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Original Research Article

Comparison of C-reactive proteins level in gestational hypertension and in normal pregnancy in 2nd and 3rd trimester and its correlation with maternal and foetal outcome

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ABSTRACT

Background: Hypertensive pregnancy disorder covers a spectrum of clinical conditions namely preeclampsia, eclampsia, chronic hypertension and gestational hypertension. Impaired function of vascular endothelium in preeclampsia may cause abnormal immune activation causing release of inflammatory agents like cytokines, C-reactive proteins (CRP) etc. Aim of this study is to evaluate the CRP (Q) levels in gestational hypertension and in normal pregnancy in 2nd and 3rd trimester and its correlation with maternal and foetal outcome.
Methods: Total 350 patients were involved in the study with 160 subjects in Study group meeting the eligibility criteria and 190 subjects in control group. All the cases were followed up during the rest part of their antenatal, labour and postpartum period for development of preeclampsia and eclampsia and their effect on mother and foetus.
Results: In 2nd and 3rd trimester mean CRP level in study group was 10.01 mg/L and 10.28 mg/L compare to control group 1.85 mg/L and 3.06 mg/L respectively. Difference of mean CRP level was statistically significant (P value <0.001) in both 2nd and 3rd trimester. Gestational age at delivery and birth weight, Apgar score for baby was lower in study group as compared to control group. Maternal morbidity, maternal mortality, mode of delivery by caesarean section, IUD, still birth, preterm delivery, IUGR, baby with respiratory distress syndrome was significantly higher in study group.
Conclusions: Increased serum CRP level can be used as a biomarker for identifying women at risk of preeclampsia and its complications along with adverse effect.

Keywords: C - reactive protein, Hypertensive pregnancy disorder

INTRODUCTION

Hypertensive pregnancy disorders complicates 10% of all pregnancies and covers a spectrum of clinical conditions namely preeclampsia, eclampsia, chronic hypertension and gestational hypertension.[1]

Gestational hypertension is defined as high BP (≥140/90 mm Hg) that develops after 20 week of pregnancy and goes away after delivery.[2] Preeclampsia afflicts 3 to 5% of pregnancy defined as new onset hypertension with BP ≥140/90 mmHg and proteinuria after 20 weeks of gestation in a previously normotensive, non-proteinuria woman. The incidence is gradually increasing over last few decades. The causes of preeclampsia are complex and are not fully understood but the condition may be associated with poor placentation.[3]

Endothelial dysfunction may play a pivotal role in the genesis of multisystem disorder developed in preeclampsia. Impaired function of vascular endothelium in preeclampsia may cause abnormal immune activation

causing release of inflammatory agents like cytokines; C-reactive proteins (CRP) etc.[4] There is evidence suggesting that normal pregnancy itself stimulates the maternal inflammatory response.[5]

GHTN and preeclampsia are characterised by peripheral vasoconstriction and decreased arterial compliance .The proteinuria of preeclampsia is associated with a path gnomic renal lesion, known as glomerular endotheliosis, in which the endothelial cells of the glomerulus swell and endothelial fenestrations are lost.[6]

The severe preeclampsia variant HELLP syndrome (haemolysis, elevated liver enzymes, and low platelets) occurs in nearly 20% of women with severe preeclampsia and is named not only for the liver involvement, but also for the disorder of the coagulation system that develops.[7,8] Approximately 20% of women with HELLP syndrome develop disseminated intravascular coagulation, which carries a poor prognosis for both mother and foetus.[9]

The most feared complication of preeclampsia is eclampsia itself, defined by the presence of seizures, for which women with severe preeclampsia are often treated with MgSO4 prophylaxis.[10] Complications affecting the developing foetus include prematurity, IUGR, oligohydramnios, bronchopulmonary dysplasia and increased risk of perinatal deaths.[11]

