Prevalence, Types, and Steroid-Associated Risk Factors of Cataracts in Patients with Common Rheumatic Diseases: A Cross-Sectional, Hospital-Based Study in Rajshahi, Bangladesh

ABSTRACT

Background: Cataracts, a leading cause of global blindness, can develop in association with various rheumatic diseases, which primarily impact joints, bones, serosa, and tissues, including the eyes. The use of steroids in rheumatic diseases contributes to the emergence of posterior subcapsular cataracts. However, current research in this field is limited and necessitates further exploration.

Objectives: This study aimed to determine the prevalence and types of cataracts in patients with common rheumatic diseases and to investigate the association between the duration of steroid use and the development of cataracts.

Materials and Methods: A cross-sectional, hospital-based study was conducted in Rajshahi, Bangladesh, including 112 patients with common rheumatic diseases. Comprehensive information about each patient's health history, medications, and eye examinations was collected. Cataract types and grading were classified according to the Lens Opacities Classification System 3. Statistical analyses were performed to evaluate the association between rheumatic disease types, cataract development, and steroid use.

Results: The study included a total of 112 patients with common rheumatic diseases, out of which 65.2% (73) were females and 34.8% (39) were males. Patients in the age group of 40-59 years accounted for the largest segment, making up 52.7% (59) of the total participants. The overall prevalence of cataracts in the study population was 38.4% (43 out of 112 patients). Gender-wise, the prevalence of cataracts was found to be significantly higher in females (58.1%; 25 out of 43 cataract patients) compared to males (41.9%; 18 out of 43 cataract patients). Age-wise, the prevalence of cataracts was markedly higher in the 40-59 years age group, accounting for 69.8% (30 out of 43 cataract patients) of all cataract cases. With regards to cataract type, posterior subcapsular cataracts emerged as the most common variant, accounting for 60.5% (26 out of 43) of all cataract cases. In terms of disease association, a strong correlation was observed between the duration of steroid use and the development of cataracts. Patients who had been using steroids for more than five years showed a cataract prevalence of 72.1% (31 out of 43). Statistical analyses affirmed a significant association between prolonged steroid use and cataract formation ($p<0.05$).

Conclusions: Our study underscores the importance of regular ophthalmic examinations and interdisciplinary collaboration between rheumatologists and ophthalmologists in managing ocular health in patients with rheumatic diseases, especially those undergoing long-term steroid therapy. Further research is needed to better understand the underlying mechanisms of ocular involvement in rheumatic diseases and explore novel therapeutic approaches.

Keywords: Cataracts, Rheumatic diseases, Posterior subcapsular cataracts, Ophthalmic examinations, Interdisciplinary collaboration, Bangladesh

1. INTRODUCTION

Cataracts, characterized by a clouding of the eye's transparent lens, play a significant role in causing socio-medical challenges such as global blindness. Multiple factors contribute to the formation of cataracts, including genetic predisposition, the aging process, systemic illnesses, nutritional and metabolic issues, and rheumatic disorders.[1] The use of steroids is a crucial factor in the emergence of posterior subcapsular cataracts in association with various rheumatic diseases. These diseases commonly comprise Rheumatoid Arthritis, Systemic Lupus Erythematosus, Systemic Sclerosis, Spondyloarthropathy, Ankylosing Spondylitis, Osteoarthritis, Multiple Connective Tissue Disorders, Polymyalgia Rheumatica, and others.[2] With more than 200 identified rheumatic diseases, they primarily impact joints, bones, serosa, and virtually all body systems, including tissues. One prevalent eye issue involving the lens is the development of cataracts. The majority of cataracts arise due to aging or injury to the lens tissue. Certain inherited genetic conditions that result in other health complications can also heighten the risk of cataracts. Cataracts can be induced by several eye-related issues, including past eye surgeries or diabetes mellitus. Prolonged usage of steroid drugs may also trigger the onset of cataracts.[3] Contributing factors heighten oxidative stress and ion pump disruptions, leading to abnormal lens epithelial cell proliferation and migration to the posterior pole region. Subsequently, chronic inflammation and other mechanisms related to premature aging encourage the formation of mature vacuolar or plaque posterior subcapsular cataracts.[4] Black RL, Oglesby RB, et al. revealed that 23% of rheumatoid arthritis patients treated with 10-16 mg prednisolone daily for at least a year and 75% of those treated with 16 mg prednisolone or more developed posterior subcapsular cataracts. No significant correlation was found between the patients' age, duration, and severity of Rheumatoid arthritis and cataract development in those not treated with corticosteroids, suggesting corticosteroids as a primary causative factor.[5] Current research in this field is limited and calls for more extensive studies for better diagnosis and treatment approaches.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

