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OBJECTIVE: To determine if Vitamin D prophylaxis decreases the incidence of hypertensive disorders of pregnancy.

STUDY DESIGN: A single center, parallel, open label, randomized control trial was performed in which pregnant women received Vitamin D3 3000 IU daily or no supplement. The primary outcome was the incidence of hypertensive disorders of pregnancy. Based on a power analysis set at 80%, a sample size of 206 women in each group (n=412) was planned for comparison. Maternal serum and cord blood were collected for 25-hydroxyvitamin D assessment. Patients were called to assess compliance with the study protocol. Maternal demographics and pregnancy outcomes were collected from the electronic medical record. Statistical analyses were performed using SPSS V24. Student's t tests and ANOVA analyses were performed for continuous variables that were normally distributed. Chi-Square or Fisher's exact tests were performed for categorical variables. Binary logistic regression for the primary outcome was performed adjusting for confounders. The analysis was conducted with an intent to treat model with omission of missing variables. A P value of <0.05 was statistically significant.

RESULTS: Enrollment occurred between October 2016 and September 2019. Of the 412 women enrolled, 392 (95.1%) had completed pregnancies for analysis. Demographic characteristics including baseline maternal 25-hydroxyvitamin D (25(OH)D) levels were similar between groups. Compared to women who did not receive Vitamin D prophylaxis, those who did had a significantly higher 25(OH)D delivery serum level (29.18 +/- 11.87 ng/mL vs. 23.79 +/- 9.29 ng/mL; $P<0.001$) and cord blood level (33.73 +/- 13.68 ng/mL vs. 26.06 +/- 9.72 ng/mL; $P<0.001$). The incidence of hypertensive disorders of pregnancy was 10.5% (41/392). Vitamin D prophylaxis did not decrease the incidence of hypertensive disorders of pregnancy when compared to controls (13.1% vs. 7.7%; RR 1.7, 95% CI 0.9-2.9; P=0.10).

CONCLUSION: Vitamin D prophylaxis does not prevent hypertensive disorders of pregnancy, but does increase maternal and cord blood Vitamin D levels.

Table 1. Maternal Baseline Characteristics by Vitamin D Intake

Characteristic	Vitamin D Prophylaxis n=206	No Vitamin D Prophylaxis n=206
Maternal age (years)	30.76 ± 5.22	30.29 ± 5.24
Race/ethnicity		
Caucasian	102 (49.5)	105 (51.0)
African American	32 (15.5)	23 (11.2)
East Asian/Indian	20 (9.7)	14 (6.8)
Hispanic	33 (16.0)	39 (18.9)
Mixed race	5 (2.4)	7 (3.4)
Other	14 (6.8)	18 (8.7)
Pre-pregnancy BMI (kg/m^2)	29.49 ± 7.27	29.78 ± 9.01
Multiparity	167 (81.1)	169 (82.0)
Married	111 (53.9)	96 (46.6)
Government insured	115 (55.8)	105 (51.0)
Smoker	21 (10.2)	16 (7.8)
History of hypertensive Disorder of pregnancy	12 (5.8)	9 (4.4)
Aspirin use	26 (12.7)	22 (10.7)
Season of delivery*		
Winter	16 (8.1)	15 (7.8)
Spring	29 (14.6)	36 (18.8)
Summer	82 (41.4)	82 (42.7)
Fall	71 (35.9)	59 (30.7)

Represented as mean ± standard deviation or n (%)
*BMI=body mass index

Table 2. Hypertensive Disorder of Pregnancy by Vitamin D use

Outcomes	Vitamin D Prophylaxis n=198	No Vitamin D Prophylaxis n=194	RR (95% CI)	RR[a] (95% CI)	*P*
Hypertensive disorder of pregnancy	26 (13.1)	15 (7.7)	1.7 (0.9-2.9)	2.0 (0.7-4.7)	0.10
Gestational hypertension	6 (3.0)	4 (2.1)	1.47 (0.4-4.9)	2.8 (0.4-14.0)	0.54
Preeclampsia with and without severe features	14 (7.1)	7 (3.6)	1.96 (0.8-4.5)	2.5 (0.5-10.0)	0.13
Superimposed preeclampsia	6 (3.0)	4 (2.1)	1.47 (0.4-4.9)	0.4 (0.1-8.5)	0.54

Represented as n (%)
[a] Adjusted for history of hypertensive disorder of pregnancy, aspirin use, dietary vitamin D intake, and season of birth

32 COVID-19 and new hypertensive disease in pregnancy

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OBJECTIVE: It is well known that the inflammatory response plays a significant role in the pathogenesis of hypertensive disease of pregnancy (HDP). As such, it is likely that the acute inflammatory state of the COVID-19 infection may incite or exacerbate HDP. Our objective was to evaluate differences in the rates of new HDP and disease severity in COVID-19 positive (COVID+) versus COVID-19 negative (COVID-) patients.