Attempts are being made continuously for having screening tests so that timely preventive prophylactic therapies can be tried to avoid such pregnancy complications. Measurement of circulatory inflammatory markers may provide an alternative method of detecting women at risk for developing GHTN. C-reactive protein (CRP) is an acute phase reactant produced by the liver in response to pro inflammatory cytokines IL-6 and TNF and reflects on-going inflammation and tissue damage. CRP activates complement through the classical pathway and participates in opsonisation of particulate antigens and bacteria. It interacts with nuclear antigens including chromatins and small nuclear ribonuclear proteins (snRNPs). CRP interacts with the nuclear antigens, released from apoptotic or necrotic cells and this interaction could militate against deposition of these antigens in tissue and autoimmune reactivity.[12]

CRP (Q) can be used as an early marker of low grade inflammation and further help in detecting pathophysiological process early in pregnancy. So the present study has been undertaken to access its importance as a predictive test for GHTN and further development of preeclampsia and eclampsia and adverse maternal and perinatal outcome.

METHODS

The present study is a prospective observational study conducted in pregnant women with Gestational Hypertension (group-I) and uncomplicated pregnancies (group-II), who attended OPD in Department of Obstetrics and Gynecology, SCB MCH, Cuttack, from August 2016 to August 2017, in 2nd and 3rd trimester and followed up until admission to IPD and delivery in labour room. Out of total 350 subjects, 160 study subjects were diagnosed with gestational hypertension (GHTN) in their 2nd and 3rd trimester (henceforth Study group) basing upon the inclusion criteria and 190 subjects were having normal pregnancy (Henceforth Control group). Singleton pregnancy in 2nd and 3rd trimester included in study group. Pregnancy with renal diseases, h/o diabetes mellitus, cardiovascular diseases, chronic hypertension, symptomatic infectious diseases, obesity, periodontitis, premature rupture of membranes, clinical chorioamnionitis, mothers taking corticosteroids are excluded from study group. Informed consent was taken from patients who were eligible for the study. Quantitative C-reactive protein (CRP-Q) estimated by immunoturbidimetric test. All the cases were followed up during the rest part of their antenatal, labour and post-partum period for development of pre eclampsia and eclampsia and their effect on mother and foetus.

Statistical analysis

The data collected was entered in Microsoft excel 2007 and analysed by using SPSS version 17. The quantitative data was expressed by mean and standard deviation. Differences in means between the groups were determined by unpaired sample t-test or Mann-Whitney U-test wherever applicable. The qualitative data was expressed in percentages and the differences between percentages were computed using $\chi 2$ test or Fischer exact test. P value <0.05 was considered statistically significant.

RESULTS

The current study was found out the association of CRP level in gestational hypertension and normal pregnancy as well as to find out its effect on pregnancy outcomes.

Table 1: Trimester wise comparison of CRP level of the study subjects in both groups.

Trimester	Cases (Mean±SD)	Control (Mean ± SD)	P value*
2nd trimester	10.01±6.98	1.85±1.20	<0.001
3rd trimester	10.28±7.71	3.06±4.15	<0.001

*Mann -Whitney U test was used.

Mean CRP level was 10.01 in study group in 2nd trimester which increased to 10.28 in 3rd trimester. Similarly, CRP value in control group increased to 3.06 in 3rd trimester from 1.85 mg/L in 2nd trimester. Difference of mean CRP level was statistically significant in both 2nd and 3rd trimester.

Table 2: Comparison of gestational age at delivery and birth weight in both the groups.

	Study group (Mean ± SD)	Control group (Mean ± SD)	P value*
Gestational age	36.32±2.38	37.77±1.27	<0.001
Birth weight	1.97±0.38	2.45±0.35	<0.001

*Independent sample t-test was used.

Gestational age at delivery was lower in study group (36.32±2.38) as compared to control group (37.77±1.27) and this difference was statistically significant (P value <0.001). Birth weight was lower in study group (1.97±0.38) as compared to control group (2.45±0.35) and this difference was also statistically significant (P value <0.001).

