

**Incidence of Roth Spots in a Tertiary Care Centre in Eastern India**Singh H<sup>1</sup>, Agarwal M<sup>2</sup>, Shukla A<sup>3</sup>, Dutta P<sup>4</sup><sup>1,2,3,4</sup>Mata Gujri Memorial Medical College and L.S.K. Hospital

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Conflict of interest: Nil

**Abstract:**

Roth spots are distinctive retinal hemorrhages with a white center which were first observed in 1872 by a Swiss physician Moritz Roth. They are found in various conditions such as anemia, hypertensive retinopathy, leukemia, diabetic retinopathy, pre-eclampsia and anoxia. Conditions such as anoxia, carbon monoxide poisoning, anemia and prolonged difficult intubation are all linked to the occurrence of Roth spots. This observational study was carried out in Mata Gujri Memorial medical college and L.S.K. hospital, Department of Ophthalmology, Kishanganj from November 2023 till May 2024. A total of 801 patients were included in this study. The selection was made based on the findings of slit lamp biomicroscopy and stereoscopic visualization of ONH by +90D lens. To estimate the incidence of Roth spots in our study population based on their diagnosis, we used the proportional Z-test and a p-value <0.05 was considered significant. A total of 28 patients in our study were found to have Roth spots on fundoscopic examination depicting an incidence of 3.49% (28/801). The mean age among these patients was 49.39 years. 53.57% (15/28) of these patients were male and 46.42% (13/28) were female. According to our data, patients with pre-eclampsia are more likely to develop Roth spots (Z-test value 10.3, p<0.000001) as compared to patients with diabetic retinopathy (Z-test value 9.4, p<0.000001) and hypertensive retinopathy (Z-test value 6.1, p<0.0001). A combination of detailed clinical examination and laboratory investigations needs to be conducted to evaluate a patient presenting with Roth spots. The occurrence of Roth spots has been rising in various diseases and a deeper study is needed to know more about their pathology.

**Keywords:** Roth spots, Diabetes, Hypertension, Retinopathy, Pre-eclampsia, Anemia.

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**Introduction**

Roth spots are distinctive retinal hemorrhages with a white center which were first observed in 1872 by a Swiss physician Moritz Roth. Earlier thought to be associated mostly with sub-acute bacterial endocarditis, it has now been established that Roth spots are also found in various conditions such as anemia, hypertensive retinopathy, leukemia, diabetic retinopathy, pre-eclampsia and anoxia. [1,2]

The pale center within this distinctive retinal hemorrhage is a platelet-fibrin thrombus formed due to retinal capillary rupture leading to the release of whole blood. [3] Ischemic damage to the capillary endothelium, regardless of the etiology and possibly linked to increased venous pressure, can result in retinal hemorrhages. Consequently, conditions such as anoxia, carbon monoxide poisoning, anemia and prolonged difficult intubation are all linked to the occurrence of Roth spots. [4]

Hypertension, pre-eclampsia, and diabetes are conditions that can lead to increased capillary fragility. In diabetic patients, micro-aneurysms are often observed at the core of numerous white-centred retinal hemorrhages. [4] To the best of our

knowledge, any similar studies have not been conducted in or published from our region despite the rising occurrence of Roth spots in various diseases. Therefore, we undertook this study to determine the incidence of Roth spots in this area and explore their connections with various systemic diseases.

**Materials and Methods**

This observational study was carried out in Mata Gujri Memorial medical college and L.S.K. hospital, Department of Ophthalmology, Kishanganj from November 2023 till May 2024.

A total of 801 patients were included in this study. Study subjects were selected from the patients attending the Ophthalmology OPD and the patients referred from other departments for ophthalmic evaluation, after obtaining their written consent. The selection was made based on the findings of slit lamp biomicroscopy and stereoscopic visualization of ONH by +90D lens.

**Inclusion Criteria:** Patients with the following diagnoses were included:

- Anemia
- Hypertensive retinopathy
- Diabetic retinopathy
- Pre-eclampsia

#### Exclusion criteria

- Significant media opacities like corneal opacities, lenticular opacities and vitreous opacities obscuring the view of the fundus.
- Non-cooperative patients
- Patients not willing to enrol themselves for the study.

**Clinical ophthalmic examination:** A thorough history was obtained from each patient and a comprehensive ophthalmic examination was then performed.

1. **Visual Acuity:** Visual acuity for distance and near was documented using Snellen's chart and Jaeger's chart respectively. In cases with reduced vision, best corrected vision was obtained.
2. **Colour vision-** Ishihara charts were used to evaluate colour vision in all cases.
3. **Slit Lamp Biomicroscopy:** Detailed examination of anterior segment was done with the help of Topcon SL-2G slit lamp (Topcon Healthcare, Japan) to exclude any anterior segment pathology.
4. **Intraocular pressure (IOP)-** IOP was measured for each eye separately in every patient using Goldmann applanation tonometer.
5. **Dilated Fundoscopic examination-** Stereoscopic examination of the fundus with a +90

Dioptre lens on a slit lamp for a thorough assessment of the posterior segment.

