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Potential Benefits of Acupuncture for Hypertensive Disorders in Pregnancy: A Case Series

By Christina Jackson, DAHM, LAc and Jacqueline Bailey, RN, DAHM, LAc

Abstract

Background: Hypertensive disorders (HD) affect up to 10% of pregnancies worldwide. Acupuncture has been used for centuries to treat a variety of symptoms associated with pregnancy and is also known to reduce blood pressure (BP) in chronic hypertension (CH). However, the use of acupuncture in addition to usual care for hypertensive disorders in pregnancy (HDP) is not widely represented in the scientific literature.

Objectives: This case series presents three pregnancies with developing symptoms of hypertension treated with acupuncture according to their Acupuncture and East Asian Medicine (AEAM) patterns in addition to usual care. Case study participants had a history of first pregnancies complicated by HD.

Methods: Inclusion criteria for the case series included two or more risk factors for preeclampsia (PE), a history of HD in a previous pregnancy, HD in the current pregnancy that began at the same gestational week or earlier than in the first pregnancy, and no acupuncture intervention in the first pregnancy.

Results: Three patients diagnosed with HD with complications in their first pregnancies successfully managed their blood pressure in the second. The patient in Case 1 had a history of PE, a family history of PE, and developed HD at week 28, 4 weeks earlier than the first pregnancy. The patient in Case 2 had CH with superimposed gestational hypertension (GH) and advanced maternal age (AMA). She developed GH at week 10, 10 weeks earlier than her first pregnancy, during which she had been hospitalized twice and had a preterm delivery. The patient in



she studied traditional Chinese and Japanese styles of acupuncture. She completed intensive training with Claudia Citkovitz, PhD, LAc, in labor and delivery at NYU Langone Health. Prior to her studies in Eastern Asian medicine, Jacqueline worked as an RN in cardiac critical care. Dr. Bailey currently operates a private practice in Seattle, Washington. Her specialties include women's health, fertility, high-risk pregnancy, pain conditions, and internal medicine.

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Case 3 had a history of PE, gestational diabetes (GD), and AMA; she developed hypertension at week 34 in both pregnancies and was rehospitalized postpartum with PE in the first pregnancy. In all second pregnancies described in this case series, the patients' blood pressures (BP) remained stable or decreased temporarily, babies were delivered at term without complications, and stress and associated symptoms were reduced.

Conclusions: Acupuncture appears to be effective in reducing symptom burden, managing blood pressure short term, and may prevent progression and complications in HDP.

Keywords: acupuncture, preeclampsia, gestational hypertension, hypertensive disorders in pregnancy, pregnancy-induced hypertension

Introduction

Hypertensive disorders in pregnancy (HDP) are the most common pregnancy complication and the number one cause of preterm birth (Meis & Goldenberg, 2000). HDP—including preexisting hypertension (PH), gestational hypertension (GH), chronic hypertension (CH) with superimposed GH, and preeclampsia (PE)—increased from 5.3% to 9.1% of US births from 1993 to 2014 and has continued to climb (CDC, 2019). In addition, rates of HDP among delivery hospitalizations increased again from 13.3-15.9% between 2017-2019 (Ford et al., 2022). The incidence of HDP rises further with an uptick in pregnant patients in high-risk categories: advanced maternal age (AMA), gestational and pregestational diabetes (GD), obesity, and CH (Ford et al., 2022).

Gestational parents with PH and GH are associated with significantly higher rates of adverse pregnancy outcomes. According to Boghossian et al. (2015), 26.6% of women who have had HDP will develop it in a subsequent pregnancy. Steegers et al. (2010) found that 16% of maternal deaths could be attributed to hypertensive disorders. Gestational parents with HDP have eight times the risk of developing PE, a 28% risk of preterm delivery (Kase et al., 2013), a 41% risk for c-section, a 16.9-21% risk for low birth weight, 2.4 times the risk of placental abruption, a 20% risk for neonatal care unit admissions, and a 4% risk of neonatal death (Seely & Ecker, 2014). Preterm infants are at an increased risk for low birth weight, developmental delays, cerebral palsy, vision and hearing issues, feeding problems, and breathing difficulties. (CDC, 2019). Low birth weight and preterm birth are the second leading causes of

infant death (Mathews & Driscoll, 2017).

