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Original Research Paper

Radiodiagnosis

MRI EVALUATION OF ORBITAL TUMOURS

Dr. Prajwaleet Gour (Prof.) Government Medical College, Nagpur , Maharastra

Dr. Abhisek Jaiswal* Government Medical College, Nagpur, Maharastra *Corresponding Author

ABSTRACT

The orbit and the visual system form the most important sense organ in humans.

Multiple disease entities affect the orbit, viz. congenital, inflammatory, infectious, vascular and traumatic. The clinical manifestations and findings are often non-specific, being protean and overlapping. Of these various pathologies, tumors are an important cause of mortality and especially, morbidity.

Plain radiographs permit the separation of the two attenuation values as bone and soft tissue. Sonography may be helpful in specific cases, but has many drawbacks and limitations with high operator dependence. Computed tomography may allow separation of the air, fat, fluid, soft tissue and bone. Direct axial and coronal imaging is also possible. In many cases, however it is limited by artifacts from bone.

Magnetic resonance imaging is non-ionizing, avoids harmful radiation to the lens. Excellent soft tissue details and multi-planar imaging is feasible. Bony artifacts are not seen and vessels can be identified by the contained flow void.

In our present study, we have evaluated 50 patients with suspected orbital tumors. An attempt has been made to devise an optimum imaging protocol in a given group of disorders. It also compares the reliability of Magnetic Resonance Imaging in diagnosis by comparing it with histopathological diagnosis.

KEYWORDS :

AIMS AND OBJECTIVES

The purpose of this study is to review the incidence of various orbital and ocular tumors, age and sex distribution, the specific imaging characteristics which aid in diagnosis and correlation with the histopathological diagnosis.

1. To identify the commonly occurring orbital and ocular tumors.
2. To formulate an appropriate imaging protocol for patients with orbital tumors.
3. To study the imaging characteristics of various tumors and delineation of tumor extent with respect to the surrounding structures.
4. To correlate the MRI diagnosis with the histopathological diagnosis.

PATHOPHYSIOLOGY OF THE ORBIT

A variety of tumors are found in the tumors; however it is important to distinguish vascular lesions. Vascular disorders of the orbit encompass vascular malformations and vascular tumors.

Capillary hemangioma
Veno-lymphatic malformations (lymphangiomas)
Choroidal Hemangiomas
Cavernous hemangioma
Retinoblastoma
Hemangiopericytoma
Orbital schwannoma
Rhabdomyosarcoma
Optic nerve glioma
Optic nerve sheath meningioma
Orbital Pseudo tumor
Lacrimal Gland tumors
Benign mixed tumor of the lacrimal gland
Adenoid Cystic Carcinoma
Lymphoma
Leukemia
Metastasis

MATERIALS AND METHODS

The present study included total 50 patients referred for orbital imaging. They underwent magnetic resonance imaging of the orbit in the Department of Radio diagnosis in a 2900 bed tertiary referral centre from December 2017 to September 2018.

SELECTION OF PATIENTS:

The patients selected were either upon having referred from the Ophthalmology or Neurosurgery out-patient departments or wards with strong clinical suspicion of orbital tumors or preliminary CT revealing a mass in the orbital region. Among 72 patients with such a strong clinical suspicion, 50 patients turned out to have a diagnosis of orbital tumors and were included in the study.

EXCLUSION CRITERIA:

- The patients who were already operated for orbital tumors and referred for follow up study.
- Patients who are not willing to undergo MRI examination.
- Patients with general contraindications for MRI, such as having any of the following: cardiac pacemakers, cochlear implants, aneurysm clips and MRI incompatible orthopedic implants as well as claustrophobic patients.

INSTRUMENTATION:

MR Imaging was done on a 1.5 Tesla, MR Achieva , Phillips. A standard head coil was used for the examination.

PATIENT PREPARATION:

- No specific preparation was required before the scans.
- Few uncooperative patients were sedated before the examination.
- All the patients were given instructions to remove all metallic belongings prior to the examination.

MRI Protocol:

Precontrast

Sequence	Slice thickness mm	Interslice gap(mm)	No.of acquisitions	FOV (cm)	Matrix
CoronalT1 Fat Sat	3	0.1	3	17	256 x256
T1 Axial	2	0.1	4	17	256 x256
PdT2 oblique sagittal	3	0.1	3	17	256 x256
Coronal T2 STIR	3	0.1	3	17	256 x256
Coronal T2W* (gradient)	3	0.1	3	17	256 x256
Postcontrast T1FS sagittal	3	0.1	3	17	256 x256
Postcontrast T1FS coronal	3	0.1	3	17	256 x256
Post contrast T1 FS axial	2	0.1	4	17	256 x256

First the standard axial FLAIR brain screening with slice thickness 5mm was performed.

