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Original Research Article

Prevalence of Sickle Cell Retinopathy among Tribal Populations of Biligirirangan Hills, Chamarajanagara

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ABSTRACT

Background
Sickle cell anaemia is a hereditary condition predominantly marked by persistent haemolytic anaemia & vaso-occlusive episodes. It impacts millions of individuals globally. No tissue or organ is exempt from damage caused by sickle cell illness, including the retina. The objective of this research work is to study the prevalence of sickle cell retinopathy in tribal populations.

Methods
The present cross-sectional study was conducted among 95 sickle cell anaemia patients coming to the Ophthalmology Department of Chamarajanagar Institute of Medical Sciences, Chamarajanagar from January 2024 to July 2024. A detailed history of patients was taken. Most important fundus examination after pupillary dilatation with tropicamide & phenylephrine hydrochloride eye drops, laboratory investigation was also done.

Results
The maximum number of patients was in the age group of 10 -20 years (30). The number of female patients (49) was higher than male patients (46). 17% of patients with sickle cell disease had retinopathy while 83% did not have retinopathy. Retinopathy was more prevalent in males (9) than females (7). It was more common in patients with SF haemoglobin ($p<0.05$), while it

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was statistically not significant in the other two diseased groups (AS & SS) ($p<0.05$) Retinopathy was prevalent in patients with age group 10-20 years. It was more common in patients with SF haemoglobin ($p<0.05$), while it was statistically not significant in the other two diseased groups (AS & SS) ($p<0.05$).

Conclusion

Retinopathy is prevalent among individuals with sickle cell disease. It is more prevalent in males & adult patients. Regular eye examinations for various stages of retinopathy, coupled with initiatives to enhance awareness of disease progression among patients can inform preventative tactics & treatment procedures.

Keywords- anaemia, prevalence, retinopathy, sickle cell disease, tribes.

INTRODUCTION

Sickle cell disease is an inherited disorder characterised by vaso-occlusive crises.[1] It is the most prevalent genetic disorder globally. Sickle cell disease is an inherited collection of hemoglobinopathies characterized by various systemic & ophthalmic manifestations; hemoglobin is an iron-containing protein in red blood cells that facilitates oxygen transfer. It comprises two alpha polypeptide chains, each of which associates with a beta, gamma, or delta chain. In adults, hemoglobin A comprises two alpha & two beta subunits. Hemoglobin F comprises two alpha & two gamma chains & is prevalent until six weeks of age.HbA2 comprises two alpha & two delta chains & is present at low levels in healthy persons. A solitary nucleotide mutation [GAG to GTG] at the sixth position of the beta chain results in the substitution of valine for glutamic acid. Heterozygosity for this mutation leads to sickle cell trait, whereas homozygosity results in sickle cell illness. This would result in red blood cells adopting an atypical morphology under conditions of hypoxia & acidosis, & these deformed red blood cells exhibit more rigidity than normal red blood cells, thereby obstructing small blood arteries & precipitating a vaso-occlusive crisis.[2]

An ocular manifestation of sickle cell disease is most often mild & asymptomatic but when it involves eyes symptoms are flashes, floaters, eye pain, diminution of vision & clinical findings are tortuosity of conjunctival vessels, anterior chamber ischemia, retinal artery occlusion, retinal changes in which peripheral retina & macula appear to be most susceptible.[3,1]

The Soliga population, estimated at 15,000-20,000, primarily inhabits the BR Hills, spanning Karnataka's Chamarajanagar & Mysore districts. They communicate in the Soliga language, which belongs to the Dravidian language family. Historically, their livelihood has centred around forest-based activities such as hunting, gathering, & shifting cultivation, aligning their economy closely with the natural environment. The geographic isolation of the BR Hills has allowed the Soligas to retain much of their traditional way of life while gradually adapting to external influences. The Soligas have an in-depth knowledge of the medicinal properties of forest plants, which they use to treat various ailments. [4]

Among the Soligas, consanguineous marriages are a deeply rooted tradition, with nearly 50% of unions occurring within close familial ties. This practice often involves uncle-niece (mama-maru) marriages, as well as first-cousin (anna-tangi) & second-cousin (tata-tangi) marriages. The preference for intra-community & intra-family marriages reflects the tribe's

