

# Orbital Tumors: A Prospective Study of 95 Cases

Mohammed Jaber Al-Mamoori

Department of Neurosurgery, Hilla Teaching Hospital, Babylon, Iraq

## Abstract

**Background:** A wide variety of tumors and pseudotumors can involve the orbit. Although the incidence of orbital tumors is relatively low, the diagnosis and the treatment strategy for such tumors are of great concern to neurosurgeons and ophthalmologists. **Objectives:** The main aim of this study is to determine the distribution of patient age, sex, pathology, origin, and location of orbital tumors for optimum management because the delay in the diagnosis and treatment is the most preventable cause of morbidity and mortality. **Materials and Methods:** In this study, 95 cases of orbital tumors are studied prospectively during 10 years' period in the Hilla Teaching Hospital in Babylon-Iraq from 2008 to 2018. The parameters dealt with in this study included; the distribution of patient age and sex, clinical manifestations, investigations, pathology, origin of tumors and tumor location in the orbit, management, surgical procedures, and mortality in 95 patients (aged from 6 months to 75 years, the mean age is 29.8). **Results:** In this study, the highest age group incidence of orbital tumors is in the first decade of life which constitutes (24.2%), the second peak is in the fourth decade of life which constitutes (17.9%). 42 (44.2%) of the patients are males and 53 (55.8%) of the patients are females. Among the 95 cases, 76 (80%) are primary orbital tumors, 15 (15.8%) are secondary orbital tumors (tumors that originating from contiguous regions), and 4 (4.2%) are metastatic orbital tumors. Orbital tumors location; 83 (87.4%) are extraconal and 12 (12.6%) are intraconal. The two most common orbital tumors are dermoid cyst (27.4%) and pseudotumor (16.8%). Overall mortality is seven patients (7.4%). **Conclusion:** Orbital tumors are a relatively rare and challenging group of tumors. The age of onset, state of vision, tumor location in the orbit and other radiological findings provide the most important information for the diagnosis of orbital tumor prior biopsy or surgical resection and to make decision about other further treatment modality. For any patient complain from visual loss, proptosis, and impaired ocular motility, it is better to undergo magnetic resonance imaging and computed tomography-scan imaging to detect or exclude intraorbital or intracranial diseases.

**Keywords:** Computed tomography-scan, magnetic resonance imaging, mortality, orbital tumor, proptosis

## INTRODUCTION

A wide variety of tumors and pseudotumors can involve the orbit. Although the incidence of orbital tumors is relatively low, the diagnosis and the treatment strategy for such tumors are of great concern to neurosurgeons and ophthalmologists. Two-thirds of the lesions are benign, and one-third are malignant.

The presenting clinical manifestations are a constellation of one or more of the following symptoms and signs; proptosis (92%), visual field defect/loss of visual acuity (74%), diplopia, strabismus (66%), pain (34%), lacrimation (23%), and conjunctival edema (22%). Proptosis can be caused by any type of orbital process. Visual acuity is often reduced by malignant and inflammatory/infectious processes (79%), as well as by optic nerve gliomas (67%) [Figure 1]; it is less commonly reduced by meningiomas (45%). Pain is a

prominent feature of inflammatory/infectious disorders (96%) and meningiomas (70%).<sup>[1]</sup>

The location of each orbital tumor is classified into extraconal and intraconal. The intraconal space is confined by the conus, which connects the four rectus muscles together. The extraconal compartment surrounds the muscular conus like a tube.<sup>[1]</sup> Orbital tumors can occur in any area of the orbit so that surgical approaches must be provide 360° access to the orbit.<sup>[2]</sup>

A lot of imaging modality are available to study the orbit and its contents, ranging from plain X-ray films to highly technical methods such as computed tomography (CT), magnetic resonance imaging (MRI), ultrasonography, arteriography,

**Address for correspondence:** Dr. Mohammed Jaber Al-Mamoori, Department of Neurosurgery, Hilla Teaching Hospital, Babylon, Iraq. E-mail: mohammedjaber76@gmail.com

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and orbital venography (which is rarely used today). For the radiologist and neurosurgeons, CT and MRI have proved to be the best and most useful technique for evaluating the majority of orbital abnormalities, with ultrasonography usually reserved for ocular diseases.<sup>[3]</sup> In this study, CT scans and MRI of the orbit is performed to all patients, while ultrasonography, angiography, and hormonal assay reserved for some patients.