6. **Additional systemic examination-** Vitals were obtained and a general physical examination conducted on all patients.

**Statistical analysis:** All significant data and examination findings were carefully documented in individual data collection forms, ensuring a comprehensive dataset for analysis and interpretation. The data was then entered into an Excel spreadsheet. SPSS version 21 was used to analyse the data. Descriptive statistics were presented as frequencies and percentages for categorical variables, and as means with standard deviations for continuous variables and a p-value <0.05 was considered significant. To estimate the incidence of Roth spots in our study population based on their diagnosis, we used the proportional Z-test: -

$$Z = \frac{(p - P_{Ho})}{\sqrt{\frac{p(1-p)}{n}}}$$

Where p = sample proportion

n = Sample size

$P_{Ho}$  = Hypothetical population proportion

#### Results

A total of 801 patients were examined and enrolled in our study out of which 50.68% (406/801) patients were male and 49.31% (395/801) were female. The mean age among the study subjects was 47.96 years.

**Table 1: Number of patients in each diagnostic category**

Diagnosis	No. of patients (Total=801)
Diabetic retinopathy	603
Hypertensive retinopathy	65
Pre-eclampsia	113
Anemia	20

Out of the 801 study subjects, 75.28% (603/801) patients had a diagnosis of diabetic retinopathy, 14.10% (113/801) patients were pre-eclamptic, 8.11% (65/801) patients had a diagnosis of hypertensive retinopathy, and 2.49% (20/801) patients were anaemic.

**Table 2: Number of patients with roth spots in each diagnostic category**

Diagnosis	No. of patients with Roth spots
Diabetic retinopathy (n=603)	18
Hypertensive retinopathy (n=65)	8
Pre-eclampsia (n=113)	2
Anemia (n=20)	0

A total of 28 patients in our study were found to have Roth spots on fundoscopic examination depicting an incidence of 3.49% (28/801).

The mean age among these patients was 49.39 years. 53.57% (15/28) of these patients were male and 46.42% (13/28) were female. Among the patients with diabetic retinopathy, the incidence of Roth spots was 2.98% (18/603).

Patients with pre-eclampsia had a 1.76% (2/113) incidence of Roth spots among them. Patients with hypertensive retinopathy showed a 12.30% (8/65) incidence of Roth spots while none of the anaemic patients exhibited Roth spots on fundoscopic examination in our study.

**Table 3: Demographic data for the patients with roth spots in each diagnostic category**

Diagnosis	Male	Female	Avg Age	SD
Diabetic retinopathy (n=18)	13	5	47.22	12.9
Hypertensive retinopathy(n=8)	2	6	60.44	12.47
Pre- eclampsia (n=2)	NA	2	29	0

Among the patients with diabetic retinopathy who exhibited roth spots, 72.22% (13/18) were males and 27.77% (5/18) were females. The mean age among these patients was 47.22 ( $\pm$ 12.9) years. Among the patients with hypertensive retinopathy

who exhibited Roth spots, 25% (2/8) were males and 75% (6/8) were females. The mean age group among these patients was 60.44 ( $\pm$ 12.47) years. The pre-eclamptic patients exhibiting Roth spots were both 29-year-old females.

**Table 4: Z-test statistic for each diagnostic category along with the p-value**

Diagnosis	No. Of Cases	Total Number of Patients	Z test Statistic	p value	Remark
Diabetic retinopathy	18	603	9.4	<0.000001	Statistically Significant
Hypertensive retinopathy	8	65	6.1	<0.0001	Statistically Significant
Pre- eclampsia	2	113	10.3	<0.0000001	Statistically Significant
Anemia	0	20			
Total	28	801			

According to our data, patients with pre-eclampsia are more likely to develop Roth spots (Z-test value 10.3,  $p < 0.0000001$ ) as compared to patients with diabetic retinopathy (Z-test value 9.4,  $p < 0.000001$ ) and hypertensive retinopathy (Z-test value 6.1,  $p < 0.0001$ ).

### Discussion

Roth spots are white centred retinal hemorrhages that can appear in a variety of conditions that may seem unrelated, yet they all involve a tendency for bleeding in the retinal capillaries. It's important to recognize that Roth spots represent ruptured retinal capillaries and their healing process, thus serving as a nonspecific indicator. [5]

Many case reports of Roth spots manifesting in different disease conditions have been published. One of these is a case reported by Tong et al. of a patient with a 12-year history of diabetes having multiple Roth spots on fundus examination was diagnosed with myelodysplastic syndrome after complete blood counts and bone marrow biopsy were performed. [6]

Another interesting case of a poorly controlled type 2 diabetic patient who presented with proliferative retinopathy, including multiple Roth spots in all quadrants in both eyes, was found to have chronic myeloid leukemia only after complete blood counts were performed revealing significant leucocytosis. [7] Our study revealed a 2.98% incidence of Roth spots among the diabetic patients. This highlights the importance of thorough clinical examination and lab investigations for patients with Roth spots among other retinal findings. A recently published study from a tertiary care centre in India reported a 1.9% incidence of Roth spots among women with pregnancy induced hypertension along. [8]

This corroborates the observations made in our study where 1.76% patients with a pre-eclampsia showed Roth spots on funduscopy. Therefore, comprehensive ocular assessment, especially in hypertensive pregnancies, is crucial to identify any vision-threatening features.

