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Original Article

Maternal serum uric acid and calcium as predictors of hypertensive disorder of pregnancy: A case control study

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ABSTRACT

Objectives: Compare serum uric acid and calcium levels among normotensive and hypertensive pregnant women, to compare maternal and perinatal outcomes in two groups.
Materials and methods: Prospective case control study was conducted after ethical approval in Obstetrics and Gynaecology department of rural tertiary care centre of Northern India, over seven months. Total 220 antenatal women ≥34 weeks of gestation with 110 cases having hypertensive disorder of pregnancy and 110 controls with normal blood pressure were compared for maternal uric acid and calcium levels and maternal, perinatal outcomes.
Results: Mean ± SD values of uric acid and calcium in control group was 4.42 ± 1.42 mg/dl and 8.94 ± 0.6 mg/dl, whereas in cases they were 6.8 ± 2.72 mg/dl and 8.61 ± 0.78 mg/dl ($p < 0.05$). Induced labour followed by lower segment caesarean section was the most common mode of delivery in hypertensive cases, whereas, in controls, the majority had spontaneous onset of labour and delivered vaginally ($p < 0.05$). Hypertensive women with higher uric acid and lower calcium had adverse perinatal outcome as compared to controls ($p < 0.05$). Mean ± SD of neonatal birth weight in controls was 2.81 ± 0.295 Kg and in cases 2.56 ± 0.421 Kg. Neonatal birth weight was significantly associated with maternal uric acid than calcium in hypertensive women. Cases with hyperuricemia and low calcium levels had adverse overall outcome as compared to controls.
Conclusion: Maternal hyperuricemia and hypocalcaemia was associated with adverse maternal, perinatal outcomes in women with hypertensive disorder of pregnancy as compared to healthy normotensive women.

Introduction

Hypertensive disorders of pregnancy (HDP) are the leading cause of maternal, perinatal morbidity and mortality [1] and affect around 2–10% of all pregnancies globally [2]. According to the World Health Organization (WHO), estimated incidence of HDP is seven times higher in developing countries as compared to developed countries [3] and risk of maternal deaths due to it in low-income countries is 300 times that of high-income [4]. Pre-eclampsia and eclampsia together account for an estimated 16% of global maternal mortality annually (63 000 maternal deaths) [5].

The incidence of HDP in India is 7–10% of all antenatal admissions [6] and account for more than 7% of all maternal deaths annually [7]. The adverse maternal and perinatal outcome in women with HDP is mainly due to lack of accurate tests that can diagnose this disease at an early stage. Studies indicate that low maternal serum calcium [8] and high uric acid levels can be used as predictors for early diagnosis of HDP and its severity [9]. High maternal serum uric acid, especially in women with HDP results from decreased uric acid clearance, increased tubular reabsorption and decreased secretion. Furthermore, calcium intake during pregnancy decreases the risk and severity of HDP by causing reduction in parathyroid calcium release and intracellular calcium concentration (which causes vasoconstriction by decreasing prostacyclin production and by increasing vasoconstriction effect of angiotensin II and noradrenaline in blood vessel wall) [10], thereby

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reducing smooth muscle contractility and promoting vasodilatation and hence, decreasing risk and or severity of HDP.

Hence, present study was conducted with aim to compare maternal serum uric acid and calcium levels in women with HDP and healthy normotensive women and to know overall maternal and perinatal outcomes in both groups.

Material and methods

Study design

Prospective case control study.

Study setting

Present study was conducted in the Obstetrics and Gynaecology department of rural tertiary care centre of Northern India.

Duration

7 months (October 2016 to May 2017).

Study sample

Two hundred and twenty (220) antenatal women, including 110 healthy normotensive women and 110 women with Hypertensive Disorders of Pregnancy.

Inclusion criteria

All antenatal women admitted in labour ward of Obstetrics and Gynaecology department of rural tertiary care centre at gestation ≥34 weeks with/without features of HDP. All antenatal women in good health with normal blood pressure (<-120/80 mmHg) and without proteinuria on dipstick test were enrolled as controls and all antenatal women with raised blood pressure (≥140/90 mmHg) with or without proteinuria and with or without convulsions were included as cases.