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emphasis on maintaining social cohesion & preserving clan identity. The reasons for this tradition are multifaceted. Marriages within the clan ensure the retention of property & resources within the community, preventing their dispersal to outsiders. They also strengthen familial ties & foster unity within the group. Economically, these unions reduce the burden of dowry & encourage resource sharing, which is particularly important in a subsistence-based economy. Moreover, the practice is deeply embedded in the tribe's cultural & traditional framework, making it an integral part of their social organization.[5]

While consanguineous marriages have social & economic benefits, they also pose significant health & genetic challenges. The limited genetic diversity resulting from close familial unions increases the risk of hereditary disorders, such as sickle cell anemia, & other health complications. Additionally, the likelihood of infant mortality is higher among children born to closely related parents. These consequences highlight the complex interplay between tradition & modern health concerns The challenges posed by practices like consanguineous marriages call for a nuanced approach that respects their traditions while addressing health concerns through education & healthcare interventions.[4,5]

Hence the objective of this research work is to study the prevalence of sickle cell retinopathy in the tribal population of B.R. Hills, Chamarajanagar.

MATERIAL & METHODS

The present cross-sectional study was conducted among Sickle cell anaemia patients coming to the Ophthalmology Department of Chamarajanagar Institute of Medical Sciences, Chamarajanagar from January 2024 to July 2024. Ethical permission was taken from the institutional ethics committee before the commencement of the study. Patients were explained about the study in their local language & were asked to sign an informed consent form.

A convenience sampling method was used. Based on the previous study conducted by Tamer Hassan prevalence was 56%

$N= 1.96^2PQ/D^2$

N= sample size
Z=standard score corresponding to 95% confidence interval
P= prevalence
Q=100-P
D=absolute error =10%
Formula:-

$$N= \frac{1.96X1.96X0.56X0.44}{0.1X0.1}$$

N=94.6

The final sample size came out to be 95. Tribal patients who came to the hospital were selected based on inclusion & exclusion criteria.

Inclusion Criteria

- The Sickle cell Anaemic patients aged 10 -50 years.
- The patients who were willing to give consent for the study

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- Both sexes

Exclusion Criteria

- Patients with congenital or acquired eye diseases which started before the study.
- Hazy media or corneal opacity can interfere with anterior segment examination.
- Any other systemic diseases other than Sickle cell Anemia which causes fundus changes.

Methodology

The workup of the patients was started with detailed history regarding initial clinical presentation, transfusion history, chelation history; systemic diseases like diabetes & hypertension associated with thin retina;[6] personal history like smoking one of the risk factors;[7] general examination':systemic examination of various systems detailed ophthalmic examination of extraocular & ocular structures. The most important fundus examination after pupillary dilatation with tropicamide & phenylephrine hydrochloride eye drops, laboratory investigation was also done.

Nonproliferative sickle cell retinopathy fundus changes in sickle cell anaemic patients

Salmon patches

Angeoid streaks

Tortuous vessels

Proliferative sickle cell retinopathy fundus changes based on Goldberg classification.[6]

Goldberg classification -

Stage 1- Peripheral arterial occlusion

Stage 2- Peripheral arteriovenous anastomoses

Stage 3- Neovascular & fibrous proliferation

Stage 4- Vitreous haemorrhage

Stage 5- Retinal detachment

Materials required

Visual acuity examination

Snellen visual acuity chart

intraocular pressure measurement-

Digital Method

Schiotz tonometer

Anterior segment examination

Slit lamp biomicroscopy

Fundus examination

Indirect ophthalmoscopy

Direct ophthalmoscopy

Slit lamp biomicroscopy with 90D

Laboratory test - Peripheral smear[8]

Risk

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After putting drops for 3-4 hrs there is blurring of vision & after dilatation with direct & indirect ophthalmoscopes because of bright intense light patient might become uncomfortable. There are invasive procedures involved in the study so an infected needle prick can happen. Less risk is involved rather than beneficial to your good health. You may decline to answer any or all questions & you may terminate your involvement at any time if you choose.

Benefits

There was a direct benefit for the patient for his or her participation in this study & an indirect benefit to every other patient associated with risk factors of severe fundus changes in Sickle cell anaemia of the same age group in this geographical area who were represented by the patient.