Organ and hemolytic dysfunction characterized by abnormalities in complete blood count (CBC), total platelets (PLT), serum creatinine, blood urea nitrogen (BUN), proteinuria, or liver enzymes, and sudden uncontrollable hypertension separate the progression to PE from the other HDP. In other HDP, these tests will be normal, and medication can manage the BP. However, the more serious condition, PE, can occur rapidly and without warning; if untreated, it may lead to cardiac events and fetal or maternal death.

For gestational parents at high risk, 100 mg low-dose aspirin administered daily from week 16 or earlier is currently the only medical treatment available that reliably decreases the risk for the development of PE (by 5%). ACOG, 2019). The usual care for HDP is expectant management and patient education, including fetal and placental monitoring, serial blood pressure (BP) monitoring, and lab testing. The standard intervention for HDP is BP management with medications such as hydralazine, labetalol, nifedipine, and methyldopa. Such medications can manage HDP, but these interventions have not been shown to reverse or prevent PE, as hypertension in PE is caused by abnormalities in uterine perfusion. Usual care for PE includes BP and antiseizure medication, hospitalization, and early delivery if severe features develop (ACOG, 2019).

The historical use, theory, and practice of acupuncture and modern clinical observations from experienced clinicians suggest that it may help prevent and treat HDP and PE. Treatment of associated symptoms, including headaches, dizziness, and edema, can be found in the earliest gynecological writings in Chinese medicine (Qing-zhu et al., 1995) as well as major modern gynecological texts. (Maciocia, Giovanni, 2011; Betts, 2006). Management of these symptoms is also routinely taught in modern acupuncture school curriculums.

Meta-analysis has shown that acupuncture can transiently lower BP in non-pregnant patients (Zhao et al., 2015). To date, there are three published articles in English addressing acupuncture and HDP. Kocher and Hobbs (2019) detail the care of a 27-year-old primiparous woman with PE hospitalized at 27 weeks gestation, who, with acupuncture treatment two to four times per week, was able to successfully normalize her BP and maintain pregnancy for an additional five weeks. Betts reported two cases of HDP successfully treated with acupuncture in addition to the usual care that carried to term without complications (Betts, 2003). Finally, a small case-controlled feasibility study of 11 Chinese women with PE showed acupuncture lowered the BP in the treatment group both at delivery and postpartum, compared to the usual care control group in a two-week, ten-treatment trial (Zeng et al., 2016). The small



cohort did not show significant differences in any other perinatal outcomes. Given these results, acupuncture in HDP may show promise; however, its effect has yet to be widely studied in rigorous controlled trials.

Despite limited evidence, acupuncture is widely used in some countries to treat HDP. For example, a 2006 study of Taiwan's national health records found that 24% of pregnant women utilized (AEAM) and the most commonly treated condition was HD (Yeh et al., 2009). This case series will examine the underlying mechanisms and benefits of acupuncture used in conjunction with usual/standard/conventional care to decrease the severity of associated symptoms of HDP and possibly reduce the incidence of recurrence. We will also examine the ability of acupuncture to show benefits in associated symptoms, physiological factors, patient satisfaction, and quality of life.

Materials and Methods

This case series consists of a retrospective chart review of patients treated between January 2016 and March 2020 at two private acupuncture clinics in the Seattle area. Patient informed consent was obtained for inclusion in the case series and to enable access to medical records for review. This case series was approved by the Institutional Review Board of the Seattle Institute of East Asian Medicine.

Inclusion criteria

Inclusion criteria for the case series consisted of multigravida patients with a developing HDP, a history of HD with complications in the first pregnancy, no previous acupuncture treatment in pregnancy, and the HD detected in the same week or earlier in the second pregnancy than the first pregnancy.

Cases

Patient 1: a 30-year-old multigravida with a history of PE

Brief medical history

During her first pregnancy, at 32 weeks, she experienced extreme dizziness, visual disturbances, lightheadedness, nausea, and a diagnosis of GH that later progressed to PE. Her labs were within normal limits. Other risk factors

included a family history of PE and asthma and a personal history of a seizure disorder in her teens.

