Pregnancy Hypertension 18 (2019) 117–121

Contents lists available at ScienceDirect

Pregnancy Hypertension

journal homepage: www.elsevier.com/locate/preghy

A randomized-controlled trial to assess the effect of ibuprofen on postpartum blood pressure in women with hypertensive disorders of pregnancy

Jourdan E. Triebwasser*, Ashley Hesson, Elizabeth S. Langen

Department of Obstetrics & Gynaecology, Division of Maternal-Fetal Medicine, Michigan Medicine, University of Michigan, L4000 University Hospital South, 1500 East Medical Center Drive, Ann Arbor, MI 48109-5276, United States

ARTICLE INFO

Keywords:
Gestational hypertension
Ibuprofen
Non-steroidal anti-inflammatory drugs
Preeclampsia
Randomized controlled trial

ABSTRACT

Objectives: To test the hypothesis that ibuprofen is equivalent to acetaminophen in its effect on postpartum blood pressure in women with gestational hypertension or preeclampsia without severe features.
Study design: Single-center randomized, crossover, equivalence trial among women with hypertensive disorders of pregnancy without severe features after vaginal delivery. Participants were assigned in a double-blind fashion to ibuprofen 600 mg or acetaminophen 650 mg every 6 h for 24 h followed by crossover to the other drug. We assessed clinical blood pressures and ambulatory blood pressure monitor measurements. Intention-to-treat analyses were performed using a linear mixed model adjusted for time period.
Main outcome measures: The mean difference in systolic blood pressure through 24 h of drug exposure with an equivalence margin of 10 mmHg.
Results: Of 185 screened women, 74 enrolled prior to delivery. Forty-three women remained eligible and were randomized to ibuprofen first (n = 20, 46.5%) or acetaminophen first (n = 23, 53.5%). A total of 37 women (86.0%) received study drug (ibuprofen first n = 19, acetaminophen first n = 18). Most participants were white (91.9%) and had gestational hypertension (86.5%); mean (SD) age was 31.0 (6.5) years. The mean adjusted difference in systolic blood pressure was 1.0 mmHg (95% CI, −3.7 to 5.7 mmHg), which was within the equivalence margin. A linear mixed model did not demonstrate a main effect of group assignment, nor did it show an interaction effect with time period.
Conclusions: Among women with gestational hypertension and preeclampsia without severe features, ibuprofen is an equally safe option as acetaminophen with respect to postpartum blood pressure concerns.

1. Introduction

Non-steroidal anti-inflammatory drugs (NSAIDs) are frequently prescribed for postpartum analgesia after vaginal delivery. Though supporting data is limited on postpartum pain specifically, ibuprofen and other NSAIDs appear to be superior to acetaminophen in ameliorating uterine and perineal pain [1,2].

The effect of NSAIDs on blood pressure (BP) in women postpartum is less certain. In non-pregnant hypertensive patients NSAIDs are associated with increased BP over short courses of days to months, though effects of various NSAIDs differ [3,4]. Pooled analyses suggest changes in mean BP of up to 3–6 mm Hg depending on the measurement method. There are also case reports of hypertensive crises after NSAID administration postpartum in both normotensive and hypertensive women [5]. In light of the potential for worsening BP in women with hypertensive disorders of pregnancy, the Task Force on Hypertension in Pregnancy of American College of Obstetricians and Gynecologists (ACOG) recommended that NSAIDS "be replaced by other analgesics in women with hypertension that persists for more than 1 day postpartum", such as acetaminophen (a non-narcotic without a known effect on postpartum BP) [6].