Exclusion criteria

All antenatal women with gestation<34 weeks or those suffering from medical disorders like renal, hepatic, cardiovascular or neuronal disorders, chronic hypertension, chronic or acute infections, blood disorders, Type II diabetes mellitus, thyroid or other endocrinal disorders, autoimmune diseases or history of smoking, tobacco chewing or substance abuse were excluded from study.

Study population

Two hundred and twenty (220) antenatal women at gestation ≥34 weeks admitted in labour ward of Obstetrics and Gynaecology department, including 110 normotensive women and 110 women with HDP. The 110 women with HDP were further divided into three groups depending on presence or absence of proteinuria on dipstick and on presence or absence of history of convulsions (for first time and of unknown aetiology) as Gestational hypertension, Pre-eclampsia and Eclampsia respectively.

Definitions

Gestational hypertension is defined as blood pressure ≥140/90 mmHg without proteinuria after 20 weeks of gestation [11].

Preeclampsia is multi-system disorder of unknown aetiology characterized by systolic blood pressure of ≥140 mm Hg or a diastolic blood pressure of ≥90 mm Hg on two/more occasions, six hours apart and proteinuria of greater than 300 mg in 24-h urine specimen after 20 weeks of gestation [12]. Severe preeclampsia is systolic blood pressure ≥160 mm Hg or diastolic ≥110 mm Hg on two occasions at least six hours apart along with proteinuria ≥5 g (3 + or greater) in 24-h urine specimen [12].

Eclampsia is convulsive condition associated with pre-eclampsia [12].

Ethical issues

Present study was conducted after proper Institutional Ethical Committee approval and informed written consent from all participants.

Methodology

After taking informed written consent from all the participants, demographic features like age, gestation, parity, etc were recorded on structured data collection sheet. A detailed medical and family history of all participants was taken to ensure that they fulfil the inclusion criteria for study. This was followed by a thorough physical examination of every case and control which was recorded. Blood pressure of all participants was then measured using manual mercury sphygmomanometer twice in each participant at an interval of 15–20 min and then again after two hours of rest, before labelling them as normotensive or with HDP. Blood pressure was carefully recorded, with woman in sitting position with feet flat on floor and back well supported and with arm at level of heart using an appropriately sized cuff, such that the inflatable bladder covered 75–100% of circumference of upper arm of the patient. Korotkoff phase V sounds were used for diastolic readings. Urine analysis was done in all participants using dipstick test in freshly voided early morning urine collected in clean, wide mouthed container. Degree of proteinuria was graded as Trace to 4+ (Trace, 0.1 gm/L; 1+, 0.3 gm/L; 2+, 1 gm/L; 3+, 3.0 gm/L; 4+, 10 gm/L). Participants with normal blood pressure (<-120/80 mmHg) and no proteinuria were considered as controls and those with high blood pressure (≥140/90 mmHg) on two occasions, at least six hours apart, with or without dipstick proteinuria and or convulsions were enrolled as cases.

Sample collection and laboratory analysis

After overnight fasting blood sample was drawn from antecubital vein using sterile needle and syringe early in the morning for serum calcium and uric acid measurement. For serum calcium the blood sample was allowed to clot and then centrifuged at 3000 revolutions per minute for 10 min. Serum calcium levels were then measured by O- Cresol Phthalein Complexone (OCPC) method. Serum uric acid was measured by enzymatic colour test using Uricase and Peroxidase enzymes. Normal reference ranges of maternal serum calcium and uric acid considered were [13]:

Parameter	First Trimester	Second Trimester	Third Trimester
Serum Calcium (mg/dl)	8.8–10.6	8.2–9	8.2–9.7
Serum Uric acid (mg/dl)	2–4.2	2.4–4.9	3.1–6.3

Statistical analysis

Statistical analyses were performed using software SPSS version 21.0. Comparison between two continuous variables was done using unpaired t test/Mann–Whitney U- test and ANOVA/Kruskal Wallis test for comparison between more than two groups.

Qualitative variables were correlated using Chi–Square test/ Fisher's exact test. A p value of <0.05 was considered statistically significant.