After this, high resolution T1SE and T2SE sequences focussed on the orbital region are performed in all cases, using following parameters.

Routine T1FS post contrast axial sequence of the brain was also (slice thickness 5mm) performed in all cases.

Additional sequences:
The gradient sequence was used for evaluation of foci of hemorrhage and calcification. Additionally Pd T2 Axial sequence with a small FOV was taken along with or instead Pd T2 oblique sagittal wherever they would give a better anatomical delineation.

CLINICAL PROFILE :
Symptoms of a space occupying lesions were noted such as proptosis, pain and reduced motility of the eye.

Visual symptoms like dimunition of vision, blurring of vision, transient loss of vision and flashes of light.

Whether inflammatory symptoms like fever, pain, chemosis and lacrimation of the eye were present.

MRI interpretation:
MRI was interpreted for the following:
Presence of a space occupying lesions:

1) Size of lesion:
- Small (largest diameter less than 2 cm)
- Medium (largest diameter between 2 to 4cm)
- Large (largest diameter more than 4 cm)

2) Morphology and shape of lesion:
- Well defined
- Ill defined
- Round, oval, fusiform, conical, dumb bell shaped or irregular.

3) Location of the lesion
- Intra conal
- Extra conal
- Both intra as well as extra conal
- Intra ocular
- Intra cranial extension
- Quadrant of the lesion
- Superior, lateral, inferior or medial

4) Signal intensity characteristics: compared to the extra ocular muscles of the orbit on T1W, T2W, STIR and T1W fat sat sequences.

- Isointense.
- Hypo intense.
- Hyperintense.
- Heterogeneous.

5) Contrast enhancement:
- Homogenous.
- Inhomogeneous
- Mild
- Intense.

6) Flow voids or septae in the lesion.
7) Involvement of the extra ocular muscles.
8) Hemorrhage/ calcification within the tumor.
9) Intracranial extension
10) Bony erosion or destruction.
11) Mass effect and displacement / indentation on the globe
12) Associated retinal detachment or optic atrophy

MRI diagnosis was correlated with histopathological diagnosis given from the pathology department in our hospital

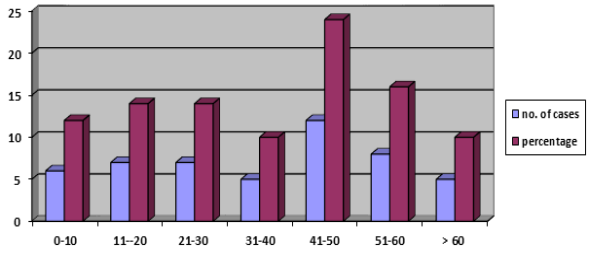
RESULTS

Age distribution: The youngest patient was a 4 months male child while the eldest was a 75 year old man. Maximum no. of patients were in 41to 50 years age group (24%)

Table 1- Age distribution in orbital tumors.

Age distribution(years)	No. of cases(total no. 50)	Percentage
0-10	6	12
11-20	7	14
21-30	7	14
31-40	5	10
41-50	12	24
51-60	8	16
>60	5	10

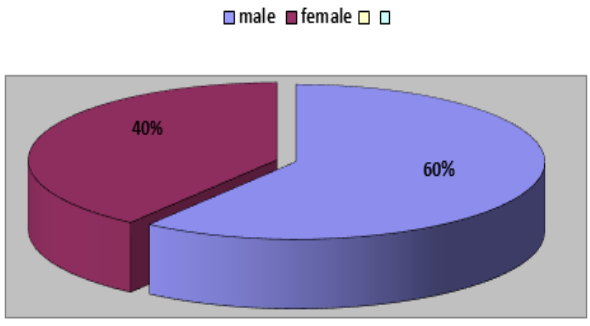
Chart 1- Age distribution in orbital tumors



Sex distribution :
Table 2- Sex distribution in orbital tumors.

Sex	No. of cases (n=50)	Percentage
Male	30	60
Female	20	40

Chart 2- Sex distribution in orbital tumors.