Recent retrospective cohort studies have not demonstrated an association between NSAIDs and persistent postpartum hypertension or need for antihypertensive therapy in women with severe hypertensive disorders of pregnancy [7,8]. Results of two randomized trials conducted in women with preeclampsia with severe features have been

* Corresponding author at: University of Pennsylvania Perelman School of Medicine, Department of Obstetrics & Gynecology, Pennsylvania Hospital, 800 Spruce St., 2 Pine East, Philadelphia, PA 19107, United States.
E-mail addresses: Jourdan.triebwasser@pennmedicine.upenn.edu (J.E. Triebwasser), ahesson@med.umich.edu (A. Hesson), elangen@med.umich.edu (E.S. Langen).

https://doi.org/10.1016/j.preghy.2019.09.012
Received 6 June 2019; Received in revised form 23 August 2019; Accepted 21 September 2019
Available online 03 October 2019

mixed. An open-label study demonstrated an increased incidence of postpartum hypertension among women exposed to ibuprofen [9]. A subsequent trial showed no difference in incidence of postpartum hypertension or time to BP control among women receiving ibuprofen versus acetaminophen [10].

The aforementioned studies have all assessed the impact of ibuprofen or other NSAIDs on women with severe hypertensive disorders. Additionally, the authors used routine postpartum BP measurements to assess their outcomes although the frequency of measurement varies by institution. More frequent BP monitoring could demonstrate different results than those seen with routine evaluation. Twenty-four-hour ambulatory blood pressure monitoring (ABPM) using a wearable device has been validated in pregnancy and is satisfactory to women, but use in the immediate postpartum setting has not been reported [11–13].

We sought to assess the impact of ibuprofen on postpartum BP among women with gestational hypertension or preeclampsia without severe features using a combination of clinical BP measurements and ABPM. We hypothesized that ibuprofen and acetaminophen have equivalent effects on postpartum systolic blood pressure in the days after delivery.

2. Methods

We conducted a double-blind, randomized, cross-over equivalence trial of ibuprofen versus acetaminophen given for postpartum pain control among women with gestational hypertension or preeclampsia without severe features at the University of Michigan Medical Center.

Women ages 18–45 diagnosed prior to delivery with gestational hypertension or preeclampsia without severe features as defined by ACOG were eligible for the trial [6]. The following additional inclusion criteria were used: singleton gestation, taking one or fewer oral medications for blood pressure control, and ability to give written informed consent in English prior to delivery. We excluded women with chronic hypertension or severe features of preeclampsia including neurologic symptoms; pulmonary edema; alanine aminotransferase (ALT) greater than 70 units/L or aspartate aminotransferase (AST) greater than 60 units/L; platelet count less than 100,000 per microliter; or serum creatinine > 1.1 mg/dL or double the baseline serum creatinine (if known). If a woman had more than one severe range BP, defined as systolic blood pressure (SBP) ≥ 160 mmHg or diastolic blood pressure (DBP) ≥ 110 mmHg, she was excluded. Women in whom NSAIDs should be used with caution, including moderate or severe persistent asthma and those on therapeutic anticoagulation were excluded. Additional exclusion criteria were chronic opiate use (daily for at least 2 weeks) and reported allergy to NSAIDs, aspirin, acetaminophen, or lactose (placebo pill). After enrollment, women were excluded from randomization if they developed any severe features of preeclampsia, delivered via cesarean, or required additional sedation or general anesthesia for any reason. Before recruitment began, approval was obtained from the institutional review board at the University of Michigan Medical Center, and the trial was registered with ClinicalTrials.gov (NCT 02891174).

Women were recruited prior to delivery with study coordinators or a fellow in Maternal-Fetal Medicine available Monday through Friday during the day. Eligible women were randomized in a 1:1 ratio to receive ibuprofen or acetaminophen for pain management postpartum. The random allocation sequence without block size restrictions was generated by the study statistician and provided to the research pharmacy. At the time of delivery, a Maternal-Fetal Medicine physician entered an electronic order for study medications including the participant's study ID number. The study drugs were procured by the research pharmacy from commercial supply and were compounded by over-encapsulating the tablets in matching gelatin capsules. Participants were assigned to identical encapsulated tablets of either ibuprofen 600 mg (three 200 mg tablets) or 650 mg of acetaminophen (two 325 mg tablets of acetaminophen plus one placebo capsule [lactose]) to be given every 6 h when the participant first desired pain control postpartum. Patients, nurses, and obstetric providers were blinded to study allocation.