In this study, the relationships between the clinical presentation, radiological findings, pathological profile, patient age at diagnosis and tumor origin and location in the orbit are investigated prospectively for 95 consecutive patients with orbital tumors during 10 years' period in the Hilla Teaching hospital in Babylon-Iraq from 2008 to 2018.

## MATERIALS AND METHODS

In this study, 95 cases of orbital tumors are studied prospectively during 10 years' period in the Hilla Teaching hospital in Babylon-Iraq from 2008 to 2018. The parameters

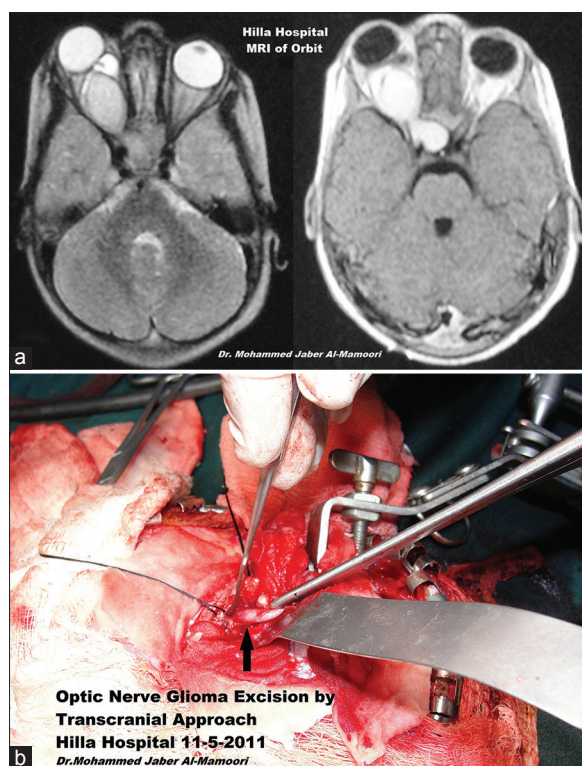
dealt with in this study included; the distribution of patient age and sex, clinical manifestations, investigations, pathology, origin of tumors and tumor location in the orbit, management and surgical procedures and mortality in 95 consecutive patients.

The patient's age range from 6 months to 75 years, the mean age is 29.8, including 42 males and 53 females. Those patients who are below 12-year-old constitute 25 patients (26.3%) of all patients. There are 10 patients who have orbital diseases in which the presenting complains like orbital tumors [Table 1], those patients have been excluded from this study, and only 95 of the patients who have clinical, radiological, and histopathological evidence of the orbital tumor are included in this study.

In our study, the presenting symptoms and signs of patients with orbital tumors are documented by clinical history. All the patients undergo CT and/or MRI; some of them undergo magnetic resonance angiography, magnetic resonance venography, CT-angiography, ultrasound, thyroid function test, perimetry, visual evoked potential, visual acuity, and intraocular pressure measurement.