Results

Of total 220 antenatal women with gestation ≥34 weeks; 110 were normotensive and 110 had HDP. Of these 110 women with HDP; 35 (31.81%) had Gestational hypertension, 49 (44.54%) had Pre-eclampsia and 26 (23.63%) Eclampsia. The mean age of controls at time of presentation was 25.34 ± 4.06 years, whereas in cases it was 26.37 ± 3.87 years (Gestational hypertension: 26.51 ± 3.82; Pre-eclampsia: 27.14 ± 3.64 and in Eclampsia: 24.73 ± 4.01 years respectively). Demographic features of all the controls and cases are depicted in Table 1. Of total 110 women with normal blood pressure (controls), there were 11 (10%) preterm (<37 weeks) patients and 99 (90%) term (>37) patients, whereas of 110 cases there were 52 (47.27%) preterm and 58 (52.73%) term patients ($p < 0.0001$) (Fig. 1).

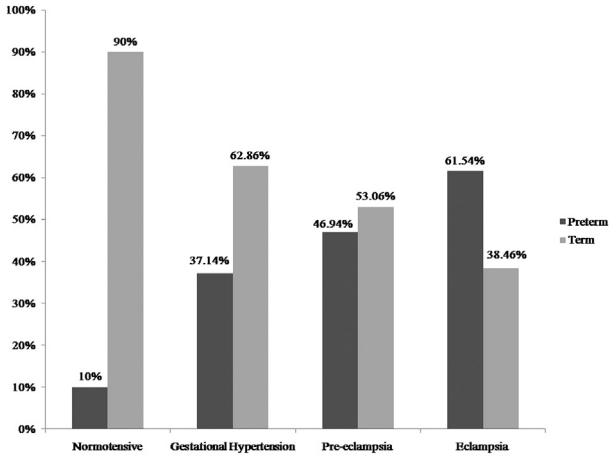

Fig. 1. Gestation-wise distribution of control and cases.

Of 110 women in control group, 14 (12.72%) patients had induction of labour [five (35.71%) for Intra-uterine fetal demise (IUFD) and nine (64.29%) for post-term and post-datism] with pharmacological agents, out of which ten (71.43%) had lower segment caesarean section (LSCS) [eight (80%) for fetal distress, one (10%) for non-progress of labour and one (10%) for obstructed labour with IUFD] and remaining four (28.57%) patients with IUFD had vaginal delivery. The remaining 96 (87.27%) out of 110 women had spontaneous onset of labour, of which 31 (32.29%) had LSCS [19 (61.29%) for previous LSCS, four (12.90%) for Breech presentation, two (6.45%) for Abruptio placentae, two (6.45%) for fetal distress, one (3.23%) for twins and one (3.23%) for Cephalo-pelvic disproportion] and remaining 65 (67.71%) had vaginal delivery. Similarly in cases group, of 110 women with HDP; 79 (71.82%) had induction of labour for deteriorating maternal condition or IUFD [23 (29.11%) in Gestational hypertension group, 37 (46.84%) in Pre-eclampsia, 19 (24.05%) in Eclamptic women], of which 12 (15.19%) had LSCS [three (25%) in Gestational hypertension, four (33.33%) in Pre-eclampsia and remaining five (41.67%) in Eclampsia group], 64 (81.01%) had vaginal delivery [20 (31.25%) in Gestational hypertension, 31 (48.44%) in Pre-eclampsia and 13 (20.31%) in Eclampsia group], two (2.53%) had vaginal birth after caesarean section (VBAC) in women with pre-eclampsia group and remaining one (1.27%) was delivered by forceps in eclampsia group. The remaining 31 (28.18%) out of 110 cases had spontaneous onset of labour [12 (38.71%) in gestational hypertension group, 12 (38.71%) in Pre-eclampsia and seven (22.58%) in eclampsia group], of which nine (29.03%) had vaginal delivery [eight (88.89%) with Gestational hypertension and one (11.11%) in Pre-eclmapsia] remaining 22 (70.97%) had LSCS [four (18.18%) in Gestational hypertension, 11 (50%) in Pre-eclampsia and seven (31.82%) in Eclampsia group] (Table 2).

The mean ± SD values of maternal serum uric acid were 4.42 ± 1.42 mg/dl and calcium were 8.94 ± 0.6 mg/dl in controls whereas in HDP group it was 6.8 ± 2.72 mg/dl and 8.61 ± 0.78 mg/dl respectively (Table 3). Relation between maternal serum uric acid and calcium with mode of delivery in control and cases is depicted in Table 4.