The intervention was conducted in a cross-over fashion to reduce variation as each participant would serve as her own control. After randomization, women were given study medication every 6 h for 24 h. The other drug was then administered in the subsequent 24 h. Oxycodone (5–10 mg) was available every 6 h as needed for uncontrolled pain. All medications were administered by obstetric nurses. Routine BPs were recorded after delivery every 15 min for 1 h, then every 30 min for 1 h, then every 4–8 h until discharge. All other aspects of postpartum management were at the discretion of treating physicians or nurse midwives, including initiation of antihypertensive therapy, timing of hospital discharge, and pain medications after study drug administration.

We obtained additional BP measures during the 48 h of study drug administration with the Spacelabs model 90,207 ambulatory blood pressure monitor [12,14]. The monitor was programmed to automatically record BP every 60 min. The monitor display was covered by an accompanying carrying pouch. BP measurements from the ambulatory cuff were uploaded to Spacelabs software after each participant completed the study and values were not used for clinical management.

A self-administered survey packet was given to each participant at the time that the ambulatory blood pressure cuff was distributed. The first survey asked the level of (1) abdominal, (2) perineal, and (3) overall pain on a 0–10 scale prior to administration of study drug. Participants were asked to repeat the same survey questions two hours after the first dose of study medication. The last survey assessed satisfaction with pain control during the postpartum stay during the first 24-h period postpartum, the second 24-h period postpartum, and overall. Satisfaction was assessed on a 5-point scale: not at all satisfied (1) to extremely satisfied (5). Nursing recorded clinical pain scores on a 1–10 scale were also extracted from the electronic medical record (EMR).

Clinical data from the EMR, including intrapartum and postpartum blood pressures, were abstracted 6 weeks after delivery. Study data were collected and managed using REDCap electronic data capture tools hosted at the Michigan Institute for Clinical & Health Research, University of Michigan [15].

The primary outcome was the adjusted mean difference in SBP after 24 h of drug exposure compared to baseline. The baseline SBP is the mean of the initial 5 blood pressures recorded after admission for labor or induction of labor. Secondary outcomes were change in pain score after one dose of study medication and satisfaction with pain control based on self-administered surveys. Additional outcomes included difference in DBP, need for any antihypertensive medication, incidence of severe-range hypertension, average pain using clinical pain scores, and opiate use.

With a two-sided test at a significance level of 0.05, and equivalence margin of 10 mmHg, we had 80% power to detect a difference with 44 outcome measurements. Given the crossover nature of the study, each woman contributes two measurements. We anticipated a drop-out rate of 15%. We then planned to recruit 40 women in order to have reserve power to detect carry-over effects of treatment into the next period as there was no washout period.

Analyses were performed by the intention-to-treat principle and no interim analyses were performed. Normality was assessed visually and with the Shapiro-Wilk test. Comparisons between groups for continuous variables were performed using the Mann-Whitney *U* test or Student *t* test as appropriate. Categorical variables were analyzed by Fisher exact test or χ^2 test. For the primary outcome a linear mixed model was used to regress the longitudinal BP measurements on treatment time period, group assignment, and the interaction of group with treatment time period. P-value < 0.05 was considered significant. Bivariate analyses were performed using SAS 9.4 software (SAS Institute Inc., Cary, NC) and STATA 15.0 (StataCorp LLC, College Station, TX). Modeling was