At week 29 in her second pregnancy, she was diagnosed with GH accompanied by dizziness, lightheadedness, and visual disturbances. The symptoms presented four weeks earlier than in the first pregnancy. She also reported difficulty sleeping, pubic symphysis pain, frequent left-sided and frontal headaches, extreme stress, and anxiety due to her medical situation while trying to manage her first infant and a full-time job.

Diagnostic workup

At 29 weeks into her second pregnancy, the patient's BP averaged 135/85 mmHg; the highest reading that week was 162/102 mmHg. Ultrasound and labs were within normal limits. She was diagnosed with GH. (See Table 1 for more details.)

Table 1.

DIAGNOSTIC DATA	Patient 1	Patient 2	Patient 3
Age	30	37	37
Number of pregnancies	2	2	2
Comorbidities	Asthma, seizure disorder	Myomectomy, hypothyroid, chronic hypertension	Hypothyroid, chronic urinary tract infections, GD, high BMI
Risk factors	FH of PE, hx PE first pregnancy	AMA, CH, hx GH first pregnancy	GD, AMA, hx of PE first pregnancy
Biomedical diagnosis	Preeclampsia	Chronic hypertension with superimposed gestational hypertension	Gestational hypertension
BP rise detected in 1st pregnancy	32 weeks	20 weeks	34 weeks
BP rise detected in 2nd pregnancy	28 weeks	10 weeks	34 weeks
Biomedical intervention in 1st pregnancy	100 mg labetalol from 32 weeks	Labetalol 200 mg from 20 weeks	Preterm induction 34 weeks
Biomedical intervention in 2nd pregnancy	Expectant management and acupuncture	Labetalol 100 mg from start, change to 200 mg at week 10 and acupuncture	Expectant management, acupuncture



Labs/ultrasound 1st pregnancy	All normal	IUGR 32 weeks, nonreassuring fetal status at 34 weeks	Elevated liver enzymes
Labs/ultrasound 2nd pregnancy	All normal	All normal	All normal

Past treatment

During the patient's first pregnancy, she had been prescribed 100 mg of labetalol and placed on bed rest. She remained on medication and bed rest until 37 weeks and two days (37+2) when sudden, uncontrollable high BP and a consequent diagnosis of PE resulted in emergency induction of labor (IOL). Intrapartum, she was given IV labetalol and magnesium sulfate. She remained on labetalol for one month postpartum.

Acupuncture course

The patient began acupuncture 27 weeks into her second pregnancy to treat pubic symphysis pain. At that time, she reported managing her BP only with bed rest. Acupuncture was increased to twice weekly at 29 weeks for a total of 14 treatments. In accordance with her Traditional Chinese Medicine (TCM) diagnosis of Liver Blood deficiency, Liver qi stagnation, Liver yang rising, and Wind, commonly selected points included the following: LR2 (*Xing Jian*), LR3 (*Tai Chong*), GB41 (*Zu Ling Qi*), TE5 (*Wai Guan*), ST36 (*Zu San Li*), LI10 (*Shou San Li*), KI3 (*Tai Xi*), LU7 (*Lie Que*), KI1 (*Yong Chuan*), auricular *Shen Men*, and *Yin Tang*. (See Table 2 for details) Acupuncture lowered blood pressure more effectively when stronger stimulation was applied with 40-minute retention times. The practitioner used the detection of improvement in the patient's pulse to guide point selection and retention times.

Clinical course

Daily logs showed stable BP with readings out of normal range each successive week. The patient did not require BP medication. She was scheduled for induction at 38 weeks + 3 days (38+3). Four days before that date, she experienced a spike in BP at night. The following morning her obstetrician moved up her induction due to suspected PE. That same morning, she received acupuncture to regulate BP, subdue Liver Wind, and calm the shen using points LR3 (*Tai Chong*), LR2 (*Xing Jian*), GB43 (*Xia Xi*), auricular *Shen Men*, and *Yin Tang*, retained for 20 minutes. (See Table 2 for details.) She was then treated with electroacupuncture for 30 minutes to encourage labor to begin: LI4 (*He Gu*) with UB32 (*Ci Liao*) to SP6 (*San Yin Jiao*) for 30 minutes. She went into labor that day and delivered a 7 lb 9 oz infant that evening without intervention or additional BP management.



