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Original Article

Orbital tumors: A retrospective analysis of cases from Iraq and orbital anatomical perspectives

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ABSTRACT

Background: With its vital ocular and adnexal structures, the orbit may be affected by a wide array of neoplasms, including primary, secondary, and metastatic neoplasms. These lesions pose significant diagnostic and therapeutic challenges in view of complex orbital anatomy and overlapping clinical presentations. This study aimed to analyze the epidemiology, clinical features, refractive impacts, and management outcomes of orbital tumors, providing insights to optimize diagnosis and treatment strategies.

Methods: This study retrospectively analyzes 22 patients who had a presentation of orbital tumors at the Istishari Ophthalmic Eye Hospital between January 2019 and January 2024. Collected data were demographic, clinical, refractive, tumor type, laterality, and management outcome. Advanced imaging studies and histopathological diagnoses confirm the diagnoses. Statistical tests will be applied in assessing the relationship among tumor types, clinical presentations, and refractive changes by means of Analysis of Variance and Chi-square tests.

Results: Cavernous hemangioma was the most prevalent tumor (54.5%), followed by adenoid cystic carcinoma and optic nerve meningioma (13.6% and 9.1%, respectively). Proptosis (31.8%) was the predominant symptom. Significant refractive changes were noted across tumor types (P = 0.012). Lateral orbitotomy was the most common surgical approach (68.2%), with adjuvant therapies utilized in 22.7% of cases. Tumors predominantly affected females (54.5%) and the left orbit (77.3%).

Conclusion: Orbital tumors present diverse clinical and refractive manifestations, necessitating individualized, multidisciplinary approaches for effective management. This study underscores the importance of advanced imaging, tailored surgical strategies, and the integration of minimally invasive techniques. Future multicenter studies are needed to validate these findings and enhance therapeutic outcomes.

Keywords: Lateral orbitotomy, Multidisciplinary management, Orbital tumors, Proptosis, Refractive changes

INTRODUCTION

The orbit is a complex anatomic structure that houses the eye and its adnexa, comprising muscles, nerves, blood vessels, and connective tissue. This limited, closed space is very prone to both primary and secondary tumor growth. Orbital tumors encompass a broad category of benign and malignant neoplasms.[15] The complex anatomy of the orbit often makes diagnosis and management difficult and mostly requires a multidisciplinary approach.[8] Orbital tumors are categorized into primary, secondary, and metastatic types. Common primary orbital tumors include cavernous hemangioma, lymphoma, and meningioma. Secondary tumors may extend from adjacent structures, such as the paranasal sinuses, while metastatic tumors commonly originate from breast, lung, or prostate cancers.[5] Epidemiological studies have suggested that the prevalence of tumor types is age and sex-dependent. Malignant tumors are more common in older adults.[11] Clinically, the symptoms most often reported in orbital tumors include proptosis, visual disturbances, pain, or palpable masses. Most of these clinical symptoms often overlap between benign and malignant conditions, which complicate the diagnosis accurately.[15] Advanced imaging modalities such as computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography are pivotal in delineating tumor characteristics, extent, and anatomical relationships. Histopathological analysis remains the gold standard for definitive diagnosis.[4] Management of orbital tumors is very individualized, according to the type of tumor, size, and extent of invasion. The treatment modalities vary from observation and minimally invasive surgical approaches to radical excision and adjuvant therapies such as chemotherapy or radiotherapy. Recently, also minimal invasive approaches, as well as stereotactic radiosurgery in selected cases, have likewise revealed some encouraging efficacies.[2,8] The paper, therefore, aims at an encompassing discussion regarding epidemiology, clinical presentation, diagnostic workup, and the treatment of orbital tumors so that these would serve in deepening our knowledge toward optimization of orbital tumor diagnosis and treatment.

MATERIALS AND METHODS

Study design

This study was a retrospective observational analysis conducted on patients diagnosed with orbital tumors at Istishari Ophthalmic Eye Hospital. The primary objective was to analyze the epidemiological, clinical, and refractive characteristics of orbital tumors and assess the surgical and adjuvant management outcomes. Thus, the study recruited 22 patients diagnosed with orbital tumors between January 2019 and January 2024 based on specific inclusion and exclusion criteria. Besides, the inclusion criteria included confirmed orbital tumors by histopathology and availability of complete clinical, diagnostic, and management data. On the other hand, incomplete records constituted the criteria for exclusion.

