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Evaluation of Laterality, Tumor Stage and Management Modalities in Retinoblastoma Patients

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Abstract | **Original Research Article**

Background: Retinoblastoma is the most common primary intraocular malignancy of childhood and remains a major cause of ocular morbidity and mortality in developing countries due to delayed presentation and limited access to specialized care. Early recognition of clinical features and appropriate treatment strategies are crucial for improving survival and ocular outcomes. ***Methods:*** This hospital-based descriptive study was conducted in the Department of Ophthalmology, National Institute of Ophthalmology and Hospital, Dhaka, Bangladesh, from April 2011 to March 2013. A total of 46 children clinically diagnosed with retinoblastoma were included. Patients with other ocular diseases or incomplete medical records were excluded. Data regarding demographic characteristics, clinical presentation, tumor stage, laterality and treatment modalities were collected and analyzed using descriptive statistics. ***Results:*** The majority of patients presented between 1 and 3 years of age (56.5%), with a slight male predominance (56.5%). Leukocoria was the most common presenting feature, observed in 69.6% of cases, followed by leukocoria with proptosis (15.2%). Most patients were diagnosed at Stage II (60.9%), while Stage I and Stage III accounted for 19.6% each; no Stage IV disease was identified. Unilateral involvement was more frequent (71.7%) than bilateral disease (28.3%). Enucleation combined with radiotherapy was the most commonly employed treatment (26.1%), followed by enucleation alone (21.7%) and chemotherapy (19.6%). A small proportion of patients (6.5%) were lost to follow-up. ***Conclusion:*** Retinoblastoma in this cohort predominantly presented in early childhood with leukocoria and unilateral disease. Most patients were diagnosed at a moderately advanced intraocular stage, necessitating combined treatment approaches. Strengthening early detection and referral systems may further improve outcomes.

Key words: Retinoblastoma, Leukocoria, Enucleation, Pediatric ocular tumor.

INTRODUCTION

Retinoblastoma (RB) is the most common primary intraocular malignancy of childhood and a significant cause of pediatric ocular morbidity [1]. It arises from the retinal cells due to mutations in the RB1 gene and may present as unilateral or bilateral disease. Early diagnosis is crucial, as tumors confined to the globe are potentially curable, whereas extraocular spread is associated with poor prognosis [2]. In developing countries, delayed presentation is common, often resulting in advanced stages at diagnosis and necessitating more aggressive treatment [3].

Children with retinoblastoma usually present with leukocoria (white reflex), strabismus, proptosis, or less commonly, hyphema, pseudohypopyon, redness, pain, or defective vision [4]. Tumor laterality has important implications for prognosis, management and family counseling. Bilateral tumors are more likely to be hereditary and appear at a younger age, whereas unilateral tumors are usually sporadic. Family history, consanguinity and other genetic factors may influence disease occurrence [5,6].

Accurate staging of retinoblastoma helps

determine treatment strategies and predict outcomes [7]. Management may include enucleation, external beam radiotherapy, cryotherapy, or chemotherapy, used alone or in combination depending on tumor size, location and severity [8]. Early-stage tumors may be treated conservatively to preserve the eye, while advanced cases often require enucleation to prevent progression and metastasis [9].

Despite available treatment options, late presentation and limited awareness remain significant challenges in many settings [10]. Hospital-based studies provide valuable insight into the patterns of laterality, tumor stage, clinical features and treatment modalities, which can guide early diagnosis, patient counseling and optimal management [11].

The present study was conducted to evaluate the laterality, tumor stage, clinical features and management approaches among children diagnosed with retinoblastoma at a tertiary ophthalmology center.

