Research Article

The Role of Mca/Ua Pulsatility Index Ratio in Managing Preeclampsia and Gestational Hypertension: A Prospective Study

Dr. T. Shireesha

Assistant Professor, Institute Maheshwara Medical College, India.

ABSTRACT

Background: Preeclampsia and gestational hypertension pose significant risks to both mother and fetus. The middle cerebral artery to umbilical artery (MCA/UA) pulsatility index ratio may serve as a valuable tool in predicting and managing adverse outcomes.

Methods: In a prospective observational study, 200 pregnant women with preeclampsia or gestational hypertension were assessed using Doppler ultrasound to determine the MCA/UA PI ratio. Participants were grouped into cases (ratio ≤1) and controls (ratio >1). Maternal and neonatal outcomes were analyzed.

Results: The study found that 52 women (26%) had an MCA/UA PI ratio ≤1. These cases had a higher progression to severe preeclampsia and eclampsia ($p<0.00001$), increased incidence of severe oligohydramnios ($p<0.0001$), and higher rates of emergency cesarean sections ($p=0.00027$). Neonatal complications, including low birth weight, low Apgar scores, and NICU admissions, were significantly higher in cases.

Conclusion: The MCA/UA PI ratio is a significant predictor of both maternal and neonatal adverse outcomes in preeclampsia and gestational hypertension. Utilizing this ratio can enhance clinical decision-making and improve management strategies.

Keywords: Preeclampsia, Gestational Hypertension, MCA/UA Pulsatility Index Ratio, Maternal Outcomes, Neonatal Outcomes.

INTRODUCTION

Preeclampsia and gestational hypertension are prevalent complications in pregnancy, affecting approximately 5-10% of pregnancies [1][2]. These conditions are major contributors to maternal and fetal morbidity and mortality worldwide. Despite advancements in obstetric care, the prevention of preeclampsia remains elusive, emphasizing the need for effective monitoring and early intervention strategies. Doppler ultrasound has revolutionized fetal monitoring by enabling non-invasive assessment of fetal and placental circulation [3][4][5]. The middle cerebral artery (MCA) and umbilical artery (UA) Doppler indices provide critical insights into fetal hemodynamics [9][11]. The MCA/UA pulsatility index (PI) ratio, in particular, has emerged as a promising parameter for predicting adverse perinatal outcomes [13][14][15]. This study investigates the diagnostic value of the MCA/UA PI ratio in predicting adverse maternal and neonatal outcomes in pregnancies complicated by preeclampsia and gestational hypertension.

MATERIALS AND METHODS
Study Design and Population

A prospective observational analytical case-control study was conducted at the Muslim Maternity and Children's Hospital, Chaderghat, Hyderabad, from August 2013 to May 2015. The study included 200 antenatal women with singleton pregnancies beyond 30 weeks of gestation diagnosed with preeclampsia or gestational hypertension.

Inclusion and Exclusion Criteria
Inclusion Criteria
- Singleton pregnancy
- Gestational age ≥30 weeks
- Diagnosed with gestational hypertension or preeclampsia

Exclusion Criteria
- Multiple pregnancies
- Fetal congenital anomalies
- Chronic hypertension or other chronic medical conditions

Data Collection and Doppler Assessment
Participants underwent thorough clinical evaluations, including blood pressure measurements following standard protocols. Doppler ultrasound was performed using the ALOKA SSD 630 with UGR 38 Doppler unit. The

MCA and UA PI ratios were measured, and the MCA/UA PI ratio was calculated.

Grouping
- **Cases:** MCA/UA PI ratio ≤1 (n=52)
- **Controls:** MCA/UA PI ratio >1 (n=148)

Outcome Measures
Maternal Outcomes Assessed
- Progression to severe preeclampsia or eclampsia
- Development of HELLP syndrome
- Mode of delivery

Neonatal Outcomes Assessed
- Birth weight
- Apgar score at 5 minutes
- NICU admissions
- Early neonatal complications

Statistical Analysis
Statistical analysis was performed using SPSS version 15.0. Associations between the MCA/UA PI ratio and outcomes were analyzed using Chi-square tests, with a significance level set at $p<0.05$.

RESULTS
Maternal Outcomes
- **Progression to Severity:** Cases had a higher progression to severe preeclampsia
- (44.2% vs. 20.2%, $p<0.00001$) and eclampsia (11.5% vs. 1.4%, $p<0.00001$).
- **HELLP Syndrome:** Observed in 1.9% of cases and 0.6% of controls.
- **Mode of Delivery:** Emergency cesarean sections were more frequent in cases (71.15% vs. 37.16%, $p=0.00027$).

Neonatal Outcomes
- **Birth Weight:** Low birth weight (<2.5 kg) was significantly higher in cases (59.61% vs. 25.67%, $p<0.00001$).
- **Apgar Score:** A greater proportion of cases had Apgar scores <7 at 5 minutes (54.9% vs. 19.44%, $p<0.00001$).
- **NICU Admissions:** Significantly higher in cases (68.62% vs. 30.55%, $p<0.00001$).
- **Early Neonatal Complications:** Cases had higher incidences of respiratory distress, preterm births, and IUGR.