Statistical analysis

The data collected was entered in Microsoft Excel Version 2019 & was analysed using Epi lnfoTM Build 7.2.5 2021 by CDC. Descriptive statistics like frequency tables & grafts were applied for quantitative data. The data was represented in the form of graphs & tables. The chi-square test was applied for analysis. P- P-value <0.05 is considered a statistically significant.

RESULTS

Table 1 shows distribution of patients according to age & gender . The maximum number of patients was in the age group of 10 -20 years (30). The number of female patients (49) was higher as compared to male patients (46).

Age group(years)	SS		AS		SF		Total
	Male	Female	Male	Female	Male	Female	
10-20	5	6	6	2	6	5	30
21-30	7	4	5	5	4	4	29
31-40	3	5	2	3	2	3	18
41-50	3	5	1	3	2	4	18
Total No.	18	20	14	13	14	16	95

Table 1 Age & gender distribution of patients

17% of patients with sickle cell disease had retinopathy while 83% does not have retinopathy as shown in figure 1.

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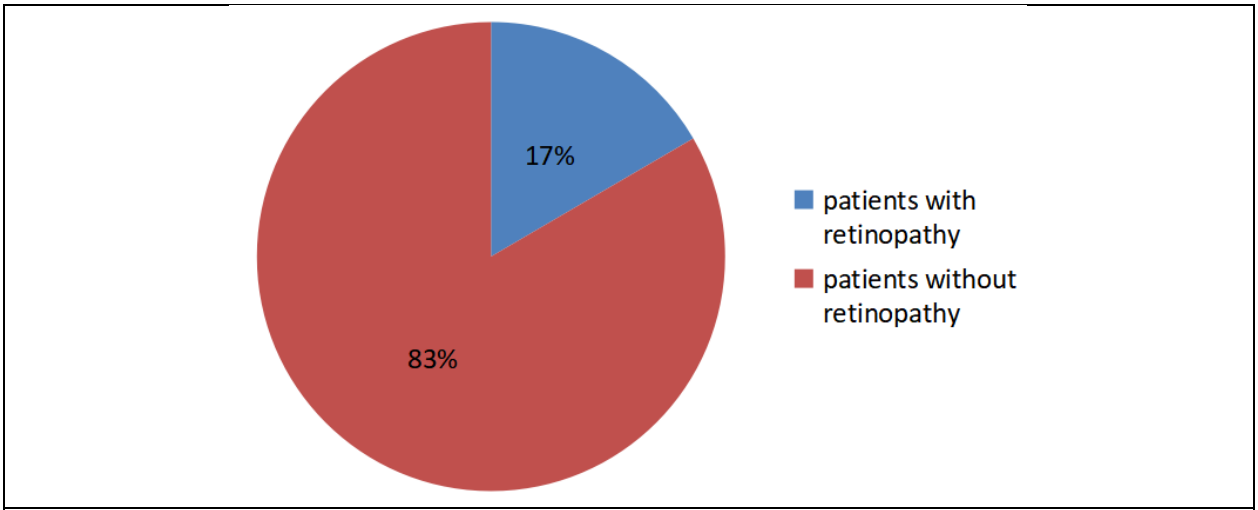

Figure 1 Prevalence of retinopathy

P>0.05 indicates that there were no significant differences between individuals with AS & SS hemoglobin types & those without retinopathy. However, as indicated in table 2, patients with SF hemoglobin exhibited highly significant variations in the prevalence of retinopathy when compared within the two groups (P < 0.001).

Groups	**SS**	**AS**	**SF**	***Total***
Patients with Retinopathy	6	5	5	16
Patients without retinopathy	32	22	25	79
P-Value	> 0.05	> 0.05	> 0.001	> 0.05

Table 2 The prevalence of retinopathy in the three patient's groups

Males (9) were more likely than females (7) to have retinopathy. According to Table 3, it was statistically not significant in the other two afflicted categories (AS & SS) (p<0.05), but it was more prevalent in patients with SF hemoglobin (p<0.05).

Studied group	**Total No.**	**Female (Retinopathy)**	**Male (Retinopathy)**	**P-Value**
SS	5	3	2	> 0.05
AS	5	2	3	> 0.05
SF	6	2	4	< 0.05
Total No.	16	7	9	<0.05

Table 3 Association of patients with retinopathy with respect to gender among three groups

Patients between the ages of 10 -20 were more likely to have retinopathy. According to table 4, it was statistically not significant in the other two diseased categories (AS & SS) (p<0.05), but it was more prevalent in patients with SF hemoglobin (p<0.05).

