International Journal of Clinical Obstetrics and Gynaecology

ISSN (P): 2522-6614
ISSN (E): 2522-6622

www.gynaecologyjournal.com
2017; 1(1): 52-55
Received: 05-04-2017
Accepted: 20-04-2017

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Evaluation of retinal vascular changes in preeclampsia: A case-control study

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DOI: https://www.doi.org/10.33545/gynae.2017.v1.i1a.1686

Abstract
Background and Objectives: Preeclampsia is a hypertension condition of pregnancy characterized by systemic vascular abnormalities, including modifications in the retinal vasculature. Changes in the blood vessels in the retina can be used as a non-invasive way to measure the severity of a disease and the risk of getting it. This study sought to assess and contrast retinal vascular alterations in preeclamptic patients with normotensive pregnant controls.
Materials and Methods: A case-control study was performed involving 50 pregnant women, comprising 25 preeclamptic patients and 25 normotensive controls matched for age and gestational age. All subjects had a comprehensive ocular evaluation, encompassing visual acuity testing, slit-lamp examination, and fundus evaluation via indirect ophthalmoscopy. Retinal vascular alterations were recorded and classified using the Keith-Wagener-Barker system. Blood pressure and proteinuria levels were documented and associated with fundoscopic results. Statistical analysis was conducted to compare retinal alterations between patients and controls.
Results: Retinal vascular alterations were noted in 18 (72%) of preeclamptic individuals, in contrast to 4 (16%) of normotensive controls. In the cases, the most prevalent observations were overall arteriolar constriction (48%), abnormalities in arteriovenous crossing (32%), and cotton wool patches (20%). There were no occurrences of retinal detachment. The severity of retinal alterations was positively linked with elevated systolic and diastolic blood pressures ($p < 0.05$). Normotensive controls demonstrated only minor, non-significant alterations in the retina.
Conclusion: Retinal vascular alterations are markedly more common in preeclampsia compared to normotensive pregnancies and are associated with the severity of the condition. Ophthalmic examination can be a helpful, non-invasive way to keep an eye on vascular involvement in preeclamptic patients, which can help find and treat problems early on.

Keywords: Preeclampsia, retinal vascular changes, hypertensive retinopathy, fundus examination, pregnancy

Introduction
Preeclampsia is a pregnancy-specific hypertension condition marked by increased blood pressure and proteinuria occurring after 20 weeks of gestation. It is one of the main causes of sickness and death in mothers and babies around the world. The pathogenesis of preeclampsia entails extensive endothelial dysfunction and systemic vascular alterations, potentially impacting several organs, including the eyes [1-3].
The retinal vasculature is unusually accessible for non-invasive evaluation, and alterations in retinal arteries frequently reflect systemic vascular involvement. Generalized arteriolar constriction, arteriovenous crossing alterations, retinal hemorrhages, and cotton wool patches are all common eye problems that happen with preeclampsia. These alterations may function as preliminary indications of illness severity and assist in forecasting maternal and fetal outcomes [4-6].
Despite its clinical importance, there is a scarcity of case-control studies that have comprehensively assessed retinal vascular alterations in preeclampsia relative to normotensive pregnancies, especially within the Indian community. Recognizing and assessing retinal alterations can yield significant insights into the vascular implications of preeclampsia and facilitate risk classification [7-10].
This study was conducted to assess retinal vascular alterations in preeclamptic women and to compare these changes with age- and gestational age-matched normotensive controls, aiming to correlate ocular findings with blood pressure levels and illness severity.

Materials and Methods

This case-control study was performed in the Department of Ophthalmology in conjunction with the Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry, India, from January 2016 to December 2016. The study involved 50 pregnant women, consisting of 25 preeclamptic patients and 25 normotensive controls matched for age and gestational age. The Institutional Ethics Committee granted ethical clearance, and informed written consent was acquired from all subjects.

Inclusion Criteria

- Singleton pregnancy.
- Age between 18-40 years.
- Willingness to participate and provide informed consent.
- Normotensive pregnant women matched for age and gestational age for the control group.

Exclusion Criteria

- History of chronic hypertension, diabetes mellitus,
- Pre-existing ocular diseases affecting the retina or optic nerve
- Multiple pregnancies.
- History of ocular trauma or prior ocular surgery.
- Patients unwilling or unable to undergo ophthalmic examination.

Data Analysis

SPSS version X was used to record and evaluate the data. Descriptive statistics encapsulated demographic and clinical attributes. We used the right tests, such the Chi-square test and the t-test, to compare preeclamptic cases to normotensive controls. A correlation between blood pressure and alterations in the retinal vasculature was evaluated, with $p < 0.05$ being statistically significant.

Results

The study comprised 50 pregnant women, consisting of 25 preeclamptic patients and 25 normotensive controls matched for age and gestational age. The average age of the participants was 28.2 ± 3.8 years. The average gestational age at the time of enrollment was 33.1 ± 2.9 weeks.