Table 3 shows maternal morbidity was significantly higher in study group (43.1% vs. 4.2%) (P value <0.001). Similarly, there were 13 (8.1%) maternal deaths in study group as compared to only 1 (0.5%) maternal death in control group this difference was also statistically significant (P value <0.001).

Table 4 Shows majority of the subjects (30.6%) in study group suffered from post-partum haemorrhage in compare to control group only 4.2% cases suffered from PPH. The difference in these values were statistically significant (P value <0.001).

Table 3: Comparison of maternal outcome in both the groups.

Outcome	Study group N (%)	Control group N (%)	P value*
Maternal morbidity			
Present	69 (43.1)	8 (4.2)	<0.001
Absent	91 (56.9)	182 (95.8)	
Maternal mortality			
Present	13 (8.1)	1 (0.5)	<0.001
Absent	147 (91.9)	189 (95.5)	

*Chi-square and Fischer exact test was used.

Table 4: Comparison of Maternal morbidity in both groups.

Maternal morbidity	Study group N (%)	Control group N (%)	
ARF	17 (10.6)	0 (0)	<0.001
HELLP	3 (1.9)	0 (0)	
PPH	49 (30.6)	8 (4.2)	

Table 5: Comparison of CRP value according to maternal morbidity in both the groups.

Maternal morbidity	Cases	Control	P Value
	Mean±SD	**Mean±SD**	
ARF	11.01±8.98	0	Cannot be calculated
HELLP	10.84±9.71	0	Cannot be calculated
PPH	12. 48±7.85	4.56±7.89	< 0.001

Maternal morbidity like PPH has higher CRP level (12.48±7.85) as compared to (4.56±7.89) in the control group. This difference was statistically significant.

Table 6 shows statistical significant difference in CRP levels at 2nd and 3rd trimester with respect to maternal morbidity.

Table 6: Association of CRP level in 2nd and 3rd Trimester with maternal morbidity.

Trimester	Maternal morbidity	Study group		Control group		
		Mean	SD	Mean	SD	P value
2nd trimester	Present	11.79	7.30	0.84	0.70	<0.001
	Absent	9.03	6.58	1.90	1.20	
3rd trimester	Present	11.93	8.64	3.68	5.84	<0.001
	Absent	9.12	6.80	3.03	4.08	

Table 7: Association of CRP level in 2nd and 3rd trimester with maternal mortality.

Trimester	Maternal mortality	Cases group		Control group		
		Mean	SD	Mean	SD	P value
2nd trimester	Present	11.06	8.27	.41	0.01	<0.001
	Absent	10.06	6.96	1.86	1.20	
3rd trimester	Present	14.28	6.82	.50	0.12	<0.001
	Absent	9.94	7.71	3.07	4.16	

Table 8: Comparison of foetal and pregnancy outcome in both the groups.

Outcome	Study group N (%)	Control group N (%)	P value*
Type of delivery			
CS	62 (38.8)	20 (10.5)	<0.001
VD	98 (61.2)	170 (89.5)	
Birth status			
IUD	16 (10.0)	0 (0)	<0.001
Still birth	10 (6.2)	1 (0.5)	
Live birth	134 (83.8)	189 (99.5)	
Maturity			
Preterm	36 (22.5)	12 (6.3)	<0.001
Term	124 (77.5)	178 (93.7)	
Apgar score 1 min			
0 - 3	37 (23.1)	4 (2.1)	<0.001
3 - 7	69 (43.1)	21 (11.1)	
> 7	54 (33.8)	165 (86.8)	
Apgar score 5 min			
0 - 3	26 (16.3)	1 (0.5)	<0.001
3 - 7	47 (29.4)	3 (1.6)	
> 7	87 (54.3)	186 (97.8)	

Table 9: Association of CRP level at 2nd and 3rd trimester with Apgar score at 1 min.