Data collection

Clinical and demographic data were extracted from the records of patients with orbital tumors, including age, gender, presenting complaints, tumor type, laterality, and surgical outcomes. In addition, detailed refractive measurements such as intraocular pressure (IOP), spherical power (SPH), cylindrical power (CYL), and orientation of astigmatism were recorded for the affected eye. The study analyzed various variables and parameters: epidemiological variables included age, gender, and tumor laterality; clinical variables encompassed presenting complaints (e.g., proptosis, vision distortion, pain), tumor type, and location; refractive parameters such as IOP, SPH, CYL, and astigmatism orientation were assessed to determine the impact of the tumor type on ocular parameters; and management outcomes focused on the types of surgical approaches and the use of adjuvant therapies such as chemotherapy and radiotherapy.

Diagnostic and therapeutic approaches

The general comprehensive ophthalmologic examination of patients with a diagnosis of an orbital tumor condition includes imaging studies such as CT and MRI for tumor extent, location, invasion possibility determination, and histopathological diagnosis on biopsy specimen for the definitive diagnosis of tumor types. Surgical interventions included lateral orbitotomy, enucleation, and endoscopic sinus surgery, which were selected according to the type and location of the tumor. Besides, adjuvant therapies, including chemotherapy and radiotherapy, were performed in cases of malignant or aggressive tumors.

Statistical analysis

Descriptive and inferential statistical analyses were conducted using the Statistical Package for the Social Sciences software to evaluate the data from patients with orbital tumors. Descriptive statistics included the calculation of frequencies, percentages, means, medians, and standard deviations (SDs) for demographic, clinical, and refractive data. The Chi-square test was utilized to determine associations between categorical variables, such as the distribution of gender across different tumor types and main complaints. Analysis of Variance (ANOVA) was applied to compare refractive parameters (e.g., SPH, CYL) across various tumor types. A significance threshold was set, where a p-value of less than 0.05 was considered statistically significant.

Ethical considerations

The protocol was in accordance with the principles of the Declaration of Helsinki. Patient confidentiality was guaranteed by anonymizing the data.

RESULTS

Epidemiological analysis

Among patients with orbital tumors, females comprised 54.5% ($n = 12$) and males 45.5% ($n = 10$), indicating a slight female predominance. The mean age of patients was 49 years

(SD 16.4), with a wide range spanning from 5 to 73 years and a median age of 49 years [Table 1].

Table 1: Epidemiological and clinical analysis of orbital tumors: gender, complaints, tumor types, and surgical outcomes.

Frequencies			
Frequencies of Gender			
Gender	**Counts**	**% of Total**	**Cumulative %**
Female	12	54.5	54.5
Male	10	45.5	100.0%
Frequencies of Complaint			
Main Complaint	**Counts**	**% of Total**	**Cumulative %**
Vision distortion	5	22.7	22.7
Red eye	3	13.6	36.4
Mass	5	22.7	59.1
Proptosis	7	31.8	90.9
Eye pain	2	9.1	100.0
Frequencies of type of tumor			
Type of tumor	**Counts**	**% of Total**	**Cumulative %**
Optic nerve meningioma	2	9.1	9.1
Choroidal melanoma	2	9.1	18.2
Cavernous hemangioma	12	54.5	72.7
Adenoid cystic carcinoma	3	13.6	86.4
Lymphoma	1	4.5	90.9
Capillary hemangioma	1	4.5	95.5
Sinonasal Carcinoma	1	4.5	100.0
Frequencies of effected side			
Effected side	**Counts**	**% of Total**	**Cumulative %**
Right Eye	5	22.7	22.7
Left Eye	17	77.3	100.0
Frequencies of surgical approach			
Surgical approach	**Counts**	**% of Total**	**Cumulative %**
Biopsy	3	13.6	13.6
Enucleation	2	9.1	22.7
Lateral orbitotomy	15	68.2	90.9
Endoscopic sinus surgery	1	4.5	95.5
Observation	1	4.5	100.0
Frequencies of adjuvant therapy			
Adjuvant therapy	**Counts**	**% of Total**	**Cumulative %**
Chemotherapy and Radiotherapy	5	22.7	22.7
Oral β-blockers	1	4.5	27.3
N/A	16	72.7	100.0

N/A: Not available

Clinical presentations

Proptosis was the most common complaint, reported by 31.8% of patients ($n = 7$). Other symptoms included vision distortion and mass (both 22.7%, $n = 5$ each), red eye (13.6%, $n = 3$), and eye pain (9.1%, $n = 2$).