Follow-up

Six weeks postpartum, her blood pressure remained within normal range following delivery, and there were no complications. Biweekly acupuncture treatments managed her anxiety well. The patient reflected, "My pregnancy with acupuncture was an entirely different experience [than prior pregnancy without acupuncture]. The stress and anxiety of feeling miserable and watching my body go through a gigantic battle that was always trying to evict my baby was terrifying. Every weekly milestone we passed was celebrated. Acupuncture gave me not only an effective solution to keep my baby safely inside my womb, but provided some relief to the extreme stress and anxiety I was feeling to keep a baby that I desperately wanted, but my body would have much preferred to evict before it was time." Acupuncture also appeared to relieve her physical symptoms of pain, dizziness, visual disturbances, pubic symphysis pain, and headaches.

Patient 2: a 37-year-old multigravida with a history of CH superimposed on GH

Brief medical history

Superimposed GH and hypothyroidism complicated her first pregnancy. The patient had two hospitalizations around 32 weeks due to increased hypertension and intrauterine growth restriction (IUGR). She gave birth via cesarean section due to IUGR and nonreassuring fetal status at 34.5 weeks to a low-birth-weight infant weighing 4 lbs 10 oz. Risk factors included advanced maternal age, myomectomy, and hypertension.

Diagnostic workup

At week 10 of the patient's second pregnancy, blood pressure readings registered as high as 150/100. Lab findings and ultrasound were within normal limits. Her diagnosis was PH with superimposed GH. (See Table 1 for details.)

Past medical treatment

She was treated with 200 mg of labetalol in her first pregnancy, starting at 20 weeks. As mentioned, she had been hospitalized twice for intrauterine growth restriction (IUGR) and gave birth to a preterm, low-birth-weight infant at 34 weeks. (See Table 1.) Before her second pregnancy, she restarted labetalol at 100 mg daily due to a rise in BP attributed to increased work-related stress.

Acupuncture course

She began receiving acupuncture weekly one month prior to conception. (See Table 2 for AEAM diagnoses.) At 10 weeks gestation, her BP rose outside of



normal limits. At that time, the patient started to feel warmer; her pulse qualities changed to floating and tense, and the tongue developed red sides and a yellow coat. As a result, the labetalol dose was increased to 200 mg daily. Her acupuncture treatments were also increased to twice weekly in accordance with her AEAM diagnosis. The most commonly used points were ST36 (*Zu San Li*), LR3 (*Tai Chong*), TE5 (*Wai Guan*), UB23 (*Shen Shu*), KI3 (*Tai Xi*), HT7 (*Shen Men*), and auricular *Shen Men*. (See Table 2 for details.) In addition, the practitioner placed an intradermal needle to be retained until the next visit on TE5 (*Wai Guan*). Her blood pressure record showed that as long as she wore the intradermal needle every week, her BP had fewer spikes outside the normal range.

TREATMENT DATA	Patient 1	Patient 2	Patient 3
AEAM diagnosis and rationale	LR Blood deficiency, LR qi stagnation, LR yang rising, Wind, TCM diagnosis	KI qi deficiency, HT, and LR Blood deficiency, TCM diagnosis	LR/SP/KI qi deficiency, stagnation in TE and GB, (Japanese meridian therapy diagnosis)
Associated symptoms	Headaches, lightheadedness, visual disturbances, insomnia, headaches, pubic symphysis pain, anxiety, red, thin, scalloped, and quivering tongue, wiry pulse, thin on the left and floating bilaterally in the first position	Insomnia, thinning hair, anxiety, feeling cold, nocturia, fatigue, heart palpitations, pale low back pain	Nausea, headaches, anxiety, insomnia, channels dry on palpation, pale pink tongue with a thin white coat and red speckles on the tip, pulse thin on the left side, first and second positions slippery and weak on the right
Acupuncture treatment course	1x weekly acupuncture week 27–28, 2x weekly week 29 until delivery	1x weekly 1 month prior to pregnancy through week 10; 2x weekly week 11–1 month postpartum	2x weekly from week 34-38
Summary of points	LR2, LR3, GB41, TE5, ST36, L110, K3, LU7, K11, auricular <i>Shen Men</i> , and <i>Yin Tang</i> ; day of delivery added: L14 and electroacupuncture UB32 to SP6; average 8 needles per visit	ST36, LR3, TE 5, UB 23, K 3, auricular <i>Shen Men</i> , and HT7; average 8 needles per visit	SP3, LR3, LR8, PC6, PC7, GB40, TE15, TE5, GB30, GB20