METHODOLOGY & MATERIALS

This hospital-based descriptive study was conducted in the Department of Ophthalmology, National Institute of Ophthalmology and Hospital, Dhaka, from April 2011 to March 2013. A total of 46 children suspected to have retinoblastoma, including those referred from other hospitals, were included. Patients with ocular conditions other than retinoblastoma or incomplete medical records were excluded. Detailed history regarding presenting symptoms such as white reflex in the pupil, watering, pain, redness, protrusion of the eyeball, squint, hyphema and defective vision was obtained. Information on laterality, duration and progression of the disease was recorded. Family history, including consanguinity between parents and the health status of siblings and other relatives, was noted. All patients underwent thorough ocular examination, which included assessment of visual acuity, pupillary reaction, anterior and posterior segment evaluation, intraocular pressure and corneal diameter. Investigations included X-ray of the orbit and skull, computed tomography (CT) scan of the orbit and brain, B-scan ultrasonography and measurement of aqueous lactate dehydrogenase. Enucleated eyes were subjected to histopathological examination. Treatment modalities included enucleation, radiotherapy (referred to the Radiology Department), cryotherapy and chemotherapy, depending on the stage and severity of the tumor. All patients were followed up regularly, with careful examination of the empty socket and the apparently normal eye at each visit to monitor for recurrence or involvement. Data were entered and analyzed using Microsoft Excel. Descriptive statistics, including frequency, percentage, mean and standard deviation, were calculated to summarize the patients' demographic profile, clinical features, tumor stage, laterality and treatment modalities.

RESULTS

Table 1: Age and Sex Distribution of Patients (n = 46)

Age	Males	Females	Total	Percentage (%)
<1 year	5	3	8	17.4
1–3 years	14	12	26	56.5
3–5 years	4	3	7	15.2
>5 years	3	2	5	10.9
Total	26	20	46	100

Table 1 shows the age and sex distribution of the 46 patients included in the study. The majority of cases (56.5%) presented between 1 and 3 years of age, followed by 15.2% between 3 and 5 years, 17.4% under 1 year and 10.9% over 5 years. Male patients (26/46, 56.5%) were slightly more than female patients (20/46, 43.5%) across all age groups.

Table 2: Clinical Presentation of Retinoblastoma (n = 46)

Presentation	Number of Cases	Percentage (%)
White reflex in the pupil	32	69.6
White reflex with proptosis	7	15.2
Pseudohypopyon	5	10.9
Hyphema	2	4.3
Total	46	100

Table 2 presents the clinical presentations of retinoblastoma among the 46 patients. The most common presenting feature was white reflex in the pupil (leukocoria), observed in 32 patients (69.6%), followed by white reflex with proptosis in 7 patients (15.2%). Pseudohypopyon was seen in 5 patients (10.9%) and hyphema was the least common, occurring in 2 patients (4.3%).

Table 3: Distribution of Retinoblastoma Stage at Presentation (n = 46)

Stage	Number of Cases	Percentage (%)
I	9	19.6
II	28	60.9
III	9	19.6
Total	46	100

Table 3 illustrates the distribution of retinoblastoma stages at presentation among the 46 patients. The majority of cases, 28 patients (60.9%), presented at Stage II, followed by 9 patients (19.6%) at Stage I and 9 patients (19.6%) at Stage III. No patients were observed in Stage IV.

Table 4: Treatment Modalities Applied (n = 46)

Mode of Treatment	Number of Cases	Percentage (%)
Enucleation	10	21.7
Enucleation + Radiotherapy	12	26.1
Radiotherapy alone	8	17.4
Enucleation + Cryotherapy	4	8.7
Chemotherapy	9	19.6
Lost to Follow-up	3	6.5
Total	46	100

Table 4 shows the treatment modalities applied to the 46 patients with retinoblastoma. The most commonly used treatment was enucleation combined with radiotherapy (12 patients, 26.1%), followed by enucleation alone in 10 patients (21.7%) and chemotherapy in 9 patients (19.6%). Radiotherapy alone was administered to 8 patients (17.4%), while enucleation with cryotherapy was used in 4 patients (8.7%). Three patients (6.5%) were lost to follow-up.

Table 5: Laterality of Retinoblastoma (n = 46)

Laterality	Number of Cases	Percentage (%)
Unilateral	33	71.7
Bilateral	13	28.3
Total	46	100

Table 5 presents the laterality of retinoblastoma among the 46 patients. Unilateral disease was observed in 33 patients (71.7%), while bilateral involvement was seen in 13 patients (28.3%).

