part of hypertension management. It is well tolerated by patients and is a better predictor of end-organ damage than clinic measurement.[81] In 2018, the efficacy of self-monitored blood pressure, with or

without telemonitoring, for titration of antihypertensive medication (TASMINH4) randomized trial[82] showed that using self-monitored BP to titrate antihypertensives achieved better BP control when using telemonitoring. Trials have now shown that telemonitoring postpartum is also safe and effective when compared with standard care, with 8-fold fewer hypertension-related readmissions.[83] The role of home BP monitoring, which is both liked by patients, widely available, practical, and cost-effective makes this an attractive option for facilitating postpartum BP care.[84] Two recent large trials in the UK (Blood Pressure Monitoring in High Risk Pregnancy to Improve the Detection and Monitoring of Hypertension [BUMP]1 and 2) assessed whether self-monitoring improves the detection or control of hypertension during pregnancy itself[85,86]. Once a person has been found to have high BP, 24-hour ambulatory BP monitoring is still the most accurate way to diagnose hypertension.[87,88] The BUMP trials demonstrated that remote self-monitoring resulted in equivalent pregnancy outcomes compared with clinic-based BP monitoring in the antenatal and postpartum period. Home telemonitoring following HDPs may also reduce ethnic health disparities in postpartum care. When engaged in a virtual BP monitoring program in one trial, both black and nonblack women demonstrated compliance rates of >90%.[89]

Frequency of BP measurement

In a trial by Hoppe et al,[83] severe hypertension (>160/110 mm Hg) occurred in ≈1 in 4 women following discharge, and over half had increased BPs that required treatment after discharge. Systematic reviews show the latency to the first severe hypertension reading, and to the first BP level that necessitated treatment being ≈6 days.[90] These findings suggest that it is sensible to measure BP for at least the first ten days postpartum. Given the significant diurnal variation in BP in HDP, with the BP climbing in the afternoon and evening in ≈50% of women, twice daily readings would seem appropriate[91]. If the home BP monitoring was timed in the morning and afternoon it would allow early recognition and adjustment in office hours of medication. Frequency could be increased but at the risk of reducing compliance and thus a balanced approach is needed based on the clinical scenario.

Clinical Benefits of Improved-BP Control During the Puerperium

Telemonitoring can be combined with self-titration or self-management, which can take the form of in person, or remote doctor support by telephone, text messages, or an application (app). The Self-management of Post-Natal Hypertension Trial (SNAP-HT) randomized control trial (RCT) compared self-management to usual GP and midwife-led care following HDP.[92] It allowed women to self-monitor their BP and provided self-management via remote medication advice feedback (Table 2). The results demonstrated the technique was acceptable; women self-monitored daily with 85% adherence, a median accuracy of 94%, and there was a significant improvement in BP control. Not surprisingly, BP control was better while on treatment with the difference most marked at 6 weeks, but another striking finding was the diastolic BP being a mean 4.5 mm Hg lower 6 months postpartum, long after stopping medication. The SNAP-HT Extension at four years postpartum went on to demonstrate that DBP was >7 mm Hg lower in those originally randomized to postpartum BP self-management versus those treated with standard care (Figure 3) [93]. This work suggests there is a window to optimize

Table 2. Traffic-Light System to Guide Frequency of Blood Pressure Readings Postpartum or Women With HDP While on Antihypertensive Treatment

Color	Level	BP	Action
Red	Very high	SBP ≥160 or DBP ≥110	Repeat BP in 5 min.
			If this is a repeat reading: contact local maternity unit immediately for an urgent (same-day) assessment.
Orange	High	SBP 150–159 or DBP 100–109	Repeat BP in 5 min.
			If this is a repeat reading: call from study physician 9–5 PM and to see own GP/midwife for an urgent (same-day) appointment.*
Yellow	Raised	SBP 140–149 or DBP 90–99	No action
Green	High normal	SBP 130–139 or DBP 80–89	No action
Blue	Low normal	SBP 100–129 and DBP <80	Switch to twice daily readings and if in this zone for 2 consecutive days, medication titration will be signed off by study doctor, and instructions sent via app to participant
Purple	Low	SBP <100 and DBP <80	Repeat BP in 5 min.
			If this is a repeat reading: option of opting for a call from study physician 9–5 PM vs opting to see own GP/midwife for an urgent appointment.*

No action prompts an app notification to continue daily readings.[95] App indicates application; BP, blood pressure; DBP, diastolic BP; GP, general practitioner; HDP, hypertensive disorders of pregnancies; and SBP, systolic BP.

*Switch to twice daily readings until back in yellow/green.