Needle gauge and brand	20x30 mm DBC Spring 10	20x30 mm DBC Spring 10	16x30 mm Seirin J-Type
Retention time	30-40 minutes	20 min	20 min
Needle technique	Manual acupuncture; 7–12 mm depth; moderate qi sensation on all points	Manual acupuncture; 7–12 mm; minimal stimulation	Manual acupuncture; 1-5mm depth; minimal stimulation
Practitioner background	American trained licensed acupuncturist (LAc), 25 years experience	American trained LAc, 25 years experience	American trained LAc, 25 years experience

Clinical course

Her BP remained well-managed and within normal range. One week she missed acupuncture due to practitioner illness, during which her BP spiked outside of normal range on several occasions. She reported that the stress of her full-time job was harder to manage, and her insomnia became more severe. She resumed acupuncture treatments twice weekly and continued a healthy, uneventful pregnancy with normal labs, ultrasounds, thyroid parameters, and well-managed BP without complications until the last two weeks of pregnancy. At that time, due to increased blood pressure, the patient increased labetalol intermittently up to 300 mg daily. She delivered a normal-weight infant via scheduled cesarean section at 40.1 weeks gestation. Before giving birth, she had difficulty finding time for acupuncture treatment. With less frequent treatment, her BP again increased, and her dosage of labetalol increased to 400 mg, with 25 mg of hydralazine added.

Follow-up

When she resumed biweekly acupuncture treatments, her BP steadily decreased. At six-weeks postpartum, a severe storm kept her from acupuncture treatment for 10 days, and her BP rose out of the normal range, accompanied by dizziness and feelings of rage. When acupuncture resumed, BP stabilized. Her OB/GYN recommended she start to decrease her BP medication at that time. All labs for postpartum for hemolysis, elevated liver enzymes, and low platelet count syndrome (HELLP) were negative. Many of her secondary associated symptoms also improved at the time acupuncture was reintroduced. Her internal temperature felt more comfortable, and her hair thicker as hypothyroidism resolved; additionally, her emotions were easier to manage, and heart palpitations ceased. Acupuncture improved her insomnia for a few days, but it would then return. This was a chronic problem and difficult to manage.



Patient 3: a 37-year-old multigravida presenting for BP management

Brief medical history

The patient had a history of GH with accompanying headaches, nausea, and visual disturbances that started at 34 weeks gestation in her first pregnancy. After a long induction at 37 weeks, she experienced a delayed postpartum hemorrhage. She was transfused, stabilized, then later discharged home. She was readmitted to the hospital for PE accompanied by elevated liver enzymes 24 hours after discharge. The patient's past medical history included anxiety, thyroid disorders, urinary tract infection (UTI), and anemia. She had the additional risk factor of gestational diabetes (GD).

Diagnostic workup

With her prior pregnancy, she was readmitted for PE accompanied by elevated liver enzymes 24 hours after discharge. During her second pregnancy, her diastolic BP climbed into the 80s, but her systolic BP and labs remained within normal limits both before and after birth. Outside her hospital stay, she received acupuncture twice weekly.

Past treatment

In her first pregnancy, she experienced a long induction, postpartum hemorrhage, and transfusion. After discharge, she was readmitted with hypertension, elevated liver enzymes, and a diagnosis of PE. The patient spent five days in the hospital after being stabilized with IV magnesium and labetalol.