Tumor types

Cavernous hemangioma is the most commonly observed tumor, accounting for 54.5% ($n = 12$). Adenoid cystic carcinoma constitutes 13.6% or $n = 3$. The number of cases constituted optic nerve meningioma to the tune of 9.1% $n = 2$. Choroidal melanoma had an occurrence to the extent of 9.1%, that is, $n = 2$. Other miscellaneous rare tumors include lymphoma 4.5% or $n = 1$, and capillary hemangioma was also of similar occurrence; a further type of sinonasal carcinoma amounted to the remaining 4.5%, $n = 1$, which is reported as given in Table 1.

Laterality

Most tumors affected the left eye (77.3%, $n = 17$), whereas the right eye was involved in 22.7% ($n = 5$) of cases.

Surgical management

Lateral orbitotomy was the most common surgical approach, performed in 68.2% ($n = 15$) of cases. Other procedures included biopsy (13.6%, $n = 3$), enucleation (9.1%, $n = 2$), endoscopic sinus surgery (4.5%, $n = 1$), and observation (4.5%, $n = 1$).

Adjuvant therapy

Chemotherapy and radiotherapy were utilized in 22.7% ($n = 5$) of cases. Oral β-blockers were used in 4.5% ($n = 1$) of cases, and 72.7% ($n = 16$) did not require adjuvant therapy [Table 1].

Descriptive statistical profile of orbital tumor cases

The mean IOP of the affected eye was 20.1 mmHg, with an SD of 3.17 mmHg, ranging from 14 mmHg to 28 mmHg and a median value of 20 mmHg. Regarding refractive characteristics, the mean refractive error was −1.23 D (SD 0.704), ranging from −3 D to −0.5 D with a median of −1.13 D. The mean SPH was also −1.23 D (SD 0.819), ranging from −3.25 D to 0 D, with a median of −1.13 D. The mean CYL was −0.713 D (SD 0.284), ranging from −1.25 D to −0.25 D, with a median of −0.75 D. The mean orientation of astigmatism was 15.5° (SD 6.05°), ranging from 5° to 30°, with a median of 15° [Table 2].

ANOVA for clinical and refractive parameters across tumor types

The ANOVA results demonstrated that IOP showed no significant difference across tumor types (F = 1.71,

Table 2: Descriptive statistical profile of orbital tumor cases: Age, intraocular pressure, and refractive characteristics.

Descriptive						
Statistical measure	**Age**	**IOP of the affected eye**	**Estimated Diopters (D) of the affected eye**	**SPH of the affected eye**	**CYL of affected eye**	**The orientation of the astigmatism of the affected eye**
N	22	22	16	20	20	20
Missing	0	0	6	2	2	2
Mean	49	20.1	−1.23	−1.23	−0.713	15.5
Median	49	20	−1.13	−1.13	−0.75	15
Standard deviation	16.4	3.17	0.704	0.819	0.284	6.05
Minimum	5	14	−3	−3.25	−1.25	5
Maximum	73	28	−0.5	0	−0.25	30

CYL: Cylindrical power, IOP: Intraocular pressure, SPH: Spherical power

P = 0.186), indicating that IOP is not influenced by tumor type [Table 3]. However, SPH (F = 4.41, *P* = 0.012) and CYL (F = 4.4, *P* = 0.012) both exhibited statistically significant differences among tumor types, suggesting that these refractive parameters are significantly affected by the type of tumor. In contrast, the orientation of astigmatism showed no significant variation across tumor types (F = 1.06, *P* = 0.433), indicating that astigmatism orientation remains unaffected.

Table 3: Analysis of variance for clinical and refractive parameters across tumor types.

ANOVA					
ANOVA - IOP of the effected eye					
Parameter	**Sum of Squares**	**df**	**Mean Square**	**F**	***P*-value**
Type of tumor	85.7	6	14.28	1.71	0.186
Residuals	124.9	15	8.33		
ANOVA - SPH of effected eye					
Parameter	**Sum of Squares**	**df**	**Mean Square**	**F**	***P*-value**
Type of tumor	8.54	6	1.423	4.41	0.012
Residuals	4.2	13	0.323		
ANOVA - CYL of the effected eye					
Parameter	**Sum of Squares**	**df**	**Mean Square**	**F**	***P*-value**
Type of tumor	1.028	6	0.1714	4.4	0.012
Residuals	0.506	13	0.0389		
ANOVA - The orientation of the astigmatism of the effected eye					
Parameter	**Sum of Squares**	**df**	**Mean Square**	**F**	***P*-value**
Type of tumor	228	6	38.1	1.06	0.433
Residuals	467	13	35.9		

CYL: Cylindrical power, ANOVA: Analysis of variance, SPH: Spherical power, df: Degrees of freedom, F (F-statistic): A ratio of the variance between groups to the variance within groups.