Ninety-one patients of our study undergo biopsy or tumor resection at our institute, and orbital tumors were verified histopathologically. Four patients with clinically and radiologically verified orbital tumors are included in this study. The four patients consisted of; one case of cavernous hemangioma, one case of orbital varix, one case of optic nerve sheath meningioma, one case of mucocele, all of which were verified on the basis of the characteristic findings of CT or MRI.<sup>[4,5]</sup> For pathological diagnosis, tissue samples are routinely stained with hematoxylin and eosin and examined under a light microscope. Immunohistochemical techniques and polymerase chain reaction technique are also used for some cases and incorporated into the final diagnosis.<sup>[6]</sup>

The origins of tumors are divided into three categories: primary tumors; those tumors which are originating in the orbit, secondary tumors; those tumors which are originating in contiguous spaces and invading the orbit by direct extension and metastatic tumors. The locations of tumors are divided into two areas, the extraconal and intraconal according to CT and/or MRI findings. The pathological profiles of tumors are define according to tumor location and origin. The majority of patients included in this study undergo surgical intervention for diagnosis and/or resection their orbital tumors.



**Figure 1:** (a) Optic nerve glioma. 1.5 years girl complain from loss of vision, proptosis and pain of the right eye since 1 year. A. Magnetic resonance imaging of orbit. Showing the fusiform enlargement of the entire optic nerve with intracranial extension to optic chiasm. (b) Operative view, bicoronal frontal flap. Right frontal craniotomy, unroofing of right orbital roof, retraction of superior rectus muscle laterally, opening of optic nerve sheath, total excision of fusiform enlarged optic nerve from just behind the globe to the optic foramen (prechiasmatic transection). The intracranial part of tumor involving the optic chiasm, undergo subtotal resection to preserve vision on the other side, followed by chemotherapy. Histopathology is pilocytic astrocytoma. Hilla Hospital May 11, 2011

**Table 1: Diagnosis of (10) patients complaining orbital diseases which resemble orbital tumors**

| Diagnosis           | Number of patients | Percentage of orbital diseases that mimic orbital tumors |
|---------------------|--------------------|----------------------------------------------------------|
| Thyroid orbitopathy | 6                  | 60                                                       |
| Orbital cellulitis  | 3                  | 30                                                       |
| Orbital emphysema   | 1                  | 10                                                       |

## RESULTS

In this study, the relationships between the patient age at diagnosis, sex, pathological findings, origin of tumors, tumor location in the orbit, management and mortality are studied in 95 cases of orbital tumors.

### Age distribution of patients with orbital tumors

In this study, the highest age group incidence of orbital tumors is in the first decade of life which constitutes (24.2%) the second peak is in the fourth decade of life which constitutes (17.9%). Figure 2 shows the age distribution of the 95 patients at diagnosis. The incidence of orbital tumors is relatively low in second and third decade of life and continues to decrease gradually after the fourth decade of life in corresponding to decrease the percentage of the population with aging in Iraq [Figure 2]. Figure 3 shows the pathological profiles of patients in the first decade of life. The most common tumor is dermoid cyst (47.8%) [Figure 3]. Figure 4 shows the pathological profiles of patients in the fourth decade of life. The most common tumor is pseudotumor (23.5%), the second-most common tumors are cavernous hemangioma (11.8%), fibrous dysplasia (11.8%), and mucocele (11.8%) [Figure 4]. 42 (44.2%) of the patients are males, and 53 (55.8%) of the patients are females.

### Origin of orbital tumors

Among 95 cases, 76 (80%) are primary orbital tumors, 15 (15.8%) are secondary orbital tumors, and 4 (4.2%) are metastatic orbital tumors. The two most common orbital tumors are dermoid cyst (27.4%) and pseudotumor (14.7%). Table 2 shows the pathological profiles of the 76 primary tumors. Dermoid cyst is the most common primary orbital tumor (34.2% of the total number of primary orbital tumors). Pseudotumor is the second-most common tumor (18.4% of the total number of primary orbital tumors). Table 3 shows the pathological profiles of the 15 secondary tumors. Mucocele is the most common tumors (33.3% of the total number of secondary orbital tumors). Sphenoid wing meningioma is the second-most common tumor (26.7% of the total number of secondary orbital tumors). Table 4 shows the pathological profiles of the four metastatic tumors with equal pathological percentages.