DISCUSSION

Retinoblastoma remains the most common primary intraocular malignancy of childhood, with its clinical behavior strongly influenced by age at presentation, tumor laterality, stage and available treatment modalities. In the present study, the majority of patients (56.5%) presented between 1 and 3 years of age. The slight male predominance observed in our study (56.5%) has also been noted in studies from Korea, Turkey and the Middle East, although gender differences are generally considered minimal in retinoblastoma epidemiology [12, 13, 14].

Leukocoria was the most common presenting feature in our cohort, occurring in 69.6% of cases, followed by leukocoria with proptosis (15.2%). This finding is comparable to reports from Central America and South Africa, where leukocoria remains the dominant early sign, while proptosis reflects more advanced disease at presentation [15, 16]. The presence of pseudohypopyon (10.9%) and hyphema (4.3%) in our study indicates delayed presentation in a subset of patients, a pattern commonly reported in developing countries where awareness and early screening are limited.

Tumor staging analysis revealed that most patients presented with Stage II disease (60.9%), while Stage I and Stage III accounted for 19.6% each. The absence of Stage IV disease suggests that although presentation was often delayed, most tumors remained confined to the globe. Similar stage distributions have been reported by Ozdemir et al. and Al-Nawaiseh et al., who noted a predominance of intraocular disease at diagnosis in tertiary referral centers [13, 17]. Yan et al. emphasized the importance of tumor size and extent of histological involvement in determining management, supporting the rationale for aggressive treatment in Stage II and III cases to prevent progression [18].

Laterality analysis showed that unilateral retinoblastoma was more common (71.7%) than bilateral disease (28.3%), which aligns with global data indicating unilateral involvement in approximately two-thirds of cases [19,20]. Bilateral cases are more often associated with germline mutations and earlier onset, as described by Ali et al., although genetic testing was not routinely available in our setting during the study period [21].

Management strategies in our study reflected disease stage and resource availability. Combined enucleation and radiotherapy was the most frequently used modality (26.1%), followed by enucleation alone (21.7%) and chemotherapy (19.6%). These findings are consistent with recommendations from Chantada et al., who proposed graduated-intensity treatment protocols for developing countries, where eye salvage therapies may be limited by late presentation and infrastructure constraints [22].

While newer eye-salvaging techniques such as intra-arterial chemotherapy have shown promising results in specialized centers, such modalities were not widely available during the period of this study [23, 24]. Chemotherapy-based approaches, as described by Kim et al. and Varan et al., were selectively used in our cohort, reflecting evolving treatment practices [25, 26]. Loss to follow-up in 6.5% of patients highlights ongoing challenges in long-term care adherence, a problem also noted by Aziz et al. in their evaluation of treatment burden and socioeconomic impact [27].

Limitations of the study

This study has several limitations that should be considered while interpreting the findings. It was a hospital-based descriptive study conducted at a single tertiary care center, which may limit the generalizability of the results to the wider population. The sample size was relatively small and advanced genetic testing and newer imaging or treatment modalities were not routinely available during the study period. Additionally, long-term visual and survival outcomes could not be fully assessed due to loss to follow-up in a small proportion of patients. Despite these limitations, the study provides valuable insight into the clinical presentation, staging, laterality and management practices of retinoblastoma in a resource-limited setting.

CONCLUSION

Retinoblastoma in this cohort predominantly affected children in early childhood, with leukocoria being the most common presenting sign and unilateral involvement occurring more frequently than bilateral disease. Most patients presented with moderately advanced intraocular tumors, requiring a combination of surgical and adjunctive treatment modalities, with enucleation remaining a commonly employed approach. The findings highlight the importance of early detection, prompt referral and appropriate staging to improve eye salvage and patient outcomes. Strengthening public awareness and improving access to specialized ophthalmic care may contribute to earlier diagnosis and better management of retinoblastoma in similar settings.

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