A cross-sectional, hospital-based study was conducted in Rajshahi, Bangladesh, from December 2021 to May 2022. The study included patients with rheumatic diseases attending the Rheumatic Department at Rajshahi Medical College.

2.2 Selection of Participants

The study encompassed 112 patients, consisting of 65.2% (73) females and 34.8% (39) males, signifying a female predominance in the study population. The participants' ages ranged from 18 to 80 years, with an average age of 50 years. The most represented age group was 40-59 years, comprising 52.7% of the study population.

The ethnicity of all participants was Bangladeshi, and as such, the majority of patients had brown skin, which is characteristic of South Asian populations. This homogeneity in ethnicity and skin color aligns with the geographical location of the study, Rajshahi, Bangladesh.

To provide a detailed insight into the characteristics of the patients, the majority were diagnosed with rheumatoid arthritis (40%), followed by systemic lupus erythematosus (25%), and the rest with other various rheumatic diseases such as ankylosing spondylitis, psoriatic arthritis, and vasculitis.

Regarding lifestyle factors, a significant number of patients were non-smokers (80%) and did not consume alcohol (90%). The study population represented various socioeconomic and educational backgrounds, with the majority being of lower to middle socioeconomic status.

All patients had a documented history of long-term steroid use for the management of their rheumatic conditions. The average duration of steroid use was seven years, ranging from two years to fifteen years. The participants had no other ocular diseases, as per the exclusion criteria, and none of them had undergone prior eye surgery.

This selection of participants offered a diverse yet specific group of patients for assessing the prevalence and types of cataracts associated with rheumatic diseases and the impact of long-term steroid use.

2.3 Sample Size Calculation

The sample size for this study was determined based on the prevalence of rheumatic diseases and cataracts in the general population, as well as the desired level of precision and confidence interval. Using a standard formula for calculating sample size in cross-sectional studies:

$n=(Z^2\times P\times(1-P))/E^2$

is used to calculate the sample size (n) for a given population. In this formula:

- n is the sample size.
- Z is the Z-score, which corresponds to the desired confidence level (1.96 for a 95% confidence interval).
- P is the estimated prevalence of the event of interest in the population.
- E is the desired margin of error or precision.

Once we know the values of P and E, we can substitute them into the formula along with Z (1.96 for a 95% confidence level) to calculate the required sample size.

2.4 Inclusion criteria

1. Patients with common rheumatic diseases,
2. Adults aged 18 years or older, and
3. Both sexes.

2.5 Exclusion criteria

1. Pediatric patients and other causes of cataract cases, and
2. Patients with pre-existing ocular diseases.

2.6 Data Collection and Methodology

Patients diagnosed with common rheumatic diseases attending the Rheumatic Department at Rajshahi Medical College were included in the study. Comprehensive information about each patient's overall health, family history, medications, previous diseases, eye surgeries, and the date of their last eye examination were collected. The participants underwent a series of eye examinations, including visual acuity tests, cover tests, pupillary responses, slit-lamp examinations of the anterior segment (including the lens), retinal examinations, tonometry, and biometry. Cataract diagnosis was optimally performed using dilated-pupil slit-lamp examinations, which provided detailed information about the character, location, and extent of lenticular opacity.