Acupuncture course

The patient was scheduled for an IOL at 38 weeks in her second pregnancy. At 34 weeks, she presented for acupuncture treatment. She was very anxious about developing PE again after her last experience; her stress levels were very high. Her sleep had been poor due to caring for her two-year-old son. She was suffering from nausea, headaches, and anxiety. (See Table 2 for diagnostic details.) The practitioner utilized a meridian therapy approach and focused on treating the root first by tonifying the Spleen and Liver qi, most frequently using SP3 (*Tai Bai*), LR3 (*Tai Chong*), LR8 (*Qu Quan*), PC6 (*Nei Guan*), and PC7 (*Da Ling*). The branch treatment addressed moving the Gallbladder and Triple Energizer channels with alternating points GB20 (*Feng Chi*), GB30 (*Huan Tiao*), GB40 (*Qiu Xu*), TE5 (*Wai Guan*), and TE15 (*Tian Liao*). (See Table 3 for details.) During treatment, the practitioner assessed pulse qualities and made point adaptations until the pulse deficiencies and excesses normalized.



Table 3.

RESULTS	Patient 1	Patient 2	Patient 3
Complication s with 1st pregnancy, labor, and delivery	Emergency IOL at 37 weeks +2 days due to BP spikes, magnesium sulfate and IV labetalol given intrapartum, remained on medication 4 weeks postpartum	Two hospitalizations for IUGR, preterm delivery, low birthweight infant, labetalol for 6 months postpartum, low birth weight 4 lb 10 oz infant	IOL 34 weeks, postpartum hemorrhage, postpartum elevated liver enzymes with hospital readmission to stabilize with IV magnesium, labetalol, and a beta-blocker for 5 days.
Complication s with 2nd pregnancy, labor, and delivery	Normal vaginal birth, no complications	C-section as scheduled (due to myomectomy), medications increased during delivery to 400 mg of labetaloland 25 mg hydralazine	Normal vaginal birth, no complications
Gestational age at delivery, 1st pregnancy	37 weeks +2 days	34+5	34
Gestational age at delivery, 2nd pregnancy	37 weeks +6 days	40+1	38+6

Clinical course

She continued this treatment regimen twice a week for four weeks. After eight acupuncture treatments, the patient felt calmer, and her BP remained stable at 125/80 mmHg. At 38.6 weeks gestation, a membrane sweep was performed to induce labor, and she delivered a healthy baby at 39 weeks with no complications.

Follow-up

At six weeks postpartum, the mother and baby were doing well with no signs of complications. In addition, her headaches, nausea, digestive issues, and anemia were completely resolved. The patient reported her "recovery was much smoother this time around."

Safety Evaluation



All three patients were under the care of either a midwife or an obstetrician. They were all treated with acupuncture in addition to usual care. In all cases, practitioners used their knowledge of pulse diagnosis to guide and gauge treatment effectiveness and safety. For example, a common pulse with HDP will present with a wiry pulse floating in the first and second positions, deep and weak or absent in the third position. The practitioner would choose points based on the treatment's ability to bring up a weak third position, soften the wiriness, and normalize the floating first position. In Case 3, the patient initially became nauseated after the insertion of SP3 (*Tai Bai*). The needle was quickly removed, and the patient's nausea resolved. Aside from that one adverse effect, no others were observed in any of the cases. In Case 2, the patient presented with new dizziness and anger on one postpartum visit. She was referred back to her doctor that day to rule out progression to HELLP syndrome. The outcome was negative, and treatment continued.

Discussion

The strongest predictor of GH in a second pregnancy is GH in a first pregnancy (Boghossian et al., 2015). Various studies have shown that women have a 25-47% risk of developing a hypertensive disorder in a subsequent pregnancy, and another 3% will go on to develop chronic hypertension following that pregnancy, though the more severe type of proteinuric hypertension is less common in subsequent pregnancies (Hargood & Brown, 1991). These cases were chosen as examples of patients at the highest level of risk for recurrence of HDP who also had signs of GH developing at the same time or earlier than in their first pregnancy. All three patients had better outcomes in the second pregnancy, including significant symptomatic relief, temporary blood pressure reductions, and significant stress reduction. While acupuncture may be a useful tool in symptom management, understandably, the clinical focus for patients with HDP is through maternal and fetal monitoring for the progression of the disease. The standard of care focuses on safety but does not specifically address symptom management, including significant psychological symptoms in patients. Of all perinatal deaths in 2017-2019, HDP accounted for 31.9% (Ford et al., 2022). The cases in this series illustrate the potential for acupuncture to increase perinatal safety and improve birth outcomes in one of the most difficult obstetrical conditions, as well as address associated symptoms and improve quality of life.