Predictive Value
- **Maternal Outcomes:** The MCA/UA PI ratio had a sensitivity of 43.50% and specificity of 90.26% in predicting adverse maternal outcomes.
- **Neonatal Outcomes:** Sensitivity was 39.04% and specificity was 88.40% for predicting adverse neonatal outcomes.

Table 1: Progression to Severe Preeclampsia and Eclampsia

Condition	Cases (n=52)	Controls (n=148)	Total (n=200)	p-value
Gestational Hypertension	10 (19.2%)	77 (52.0%)	87 (43.5%)	<0.00001
Preeclampsia	12 (23.1%)	38 (25.7%)	50 (25.0%)	
Severe Preeclampsia	23 (44.2%)	30 (20.2%)	53 (26.5%)	
Eclampsia	6 (11.5%)	2 (1.4%)	8 (4.0%)	
HELLP Syndrome	1 (1.9%)	1 (0.7%)	2 (1.0%)	

Table 2: Mode of Delivery among Cases and Controls

Mode of Delivery	Cases (n=52)	Controls (n=148)	p-value
Spontaneous Vaginal Delivery	5 (9.6%)	41 (27.7%)	0.00027
Induced Vaginal Delivery	1 (1.9%)	23 (15.5%)	
Elective Cesarean Section	8 (15.4%)	27 (18.2%)	
Emergency Cesarean Section	37 (71.1%)	55 (37.2%)	
Outlet Forceps	1 (1.9%)	2 (1.4%)	

Table 3: Neonatal Outcomes in Cases and Controls

Outcome	Cases (n=52)	Controls (n=148)	p-value
Low Birth Weight (<2.5 kg)	31 (59.6%)	38 (25.7%)	<0.00001
Apgar Score <7 at 5 minutes	28 (54.9%)	28 (19.4%)	<0.00001
NICU Admissions	35 (68.6%)	44 (30.6%)	<0.00001
Early Neonatal Deaths	4 (7.7%)	4 (2.7%)	0.114

Table 4: Predictive Value of Mca/Ua Pi Ratio for Adverse Maternal Outcomes

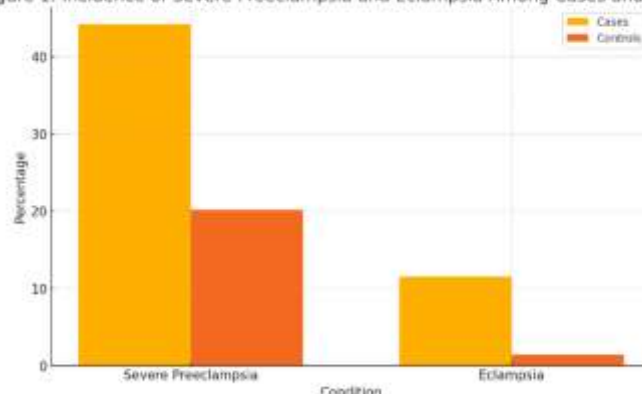| Parameter	Value
Sensitivity (%)	43.5
Specificity (%)	90.3
Positive Predictive Value (%)	78.8
Negative Predictive Value (%)	68.9
Positive Likelihood Ratio	4.48
Negative Likelihood Ratio	0.63

Figure 1: Incidence of Severe Preeclampsia and Eclampsia among Cases and Controls

A bar chart showing the percentage of participants who progressed to severe preeclampsia and eclampsia in both groups, demonstrating the higher incidence in cases.
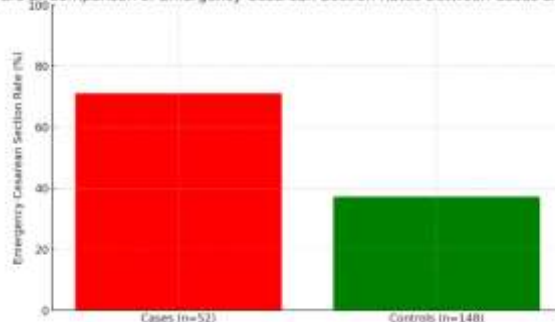

Figure 2: Comparison of Emergency Cesarean Section Rates between Cases and Controls

A bar graph illustrating the significant difference in emergency cesarean section rates between cases and controls.

The ratio reflects both placental insufficiency and fetal compensatory mechanisms, providing a comprehensive assessment of fetal status.

DISCUSSION
The study highlights the significant association between an abnormal MCA/UA PI ratio and adverse maternal and neonatal outcomes in preeclampsia and gestational hypertension. The higher progression to severe forms of preeclampsia and increased rates of emergency cesarean sections in cases underscore the utility of the MCA/UA PI ratio in maternal risk stratification.

The findings corroborate previous research indicating that the MCA/UA PI ratio is a sensitive parameter for fetal well-being [13][16][17].