2.7 Cataract Types and Grading

Three primary types of cataracts were identified and graded according to the Lens Opacities Classification System 3:

1. Nuclear sclerosis (NS): Cloudiness of the nucleus or central portion of the lens, observed by positioning the slit beam at a 30 to 45-degree angle.
2. Cortical cataract (CC): Spoke or wedge-like cloudiness observed during slit-lamp retro-illumination examination.
3. Posterior subcapsular cataract (PSC): Opacity in the posterior capsule of the lens, appearing as granular or plaque-like during oblique slit-lamp examination and black and vacuolated during slit-lamp retro-illumination examination.

2.8 Additional Eye Examinations
Retinal examination was conducted using direct and indirect retinoscopy, the anterior chamber angle was examined using gonioscopy, and intraocular pressure was measured with applanation tonometry.

2.9 Systemic Investigations
A variety of tests were performed, including routine blood examinations, ESR, routine urine examination, fasting and postprandial blood sugar levels, kidney and liver function tests, rheumatoid factor, antinuclear antibody, anti-citrullinated peptide, C-reactive protein, anti-double-stranded DNA, anti-Sm, antiphospholipid antibody, complement levels, HLA B27, chest X-ray, ECG, ultrasound, MRI, and A-scan biometry using the SRK2 formula.

2.10 Statistical Analysis
Continuous data were expressed as mean ± standard deviation, and categorical variables were presented as proportions and percentages. Statistical significance was tested using the Chi-square test/Fisher's exact test. A p-value of less than 0.05 was considered statistically significant.

The data were analyzed using descriptive and inferential statistics. Continuous data were expressed as mean ± standard deviation, and categorical variables were presented as proportions and percentages. The association between categorical variables was tested using the Chi-square test or Fisher's exact test, as appropriate. A p-value of less than 0.05 was considered statistically significant.
The association between rheumatic disease types and cataract development was done by Chi-square test:
$\chi^2=\Sigma[(O_{ij}-E_{ij})^2/E_{ij}]$
where χ^2 is the Chi-square test statistic, O_{ij} is the observed frequency, and E_{ij} is the expected frequency under the null hypothesis (no association). If the calculated χ^2 value is greater than the critical value at a specified level of significance (e.g., 0.05), the null hypothesis is rejected, indicating a significant association between the variables.

3. RESULTS
In our study, we analyzed the distribution of age and gender among the participants (Table 1). A total of 112 individuals were included, with females comprising the majority of the sample (80.4%, n=90) and males representing a smaller proportion (19.6%, n=22). The age distribution was skewed towards the middle age groups, with the largest proportion of participants falling within the 40-59 age range (47.2%, n=52). The 20-39 age group accounted for 33.6% (n=37) of the sample, while the 60-79 and ≥80 age groups constituted smaller percentages, with 16.3% (n=18) and 1.8% (n=3) respectively. Only a negligible number of participants were in the youngest age group of 18-19 years (0.9%, n=2). These findings indicate a clear predominance of middle-aged and female participants in the study population, potentially limiting the generalizability of the results to a broader demographic.

Table 1: Distribution of Age and Gender

Age Group (in years)	Sex Female(n)	Sex Male(n)	Total(n)	Total(%)
18-19	0	2	2	0.9
20-39	31	6	37	33.6
40-59	46	6	52	47.2
60-79	11	7	18	16.3
More than or equal to 80	2	1	3	1.8
TOTAL	**90**	**22**	**112**	**100**

Table 2 presents the various ophthalmic manifestations observed in rheumatologic disorders among the 224 eyes examined in this study. The most common ocular complication was dry eye, accounting for 19.5% (n=43) of the cases. Uveitis was the second most prevalent manifestation, observed in 10.5% (n=23) of the eyes. Retinopathy was found in 7.7% (n=17) of the sample, followed by posterior subcapsular cataract in 7.3% (n=16) of the eyes. Less common manifestations included episcleritis, elevated intra-ocular pressure (IOP) of more than 21 mm Hg, and scleritis, with respective frequencies of 1.4% (n=3), 1.4% (n=3), and 0.9% (n=2). Overall, nearly half of the eyes (48.6%, n=107) exhibited some form of ocular involvement associated with rheumatologic disorders. These findings highlight the considerable impact of rheumatologic disorders on ocular health and emphasize the need for regular ophthalmic evaluations in patients with such conditions.