Limitations

Given the previous statistics of recurrence and the small sample size, it is impossible to know if these cases would have developed increasing hypertension, PE, or complications without acupuncture intervention. Further research is needed to ascertain the benefits of acupuncture for symptom management as well as the prevention of HDP.

Possible Mechanisms

The mechanism by which acupuncture may alleviate associated symptoms of HD is not fully understood. Several studies of stress and worry before and during pregnancy have been found to correlate with the development of HDP and PE (Leeners et al., 2007; Yu et al., 2013; Zhang et al., 2013). In a study of over 10,000 nulliparous women, Krishnamurthi et al. (2019) found a statistically significant relationship between worry in the first trimester of pregnancy and PE onset when controlled for other potential predictors.

Another study found statistically significant relationships between depression and anxiety in the first trimester and subsequent development of PE (Kurki et al., 2000). Other studies have shown that PE patients also perceive more stress and less social support than healthy pregnant controls (Sarmasti et al., 2019). There have been numerous studies done on acupuncture's ability to regulate the autonomic nervous system (ANS), which is responsible for responses to stress. Emerging evidence indicates that when addressing anxiety and nervousness, acupuncture treatment activates distinct brain regions caused by an imbalance between sympathetic and parasympathetic activities. It also modulates adaptive neurotransmitters in related brain regions to alleviate autonomic responses (Qian Qin Li et al., 2013). Some neurotransmitters, including serotonin, opioid peptides, catecholamines, and amino acids, appear to be participating in the modulation mechanism of acupuncture for certain ANS (Qian Qian Li et al., 2013).

Acupuncture has been shown to ameliorate anxiety and stress in a variety of populations, including infertile women, college students, and patients with post-traumatic stress disorder. (Hollifield et al., 2007; Schroeder et al., 2017; Taguchi et al., 2019). Meta-analyses have found acupuncture effective in treating anxiety disorders (Amorim et al., 2018; Errington-Evans, 2012). Other types of self-care before and during pregnancy have been found to prevent and control PE in these patients (Rasouli et al., 2019).

One of the underlying mechanisms of GH and PE is limited uterine perfusion, as the spiral arteries of the uterus do not completely develop in the first and early second trimester of pregnancy. During a normal pregnancy, fetal syncytiotrophoblasts penetrate and remodel maternal spiral arteries, causing



them to dilate into large, flaccid vessels. This remodeling accommodates the vast, increased maternal circulation needed for adequate placental perfusion. This remodeling is somehow prevented in preeclamptic pregnancies. The placenta is unable to burrow properly into the maternal blood vessels, leading to intrauterine growth restriction and other fetal manifestations of the disorder (Mammaro et al., 2009). This placental ischemia can also lead to more frequent preterm deliveries (ACOG, 2019).

Several studies have shown that acupuncture and moxibustion may influence uterine, endometrial, and placental circulation. There is significant evidence that acupuncture has a specific effect on uterine perfusion and the endometrium in cases of in vitro fertilization (IVF) preparation in infertility cases (Stener-Victorin et al., 1996; Su et al., 2019). Patients who develop PE have been correlated with statistically significantly higher uterine artery pulsation index (PI), resistance index (RI), and systolic/diastolic ratios (S/D) on doppler ultrasound than normal controls (Adekanmi et al., 2019). A 2019 meta-analysis of acupuncture in the treatment of endometrial receptivity in infertility patients showed the statistical significance of acupuncture in reducing the PI, RI, and S/D (Zhong et al., 2019). A German AEAM examined 61 normal singleton pregnancies at 30-36 weeks gestation and looked at blood pressure and cardiotocography before and after acupuncture. They found statistically significant changes in BP and short-term somatic effects on maternal and fetal circulation parameters. (Scharf et al., 2003). A positive effect on the umbilical artery waveforms with acupuncture has also been documented. (Zeisler et al., 2001).