### Locations of orbital tumors

Eighty-three (87.4%) are extraconal and 12 (12.6%) are intraconal. Table 5 shows the pathological profiles of 83 patients with extraconal orbital tumors. Dermoid cyst is the most common primary tumor in the extraconal area (31.3%). Mucocele is the most common secondary tumor in the extraconal area (6%). Table 6 shows the pathological profiles of 12 patients with intraconal tumors. All cases of intraconal orbital tumors are a primary orbital tumor with a relatively higher incidence of cavernous hemangioma, retinoblastoma, optic nerve sheath meningioma, and optic nerve glioma in the intraconal area (about 66.8%).

### Maligancy of orbital tumors

Of the 95 cases of orbital tumors, 75 (79%) are benign and 20 (21%) are malignant. The percentage of malignant lesions

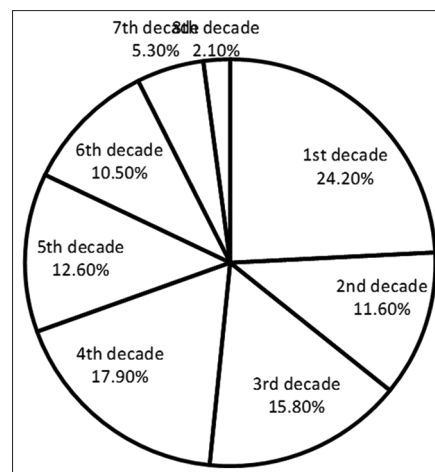


Figure 2: Age distribution of 95 patients with orbital tumors

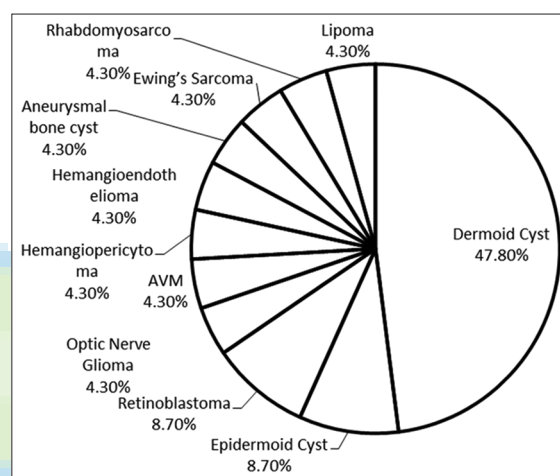


Figure 3: Pathological profiles of orbital tumors in 23 patients in the first decade of life

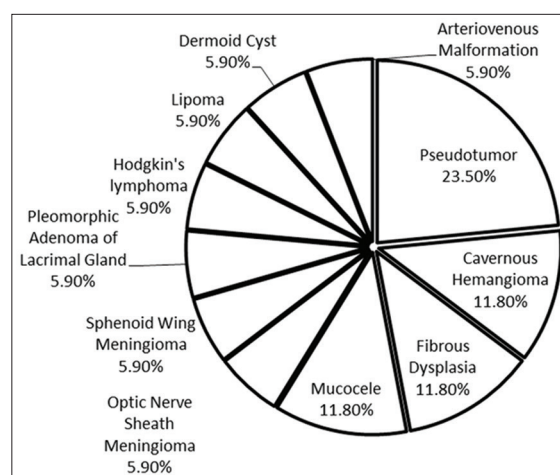


Figure 4: Pathological profiles of orbital tumors in 17 patients in the fourth decade of life

is 20% in children and teenage (age range, 0–18 years), 60% in young adults and middle-aged patients (age range, 19–59 years), and 20% in older patients (age range,