Gender distribution across tumor types

This analysis of sex distribution showed that in the case of cavernous hemangioma, there was a predominance of females (*n* = 7), while choroidal melanoma, sinonasal carcinoma, and lymphoma were found to affect more males, with one case each. Optic nerve meningioma was found only in females (*n* = 2). However, according to the Chi-square test, no significant association was found between gender and tumor type ($\chi^2 = 7.55$, df = 6, *P* = 0.273) [Table 4].

Main complaints across tumor types

The statistical analysis of main complaints revealed that proptosis was most commonly associated with cavernous hemangioma (*n* = 4), while vision distortion occurred in cases of optic nerve meningioma (*n* = 1), choroidal melanoma (*n* = 1), and cavernous hemangioma (*n* = 2). Mass presentation was frequently observed in cavernous hemangioma (*n* = 4) and adenoid cystic carcinoma (*n* = 1), whereas eye pain was relatively rare, reported only in cases of cavernous hemangioma (*n* = 1) and adenoid cystic carcinoma (*n* = 1). However, the Chi-square test indicated no statistically significant association between main complaints and tumor type ($\chi^2 = 20.9$, df = 24, *P* = 0.644) [Table 5].

DISCUSSION

In our study, females represented 54.5% of cases, with cavernous hemangioma being predominantly seen in women. This gender distribution is consistent with findings from prior studies, such as Demirci *et al*. (2002), which reported a higher prevalence of benign orbital tumors, including cavernous hemangioma, in females.[5] However, our data contrasts with the results of Markowski *et al*. (2014),[11] where no significant gender bias was observed for certain tumor types such as meningiomas and lymphomas.

Table 4: Contingency table and Chi-square test for gender distribution across tumor types.

Contingency Tables								
	Type of tumor							
Gender	**Optic Nerve Meningioma**	**Choroidal Melanoma**	**Cavernous hemangioma**	**Adenoid Cystic Carcinoma**	**Capillary Hemangioma**	**Sinonasal Carcinoma**	**Lymphoma**	**Total**
Female	2	0	7	2	1	0	0	12
Male	0	2	5	1	0	1	1	10
Total	2	2	12	3	1	1	1	22
χ^2 Tests								
Test	**Value**	**df**	***P*-value**					
χ^2	7.55	6	0.273					
n	22							

df: Degrees of freedom

Table 5: Contingency table and Chi-square test for main complaints across tumor types.

Contingency Tables						
	Complaint					
Type of tumor	**Vision distortion**	**Red eye**	**Mass**	**Proptosis**	**Eye pain**	**Total**
Optic Nerve Meningioma	1	0	0	1	0	2
Choroidal Melanoma	1	1	0	0	0	2
Cavernous hemangioma	2	1	4	4	1	12
Adenoid Cystic Carcinoma	1	0	1	0	1	3
Capillary Hemangioma	0	1	0	0	0	1
Sinonasal Carcinoma	0	0	0	1	0	1
Lymphoma	0	0	0	1	0	1
Total	5	3	5	7	2	22
χ^2 tests						
Test	**Value**	**df**	***P*-value**			
χ^2	20.9	24	0.644			
n	22					