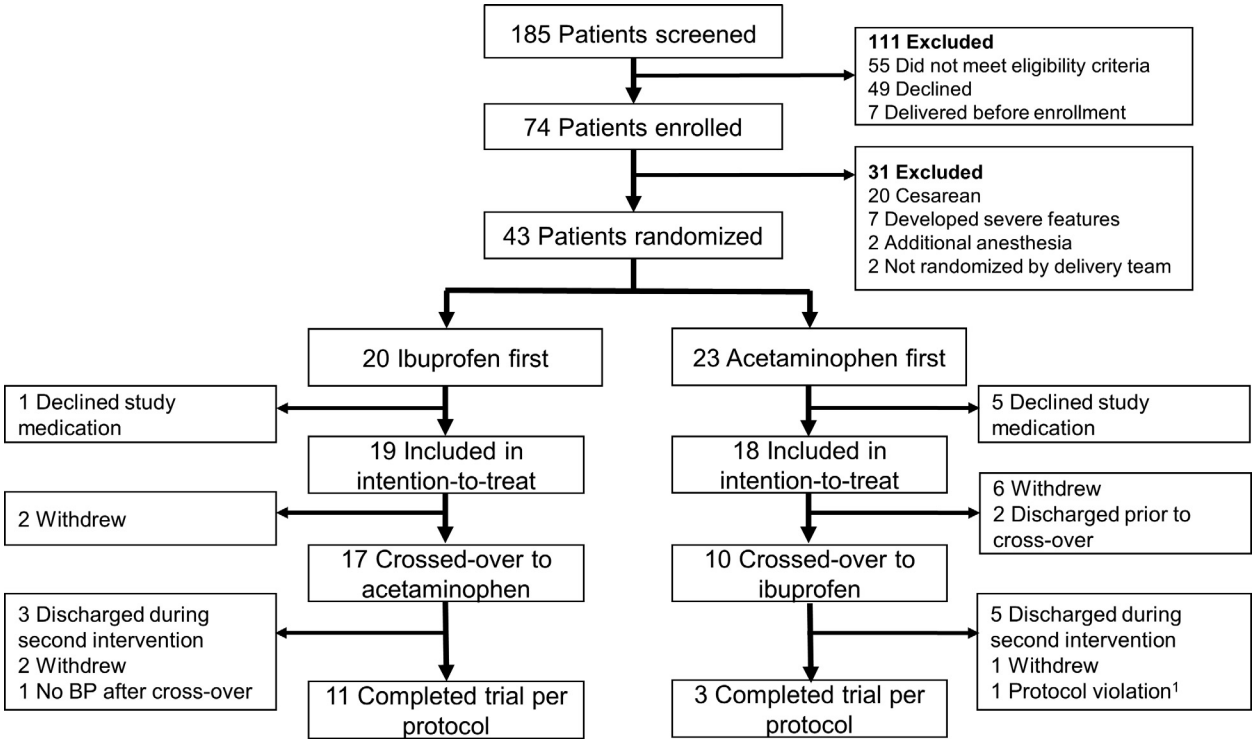

Fig. 1. Randomization of study participants. BP, blood pressure. 1. Patient administered clinically ordered ibuprofen and acetaminophen after 7th (of 8) doses of study medication.

conducted using R (R Core Team, Vienna, Austria; https://www.R-project.org).

3. Results

Between December 7, 2016 and January 24, 2018, 185 women were screened for study eligibility (Fig. 1). Of these, 130 met eligibility criteria, 74 were consented to participate, and 43 women were randomized. Prior to initiating study medications, 6 women withdrew. There were 37 women in the intention-to-treat analysis, 19 who received ibuprofen first and 18 who received acetaminophen first.

Baseline characteristics between the groups were similar (Table 1). Overall, the mean age of the study population was 31.0 ± 6.5 years and median BMI was 32.3 kg/m^2 (interquartile range 29.2–36.3). The majority in both study arms had gestational hypertension (86.5%) and just over half (56.8%) were nulliparous. Average maximum SBP and DBP before delivery were similar between groups. Only 1 participant in the acetaminophen-first group was taking blood pressure medication prior to delivery (labetalol 100 mg twice daily).

Systolic blood pressure distribution by time period is shown in Fig. 2 with the majority of BP measurements between 120 and 140 mmHg. The adjusted mean difference in SBP between treatments was 1.0 mmHg (95% CI −3.7, 5.7), which was within the margin of equivalence. The group assignment and interaction of group with time period were not significant, and only treatment time period (first 24 h of treatment versus 24–48 h) was retained in the model.