Distribution of pathologies in orbital tumors

Table 3-Distribution of orbital tumors

Sr. No.	Pathology	No. of cases(n=50)	percentage
1	Pseudotumor	10	20
2	Cavernous Hemangioma	8	16
3	Lymphoma	11	22
4	Retinoblastoma	4	8
5	Optic nerve glioma	3	6
6	Meningioma	4	8
7	Dermoid	1	1
8	Melanoma	2	4
9	Lymphangioma	1	2
10	Hemangiopericytoma	1	2
11	Schwannoma	1	2
12	Pleomorphic adenoma	1	2
13	Metastases	2	4
14	Others	1	2

Chart 3-Distribution of orbital tumors

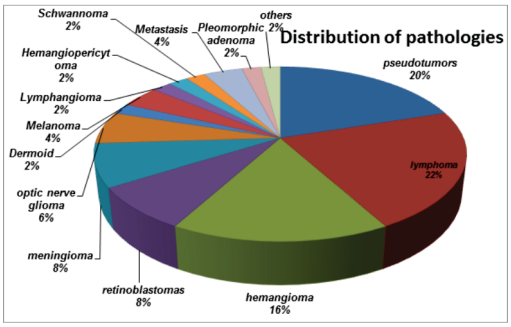


Table 4 - MRI and histopathological correlation:

Sr. No.	Histopathological diagnosis	No.	MRI diagnosis	No.
1	Pseudotumors	10	Pseudotumor Lymphoma	7 3
2	Cavernous Hemangioma	8	Cavernous Hemangioma Lymphangioma	7 1
3	Lymphoma	11	Lymphoma Pseudotumor	8 3
4	Retinoblastoma	4	Retinoblastoma Dermoid cyst	3 1
5	Meningioma	4	Meningioma	4
6	Optic nerve glioma	3	Optic nerve glioma	3
7	Melanoma	2	Melanoma	2
8	Metastasis	2	Metastasis	2
9	Pleomorphic Adenoma	1	Pleomorphic adenoma	1
10	Schwannoma	1	Schwannoma	1
11	Dermoid	1	Dermoid	1
12	Lymphangioma	1	Lymphangioma	1
13	Hemangiopericytoma	1	Meningioma	1
14	Others Adenosquamous Ca	1	Squamous cell Carcinoma	1

Table 5 - Sensitivity and specificity for the commonest 5 pathologies

Tumor	Sensitivity	Specificity
Pseudotumor	70%	92.5%
Lymphoma	72.7%	92.31%
Cavernous hemangioma	87.5%	100%
Retinoblastoma	75%	100%
Optic nerve sheath meningioma	100%	100%

Table 6 - Common clinical symptoms in orbital tumors

Symptoms	No. of cases	Percentage %
Visual disturbances	21	42
Proptosis	19	38
Inflammatory symptoms	10	20
Reduced extra ocular motility	10	20
Pain	8	16
Constitutional symptoms	7	14

Chart 4 - Common clinical symptoms in orbital tumors

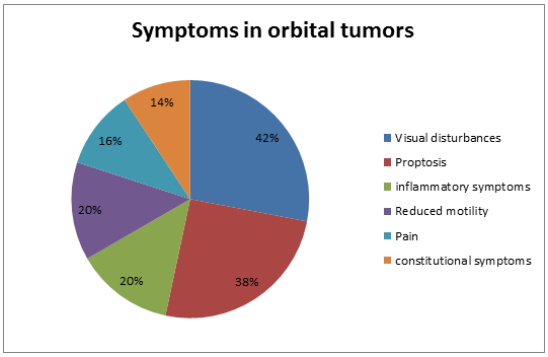


Table 7 - Location of the lesions

Location	No. of cases	Percentage %
Intra conal	11	22
Extra conal	18	36
Both	14	28
Intra ocular	7	14
Intracranial extension	10	20