**Table 2: Diagnosis of (76) patients with primary orbital tumor**

| Diagnosis                               | Number of patients | Percentage of primary tumors | Percentage of total tumors |
|-----------------------------------------|--------------------|------------------------------|----------------------------|
| Dermoid cyst                            | 26                 | 34.2                         | 27.4                       |
| Pseudotumor                             | 14                 | 18.4                         | 14.7                       |
| Cavernous hemangioma                    | 6                  | 7.9                          | 6.3                        |
| Arteriovenous malformation              | 4                  | 5.3                          | 4.2                        |
| Fibrous dysplasia                       | 3                  | 3.9                          | 3.2                        |
| Osteoma                                 | 3                  | 3.9                          | 3.2                        |
| Retinoblastoma                          | 2                  | 2.6                          | 2.1                        |
| Pleomorphic adenoma of lacrimal gland   | 2                  | 2.6                          | 2.1                        |
| Lipoma                                  | 2                  | 2.6                          | 2.1                        |
| Epidermoid cyst                         | 2                  | 2.6                          | 2.1                        |
| Optic nerve sheath meningioma           | 2                  | 2.6                          | 2.1                        |
| Optic nerve glioma                      | 2                  | 2.6                          | 1.2                        |
| Hemangiopericytoma                      | 1                  | 1.3                          | 1.1                        |
| Hemangioendothelioma                    | 1                  | 1.3                          | 1.1                        |
| Osteochondroma                          | 1                  | 1.3                          | 1.1                        |
| Solitary fibrous tumor                  | 1                  | 1.3                          | 1.1                        |
| Malignant melanoma                      | 1                  | 1.3                          | 1.1                        |
| Non-Hodgkin's lymphoma                  | 1                  | 1.3                          | 1.1                        |
| Rhabdomyosarcoma                        | 1                  | 1.3                          | 1.1                        |
| Carcinoma <i>in situ</i> of conjunctiva | 1                  | 1.3                          | 1.1                        |

**Table 3: Diagnosis of (15) patients with secondary orbital tumors**

| Diagnosis                                    | Number of patients | Percentage of secondary tumors | Percentage of total tumors |
|----------------------------------------------|--------------------|--------------------------------|----------------------------|
| Mucocele                                     | 5                  | 33.3                           | 5.3                        |
| Sphenoid wing meningioma                     | 4                  | 26.7                           | 4.2                        |
| Non-Hodgkin's lymphoma                       | 2                  | 13.3                           | 2.1                        |
| Hodgkin's lymphoma                           | 1                  | 6.7                            | 1.1                        |
| Squamous cell carcinoma of paranasal sinuses | 1                  | 6.7                            | 1.1                        |
| Ewing's sarcoma of paranasal sinuses         | 1                  | 6.7                            | 1.1                        |
| Aneurysmal bone cyst                         | 1                  | 6.7                            | 1.1                        |

**Table 4: Diagnosis of (4) patients with metastatic orbital tumors**

| Diagnosis                | Number of patients | Percentage of metastatic tumors | Percentage of total tumors |
|--------------------------|--------------------|---------------------------------|----------------------------|
| Lung carcinoma           | 1                  | 25                              | 1.1                        |
| Breast carcinoma         | 1                  | 25                              | 1.1                        |
| Adenocarcinoma of rectum | 1                  | 25                              | 1.1                        |
| Leukemia                 | 1                  | 25                              | 1.1                        |

60–78 years). In this study, there is an equal sex distribution of malignant orbital tumors between male and female. Malignant lymphoma is the most common malignancy of the orbit, representing 20% of all malignant orbital tumors.

## Management

In our study, the presenting clinical manifestations of patients with orbital tumors are mainly one or more of the following combination [Table 7]; proptosis (94.7%), visual acuity impairment (49.5%), diplopia (18.9%), strabism (10.5%), ptosis (4.2%), ocular/orbital pain (26.3%), headache (31.6%), conjunctival edema (12.6%), subconjunctival hemorrhage (5.3%), lacrimation (21.1%), tinnitus (2.1%),

epistaxis (2.1%), vertigo (2.1%), any type of orbital process can cause proptosis, while visual acuity is often reduced by malignant and inflammatory/infectious processes as well as by optic nerve gliomas [Figure 1] but less commonly reduced by meningiomas. Ocular/orbital pain and headache are the major complaints of inflammatory/infectious disorders and meningiomas. 91 cases of all the patients included in this study undergo surgical intervention for diagnosis and/or resection their orbital tumors and only four patients manage by non-invasive method [Table 8]. The choice of approach depends on the location, size, demarcation, and histological type of the lesion. The least atraumatic approach has been chosen. In general, two types