Of total 110 babies delivered in control group 11 (10%) were preterm [three (27.27%) suffered mild respiratory distress and one (9.09%) was IUFD], remaining 99 (90%) were term, out of which 94 (94.95%) delivered live [13 (13.83%) neonates had mild respiratory distress, three (3.19%) had severe birth asphyxia requiring ventilator support, of which one (33.33%) died after eight days], four (4.04%) were IUFD, one (1.01%) had still birth. Of total 111 neonates (including one twin gestation) delivered to all women with HDP, 45 (40.54%) [4 (8.88%) in gestational hypertension group; 23 (51.11%) in pre-eclampsia and 18 (40%) in eclampsia group] were born preterm and remaining 66 (59.46%) [32 (48.48%) in gestational hypertension; 26 (39.39%) in pre-eclampsia and 8 (12.12%) in eclampsia group] were born at term. Table 5 shows relation between maternal serum uric acid and calcium with neonatal Apgar score at birth.

The mean ± SD of neonatal birth weight in control group was 2.81 ± 0.295 Kg and in women with HDP was 2.56 ± 0.421 Kg. Table 6 shows relation between maternal serum uric acid and calcium with neonatal birth weight in cases and control group. It was observed that uric acid was a better predictor of neonatal birth weight than serum calcium in women with HDP (regression model

Table 1
Demographic features of Controls and Cases.

Demographic Features	Normotensive (Controls) N = 110	Hypertensive Disorder of Pregnancy (Cases) N = 110		
		Gestational Hypertension (N = 35)	Pre-eclampsia (N = 49)	Eclampsia (N = 26)
Age (years)				
<-20–25	67 (60.91%)	17 (48.57%)	20 (40.82%)	17 (65.38%)
26–30	28 (25.45%)	13 (37.14%)	20 (40.82%)	7 (26.92%)
31–35	15 (13.64%)	4 (11.43%)	9 (18.37%)	2 (7.69%)
36–40	0 (0.0%)	1 (2.86%)	0 (0.0%)	0 (0.0%)
Gravidity				
Primigravida	52 (47.27%)	10 (28.57%)	12 (24.49%)	17 (65.38%)
Multigravida	58 (52.73%)	25 (71.43%)	37 (75.51%)	9 (34.61%)
Gestation (weeks)				
>34–<37	11 (10%)	13 (37.14%)	23 (46.94%)	16 (61.54%)
>-37–<40	84 (76.36%)	18 (51.43%)	24 (48.98%)	10 (38.46%)
>-40	15 (13.64%)	4 (11.43%)	2 (4.08%)	0 (0.0%)

Table 2
Onset of labour.

Onset of Labour	Normotensive	Hypertensive Disorder of Pregnancy			Total	P value
		Gestational HTN	Pre-eclampsia	Eclampsia		
Induced	14 (12.7%)	23 (65.71%)	37 (75.51%)	19 (73.07%)	93 (42.27%)	<0.0001
Spontaneous	96 (87.27%)	12 (34.28%)	12 (24.48%)	07 (26.92%)	127 (57.72%)	
Total	110 (100%)	35 (100%)	49 (100%)	26 (100%)	220 (100%)	

Table 3
Maternal serum uric acid and calcium levels in controls and cases.

Serum Levels (mg/dl)	Normotensive (Control)	Hypertensive Disorders of Pregnancy (Cases)			P value
		Gestational Hypertension	Pre-eclampsia	Eclampsia	
Sample size	110	35	49	26	
Calcium					
Mean ± SD	8.94 ± 0.6	8.83 ± 0.55	8.55 ± 0.89	8.41 ± 0.76	0.001
Median	9	8.9	8.6	8.55	
Min-Max	6.9–10.7	7.8–9.9	6.4–10.6	6.7–9.7	
Inter quartile Range	8.600–9.300	8.500–9	8–9.250	8–8.900	
Uric Acid					
Mean ± SD	4.42 ± 1.42	5.47 ± 1.93	6.72 ± 2.51	8.71 ± 2.97	
Median	4.1	5.4	6.3	8.35	<0.0001
Min-Max	1.52–9.1	2.4–11.5	2.5–16.3	3.6–13.9	
Inter quartile Range	3.500–5.100	4.350–6.300	5.275–7.525	6.700–10.600	

Table 4
Relation between Maternal Serum Uric Acid and Calcium with Mode of Delivery in. Control and Cases.