df: Degrees of freedom

The exclusive occurrence of optic nerve meningiomas in females in our study may reflect the known higher incidence of meningiomas in women, possibly linked to hormonal influences.[3,16] The mean age of 49 years in our cohort is consistent with the literature that suggests orbital tumors most commonly affect middle-aged adults. Our findings agree with observations made by Demirci *et al*. (2014), who noted that benign tumors, such as cavernous hemangioma, were more common in this age group, while malignant tumors, such as lymphoma, were more common in older patients.[11] Cavernous hemangioma was the most frequent tumor in our study (54.5%), consistent with the findings of Nguyen *et al*. (2014)[12] and Markowski *et al*. (2014),[11] where this tumor type predominated among benign lesions.[15] In contrast, malignant tumors like lymphoma were relatively rare in our study (4.5%), which may reflect differences in patient population and referral patterns compared to studies like Demirci *et al*. (2002), which reported lymphoma as the most common malignancy among older patients.[5] The most common presenting symptom in our cohort was proptosis, which accounted for 31.8%, followed by vision distortion, accounting for 22.7%. In this regard, Nguyen *et al*. (2014)[12] highlighted that proptosis is the hallmark of orbital tumors. However, the frequency in our study with regard to vision distortion and palpable mass was slightly higher compared to similar cohorts analyzed by Rizvi *et al*., 2010.[10,14,15] This variability in symptom frequency points out the importance of tumor location and type in clinical presentation. Our observation of left-sided tumors being more prevalent (77.3%) lacks extensive comparative data in the literature. While this finding is notable, it could be coincidental or influenced by anatomical or vascular factors that warrant further investigation. Lateral orbitotomy was performed in 68.2% of cases included in our series, which again corresponds to the established role of the procedure for the approach of lateral and intraconal orbital lesions.[15] The limited application of endoscopic sinus surgery in the setting of our cohort only accounts for 4.5%, compared with that reported by Dikshit *et al*. (2021),[6] who mentioned an increasing trend toward minimal access techniques for selected cases.[8] This discrepancy could be attributed to differences in surgeon expertise and case complexity. The surgical management of orbital tumors has significantly evolved with the integration of traditional and minimally invasive techniques to maximize the outcome with minimal morbidity. Lateral orbitotomy is the most commonly used procedure in orbital tumors and is particularly appropriate for lesions that involve the lateral and intraconal spaces. This is due to its versatility and because it offers direct access to the tumor site, hence a standard approach in many instances. With the advancement in technology and capability in surgery, however, treatment options for orbital tumors have been on a steady increase. There has been, in recent years, a trend toward the increasing use of minimally invasive approaches for managing these conditions, especially with tumors that consist of medial or inferomedial locations. Techniques such as the endoscopic transnasal approach and transorbital neuroendoscopic approach (TONE) offer significant advantages. These include reduced surgical trauma, improved cosmetic outcomes, and faster recovery times. Endoscopic methods have been especially effective for tumors near the optic nerve or in the medial compartments of the orbit. For example, the 360° endoscopic approach provides circumferential access to intraconal tumors with an extremely high resection rate and very few complications.[7] The tumors can safely be resected through endoscopic transnasal and transorbital approaches with only a minimal amount of displacement of the critical orbital structures.[1] Transnasal endoscopy has proved very effective for medially situated lesions without any external incisions, hence minimizing the risks to extraocular muscles and nerves. It also introduced the TONE approach by making a small skin incision laterally; this will be helpful in the management of lateral orbital apex lesions like intraconal meningioma.[6] Sometimes, only the combined endoscopic and classical external approach is adequate for completely removing the tumor. For example, the combined transnasal and transpalpebral approach can offer unrivaled exposure to the orbit with minimum tissue disturbance.[12] In superonasal orbital lesions, the upper fornix approach with lateral cantholysis allows optimal site exposure without bony removal or detachment of muscles. The technique provides maximal tumor removal while preserving function and cosmetic appearance.[9] Our findings on adjuvant therapy align with the broader literature. Chemotherapy and radiotherapy were utilized in 22.7% of cases, reflecting their established role in managing malignant or aggressive orbital tumors such as lymphoma and adenoid cystic carcinoma.[4,14] The statistically significant variation in spherical and CYL across tumor types ($P = 0.012$ for both) underscores the impact of orbital masses on ocular anatomy. Similar findings were reported by Rizvi *et al*. (2010), who noted refractive changes in patients with proptosis and orbital tumors.[10,13,14] These changes are likely due to mass effects causing globe displacement or deformation. Compared to prior studies, our data show a higher prevalence of benign tumors and a slightly lower incidence of malignant tumors. This discrepancy could be attributed to differences in population demographics or referral patterns. For instance, Markowski *et al*. (2014) reported a higher prevalence of malignant lesions (45.9%), particularly in older adults.[11] Our findings are more comparable to cohorts dominated by middle-aged patients with predominantly benign presentations. The current study has a small sample size and is single center, which restricts the representativeness of the results obtained. Therefore, further investigations with expanded cohorts and multicenter collaboration are encouraged.

CONCLUSION

The information obtained from the in-depth study of the epidemiology, clinical presentation, refractive impact, and outcome of orbital tumors revealed the majority as benign ones, with predominant involvement by the benign tumor being cavernous hemangioma, hence providing significant management approaches both at diagnosis and in the treatment process. Proptosis and refractive changes feature significantly as part of their important clinical manifestations, while the surgical landmark involves a lateral orbitotomy approach. Variations in tumor types, demographics, and clinical presentations underline the necessity for a multidisciplinary approach to optimize diagnosis and management. Future research with larger, multicenter cohorts is essential to validate these findings and improve patient outcomes.

Ethical approval: Institutional Review Board approval is not required as it was a retrospective observational analysis. The protocol was in accordance with the principles of the Declaration of Helsinki.

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