Additional blood pressure outcomes are shown in Table 2. SBP was not significantly different from baseline after ibuprofen (p = 0.11) or acetaminophen exposure (0.11). There was a statistically significant decrease in DBP from baseline after ibuprofen exposure (−4.5 mmHg, p = 0.01) and after acetaminophen exposure (−4.2 mmHg, p = 0.02), but no significant difference between treatments. There was no difference in incidence of severe range BP between treatments, and no IV antihypertensive therapy was given during the study period. Only 3 women were treated with an oral antihypertensive after delivery including the participant taking labetalol prior to delivery (100 mg daily). Nifedipine was initiated in 1 participant receiving ibuprofen first (30 mg daily) and 1 participant receiving acetaminophen first (60 mg

Table 1
Baseline characteristics by order of medication.

Characteristic[1]	Ibuprofen-Acetaminophen (n = 19)	Acetaminophen-Ibuprofen (n = 18)	p-value
Maternal age, mean (SD)	30.9 (6.9)	31.1 (6.3)	0.94
BMI, median (IQR)	33.5 (30.0–41.0)	31.7 (27.8–36.3)	0.34
Ethnicity and race			1.0
White	17 (89.5)	17 (94.4)	
Black	1 (5.3)	0 (0.0)	
Hispanic	1 (5.3)	1 (5.6)	
Marital Status			0.78
Single	4 (21.1)	5 (27.8)	
Lives with partner	1 (5.3)	1 (5.6)	
Married	14 (73.7)	11 (61.1)	
Not reported	0 (0.0)	1 (5.6)	
Insurance			0.40
Commercial	17 (89.5)	14 (77.8)	
Public/Medicaid	2 (10.5)	4 (22.2)	
Nulliparous	10 (52.6)	11 (61.1)	0.60
Parity	0 (0–1)	0 (0–1)	0.54
Gestational age in weeks, mean (SD)	39.4 (1.5)	38.6 (1.5)	0.11
Gestational hypertension	15 (79.0)	17 (94.4)	0.34
Maximum SBP before delivery, mean (SD)	154 (7)	154 (9)	0.96
Maximum DBP before delivery, mean (SD)	97 (8)	100 (7)	0.18

BMI indicates body mass index; DBP, diastolic blood pressure; IQR, interquartile range; SBP, systolic blood pressure; SD, standard deviation.
[1] Data presented as n (%) unless specified.

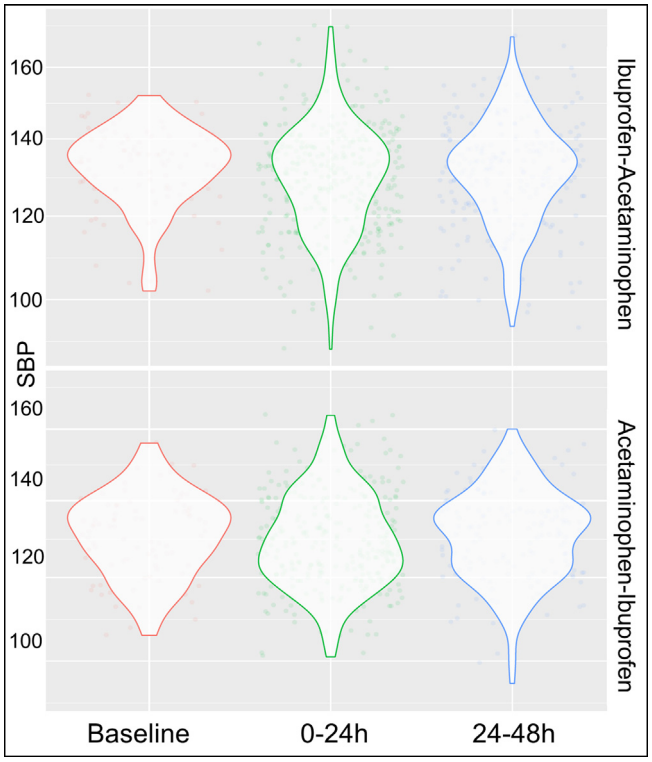

Fig. 2. Violin plots of systolic blood pressure (SBP) by treatment group and time period. For both treatment groups (top and bottom panels), patient SBP measurements are plotted (points) with a curvilinear representation of the density of these measurements (i.e., the number of points occurring at a given value) overlaid as a solid shape. The minima and maxima of these shapes represent the range of values by treatment at baseline, 0–24 h, and 24–48 h postpartum. The widest aspects of each distribution represent their respective modes.

daily).