Serum Levels (mg/dl)	Forceps	LSCS[a]	ND[b]	VBAC[c]	P value
Sample size	1	98	119	2	0.193
Calcium					
Mean ± SD	8.7 ± 0	8.71 ± 0.72	8.85 ± 0.7	7.95 ± 0.35	
Median	8.7	8.9	8.9	7.95	
Min-Max	8.7–8.7	6.4–10	6.9–10.7	7.7–8.2	
Inter quartile Range	8.7–8.7	8.2–9.2	8.4–9.28	7.7–8.2	
Uric Acid					0.001
Mean ± SD	13.9 ± 0	5.94 ± 2.35	5.1 ± 2.04	15.5 ± 1.13	
Median	13.9	5.55	4.6	15.5	
Min-Max	13.9–13.9	2.5–13.9	1.52–12.6	14.7–16.3	
Inter quartile Range	13.9–13.9	4–7.2	3.7–5.95	14.7–16.3	

[a] Lower segment caesarean section.
[b] Normal delivery.
[c] Vaginal birth after caesarean section.

Table 5
Relation between Maternal Serum Uric Acid and Calcium with Neonatal Apgar score at Birth.

Serum Levels (mg/dl)	Normotensive		Hypertensive Disorder of Pregnancy						P value
			Gestational Hypertension		Pre-eclampsia		Eclampsia		
	APGAR >7 N = 86	APGAR <7 N = 24	APGAR >7 N = 28	APGAR <7 N = 8	APGAR >7 N = 14	APGAR <7 N = 35	APGAR >7 N = 1	APGAR <7 N = 25	
Uric Acid (Mean ± SD) (Min-Max)	4.3 ± 1.32 (2.3–8.5)	4.87 ± 1.68 (1.52–9.1)	5.16 ± 1.74 (2.4–10.7)	6.52 ± 2.31 (4.3–11.5)	5.3 ± 1.44 (2.5–8.4)	7.29 ± 2.63 (3.7–16.3)	5.7 ± 0 (5.7–5.7)	8.83 ± 2.96 (3.6–13.9)	<0.0001
Calcium (Mean ± SD) (Min-Max)	8.99 ± 0.57 (7.8–10.7)	8.77 ± 0.66 (6.9–9.9)	8.91 ± 0.54 (8–9.9)	8.57 ± 0.53 (7.8–9.2)	8.69 ± 0.83 (6.9–9.8)	8.5 ± 0.92 (6.4–10.6)	8.2 ± 0 (8.2–8.2)	8.42 ± 0.77 (6.7–9.7)	<0.001

for gestational hypertension group: F (2,33) = 7.24, $p < 0.05$, $R^2 = 0.31$; Pre-eclampsia group: F (2,46) = 10.80, $P < 0.001$, $R^2 = 0.32$; Eclampsia group: F (2,23) = 7.55, $p < 0.05$, $R^2 = 0.40$, indicating it was significant in cases) whereas in control group neither the maternal serum uric acid nor the calcium had significant effect on neonatal birth weight (Regression model was insignificant, F (2,107) = 0.46, $p > 0.05$, $R^2 = 0.008$).

Of 110 women in control group, 105 (95.45%) patients remained healthy and stable in their immediate post-partum period and five (4.54%) required intensive care. There were no maternal deaths in control group. In women with HDP 62 (56.36%) women [34 (97.14%) in gestational hypertension, 27 (55.10%) in pre-eclampsia and one (3.85%) with eclampsia] remained healthy in their immediate post-partum period, 32 (29.09%) [17 (34.69%) women in pre-eclampsia

Table 6
Relation between maternal serum uric acid and calcium with neonatal birth weight in control and cases.