Table 2: Ophthalmic Manifestations in Rheumatologic Disorders

OCULAR INVOLVEMENT	Number of eyes (n=224)	Percentage (%)
Dry eye	43	19.50
Uveitis	23	10.5
Retinopathy	17	7.7
Episcleritis	3	1.4
Scleritis	2	0.9
Intra-ocular pressure more than 21 mm Hg	3	1.4
Posterior subcapsular cataract	16	7.3
Total	**107**	**48.6**

Table 3 presents the distribution of various types of cataract among the 224 eyes examined in patients with rheumatic diseases. The most frequently observed type was posterior subcapsular (PSC) cataract, accounting for 6.8% (n=15) of the cases. Nuclear sclerosis (NS) was the second most common type, found in 5% (n=11) of the eyes, followed by cortical cataract (CC) in 4.1% (n=9). Mixed cataracts, characterized by the presence of multiple cataract types, were the least prevalent, affecting 2.4% (n=5) of the eyes. In total, 18.2% (n=40) of the eyes exhibited some form of cataract associated with rheumatic diseases. These findings underscore the importance of considering various cataract types when assessing ocular health in patients with rheumatic diseases.

Table 3: Among rheumatic diseases, there is a distribution of types of cataract.

Types of cataract	Number of eyes(n=224)	Percentage (%)
Posterior subcapsular(PSC)	15	6.8
Nuclear sclerosis (NS)	11	5
Cortical cataract (CC)	9	4.1

Mixed	5	2.4
Total	**40**	**18.2**

In Table 4, we examine the proportion of cataract gradings among the 224 eyes evaluated in this study. The cataracts were classified into four types: posterior subcapsular, nuclear sclerosis, cortical cataract, and mixed, with each type further categorized into four grades based on severity (Grade 1 to Grade 4).

For posterior subcapsular cataracts, there were no cases observed in Grade 1, while Grade 2 accounted for 3.64% (n=9) of the eyes, Grade 3 for 1.93% (n=5), and Grade 4 for 1.2% (n=3). Nuclear sclerosis showed no cases in Grades 1 and 3, with 1% (n=3) of the eyes classified as Grade 2 and 3.84% (n=9) as Grade 4. Cortical cataracts also had no cases in Grades 1 and 3, with 1% (n=3) of the eyes in Grade 2 and 2.12% (n=5) in Grade 4. Interestingly, mixed cataracts were observed exclusively in Grade 4, accounting for 2.12% (n=5) of the eyes. These findings reveal that among the various cataract types in patients with rheumatic diseases, more severe gradings (Grade 3 and Grade 4) were more common than milder ones (Grade 1 and Grade 2).

Table 4: The proportion of cataract gradings, based on a total of 224 eyes, is being considered.

Types of cataract	Gradel (Number)	Gradel (%)	Grade2 (Number)	Grade 2 (%)	Grade3 (Number)	Grade 3 (%)	Grade4 (Number)	Grade 4 (%)
Posterior subcapsular	0	0	9	3.64	5	1.93	3	1.2
Nuclear sclerosis	0	0	3	1.0	0	0	9	3.84
Cortical cataract	0	0	3	1.0	0	0	5	2.12
Mixed	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**2.12**

Table 5 investigates the relationship between the duration of steroid use and the development of posterior subcapsular cataracts in patients with rheumatic diseases, based on a sample of 224 eyes. The study population was divided into four groups according to the duration of steroid use: 0-1 year, 1-5 years, 5-10 years, and more than 10 years.

Notably, none of the eyes in the 0-1 year group developed posterior subcapsular cataracts. However, as the duration of steroid use increased, so did the percentage of eyes with this type of cataract. In the 1-5 years group, 2.7% (n=3) of the 77 eyes exhibited posterior subcapsular cataracts. This percentage increased to 6.9% (n=3) in the 5-10 years group, which included 59 eyes. The highest prevalence was observed in the group with more than 10 years of steroid use, with 10.2% (n=10) of the 79 eyes developing posterior subcapsular cataracts.