There was limited participation in the self-administered pain surveys. Twenty-two women completed both the baseline and two-hour post-treatment pain surveys after their initial dose of study drug, 14 after ibuprofen (74%) and 8 after acetaminophen (44%). There was no difference between change in overall pain scores between ibuprofen and acetaminophen (−0.7 ± 1.8 vs. −0.6 ± 0.9, p = 0.88). There was also no difference in perineal (p = 0.91) or abdominal pain (p = 0.59) between groups. Only 17 of 37 women completed the satisfaction survey prior to discharge, 11 exposed to ibuprofen first (58%) and 6 exposed to acetaminophen first (33%). Women in the acetaminophen first group were more satisfied during the first 24 h (4 vs. 3, p = 0.02) and overall (4.5 vs. 3, p = 0.04). Satisfaction scores were also higher for the acetaminophen first group from 24 to 48 h (4.5 vs. 3, p = 0.06), though not statistically different.

No differences were seen between ibuprofen and acetaminophen by nursing-recorded pain scores. The mean pain score during ibuprofen administration was 2.2 ± 1.1 vs. 2.3 ± 1.3 with acetaminophen (p = 0.76). Among study participants, 29.7% used any opiate medication after delivery. There was no difference in proportion of women taking opiate pain medication (p = 0.64) and median opiate consumption (in morphine equivalents) was 0 mg (IQR 0,0) during ibuprofen administration and acetaminophen administration (p = 0.85).

4. Discussion

In this randomized, controlled trial, we found that ibuprofen and acetaminophen were equivalent in effect or lack thereof on SBP postpartum after 24 h of drug exposure. There was no difference in the incidence of severe range BP between groups, and no IV antihypertensive medication was given in either study arm.

Blue et al. [10] posited that women with less severe disease may be more susceptible to NSAID-related blood pressure alterations. Our study does not support an exaggerated response in women with less severe forms of hypertension. While currently published data are reassuring on the impact of NSAIDs in women with hypertensive disorders of pregnancy, several questions remain. Most importantly, the effect of NSAIDs taken for 7–14 days as may be typical after delivery has not been evaluated. Assessing the impact of combination therapy with acetaminophen and ibuprofen has also not been assessed in a prospective fashion even though acetaminophen has been implicated in hypertension in young women [18,19].

The primary strength of the study is its randomized, blinded design. This is also the first randomized trial to assess the relative impact of ibuprofen on postpartum blood pressure in women with non-severe hypertensive disorders in pregnancy. Including women with non-severe disease is important as it is more common and current ACOG recommendations on NSAID use are not limited to women with severe features [6,16]. Use of ABPM is another strength. By increasing blood pressure sampling frequency, the use of ABPM should increase the detection of severe range BP compared to routine clinical monitoring. The majority of severe range BP recorded in this study were detected by ABPM. ABPM has previously been used to evaluate the persistence of hypertension weeks after delivery, but this is a unique use of ABPM in the immediate postpartum period [17].

The study is limited by the small sample size and withdrawal or early discharge from the study that was greater than expected. While we still had more than 44 observations, the reduced sample size may not account for carryover effects from the first treatment given lack of washout period in the study. A washout period was neither practical (due to postpartum pain) nor clinically important given relatively short half-life (around 2 h) for both medications. It also remains possible that

Table 2
Blood pressure outcomes by treatment.