Chart 5 - Location of the lesions

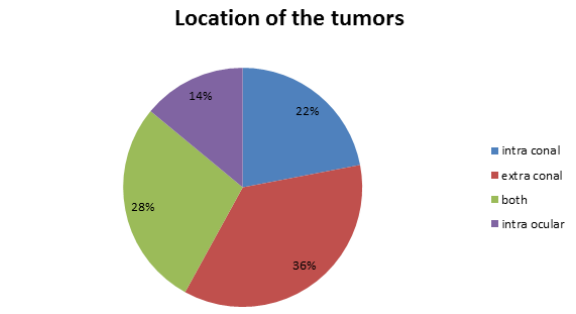


Chart 6 - Benign vs Malignant

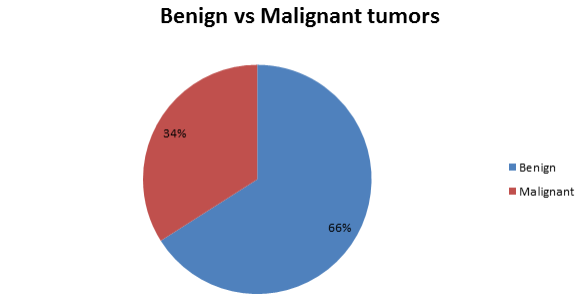


Table – 8 Distribution of Pediatric orbital tumors

Tumor	No. of cases	Percentage
Retinoblastoma	4/9	44.4%
Optic nerve Glioma	3/9	33.3%
Pseudotumor	1/9	11.1%
Hemangioma	1/9	11.1%

Chart 7- Distribution of Pediatric orbital tumors

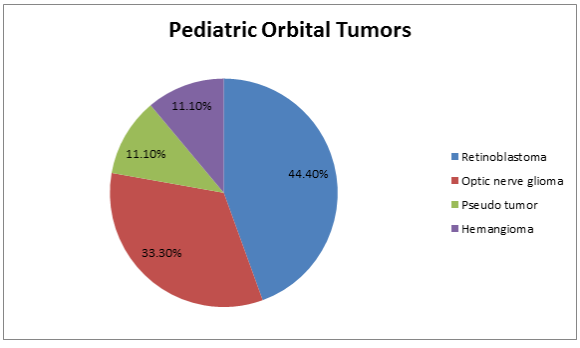


Chart 8 - Sex Distribution in pseudotumors

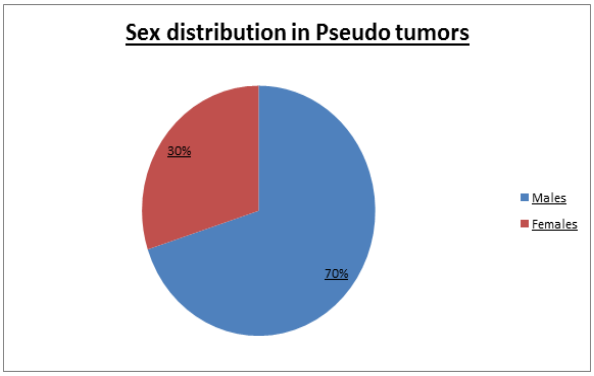


Chart 9 - Sex Distribution in lymphomas

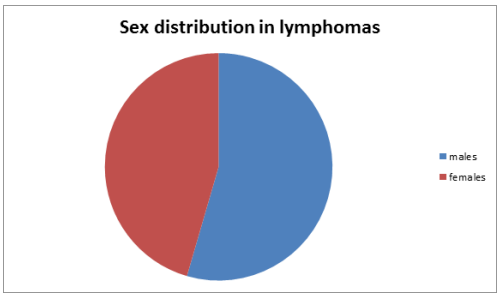


Chart 10 - Age distribution in Pseudo tumor and Lymphoma patients

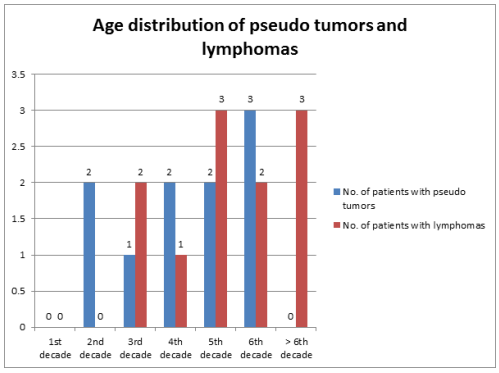


Table 9 - Incidence of inflammatory symptoms in pseudotumors

Inflammatory Symptoms	Pseudo tumors	Other diagnoses	Sensitivity	Specificity
Yes	6	4	60%	90%
No	4	36		