Parameters (Mean ± SD)	Normotensive	Hypertensive Disorders of Pregnancy		
		Gestational Hypertension	Pre-eclampsia	Eclampsia
Birth Weight (Kg)	2.81 ± 0.295	2.956 ± 0.273	2.475 ± 0.324	2.177 ± 0.282
Uric Acid (mg/dl)	4.42 ± 1.42	5.47 ± 1.93	6.72 ± 2.51	8.71 ± 2.97
Calcium (mg/dl)	8.94 ± 0.6	8.83 ± 0.55	8.55 ± 0.89	8.41 ± 0.76
P value	$P > 0.05$, ($R^2 = 0.008$)	$P < 0.05$, ($R^2 = 0.31$)	$P < 0.001$, ($R^2 = 0.32$)	$P < 0.050$ ($R^2 = 0.40$)

and 15 (57.69%) women with eclampsia] required intensive care and 16 (14.54%) [One (2.86%) women with gestational hypertension, five (10.20%) with pre-eclmapsia and ten (38.46%) with eclampsia] required ventilator support and high dependency unit (HDU) care for management of critical condition. Of these 16 (14.54%) women, ten (62.5%) could not be revived and succumbed to death. The relation between maternal serum uric acid and calcium with overall maternal outcome in control and cases group is depicted in Fig. 2.

Discussion

In present study two groups: control with normal blood pressure and cases with HDP were compared for overall maternal and perinatal outcomes, using maternal serum uric acid and calcium levels as predictors. Mean ± SD age in controls was 25.34 ± 4.06 years and in cases 26.37 ± 3.87 years. It was observed that maximum cases of pre-eclampsia and eclampsia were found in women of 20–25 years of age. This is similar to results of various other studies which have reported that highest incidence of HDP was observed in women of 21–25 years [14,15]. Also, it was found that women with severe pre-eclampsia belonged to 22–35 years of age and in eclampsia 19–32 years. This was supported by another study which reported that advanced maternal age is high risk factor for severe pre-eclampsia and eclampsia [16]. Out of 110 controls, there were 52 (47.27%) primigravida and 58 (52.73%) multigravida while in cases; there were 39 (35.45%) primigravida and 71 (64.55%) multigravida patients. Furthermore, in our study, it was found that eclampsia was more common in primigravida (65.38%) as compared to multigravida (34.61%), whereas pre-eclampsia and gestational hypertension was more prevalent in multigravida as compared to primigravida. Similar results were observed by a study which reported that eclampsia is more common in primigravida and teenage women [17]. Also, nulliparous and grand-multiparous women were at maximum risk of developing HDP [15].

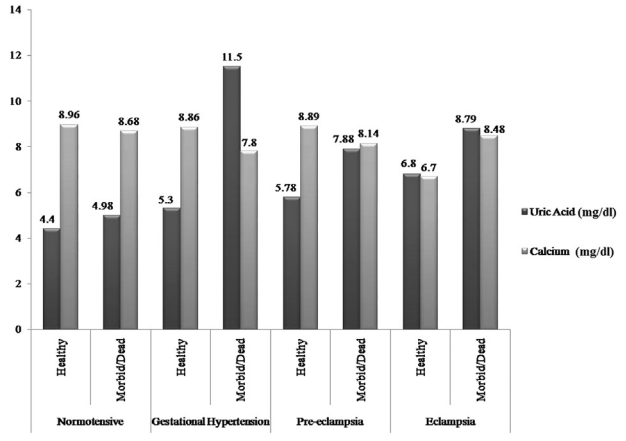

Fig. 2. Relation between maternal serum uric acid and calcium with overall maternal outcome in control and cases.

In our study 99 (90%) patients in control group were term and remaining 11 (10%) were preterm, whereas in cases group 52 (47.27%) were preterm [13/35 (37.14%) with Gestational hypertension; 23/49 (46.94%) with Pre-eclampsia; and 16/26 (61.54) with Eclampsia] and remaining 58 (52.73%) were term [22/35 (62.86%) in Gestational hypertension; 26/49 (53.06%) with Pre-eclampsia and 10/26 (38.46%) with Eclampsia], indicating that severe disease was associated with increased rate of preterm deliveries. Similar results were reported by other studies also which observed that prematurity was commonly associated with severe pre-eclampsia and eclampsia [18,19].