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Studied group	Total No.	10-20	21-30	31-40	41-50	P-Value
SS	5	2	1	1	1	> 0.05
AS	5	2	0	2	1	> 0.05
SF	6	3	2	1	0	< 0.05
Total No.	16	7	3	4	2	<0.05

Table 4 Association of patients with retinopathy with respect to age among three groups

DISCUSSION

Annually, around seven million people are believed to be born worldwide with either a congenital anomaly or a genetic disorder. Among the haemoglobinopathies, sickle cell disease is a significant problem for public health. Patients with SCD necessitate prompt intervention owing to both acute & chronic consequences, such as severe vaso-occlusive crises, cerebral vasculopathy, chronic renal disease, priapism, acute chest syndrome, pulmonary hypertension, & bacterial infections, among others. Retinopathy is relatively a common problem in sickle cell disease.[9-11]

The prevalence of SCR among the tribal population in our study was 17%. The tribal population in the scheduled geographical area resides in forests & hilly terrains with difficult accessibility. SCR has emerged as one of the notable public health concerns affecting these indigenous groups. Previous results by the Anthropological Survey reported the distribution & frequency of the sickle cell trait which reaches levels as high as 35 per cent in some of the tribes. [12-14]

Our observation indicated that retinopathy was exclusively of the non-proliferative type. This may be attributed to the distinctive genetic characteristics of our patients. Conversely, the inability to conduct fluorescent angiography could result in the oversight of cases with proliferative retinopathy. Nonetheless, Al-Salem also failed to identify any proliferative retinopathy in his study.[15]

Male patients had a higher prevalence of retinopathy compared to females, a finding that aligns with recent studies indicating a protective effect of oestrogen in females against retinal ischaemia.[15,16] Tantawy et al [17] evaluated retinal alterations in 60 children with sickle cell disease (34 boys & 26 females), resulting in a male-to-female ratio of 1.3:1. The average age of patients in their study was 10.3±7.4 years, with a range of 3 to 18 years.

This aligns with research by Asbeutah et al. with 43 patients with SCD (27 males & 16 females), resulting in a male-to-female ratio of 1.7:1.[18]

Retinopathy was markedly more prevalent in patients with SF-type hemoglobinopathy. These findings align with other research & can be attributed to the heightened viscosity of blood associated with this haemoglobin type, leading to a higher incidence of retinopathy.[19-24]

In our study retinopathy was prevalent in patients with age group 10-20 years. Gill & Lam[25] assessed the prevalence & age of onset of clinically severe retinopathy in these patients & proposed a screening method for ophthalmologists. No association was established between sickle retinopathy & the presence of systemic occlusive symptoms. Conversely, Eruchalu et al[26] demonstrated a notable incidence of retinal illness in children as young as 8 years old. Sickle retinopathy was associated with the frequency of pain crises, a history of stroke, & inconsistent use of HU treatment, consistent with the findings of Rosenberg & Hutcheson, who

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linked sickle retinopathy to the frequency of crises but not to the incidence of cerebrovascular accidents. Conversely, a retrospective analysis of 258 children with sickle cell disease discovered 54 children with sickle cell retinopathy, who were compared to age-matched controls. Rosenberg & Hutcheson[27] identified several characteristics that had a strong correlation with retinopathy: pain crisis, male sex, splenic sequestration

The study has two primary limitations: first, the absence of facilities for fluorescent angiography, which is advantageous for detecting certain types of retinopathy; second, the inability to conduct Hb variant testing, thereby precluding the diagnosis of Hb C, the most prevalent hemoglobinopathy associated with retinopathy.

CONCLUSION

Retinopathy is prevalent among individuals with sickle cell disease. SCR is more prevalent in males & adult patients, but it can also occur in older individuals. Regular eye examinations for various stages of retinopathy, coupled with initiatives to enhance awareness of associated risk factors for disease progression among patients & their carers, can inform preventative tactics & treatment procedures. Awareness of these findings could facilitate the creation of vision-preserving prevention strategies & models that can identify patients with SCD who are at the highest risk for developing retinopathy.

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