		Treatment			
Outcome	Baseline (n = 37)	Ibuprofen (n = 35)[1]	Acetaminophen (n = 36)[2]	Observed difference[3]	Adjusted difference[4]
SBP, mmHg	131.9 (6.3)	129.1 (8.3)	129.1 (8.5)	0.1 (−3.9, 4.0)	1.0 (−3.7, 5.7)
DBP, mmHg	82.8 (8.5)	78.3 (6.7)	78.6 (6.7)	−0.4 (−3.5, 2.8)	−0.5 (−4.4, 3.4)
Severe range BP[5]		5 (14.3)	7 (19.4)		

BP indicates blood pressure; DBP, diastolic blood pressure; SBP, systolic blood pressure.
Data presented as mean (standard deviation) unless specified.
[1] Two women in the acetaminophen first group were discharged prior to treatment period 2 and did not contribute outcome data in time period 2 (n = 35).
[2] One woman in the ibuprofen first group crossed over to acetaminophen but had no blood pressure recorded in period 2 (n = 36).
[3] Mean (95% confidence interval).
[4] Model adjusted for treatment period and presented as mean (95% confidence interval).
[5] Presented as n (%), p = 0.75 by Fisher's exact test.

longer courses of NSAID therapy might affect blood pressure. In this trial, each drug was only given for 24 h; the two randomized trials previously published administered study medications for 27–96 h [9,10]. We only randomized women after vaginal delivery to limit variation in pain due to delivery mode, so our results may not apply to women who undergo cesarean delivery. We are limited in our ability to draw conclusions from the pain surveys as the response rate was low. Women who were satisfied with their pain control may have been more likely to complete the survey, biasing our results. Although the differences were small, more women withdrew after receiving acetaminophen and fewer in the group receiving acetaminophen first completed the surveys suggesting that pain control may be worse with acetaminophen compared to ibuprofen.

In conclusion, ibuprofen and acetaminophen do not have differential effects on SBP in the immediate postpartum period among women with gestational hypertension and preeclampsia without severe features. Larger trials involving longer treatment duration are needed to determine the safety of commonly used analgesics in the greater postpartum period representing typical analgesic use.

Author statements

I, Jourdan Triebwasser, declare that I participated in the study design, data collection/analysis/interpretation, and drafting of the manuscript. I have the following conflicts of interest: none. Source of funding Edward Swift Dunster, MD Fellow Research Award at the University of Michigan, Department of Obstetrics & Gynecology.

I, Ashley Hesson, declare that I participated in the data analysis/interpretation, and drafting of the manuscript. I have the following conflicts of interest: none. Source of funding: none.

I, Elizabeth Langen, declare that I participated in the study design, data collection/analysis/interpretation, and drafting of the manuscript. I have the following conflicts of interest: none. Source of funding: none.

Funding

This work was supported by the Edward Swift Dunster, MD Fellow Research Award at the University of Michigan. The funding source had no involvement in the study design; collection, analysis, or interpretation of the data; in the writing of the report; or in the decision to submit for publication. Study design and data analysis were supported by the Michigan Institute for Clinical & Health Research (Clinical and Translational Science Award, UL1TR002240).

Declaration of Competing Interest

None.

Acknowledgements

We would like to acknowledge Ms. Brittany Loder and Ms. Katie Kowalk for their assistance in enrollment, and Dr. Louise O'Brien for supplying the ambulatory blood pressure monitors.