STUDY DESIGN: This was a retrospective chart review of all patients who had pre-admission COVID-19 nasal polymerase chain reaction (PCR) testing at a single institution between March-June 2020. The exposure was COVID+ versus COVID- result on admission testing and the primary outcome was overall rates of HDP including gestational hypertension (gHTN), pre-eclampsia (PEC) without severe features, and PEC with severe features. A secondary analysis was performed evaluating the subgroup of patients with HDP to determine whether disease severity differed by COVID-19 testing status. Patients with a history of chronic hypertension and multiple gestations were excluded. Secondary outcomes included selected markers of hypertensive disease severity.

RESULTS: Our primary analysis included 1,715 patients who had COVID-19 nasal PCR testing, 1,548 who tested COVID- and 167 who tested COVID+. Overall rates of gHTN (9.0 vs 3.6%, $P<0.001$) and PEC without severe features (3.6 vs. 1.3%, $P = 0.034$) were significantly higher in COVID+ patients. Rates of PEC with severe features did not differ significantly between the two groups (5.4 vs 3.6%, P=0.12, Table 1). Our secondary analysis included 161 women with a diagnosis of HDP, 30 of which were COVID+ and 131 of which were COVID-. The gestational age at time of COVID-19 testing did not differ between the two groups. COVID+ and COVID- patients did not differ significantly on variables assessing hypertensive disease severity (Table 2).

CONCLUSION: Patients who were COVID+ had significantly higher rates of gHTN and PEC without severe features compared to COVID- patients. Severity of HDP did not differ between COVID+ and COVID- patients.

Table 1. Rates of Hypertensive Disease of Pregnancy	COVID- (N=1548)	COVID+ (N=167)	*P value*
Gestational hypertension	56 (3.6)	15 (9.0)	<0.001
Pre-eclampsia without severe features	20 (1.3)	6 (3.6)	0.03
Pre-eclampsia with severe features	55 (3.6)	9 (5.4)	0.12

Data expressed as N (%)

Table 2. Severity of Hypertensive Disease of Pregnancy	COVID- (N=131)	COVID+ (N=30)	*P value*
Requirement for rapid acting anti-hypertensive medications	33 (25.19)	4 (13.33)	0.16
Total number of doses of rapid acting anti-hypertensive medications	0.47 ± 1.01	0.20 ± 0.55	0.16
Pre-eclamptic lab abnormalities	14 (10.69)	5 (16.67)	0.36
Platelets < 100 (x10^3/uL)	3 (2.29)	1 (3.33)	0.57
AST or ALT > x2 normal (U/L)	9 (6.87)	5 (16.67)	0.14
Creatinine > 1.1 (mg/dL)	4 (3.05)	0	1.00
Pre-eclamptic symptoms			0.25
Headache	9 (6.87)	0	
Vision changes	0	1 (3.33)	
Chest pain	1 (0.76)	0	
Right upper quadrant pain	1 (0.76)	0	
Pulmonary edema	1 (0.76)	0	
Magnesium intrapartum	34 (25.95)	6 (20.00)	0.50
Magnesium postpartum	55 (41.98)	9 (30.00)	0.23
Requirement for anti-hypertensive medications postpartum	48 (36.64)	6 (20.00)	0.08
Number of anti-hypertensive medications postpartum	0.41 ± 0.61	0.20 ± 0.41	0.08
One anti-hypertensive	41 (31.30)	6 (20.00)	
Two anti-hypertensives	5 (3.82)	0	
Three anti-hypertensives	1 (0.76)	0	
Readmission for pre-eclampsia	9 (6.87)	1 (3.33)	0.69