Maternal Implications
Early identification of women at risk for severe preeclampsia allows for timely interventions, such as closer monitoring, antihypertensive therapy, and planning for delivery. The significant association between an abnormal MCA/UA PI ratio and progression to eclampsia emphasizes its potential role in preventing maternal complications.

Neonatal Implications
The increased incidence of low birth weight, low Apgar scores, and NICU admissions in cases

indicates that the MCA/UA PI ratio is a valuable predictor of neonatal morbidity. Early detection enables healthcare providers to prepare for potential neonatal complications, ensuring the availability of appropriate neonatal care.

Sample Size: While adequate, a larger sample could provide more robust data.

Single-Center Study: Results may not be generalizable to all populations.

Routine assessment of the MCA/UA PI ratio in pregnancies complicated by preeclampsia and gestational hypertension can enhance clinical decision-making. Incorporating this parameter into standard prenatal care protocols may improve maternal and neonatal outcomes.

CONCLUSION

An abnormal MCA/UA PI ratio (≤1) is significantly associated with adverse maternal and neonatal outcomes in preeclampsia and gestational hypertension. Utilizing this ratio as part of routine Doppler assessments can aid in the early identification of at-risk pregnancies, allowing for timely and appropriate interventions.

REFERENCES

1. Vyas S, Nicolaides KH, Bower S, Campbell S. Middle cerebral artery flow velocity waveforms in fetal hypoxaemia. Br J Obstet Gynaecol. 1990; 97:797–803.

2. Strigini FA, De Luca G, Lencioni G, Scida P, Giusti G, Genazzani AR. Middle cerebral artery velocimetry: different clinical relevance depending on umbilical velocimetry. Obstet Gynecol. 1997; 90:953–957.

3. Baschat AA. Doppler application in the delivery timing of the preterm growth-restricted fetus: another step in the right direction. Ultrasound Obstet Gynecol. 2004; 23:111–118.

4. Sterne G, Shields LE, Dubinsky TJ.Abnormal fetal cerebral and umbilical Doppler measurements in fetuses with intrauterine growth restriction predicts the severity of perinatal morbidity. J Clin Ultrasound. 2001; 29:146–51.

5. Arduini D, Rizzo G, Romanini C. Changes of pulsatility index from fetal vessels preceding the onset of late decelerations in growth retarded fetuses. Obstet Gynecol. 1992; 79:605–10.

6. Arias F. Accuracy of the middle-cerebral-to-umbilical- artery resistance index ratio in the prediction of neonatal outcome in patients at high risk for fetal and neonatal complications. Am J Obstet Gynecol. 1994; 171:1541–5.

7. Makhseed M, Jirous J, Ahmed MA, Viswanathan DL. Middle cerebral artery to umbilical artery resistance index ratio in the prediction of neonatal outcome. Int J Gynaecol Obstet. 2000; 71(2):119–25.

8. Gramellini D, Folli MC, Raboni S, Vadora E, Merialdi A, et al. Cerebral umbilical Doppler ratio as a predictor of adverse perinatal outcome. Cerebral and umbilical ratio: Obstet Gynecol. 1992;79(3):416–20

9. Rizzo G, Arduini D, Luciano R, Rizzo C, Tortorolo G, Romanini C, et al. Prenatal cerebral Doppler ultrasonography and neonatal neurologic outcome. J Ultrasound Med. 1989; 8:237–40.

10. Chesley LC. A Short history of eclampsia. Obstet gynaecol. 1974; 43:500-502.

11. National high blood pressure Education program; working group report on High blood pressure in pregnancy. Am J .obstet gynecol. 2000; 183; 51.

12. Cunningham FG, Veno KJ, Bloom SL, et al. Williams Obstetrics. 24th ed. Mc Graw Hill Education; 2014. Chapter 40, Hypertensive disorders; p728-34.

13. Duckitt K, Harrington D. Risk factors for pre-eclampsia at antenatal booking: systematic review of controlled studies. BMJ. 2005; 330:565.

14. Zhou Y, Damsky CH, Fisher SJ. Preeclampsia is associated with failure of human cytotrophoblasts to mimic a vascular adhesion phenotype. J Clin Invest. 1997; 99(9):2152-64.

15. Zhou Y, Damsky CH, Chiu K, et al. Preeclampsia is associated with abnormal expression of adhesion molecules by invasive cytotrophoblasts. J Clin Invest. Mar 1993; 91(3):950-60.

16. Lim KH, Zhou Y, Janatpour M, et al. Human cytotrophoblast differentiation/ invasion is abnormal in pre-eclampsia. Am J Pathol. Dec1997; 151(6):1809-18.

17. Bethesda, MD. Global Burden of Disease for the Year 2001 by World Bank Region, for Use in Disease Control Priorities in Developing Countries, National Institutes of Health: WHO. Make every mother and child count. World Health Report, 2005, Geneva:World Health Organization, 2005. 2nd edition.

18. Huhta JC, Moise KJ, Fisher DJ, et al: Detection and quantitation of constructionof the fetal ductus arteriosus by Doppler echocardiography. Circulation. 1987; 75:406