References

[1] A.R. Deussen, P. Ashwood, R. Martis, Analgesia for relief of pain due to uterine cramping/involution after birth, Cochrane Database Syst. Rev. 11 (5) (2011) CD004908.
[2] B.P. Schachtel, W.R. Thoden, R.I. Baybutt, Ibuprofen and acetaminophen in the relief of postpartum episiotomy pain, J. Clin. Pharmacol. 29 (6) (1989) 550–553.
[3] A.G. Johnson, T.V. Nguyen, R.O. Day, Do nonsteroidal anti-inflammatory drugs affect blood pressure? A meta-analysis, Ann. Intern. Med. 121 (4) (1994) 289–300.
[4] J.E. Pope, J.J. Anderson, D.T. Felson, A meta-analysis of the effects of nonsteroidal anti-inflammatory drugs on blood pressure, Arch. Intern. Med. 153 (4) (1993) 477–484.
[5] A. Makris, C. Thornton, A. Hennessy, Postpartum hypertension and nonsteroidal analgesia, Am. J. Obstet. Gynecol. 190 (2) (2004) 577–578.
[6] Hypertension in Pregnancy, Executive summary, Obstet. Gynecol. 122 (5) (2013 Nov) 1122.
[7] O.A. Viteri, J.A. England, M.A. Alrais, K.A. Lash, M.I. Villegas, O.A. Ashimi Balogun, et al., Association of nonsteroidal antiinflammatory drugs and postpartum hypertension in women with preeclampsia with severe features, Obstetr. Gynecol. 130 (4) (2017) 830–835.
[8] S.W. Wasden, E.S. Ragsdale, S.T. Chasen, D.W. Skupski, Impact of non-steroidal anti-inflammatory drugs on hypertensive disorders of pregnancy, Pregnancy Hypertens. 4 (4) (2014) 259–263.
[9] P. Vigil-De Gracia, V. Solis, N. Ortega, Ibuprofen versus acetaminophen as a postpartum analgesic for women with severe pre-eclampsia: randomized clinical study, J. Matern. Fetal. Neonatal. Med. 30 (11) (2017) 1279–1282.
[10] N.R. Blue, C. Murray-Krezan, S. Drake-Lavelle, D. Weinberg, B.D. Holbrook, V.R. Katukuri, et al., Effect of ibuprofen vs acetaminophen on postpartum hypertension in preeclampsia with severe features: a double-masked, randomized controlled trial, Am. J. Obstet. Gynecol. 218 (6) (2018) 616.e1–616.e8.
[11] A. Halligan, E. O'Brien, K. O'Malley, F. Mee, N. Atkins, R. Conroy, et al., Twenty-four-hour ambulatory blood pressure measurement in a primigravid population, J. Hypertens. 11 (8) (1993) 869–873.
[12] A.H. Shennan, J. Kissane, M. de Swiet, Validation of the SpaceLabs 90207 ambulatory blood pressure monitor for use in pregnancy, Br J Obstet Gynaecol. 100 (10) (1993) 904–908.
[13] S.P. Walker, M.J. Permezel, S.P. Brennecke, L.K. Tuttle, J.R. Higgins, Patient satisfaction with the SpaceLabs 90207 ambulatory blood pressure monitor in pregnancy, Hypertens. Pregnancy 23 (3) (2004) 295–301.
[14] E. O'Brien, F. Mee, N. Atkins, K. O'Malley, Accuracy of the SpaceLabs 90207 determined by the British Hypertension Society protocol, J. Hypertens. 9 (6) (1991) 573–574.
[15] P.A. Harris, R. Taylor, R. Thielke, J. Payne, N. Gonzalez, J.G. Conde, Research electronic data capture (REDCap)–a metadata-driven methodology and workflow process for providing translational research informatics support, J. Biomed. Inform. 42 (2) (2009 Apr) 377–381.
[16] C.V. Ananth, K.M. Keyes, R.J. Wapner, Pre-eclampsia rates in the United States, 1980–2010: age-period-cohort analysis, BMJ 7 (347) (2013 Nov) f6564.
[17] A. Ditisheim, G. Wuerzner, B. Ponte, Y. Vial, O. Irion, M. Burnier, et al., Prevalence of hypertensive phenotypes after preeclampsia: a prospective cohort study, Hypertension 71 (1) (2018) 103–109.
[18] J.S. Hirshberg, A.G. Cahill, Pain relief: determining the safety of ibuprofen with postpartum preeclampsia, Am. J. Obstet. Gynecol. 218 (6) (2018) 547–548.
[19] G.C. Curhan, W.C. Willett, B. Rosner, M.J. Stampfer, Frequency of analgesic use and risk of hypertension in younger women, Arch. Intern. Med. 162 (19) (2002) 2204–2208.