AST = aspartate transaminase, ALT = alanine transaminase
Data expressed as mean +/- SD or N (%)

33 Improving Treatment for Hypertensive Emergencies among Pregnant and Postpartum Women Using a Hypertensive Pathway Intervention

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OBJECTIVE: To assess the effect of an anti-hypertensive pathway order set in improving treatment of hypertensive emergency in pregnant and postpartum women

STUDY DESIGN: A multi-disciplinary task force created a hypertensive pathway order set and provided staff training. Pregnant and postpartum women documented to have 2 or more consecutive severe range blood pressures (srBP) in the year prior (2017) and the year after (2019) implementation of the pathway were included. Use of short-acting antihypertensive (aHTN) (intravenous labetalol, intravenous hydralazine, or oral nifedipine) were considered appropriate treatment. Outcomes measured were whether aHTN was given at all, whether it was given for all instances of srBP, and time to aHTN administration. Rates of aHTN provision were compared before and after implementation of the standard order set.

RESULTS: A total of 566 women with srBP were included, with 304 women in 2017 and 262 in 2019. There were no differences in age, parity, gestational age, race, or ethnicity between cohorts. There were more preeclampsia diagnoses in 2019 than 2017 (79% vs. 59%, p<0.01) (Table 1). The rates of aHTN administration improved significantly with use of the pathway—67% in the pre-intervention cohort received an aHTN at least once vs. 80% post-intervention (p<0.01) (Table 2). Significant improvement was also evident for receipt of aHTN for all instances of srBP (29% pre-intervention vs. 47% post-intervention, p<0.01). There was a significant decrease in time to administration of aHTN (39.7 minutes [SD=33.8] pre-intervention vs. 14.9 minutes [SD=20.7] post-intervention, p<0.01).

CONCLUSION: There was an improvement in rates of and time to aHTN administration to pregnant and postpartum women after implementation of the hypertensive pathway, though rates did not approach 100%. These results are likely mediated by improved workflow, allowing greater nurse autonomy after a physician has initiated the pathway. There was also an increased rate of pre-eclampsia diagnosis in 2019, perhaps reflecting improved recognition. Future work will focus on cognitive aids for srBP recognition.

Table 1. Hypertension diagnoses among participants

Diagnosis	Pre-Intervention (n=304)	Post-Intervention (n=262)	p-value
No hypertension diagnosis	40 (13%)	7 (3%)	
Chronic hypertension	45 (15%)	31 (12%)	
Gestational hypertension	37 (12%)	14 (5%)	<0.01[1]
Pre-eclampsia	179 (59%)	207 (79%)	
Eclampsia	3 (1%)	3 (1%)	

Data are n (%)
[1]Chi-squared test

Table 2. Treatment characteristics of women with hypertensive emergency before and after hypertensive pathway intervention

Variable	Pre-Intervention (n=304)	Post-Intervention (n=262)	p-value
Proportion of women who received aHTN at all	205/304 (67%)	210/262 (80%)	<0.01[1]
Proportion of women who received aHTN for all instances of srBP	87/304 (29%)	124/262 (47%)	<0.01[1]
Time to administration of aHTN (min)	39.7 (33.8)	14.9 (20.7)	<0.01[2]

Abbreviations: short-acting anti-hypertensive (aHTN), severe range blood pressure (srBP)
Data are proportion (%) or mean (SD)
[1]Chi-squared test
[2]Wilcoxon rank-sum test

34 Long term effects of pregnancy on cardiovascular function: serial echocardiograms in non-hypertensive and hypertensive mice

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OBJECTIVE: The specific impact of pregnancy on long term cardiovascular function (CVF) is challenging to study due to multiple confounders. A mouse model allows us to study the effect of pregnancy while controlling other factors. Our aim was to evaluate CVF in pregnancy and up to the equivalent of 1 year postpartum (PP) in non-hypertensive and hypertensive murine models compared to non-pregnant (NP) controls.

STUDY DESIGN: Wild type (WT) and endothelial nitric oxide synthase (eNOS) heterozygous females were used to generate the non-hypertensive and moderately hypertensive models, respectively. Mice were divided between pregnant/PP and NP groups. Mice underwent echocardiography (echo) at age-matched time points: 0 = baseline (10 weeks of age), 1 = gestational day 18.5, 2 = 1 week PP or 4