Chart 11 - Location of pseudo tumors

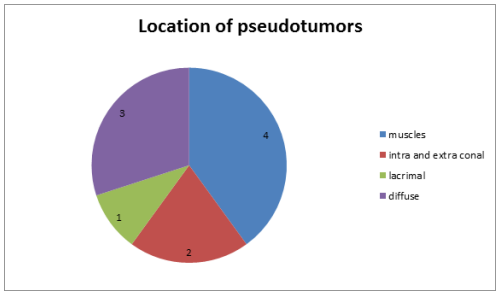


Chart 12 - Location of lymphomas

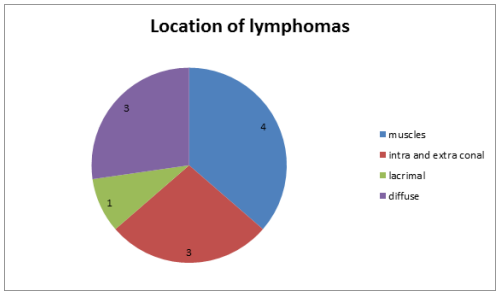


Chart 13 – Bilaterality of Lymphomas

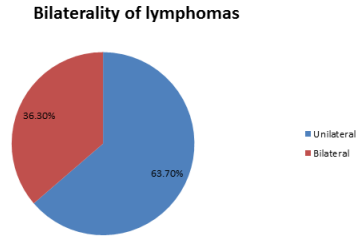


Table 10 - T2 weighted signal intensity of pseudotumor and lymphoma

Tumor	T2W SI compared to muscles		T2W SI compared to fat	
	Isointense	Hyperintense	Isointense	Hyperintense
Pseudo tumor (n = 10)	8 (80%)	2 (20%)	8 (80%)	2 (20%)
Lymphoma (n = 11)	10 (90.9%)	1 (9.1%)	2 (18.1%)	9 (81.9%)

Table 11 - Sensitivity and Specificity of T2W hyperintensity to fat of lymphoma

Tumor	T2W hyperintensity	T2W isointensity
Lymphoma	9	2
Pseudotumor	2	8

Thus, **sensitivity** and **specificity** of T2W hyperintensity in differentiating between lymphoma and pseudo tumor is **81.8%** and **80%** respectively.

Table 12 - Comparison of T1W and T2W signal intensity in lymphoma and pseudotumor

Signal intensity	T1WI > T2WI	T1WI < T2WI
Lesion		
Pseudotumor	2	9
Lymphoma	1	9

Cavernous Hemangioma:

Table 13 -Age distribution of cavernous hemangiomas:

Age distribution(years)	No. of cases(total no. 8)	Percentage
0-10	0	0
11-20	2	25
21-30	2	25
31-40	1	12.5
41-50	3	37.5
51-60	0	0
>60y	0	0

Cavernous Hemangiomas: Male Vs Female distribution

Table 14 – Gender distribution in Cavernous Hemangiomas

Sex	No. of cases(total no. 8)	Percentage
Male	5	62.5
Female	3	375

Chart 14 - Gender distribution in Cavernous Hemangiomas

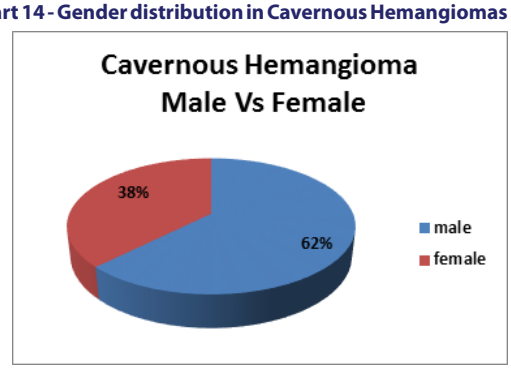


Chart 15 - Location of cavernous hemangioma

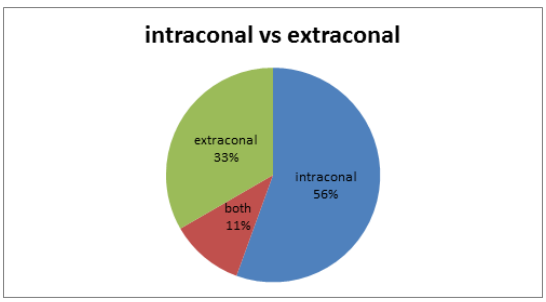


Table 15 - Characteristics of Hemangioma

Characteristics	No. of lesions	Percentage
T2W Hyperintensity	6	75%
Internal Septations	4	50%
Blooming on gradient (Calcification)	5	62.5%