Table 1: Demographic and Clinical Characteristics of Participants (n=50)

Characteristic	Preeclampsia (n=25)	Controls (n=25)	Total (n=50)
Age (years)	28.4 ± 4.0	28.0 ± 3.6	28.2 ± 3.8
Gestational age (weeks)	33.2 ± 3.0	33.0 ± 2.8	33.1 ± 2.9
Primigravida	17	16	33
Multigravida	8	9	17
Mean systolic BP (mmHg)	156.8 ± 9.5	118.2 ± 6.8	-
Mean diastolic BP (mmHg)	98.4 ± 7.2	76.6 ± 5.4	-

Table 1 highlights the basic information about the people who took part. The two groups were similar in terms of their ages and how far along they were in their pregnancies. As anticipated, preeclamptic individuals exhibited markedly elevated systolic and diastolic blood pressures in comparison to normotensive controls.

Table 2: Prevalence of Retinal Vascular Changes

Retinal Finding	Preeclampsia (n=25)	Controls (n=25)	p-value
Any retinal change	18	4	<0.001
Generalized arteriolar narrowing	12	2	0.002
Arteriovenous (AV) crossing changes	8	1	0.01
Cotton wool spots	5	0	0.04
Retinal hemorrhages	3	0	0.08
Normal fundus	7	21	<0.001

Table 2 indicates that retinal vascular alterations occurred substantially more often in preeclamptic individuals compared to normotensive controls. Generalized arteriolar constriction was the most common problem, followed by changes in AV crossing and cotton wool patches.

Table 3: Severity of Retinal Changes According to Keith-Wagener-Barker Classification

Retinopathy Grade	Preeclampsia (n=25)	Controls (n=25)
Grade I	10	3
Grade II	5	1
Grade III	3	0
Grade IV	0	0
No retinopathy	7	21

Table 3 shows how bad the alterations in the retinal blood vessels are. Grade I retinopathy was the most common type of retinopathy in women with preeclampsia. Only the preeclampsia group showed advanced alterations (Grade III). The majority of controls exhibited a normal fundus.

Table 4: Correlation Between Blood Pressure and Retinal Vascular Changes in Preeclampsia

Retinal Finding	Mean Systolic BP (mmHg)	Mean Diastolic BP (mmHg)
Normal fundus	145.2 ± 6.8	91.0 ± 5.2
Grade I retinopathy	155.1 ± 7.4	96.3 ± 6.1
Grade II retinopathy	162.4 ± 6.2	101.5 ± 4.8
Grade III retinopathy	169.0 ± 5.5	106.0 ± 3.7

Table 4 shows a definite positive link between blood pressure levels and the severity of alterations in the retina's blood vessels. More advanced grades of retinopathy were linked to higher systolic and diastolic pressures.

Discussion

Preeclampsia is a multisystem illness of pregnancy characterized by hypertension and proteinuria, frequently linked to extensive endothelial dysfunction and vascular modifications. The retinal vasculature, easily visible, offers a distinctive opportunity to evaluate systemic vascular alterations non-invasively. This study found that retinal vascular alterations were much more common in preeclamptic patients (72%) than in normotensive controls (16%). This is in line with earlier results that showed that preeclampsia can affect the eyes [11-13].

The most prevalent retinal finding was generalized arteriolar constriction, which was seen in 48% of preeclamptic patients. This was followed by arteriovenous crossing alterations (32%) and cotton wool patches (20%). These results are consistent with previous research indicating that alterations in retinal arterioles signify systemic hypertension and are associated with disease severity. Advanced retinal abnormalities (Grade II-III) were observed solely in the preeclampsia group, although most controls displayed a normal fundus, so reinforcing the specificity of retinal vascular alterations as indicators of preeclampsia [14-16].

A small number of people reported visual symptoms, such as blurred vision, which shows that alterations in the retina can happen even when there are no subjective eye problems. This underscores the significance of regular fundus examination in preeclamptic patients for early diagnosis and risk classification [17-19].

Our research also showed a strong link between high blood pressure and the degree of alterations in the retina. Patients with elevated systolic and diastolic pressures demonstrated more advanced grades of retinopathy, so showing that abnormalities in retinal vasculature indicate systemic disease burden. These results corroborate previous research indicating that retinal findings can predict maternal and fetal problems in preeclampsia [20-22].

Conclusion

Retinal vascular alterations are markedly more common in preeclamptic patients than in normotensive pregnant women and are associated with the degree of blood pressure increase. The most common things to find are generalized arteriolar constriction and changes in arteriovenous crossing. Routine ocular screening in preeclampsia can be a useful, non-invasive way to find out early if the vascular system is involved, which can help with timely treatment and possibly improve outcomes for both the mother and the baby.

Funding

None.

Conflict of Interest

None.

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