In present study maximum patients (87.27%) in control group had spontaneous onset of labour and 12.7% were induced (either for post-datism, post-term or for IUFD), whereas in cases group 79 (71.82%) patients had induction of labour (for deteriorating maternal condition of for IUFD) and remaining 31 (28.18%) had spontaneous onset of labour. Hence it was found that induction of labour was more common in cases group as compared to controls ($p < 0.0001$). Also, the most common mode of delivery in women with severe HDP (30.61% with severe pre-eclampsia and 46.15% with eclampsia respectively) was LSCS, whereas in control group it was vaginal delivery (61.82%). Similar results were reported by another study, where most common mode of delivery for women with severe HDP was LSCS [20]. Other studies have also reported that the induction of labour/caesarean section rates in women with HDP was very high as compared to normotensive women [21].

Furthermore, in present study, significant correlation was observed between maternal serum uric acid and mode of delivery in cases and control group ($p < 0.001$), but no significant relation was observed with maternal calcium levels in both groups ($p = 0.193$). This is similar to results of other studies which have observed that high maternal uric acid were associated with increased rate of LSCS [22,23].

In present study mean ± SD values of maternal serum uric acid were 4.42 ± 1.42 mg/dl and calcium were 8.94 ± 0.6 mg/dl in controls whereas in HDP group it was 6.8 ± 2.72 mg/dl and 8.61 ± 0.78 mg/dl respectively, which was highly significant ($p < 0.05$). Hence, it was found that serum uric acid levels were very high and serum calcium was low in cases as compared to control group. Similar results were observed in other studies also which concluded that hyperuricemia and hypocalcaemia were significantly associated with severe pre-eclampsia and eclampsia and their level varies with severity of disease as compared to normotensive women [10,24].

In our study, we observed that women with higher serum uric acid and lower calcium levels had adverse perinatal outcome as compared to healthy normotensive women. This is similar to results of study which observed significant correlation between perinatal deaths and maternal hyperuricemia and hypocalcaemia in patients with HDP [25]. Studies have also concluded that elevated maternal serum uric acid in women with pre-eclampsia were significantly associated with adverse perinatal outcome [25,26]. Another study concluded that maternal hyperuricemia in HDP patients was strongly associated with several maternal and perinatal complications, like an increased risk of APGAR score <7 by

six-fold, IUFD by 20-fold, intra-uterine growth retardation by 4-fold, and LSCS by 3.4-fold as compared to healthy antenatal women with normal uric acid levels [27].

Present study revealed that average birth weight in control group was 2.81 Kg and in cases was 2.56 Kg. This is similar to results of studies which concluded that women with pre-eclampsia and eclampsia delivered lighter babies than normotensive mothers, which was statistically significant. Similar to our study they also found that women with Gestational hypertension had babies with average birth weight similar to those of normotensive women [21,23]. Furthermore, in our study, we found significant correlation between maternal serum uric acid and neonatal birth weight, as compared to serum calcium levels in women with HDP. Similar results were reported by studies which observed that pregnant women with high serum uric acid levels (≥5.88 mg/dl) were associated with low birth weight (<2.5 kg) [22,23].

Present study observed significant correlation between maternal hyperuricemia and hypocalcaemia with adverse maternal outcomes in women with HDP as compared to healthy normotensive women with normal uric acid and calcium levels. This is similar to studies which have concluded that high maternal serum uric acid concentration has significant association with adverse maternal outcomes [26]. In our study maximum cases of maternal mortality belonged to eclampsia group with highest serum uric acid levels. This was supported by studies which reported that the mean serum uric acid levels in women with severe HDP were significantly higher than healthy pregnant women. Also, the hyperuricemia was associated with increased frequency of maternal complications like hepatic dysfunction and adverse maternal outcome [6,28]. Similar to our results, another study has shown that the maternal hypocalcemia, decreased iron and zinc levels were significantly associated with increased risk of preeclampsia [29].

Conclusion

Hence, maternal hyperuricemia and hypocalcaemia were associated with adverse maternal and perinatal outcomes in women with HDP. Maternal uric acid and calcium can be used for monitoring maternal and neonatal outcomes and as predictors for onset and severity of disease so that timely management can be implemented.

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Conflicts of interest

There are no conflicts of interest.

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