Given this evidence, it is possible that acupuncture treatment during preconception and in early pregnancy may be of benefit through positive effects on uterine circulation in the beginning stages of placental development. Research is needed to determine whether early pregnancy and/or continued treatment throughout pregnancy provide additional support to the placental and fetal blood supply and thus prevent complications in patients at risk for HDP and PE. Research is also needed to determine if acupuncture treatment focused on uterine circulation affects early pregnancy ultrasound markers for uterine perfusion in high-risk patients and may result in the more functional development of the spiral arteries.

AEAM Diagnosis and Pathomechanisms

The focus of AEAM diagnosis and subsequent treatment of HDP focuses heavily on the signs and symptoms of individual patients. There are three main diagnostic categories for these disorders in AEAM literature: edema in pregnancy, dizziness in pregnancy, and headaches in pregnancy. The TCM pathomechanisms are commonly spleen qi and kidney qi, yin, jing, or yang



deficiency combined with blood deficiency. The qi and yang deficiency type can develop edema. The weakness of the kidney combined with blood deficiency gives rise to liver yang rising and wind (Jie et el., 2016). The patients in the above cases were treated by two different practitioners, each with over 20 years of experience in treating obstetrical conditions. One practitioner's style utilized a TCM-based differential diagnosis, and the other practitioner was trained in Japanese acupuncture, utilizing meridian therapy to treat the root (cause) first, then focusing on the branch (symptomatic manifestation). However, both practitioners used AEAM pattern differentiation combined with their knowledge of pulse evaluation for point selection and confirmation of treatment effect.

These cases all presented with significant physical symptoms associated with HDP, and all three cases appeared to be effectively managed with acupuncture in addition to usual care. In one case, BP increased along with associated symptoms on two occasions when weeks of acupuncture were missed. In addition, they presented with symptoms such as significant pain or stress, which are also known to increase blood pressure. All three patients verbally expressed that they felt a significant reduction in stress and anxiety and an overall increase in satisfaction with their second pregnancies. A common sentiment was expressed by patient #2, "I had significant internal anxiety related to my pregnancy not going well before and so much external stress from my demanding job. Acupuncture would immediately remove the stress, make my blood pressure steady without any spikes, and make me feel relaxed for a good 24 hours following a treatment. My husband could tell when I had been to acupuncture."

Conclusions

HD affects 10% of pregnancies worldwide. It has serious short and long-term effects on birth outcomes and maternal and fetal health. It is also associated with greater healthcare costs. There are few treatments that address both the associated physical and psychological symptoms or prevention of these diseases. In these three cases, acupuncture appears to mitigate symptoms associated with HDP, reduce stress, reduce BP temporarily, and increase patient satisfaction with the birth experience. More research is needed to affirm these conclusions in larger sample sizes.

The results of this case series suggest directions for future research into the potential for acupuncture to increase safety, reduce risk, and prevent the development of complications in high-risk pregnancies such as hypertensive



disorders. We suggest that acupuncture's positive effects on uterine perfusion shown in fertility research may theoretically be applied to the uterine perfusion dysfunction found in preeclampsia. Reduction of stress markers may show a mechanism for preventing these diseases, and we encourage further investigation into these areas.

Contributions

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Glossary

AEAM Acupuncture and East Asian Medicine AGOG American College of Obstetrics and Gynecologists ANS Autonomic nervous system **BP Blood pressure** CH Chronic hypertension E Eclampsia GA Gestational age GD Gestational diabetes GH Gestational hypertension HD Hypertensive disorders HDP Hypertension disorders in pregnancy HELLP Hemolysis, elevated liver enzymes, low platelet count syndrome **IOL** Induction of labor **IRB Institutional Review Board** IUGR Intrauterine growth restriction IVF In vitro fertilization **PE Preeclampsia** PI pulsatory index **RI** resistance index S/D systolic/diastolic ratio TCM Traditional Chinese Medicine UTI Urinary tract infection



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