**Table 5: Diagnosis of (83) patients with extraconal orbital tumors**

| Diagnosis                                    | Number of patients | Percentage of extraconal orbital tumors |
|----------------------------------------------|--------------------|-----------------------------------------|
| Dermoid cyst                                 | 26                 | 31.3                                    |
| Pseudotumor                                  | 13                 | 15.7                                    |
| Mucocele                                     | 5                  | 6                                       |
| Sphenoid wing meningioma                     | 4                  | 4.8                                     |
| Cavernous hemangioma                         | 4                  | 4.8                                     |
| Non-Hodgkin's lymphoma                       | 3                  | 3.6                                     |
| Fibrous dysplasia                            | 3                  | 3.6                                     |
| Osteoma                                      | 3                  | 3.6                                     |
| Arteriovenous malformation                   | 3                  | 3.6                                     |
| Lipoma                                       | 2                  | 2.4                                     |
| Epidermoid cyst                              | 2                  | 2.4                                     |
| Pleomorphic adenoma of lacrimal gland        | 2                  | 2.4                                     |
| Hemangiopericytoma                           | 1                  | 1.2                                     |
| Hemangioendothelioma                         | 1                  | 1.2                                     |
| Osteochondroma                               | 1                  | 1.2                                     |
| Solitary fibrous tumor                       | 1                  | 1.2                                     |
| Hodgkin's lymphoma                           | 1                  | 1.2                                     |
| Squamous cell carcinoma of paranasal sinuses | 1                  | 1.2                                     |
| Ewing's sarcoma of paranasal sinuses         | 1                  | 1.2                                     |
| Aneurysmal bone cyst                         | 1                  | 1.2                                     |
| Carcinoma <i>in situ</i> of conjunctiva      | 1                  | 1.2                                     |
| Lung carcinoma                               | 1                  | 1.2                                     |
| Breast carcinoma                             | 1                  | 1.2                                     |
| Adenocarcinoma of rectum                     | 1                  | 1.2                                     |
| Leukemia                                     | 1                  | 1.2                                     |

**Table 6: Diagnosis of (12) patients with intraconal orbital tumors**

| Diagnosis                                  | Number of patients | Percentage of intraconal orbital tumors |
|--------------------------------------------|--------------------|-----------------------------------------|
| Cavernous hemangioma                       | 2                  | 16.7                                    |
| Retinoblastoma                             | 2                  | 16.7                                    |
| Optic nerve sheath meningioma              | 2                  | 16.7                                    |
| Optic nerve glioma                         | 2                  | 16.7                                    |
| Pseudotumor (myositis, globe, optic nerve) | 1                  | 8.3                                     |
| Malignant melanoma                         | 1                  | 8.3                                     |
| Arteriovenous malformation                 | 1                  | 8.3                                     |
| Rhabdomyosarcoma                           | 1                  | 8.3                                     |

of approaches are distinguished; transcranial or directly extracranial. Recently, the transcranial approach [Figure 1] is less commonly used.<sup>[1]</sup>

### Mortality

Overall mortality is seven patients (7.4%). Those patients include all of the four cases of metastatic orbital tumors [Table 4], one case of cavernous hemangioma, one case of Ewing's sarcoma of paranasal sinuses and one case of rhabdomyosarcoma.