	2nd Trimester					3rd Trimester				
	Study group		Control group			Study group		Control group		
APGAR Score	Mean	SD	Mean	SD	P value	Mean	SD	Mean	SD	P Value
<7	10.31	7.80	1.87	1.22	<0.001	9.61	7.93	2.87	3.66	<0.001
3-7	10.01	6.63	1.57	0.86	<0.001	9.91	7.70	4.92	6.94	0.003
<3	8.25	6.17	2.40	1.56	<0.001	-	-	-	-	-

Table 7 shows the CRP level where maternal mortality was present was higher in study group as compared to control group and statistically significant.

Table 8 shows 38.8% subject in study group had caesarean section as the mode of delivery as compared to 10.5% in control group (P value <0.001). In the study group there were 10% cases of IUD and 6.2% cases of still birth occurred compared to only one case of still birth and no case of IUD in control group. This difference was also statistically significant. Preterm deliveries were more found in study group (22.5%) compared to control group (6.3%) which was statistically significant. Apgar score at 1 min was between 3 to 7 in most of the subjects

in study group (43.1%) whereas majority of the subjects in control group had an Apgar score of more than 7 (86.8%). This difference in proportion was statistically significant. Similar statistical significant difference was found in comparison of Apgar score at 5 min (P value <0.001).

Table 9 shows the mean 2nd trimester CRP level decreased gradually as the Apgar score worsen in the study group but the mean CRP value remain significantly higher compared to the control group. Similarly, we found statistically significant difference in mean CRP level at 3rd trimester with the Apgar score.

Table 10: Association of CRP level with birth status at 2nd and 3rd trimester.

	2nd Trimester					3rd Trimester				
	Study group		Control group			Study group		Control group		
Birth status	Mean	SD	Mean	SD	P value	Mean	SD	Mean	SD	P Value
IUD	9.06	4.69	1.8	1.20	<0.001	12.95	7.64	3.07	4.16	<0.001
Live birth	10.01	7.08	0.9	0.12	<0.001	9.73	7.57	0.34	0.12	<0.001
Still birth	12.68	8.06	1.85	1.20	<0.001	13.45	8.79	3.06	4.15	<0.001

*Mann-Whitney U test was used

Table 11: Correlation between birth weight and the CRP level.

	Cases group (mean)	Correlation coefficient (r)	Control group	Correlation coefficient (r)
Birth weight	1.9	-0.102	2.4	-0.012
CRP level	10.1		1.85	

Table 12: Comparison of foetal outcome between both groups.

Outcome	Study group N (%)	Control group N (%)	P value*
Normal	82 (51.4)	172 (90.5)	<0.001
IUGR	26 (16.2)	3 (1.6)	<0.001
PT	36 (22.4)	12(6.3)	<0.001
Respiratory distress	16 (10.0)	3 (1.6)	<0.001

Table 13: Comparison of CRP level with different foetal outcome in 2nd and 3rd trimester.

Trimester	Foetal outcome	Study group		Control group		
		Mean	SD	Mean	SD	P value
2nd trimester	Normal	11.06	8.27	0.41	0.01	<0.001
	IUGR	10.06	6.96	1.86	1.20	<0.001
	PT	11.79	7.30	0.84	0.70	<0.001
	Respiratory distress	9.03	6.58	1.90	1.20	<0.001
3rd trimester	Normal	11.93	8.64	3.68	5.84	<0.001
	IUGR	9.12	6.80	3.03	4.08	<0.001
	PT	10.01	6.63	1.57	0.86	<0.001
	Respiratory distress	8.25	6.17	2.40	1.56	

Table 10 shows birth status like IUD, still birth or live birth had significant association with the CRP level in both 2nd and 3rd trimester of pregnancy.

Table 11 shows CRP level in the study group showed a negative correlation with birth weight where as in control group CRP level showed almost no correlation with the birth weight. Table 12 shows in study group there were only 51.4% of normal babies compared to 90.5% in control group (P value<0.001). Similarly, we found more IUGR babies (16.2%), Preterm babies (22.4%) and babies with respiratory distress (10.0%). These proportions were higher than the control group with significant difference (P value<0.001).