Roth spots manifesting as a part of anemic retinopathy have been widely reported. A case of a 28-year-old male with iron deficiency anemia and thrombocytopenia having roth spots in the left eye was reported by Fluss et al. [9] Another case of a 16-year-old female who presented with sudden onset painless loss of vision and was later diagnosed with megaloblastic anemia, was found to have Roth spots bilaterally and a sub-hyaloid hemorrhage in the left eye on funduscopy. [10]

On the other hand, none of the anemic patients included in our study showed roth spots on funduscopy. Nevertheless, this emphasizes that fundus examination must be done as standard in all subjects with anemia. The risk of anemic retinopathy increases in presence of concomitant thrombocytopenia. [11]

Roth spots have been detected in numerous atypical cases. A 67-year-old man with exogenous endophthalmitis after intravitreal injections presented with roth spots along with other signs highlighting that Roth spots can be found in bacterial endophthalmitis. [12] Roth spots have also been found in a patient with candida-induced sepsis. [13] Another case of interferon-associated retinopathy with atypical features including Roth spots, cotton-wool spots and microaneurysms bilaterally was reported by Mantel et al. [14]

In conclusion, a combination of detailed clinical examination and laboratory investigations needs to be conducted to evaluate a patient presenting with

Roth spots. The occurrence of Roth spots has been rising in various diseases and a deeper study is needed to know more about their pathology. To the best of our knowledge a similar study has not been conducted in our region, hence, our study makes grounds for extensive exploration into the incidence of Roth spots.

#### References:

1. Ścisłowicz A, Piejko P, Nowak M, Renke P, Chaniecki P, Rucka A. Infective endocarditis in a patient with vision disorders. *Polski Merkuriusz Lekarski: Organ Polskiego Towarzystwa Lekarskiego*. 2018 Nov 1; 45(269): 198-200.
2. Sabrane I, Belkhadir K, Saoudi S, Benchekroun S, El Ikhroufi M, Cherkaoui O. Roth spots suggestive of myeloid leukemia: Case report. *Journal Francais D'ophtalmologie*. 2018 Oct 24; 41(9):e423-4.
3. Pittner A, Phillips H, Patel S, Kolata I, Tripathy K, Palestine A, Cao J, Hartnett ME, Bair C, Lim JJ. Roth Spots.
4. Catalano RA, Tanenbaum HL, Majerovics A, Brassel T, Kassoff A. White Centered Retinal Hemorrhages in Diabetic Retinopathy. *Ophthalmology*. 1987 Apr 1; 94(4):388-92.
5. Ling R, James B. White-centred retinal haemorrhages (Roth spots). *Postgraduate medical journal*. 1998 Oct; 74(876):581-2.
6. Tong P, Ozaki R. Roth spots in diabetes mellitus. *The Lancet*. 2003 Feb 22; 361(9358):689.
7. Al Falah M, Ballios BG, Yeung SC, Far PM, Yan P. Atypical proliferative retinopathy as the presenting feature of chronic myeloid leukemia in a patient with diabetes mellitus. *Retinal Cases and Brief Reports*. 2023 Jan 1; 17(1):61-4.
8. Laxmi KV, Ambati SK, Moulika K. A Clinical Study of Ocular Changes in Pregnant Women Attending Tertiary Care Hospital, Guntur. *Int J Acad Med Pharm*. 2024; 6(1):1868-72.
9. Fluss R, Zguri L, Rahme R, Fulger I. Iron-deficiency anemia causes an ischemic stroke in a young man. *Cureus*. 2019 Mar 11; 11(3).
10. Shrinkhal SA, Agrawal AJ, Yadav PR, Verma RU. Sudden vision loss as first clinical manifestation of anaemic retinopathy. *J Clin Diag Res*. 2020; 14.
11. Carraro MC, Rossetti L, Gerli GC. Prevalence of retinopathy in patients with anemia or thrombocytopenia. *European journal of haematology*. 2001 Oct; 67(4):238-44.
12. Yanik Ö, Demirel S, Batioğlu F, Özmert E. An Atypical Case of Exogenous Endophthalmitis after Intravitreal Injection Presenting with Roth Spots. *Ocular immunology and inflammation*. 2023 May 28; 31(5):1061-7.
13. Mehta S, Jiandani P, Desai M. Ocular lesions in disseminated candidiasis. *The Journal of the Association of Physicians of India*. 2007 Jul 1; 55:483-5.
14. Mantel I, Konstantinidis L, Zografos L. Interferon-associated retinopathy-a case report. *Klinische Monatsblätter für Augenheilkunde*. 2007 Apr; 224(04):350-2.