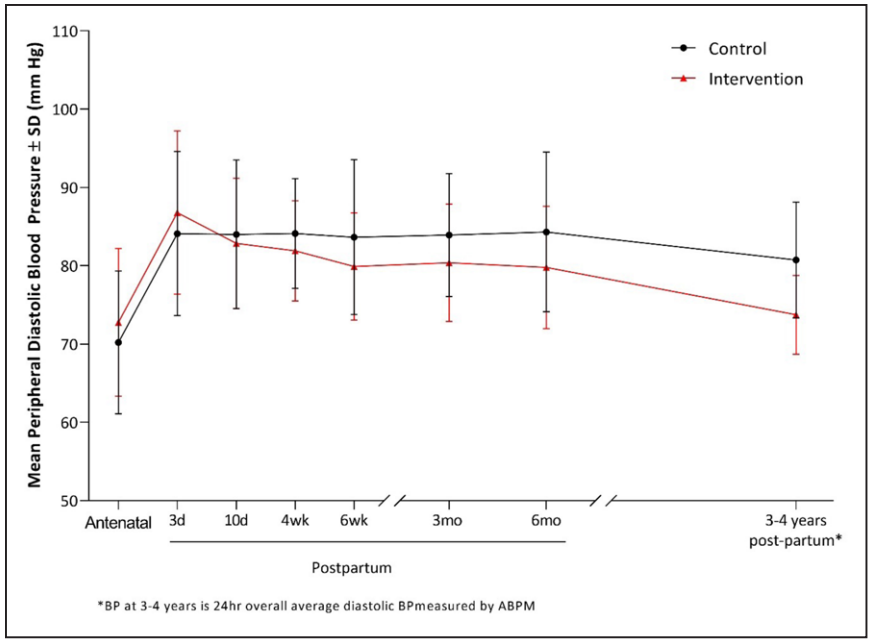

Figure 3. Longitudinal diastolic blood pressure (BP) trajectories from Self-management of Post-Natal Hypertension Trial (SNAP-HT) into SNAP-HT Extension from antenatal booking blood pressure to 3.6±0.4 years postpartum.
ABPM indicates ambulatory BP monitoring.

long-term cardiovascular risk in the puerperium and if the DBP difference were to be maintained long-term, it correlates to a ≈40% lifetime reduction in stroke and 20% lifetime reduction in coronary heart disease risk.[94]

Role for Specific Drug Interventions in the Postpartum Period

Beyond the American Heart Association recommendation of incorporating HDPs as a risk-enhancing factor to guide statin prescribing, no other specific guidelines exist to direct screening strategies or therapies for long-term cardiovascular risk reduction in these women. The Postnatal Enalapril to Improve Cardiovascular Function Following Preterm Preeclampsia trial (PICk-UP) was a randomized double-blind placebo-controlled feasibility trial of enalapril in the highest risk early-onset preeclampsia group[96]. At randomization, 88% of women had diastolic dysfunction and 68% had concentric remodeling/hypertrophy. There was no difference in the primary outcome (total vascular resistance) at 6 months postpartum but women treated with enalapril had significantly better diastolic function at 6 months than those treated with placebo, as measured by E/E′. Enalapril use was also associated with improved LV remodeling at 6 months as well as a significant improvement in DBP in the intervention arm. A second RCT specifically assessed the role of targeted calcium therapy in the puerperium, as part of a subgroup analysis of the WHO Calcium and preeclampsia study. Recruitment fell short of the sample size needed in the power calculation, but there was a statistically significant reduction in DBP in the subgroup of women who had a pregnancy previously affected by severe preeclampsia.[97] Another RCT in just under 400 women of a 5-day course of 20 mg oral furosemide versus placebo in women with HDP demonstrated a 60% reduction in the prevalence of persistently elevated BP at 7 days in the furosemide group.[98] American Heart Association/American College of Cardiology guidelines encourage statin use in women with prior HDP[99] and intermediate calculated 10-year atherosclerotic cardiovascular disease risk, although no trials to date have specifically evaluated the role of statins in cardiovascular and cerebrovascular risk reduction after HDP.

Optimal Postpartum Treatment Regimen

Larger validation studies of BP self-management are ongoing at present with mechanistic evaluation of peripheral resistance, cardiac output and function at rest, and on exercise.[95] This will hopefully help us answer the question of what is the optimal treatment regime, but there is no doubt there is a role for self-monitoring, self-management, and ACE (angiotensin-converting enzyme) inhibitors in the future of postpartum BP treatment.[83,96,100]

CONCLUSION AND FUTURE DIRECTIVES

HDP have a more immediate and detrimental impact on maternal cardiovascular health than previously known. These observations hold irrespective of whether these findings preceded the pregnancy or were caused by HDP. It is evident that maternal home BP monitoring self-monitoring combined with effective BP control in the immediate postpartum period is associated with long-term benefits to the mother including an increased likelihood of normotension off medication. The evidence

that effective care may increase the likelihood that women may be more likely to be normotensive off BP medication long-term deserves closer attention. Heightened awareness of these findings should drive increased research into clarifying the optimal BP measurement method and frequency as well as the appropriate treatment regimen with allied self-titration protocols. Improved healthcare delivery in the fourth trimester of pregnancy has important implications for women, clinicians, and public health policy.

ARTICLE INFORMATION

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