In Table 13, statistically significant difference for IUGR, Preterm and respiratory distress babies with respect to both 2nd and 3rd trimester CRP levels (P value <0.001 in these groups). Table 14 shows 2nd and 3rd trimester CRP values were statistically significant in pre-term and term between the study and the control group.

Table 14: Association of CRP level at 2nd and 3rd trimester with foetal maturity.

	2nd Trimester					3rd Trimester				
	Study group		Control group			Study group		Control group		
Birth status	Mean	SD	Mean	SD	P value	Mean	SD	Mean	SD	P Value
Pre term	9.0	0.28	1.45	0.45	<0.001	6.40	1.97	1.85	0.32	<0.001
Term	8.78	7.46	1.73	1.20	<0.001	10.49	7.11	3.09	4.25	<0.001

Table 15: Comparison of foetal mortality and morbidity in study and control group.

Category	Type	Study group N (%)	Control group N (%)	P value
Fetal mortality	DNP (Death in neonatal period)	15 (9.4)	3 (1.6)	<0.001
	IUD	16 (10.0)	0 (0)	
	Still birth	10 (6.2)	1 (0.5)	
Fetal morbidity	RD	16 (10.0)	3 (1.6)	<0.001
	LBW	34 (21.2)	1 (0.5)	
	IUGR	26 (16.2)	3 (1.6)	

Foetal mortality under group IUD, Still birth and DNP were 16 (10%), 10 (6.2%) and 15 (9.4%) in study group compared to control group (0%), 1 (0.5%) and 3 (1.6%) respectively. The difference in values are statistically significant (P value <0.001).Similarly, the foetal morbidity under the groups: Respiratory distress, LBW and IUGR in study group were 16 (10%), 34 (21.2%) and 26 (16.2%) as compared to 3 (1.6%), 1 (0.5%) and 3 (1.6%). The difference in these values are significant (P value <0.001).

DISCUSSION

The present study entitled "Comparison of CRP levels in gestational hypertension and in normal pregnancy in 2nd and 3rd trimester and its correlation with maternal and foetal outcome" was conducted in the department of Obstetrics and Gynaecology, S.C.B. Medical College and Hospital, Cuttack from August 2016 to August 2017. Total 350 patients were involved in the study with 160 subjects in Study group meeting the eligibility criteria and 190 subjects in Control group. Out of 160 study participants 36% (57) were diagnosed as GHTN, 42% (68) Preeclampsia and 22% (35) eclampsia.

The incidence of hypertensive disorders of pregnancy in our institution was 32.6%. It was found that the mean age in study group was 27.41 years as compared to 26.19 years in control group. Majority of study subjects 73.1% (117) were primi and 26.9% (43) were multi. In control group 72.1% (137) were primi and 27.9% (53) were multi. Similar to a study by Mandal KK et al, where the mean age in study group was 29.42 years and the mean age in control group was 25.96 years, maximum number of cases belong to nulliparous group 44.2% where as 55.8% cases belong to multiparous group.[13] The subjects were registered in OPD in 2nd and 3rd trimester of pregnancy and followed up until admission in IPD and delivery in labour room.

It was found that the mean weight of study participants was 51.43kg as compared to 44.90 in control group in 2nd trimester as compared to 55.27 and 49.96 years respectively in 3rd trimester. A study conducted by Leonie K et al, women who experienced HDP had a higher pre pregnancy BMI, had higher rates of overweight or obesity prior to pregnancy, gained more weight during pregnancy, delivered smaller babies at an earlier gestational age.[14]

It was found that mean SBP in 2nd trimester in study and control group (139.29 vs. 114.97) mm Hg and mean DBP (86.76 vs. 73.88), significantly differ from each other. Similar findings were also seen in 3rd trimester with higher value of SBP (159.59) mm Hg and DBP (101.01) mm Hg in study group compared to control group (P value <0.001). This is similar to a study conducted by Kaur P et al, where they found that the mean ± SD of systolic as well as diastolic blood pressure levels in pre-eclamptic women (150.8±8.6 mmHg, 101.3±8.01mmHg) are much higher than that of normal pregnant women (114.3±8.6 mmHg, 74.4±6.9 mmHg). This difference is found to be very highly significant (P=0.0001).[15]