Chart 16 - Characteristics of Hemangioma

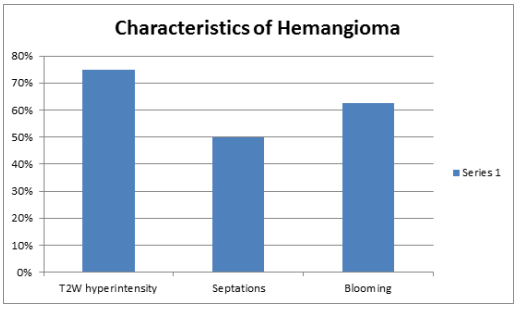


Chart 17 - Bilaterality of Retinoblastomas

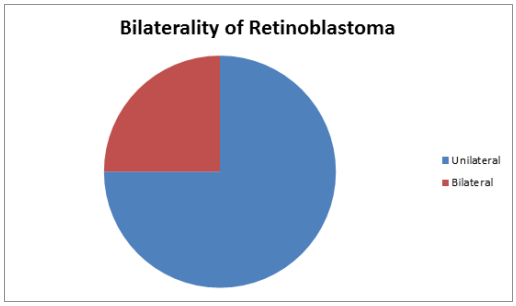


Table 16 - Growth Pattern of Retinoblastoma

Growth Pattern	No. of cases	Percentage
Exophytic	2	40%
Endophytic	0	0
Both	2	40%
Indeterminate	1	20%

Table 17 - Other characteristics of Retinoblastoma

Characteristic	No. of cases	Percentage
Retinal detachment	2	40%
Vitreous hemorrhage	1	20%
Optic nerve involved	3	60%
Pineal Lesion	1	20%

Table 18 - T2W signal intensity of the most common orbital tumors

Tumor	T2W SI compared to muscles	
	Isointense	Hyperintense
Pseudo tumor (n = 10)	8 (80%)	2 (20%)
Lymphoma (n = 11)	10 (90.9%)	1 (9.1%)
Hemangioma (n = 8)	2 (25%)	6 (75%)
Meningioma (n = 4)	0	4 (100%)

DISCUSSION

The present study was undertaken with the aim of evaluating MRI findings in orbital tumors and the diagnostic accuracy of MRI in characterization and diagnosis of the same. This was done by correlating MRI findings with histopathological diagnosis.

72 patients who were having strong clinical complaints and preliminary CT was showing abnormality were evaluated. Of these 4 patients turned out to have non-neoplastic lesions and were excluded from the study. Of the remaining 68 patients, histopathological confirmations were not obtained in 18 patients and were hence excluded from the study. Data from the remaining 50 patients was obtained and used for the study.

The patients belonged to all age groups ranging from 4 months to 75 years. However, the majority of the patients (about 40 %) belonged to the fifth and sixth decade of life. The sex ratio in our study was 1:1.5 with a male preponderance. Ohtsuka et al[5] (1981) in, their retrospective study of 244 orbital tumors encountered the mean age of patients to be 48.7 years. They however found a female preponderance of 0.8:1. This could be possibly due to a larger sample size or epidemiological differences.

Among the clinical symptoms, visual disturbances (42%) and proptosis (38%) were most common, followed by reduced motility (20%), inflammatory symptoms (acute pain and chemosis) (20%), pain (16%) and constitutional symptoms (weight loss, cachexia) (14%).

Regarding location of the lesions in the orbit, purely intra conal lesions were limited to 11 accounting for 22% while extra conal or mixed extra conal and intra conal lesions accounted for 64% with 14% being intra ocular. Ohtsuka et al[5], also found majority of lesions to be extra conal with 85% being extraconal and 15% intraconal.

In our study, 34% of the lesions were malignant while 66% were benign whereas in the study of 1264 consecutive patients by Shields et al[4], the percentage of benign lesions was 36% and malignant 64%. However their study included all consecutive patients referred over the course of 3 decades to an ocular oncology service; hence there is some amount of referral bias in their study. The sample size of their study was also much larger. The most common diagnoses in their study were: lymphoid tumor (11%), idiopathic orbital inflammation (11%), cavernous hemangioma (6%), lymphangioma (4%), meningioma (4%), optic nerve glioma (4%), metastatic breast cancer (4%) and uveal melanoma (3%). In our study the most common diagnoses were lymphoma (22%), pseudotumor (20%), hemangioma (16%), meningioma (8%), retinoblastoma (8%), optic nerve sheath (6%), metastases (4%) and uveal melanoma (4%).