## DISCUSSION

Although the incidence of orbital tumors is relatively low, their diagnosis and the treatment strategy are of great concern. The orbital tumors pathological profiles are determined according to patient age, tumor location in the orbit. Two peaks are found in the age distribution. The incidence of orbital tumors is high in children in the first decade of life which constitutes (24.2%) and in older patients in the fourth decade of life which constitutes (17.9%). A previous report also found the same age distribution of patients with orbital tumors.<sup>[7]</sup> The pathological profiles of children and older patients in this study are comparable to those in previous reports.<sup>[7-10]</sup>

The type of orbital tumor can be diagnosed before histopathological examination depending on the patient age and the location of the tumor in the orbit but the definitive diagnosis should always done by histopathological examinations. Among the primary orbital tumors listed in Table 2, dermoid cyst, cavernous hemangioma, optic nerve glioma, optic nerve sheath meningioma, rhabdomyosarcoma, and pleomorphic adenoma show characteristic features in orbital CT or MRI.<sup>[4,5]</sup> The information about the type of tumor is of great importance when determining the treatment strategy so that it is important to establish the relationships between pathological profiles of orbital tumors and patient age and tumor location in the orbit. Several reviews of the pathological profiles of orbital tumors<sup>[7-15]</sup> have demonstrated a relationship between the pathological profiles of orbital tumor patients and their age at diagnosis. On the other hand, the relationships between pathological profiles and the tumor location in the orbit are not well defined.

Table 5 shows the pathological profiles of patients with extraconal orbital tumors. Dermoid cyst is the most common primary tumor in the extraconal area, and mucocele is the most common secondary tumor in the extraconal area. All of the metastatic tumors in this study are located in the extraconal area. Table 6 shows the pathological profiles of patients with intraconal tumors. All cases of intraconal orbital tumors are a primary orbital tumor with relatively higher incidence of cavernous hemangioma, retinoblastoma, optic nerve sheath meningioma, and optic nerve glioma in the intraconal area. Secondary orbital tumors and metastatic orbital tumors are not found in the intraconal area. The most common tumors in the two orbital regions are totally different between children and older patients. In the extraconal area, the most common tumor in young patients is dermoid cyst, while the most common tumor in older patients is pseudotumor. In the intraconal area, the most common tumor in children is retinoblastoma, while the most common tumor in older patients was cavernous hemangioma.

There can be several complications, such as cosmetic problems, severe ophthalmological deficit with loss of vision or eye movement deficit, and even loss of life. It is important to obtain maximum information about an orbital tumor before determining the appropriate treatment strategy to prevent

postoperative visual impairment. Surgical excision of an optic nerve sheath meningioma and optic nerve glioma is indicated only when the eye is blind [Figure 1]. In case of optic nerve sheath meningioma surgical excision of the meningioma invariably strips, the vascular supply of the optic nerve and results in blindness. Making a decision for tumor excision with the presence of intracranial extension is much difficult and depends on; the risk to the remaining vision of the involved eye, risk of violation to the contralateral optic nerve or chiasm (the vision of the intact eye), the size, location, and rate of growth of the tumor. Steroid therapy has been given for a short-term courses and frequently used during radiation therapy.<sup>[2]</sup> For infiltrative disorders, biopsy must be done immediately, and radical resection of tumors is not always possible. The presurgical definition of the tumor type is of great importance, so that small cavernous hemangioma just observation might be possible, while in cases

of rhabdomyosarcoma, radical resection, and radiotherapy must be done immediately.

There are some major differences noted when orbital tumors in Iraqi patients are compared with those in Caucasian patients and Japanese patients. In the present study, malignant lymphoma is uncommon among Iraqi patients, the incidence of malignant lymphoma (4.2%) of the total number of orbital tumors. However, malignant lymphoma is the most common malignancy of the orbit in Iraqi patients, representing 20% of all malignant orbital tumors. In previous reports, the incidence of malignant lymphoma is 5%–15% among Caucasian patients.<sup>[7,10-12]</sup> While malignant lymphoma is more common among Japanese patients, the incidence of malignant lymphoma is (24.1%).<sup>[16]</sup> The reason for such differences is not well defined, but it might be a result of many racial or environmental differences. In this study, adenoid cystic carcinoma of the lacrimal gland is not found in Iraqi patients. The incidence of adenoid cystic carcinoma is also relatively low in a previous report of Japanese patients.<sup>[13]</sup> Adenoid cystic carcinoma is the most common malignant epithelial tumor of the lacrimal gland in Caucasian patients.<sup>[7,11,12]</sup> The reason for this difference is unclear, but it might be a result of many racial or environmental differences.