Mean CRP level was 10.01 in study group in 2nd trimester which increased to 10.28 in 3rd trimester. Similarly, CRP value in control group increased to 3.06 in 3rd trimester from 1.85 mg/L in 2nd trimester. Difference of mean CRP level was statistically significant in both 2nd and 3rd trimester. Study conducted by Kaur P et al. There is a strong association of increased level of CRP, with level of increase in blood pressure.[15] Other studies (Zaima Ali et al, Sharmin S et al, Ghosh TK et al) also found similar findings comparable to this study.[16-18]

Gestational age at delivery was lower in study group (36.32±2.38) as compared to control group (37.77±1.27) and this difference was statistically significant (P value <0.001). Study conducted by Kwame Adu- Bonsaffoh et

al, a mean gestational age at delivery was 37.4±3.3 weeks, which is associated with adverse perinatal outcomes in subjects having Hypertensive disorders of pregnancy.[19] Similarly, birth weight was lower in study group (1.97±0.38) as compared to control group (2.45±0.35) and this difference was also statistically significant (P value <0.001). Study by Sharmin S et al, mean birth weight in PE (2.52±0.42 kg) was significantly lower than normal pregnancies.[17]

Maternal morbidity was significantly higher in study group (43.1% vs. 4.2%) (P value <0.001). Similarly, there were 13 (8.1%) maternal deaths in study group as compared to only 1 (0.5%) maternal death in control group this difference was also statistically significant (P value <0.001). 10.6% of subjects suffered from ARF while 1.9% suffered from HELLP syndrome. But majority of the subjects (30.6%) suffered from post-partum haemorrhage. In study group only 4.2% cases suffered from PPH the difference in these values were statistically significant (P value <0.001). Maternal morbidity like PPH has higher CRP level (12.48±7.85) as compared to (4.56±7.89) in the control group. This difference was statistically significant. The CRP level where maternal mortality was present was higher in study group as compared to control group. CRP levels were significantly associated with maternal mortality in study group as compared to the control group. A study conducted by Paternoster DM et al, CRP serum concentrations was significantly higher in groups like PE, HELLP syndrome and transient HT Patients.[20]

38.8% subject in study group had caesarean section as the mode of delivery as compared to 10.5% in control group (P value <0.001). In the study group there were 10% cases of IUD and 6.2% cases of still birth occurred compared to only one case of still birth and no case of IUD in control group. This difference was also statistically significant. A study by E Abalos et al., where they found that babies dying or developing severe complications are particularly high when pre-eclampsia and eclampsia occur.[21] With respect to maturity, preterm deliveries were more found in study group (22.5%) compared to control group (6.3%) which was statistically significant. Apgar score at 1 min was between 3 to 7 in most of the subject in study group (43.1%) whereas majority of the subject in control group had an Apgar score of more than 7 (86.8%). This difference in proportion was statistically significant. Similar statistical significant difference was found in comparison of Apgar score at 5 min.

Birth status like IUD, still birth or live birth had significant association with the CRP level in both 2nd and 3rd trimester of pregnancy. CRP level in the study group showed a negative correlation with birth weight where as in control group CRP level showed almost no correlation with the birth weight.

In study group there were only 51.4% of normal babies compared to 90.5% in study group (P value <0.001). Similarly, there were more IUGR babies (16.2%), Preterm babies (22.4%) and babies with respiratory distress (10.0%). These proportions were higher than the control group with significant difference (P value<0.001). There was a significant correlation of CRP level with maturity of the new born in both 2nd and 3rd trimester.

CONCLUSION

Increased serum CRP level can be used as a biomarker for identifying women at risk of preeclampsia and its complications along with adverse effect.

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