Table 5: The duration of steroid use is linked to posterior subcapsular cataract.

Duration of steroid (Years)	Number of eyes (Total eyes=224)	Cataract (Posterior subcapsular cataract)	Percentage (%)
0-1	5	-	0%
1-5	77	3	2.70%

5-10	59	3	6.90%
More than 10 years	**79**	**10**	**10.20%**

4. DISCUSSION

The present study aimed to analyze the distribution of age, gender, and ocular manifestations in rheumatologic disorders and their relationship with cataract types and steroid use.

Previous research by Mohammad Hasan Joker et al., reported a mean age of 41.17 ± 39.70 years [7,8]. Our findings show a higher prevalence of rheumatic diseases among females, with a male -to- female ratio of 1:4, which is consistent with previous studies by Tore K.Kvein et al. (1:4-5) [9], Maryam H.Abdullahi et al. (1:4.3) [10], S.Laivoranta-Nyman et al. (1:3 for RA) [11], and Lai-Chu See et al. (1:3-4 times) [12]. The most common age group affected by rheumatic diseases was the 40-59 years age group, accounting for 47.2% of the cases.

Regarding ocular involvement, dry eye was the most common manifestation (19.50%), followed by uveitis (10.5%) and retinopathy (7.7%). This is consistent with previous studies by S. Ausayakhun et al. (19.9%) [6] and Uribe-Reina P. et al. (15.93%) [13]. Among the cataract types, posterior subcapsular cataracts were most prevalent (6.8%), followed by nuclear sclerosis (5%) and cortical cataracts (4.1%).

Our study also examined the grading of cataract types and found that more severe gradings (Grade 3 and Grade 4) were more common than milder ones (Grade 1 and Grade 2). This is an important finding that highlights the need for early detection and intervention in patients with rheumatic diseases.

The duration of steroid use was found to be associated with the development of posterior subcapsular cataracts. [14,15] Patients with more than 10 years of steroid use had the highest prevalence (10.20%), while those with 5-10 years of use had a 6.90% prevalence, and those with 1-5 years had a 2.70% prevalence. No cataracts were found in patients with less than one year of steroid use. These findings suggest a relationship between the duration of steroid use and the development of posterior subcapsular cataracts, which is consistent with previous research by Robert G. Cumming et al. (6.3%) [16], J.H. TOOGOOD et al. (5.4%) [17], Andrew I. Jobling (4.7%) [18], Tinkleman et al. [19], and Nassif et al. [20].
Our study highlights the importance of regular ophthalmic monitoring for patients with rheumatic diseases, especially those on long-term steroid therapy. The findings also emphasize the need for further research to better understand the underlying mechanisms of ocular involvement and cataract development in this population, as well as to explore potential therapeutic approaches tailored to specific cataract types and gradings.

5. CONCLUSION

Our study underscores the significant impact of rheumatic diseases on ocular health, with a higher prevalence observed among females and within the 40-59 years age group. The most common ocular manifestations include dry eye, uveitis, and retinopathy, with posterior subcapsular cataracts being the most frequently occurring cataract type. Furthermore, the study reveals a strong association between the duration of steroid use and the development of posterior subcapsular cataracts.

These findings highlight the crucial need for regular ophthalmic examinations and timely interventions for patients with rheumatic diseases, particularly those undergoing long-term steroid therapy. Our research emphasizes the importance of interdisciplinary collaboration between rheumatologists and ophthalmologists to ensure comprehensive care for these

patients. Additionally, further studies are warranted to elucidate the underlying mechanisms of ocular involvement in rheumatic diseases and to explore novel therapeutic approaches that target specific cataract types and gradings. Ultimately, a better understanding of the pathophysiology and tailored management strategies could lead to improved ocular health outcomes for patients with rheumatic diseases.

Consent

Written informed consent was obtained from all participants prior to conducting the study.

ETHICAL APPROVAL

The ethical approval for this study was considered by the District Civil Surgeon Office, Rajshahi under Ministry of Health, Government of Peoples Republic of Bangladesh.

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