**Table 7: Clinical manifestations of (95) patients with orbital tumors**

| Clinical manifestations    | Number of patients | Percentage of total patients |
|----------------------------|--------------------|------------------------------|
| Proptosis                  | 90                 | 94.7                         |
| Visual acuity impairment   | 47                 | 49.5                         |
| Diplopia                   | 18                 | 18.9                         |
| Strabism                   | 10                 | 10.5                         |
| Ptosis                     | 4                  | 4.2                          |
| Ocular/orbital pain        | 25                 | 26.3                         |
| Headache                   | 30                 | 31.6                         |
| Conjunctival edema         | 12                 | 12.6                         |
| Subconjunctival hemorrhage | 5                  | 5.3                          |
| Lacrimation                | 20                 | 21.1                         |
| Tinnitus                   | 2                  | 2.1                          |
| Epistaxis                  | 2                  | 2.1                          |
| Vertigo                    | 2                  | 2.1                          |

## CONCLUSION

Orbital tumors are a relatively rare and challenging group of tumors. A wide variety of tumors and pseudotumors can involve the orbit. The percentage of malignant tumors increased with age, with malignancies being common in older patients. For any patient with visual loss, proptosis and impaired ocular motility it is better to undergo MRI and CT-scan imaging to detect or exclude an intraorbital or intracranial diseases.

The age of onset, state of vision, tumor location in the orbit, and other radiological findings provide the most important information for the diagnosis and making decision for

**Table 8: Types of surgical intervention of (92) patients with orbital tumors**

| Surgical procedure                                                   | Number of patients | Percentage of total patients |
|----------------------------------------------------------------------|--------------------|------------------------------|
| Lateral orbitotomy                                                   | 10                 | 10.9                         |
| Supraorbital approach                                                | 30                 | 32.6                         |
| Infraorbital approach                                                | 7                  | 7.6                          |
| Fine needle aspiration-biopsy                                        | 12                 | 13                           |
| Frontal craniotomy-orbital unroofing                                 | 7                  | 7.6                          |
| Frontotemporal craniotomy-pterial                                    | 9                  | 9.8                          |
| Endoscopic transnasal tumor resection                                | 6                  | 6.5                          |
| Transethmoidal tumor resection                                       | 1                  | 1.1                          |
| Endovascular therapeutic intervention                                | 3                  | 3.3                          |
| Exenteration of orbital contents                                     | 2                  | 2.2                          |
| Enucleation of globe                                                 | 3                  | 3.3                          |
| Evisceration                                                         | 1                  | 1.1                          |
| Gamma knife radiosurgery (primary therapy)                           | 1                  | 1.1                          |
| Gamma knife radiosurgery (secondary to surgical intervention)        | 6                  | 6.5                          |
| Linear accelerator radiosurgery (secondary to surgical intervention) | 2                  | 2.2                          |
| Conventional radiotherapy (secondary to surgical intervention)       | 1                  | 1.1                          |

treatment strategy. The extent of tumor resection is guided by tumor type and presenting visual loss and cranial nerve palsy. Radical resection of many orbital tumors is impossible without unreasonable morbidity so that radiotherapy and chemotherapy should be assume as an accessory options in both preoperative and postoperative stage, aiming to preserve the remaining vision as long as possible.

The choice of surgical approach is determine by the optimum trajectory for reaching tumor and surgeon experience with the chosen approach aiming to protect orbital neurovascular structures from undue retraction and damage.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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