Among the intra ocular lesions, retinoblastoma was the commonest 4 cases (59%) followed by uveal melanoma 2 cases (28.5%) and metastasis 1 case (14.2%).

In the paediatric age group out of 9 cases, there were 4 patients with retinoblastoma (44.4%), 3 patients with optic nerve glioma (33.3%), 1 hemangioma (11.1 %) and 1 pseudo tumor (11.1%). Benign lesions (55.6%) were thus more common than malignant (44.4%). Johnson et al[125] in a study of 141 children with orbital tumors also found retinoblastoma (32%) to be the commonest tumor in children followed by vasculogenic tumors (22%)

There were a few shortcomings in our study. The sample size of 50 cases might be a small size for comparing the incidence of various tumors in the general population. A single case of lacrimal gland pleomorphic adenoma and orbital schwannoma may not represent the true incidence of these cases. Similarly there was a single case of dermoid, lymphangioma, and no case of capillary hemangioma and rhabdomyosarcoma. This could be explained partly by the problems with sedation of pediatric patients. In addition to this CT is advised rather than MRI for cases like rhabdomyosarcoma and orbital metastases in neuroblastoma and hence these cases do not figure in our study.

Finally in a number of cases histopathological diagnosis could not be obtained as surgery or biopsy was not considered necessary and follow up of the patients was advised. Hence some cases of capillary and cavernous hemangioma could not be histopathologically proven and were not included in the study. In some cases of pseudo tumor where biopsy was not performed, regression of the tumor on steroids was considered to be diagnostic and these lesions were included.

Orbital Pseudo tumors and Lymphoproliferative Disorders

In our study of the 50 cases, 10 cases were diagnosed histopathologically as pseudotumors and 11 cases as lymphoproliferative disorders. Although pseudotumors usually present with proptosis and inflammatory symptoms, inflammatory

symptoms may be absent in some cases. Clinical and imaging features show overlap with orbital lymphoproliferative disorders, hence it has been included in our study of orbital tumors.

Of the 10 patients with pseudo tumors, 7 (70%) were male and 3 (30%) were female. Only 1 patient (10%) was in the pediatric age group, while majority of the patients were between third and sixth decade (70%). All the cases were unilateral. These results are similar to studies performed by J Yan et al[6].

Clinical symptoms were classified into those due to mass effect including proptosis, blurring of vision and restriction of extra ocular movements and those suggestive of inflammation which included pain, chemosis and watering of eye. 6 (60%) out of the 10 patients showed signs of inflammation along with proptosis, while 4 (40%) patients showed only signs of mass effect with no signs of inflammation. Proptosis and motility restriction were the symptoms in majority of the cases in studies conducted by J Yan et al [6] and Gunalp et al[7].

The location of the tumors was as follows: 4 (40%) affected only the extra ocular muscles (figure 6) i.e. myositis, 3 (30%) diffusely involved the orbit including retro orbital fat, extra and intra conal compartment and prebulbar portions (figure 5), 2 (20%) presented as focal masses involving both intra conal and extraconal compartments, 2 involved the lacrimal gland (figure 6) with only 1(10%) affecting purely the lacrimal glands, 1(10%) involved only the prebulbar portion. In study by J Yan et al[6], however, focal mass within the orbit was the most frequent subtype (43%), followed by lacrimal inflammatory pseudotumor (32%), diffuse orbital inflammation (10%), and myositis (8%).

All the tumors appeared isointense with muscles on T1W imaging, while 8 out of 10 (80%) were isointense to fat and muscles on T2W imaging. The intensity of 1(10%) tumor decreased on T2W compared to T1W imaging, rest all were iso-hyper on T2W compared with T1W imaging. Enhancement was seen in all the lesions and 80 % enhanced intensely on post contrast fat saturated T1W images. None of the lesions showed bone destruction or intracranial extension. In study by Cytryn et al[8], all pseudo tumors were isointense to muscles on T1W imaging, approx 84% of the lesions were isointense to fat on T2W images. Only 15% lesions appeared brighter on T1W images than T2W images. All the lesions in their study showed enhancement on post contrast study. Similar results were also obtained by J Yan et al[6] in their study.

Of the 11 patients with lymphoma, 6 (54.5%) were male and 5 (45.5%) were female. Age of the patients ranged from 30 to 75 years with majority of the patients (8 out of 11 patients i.e. 72.7%) aged above the 4th decade (70%) with none of the patients below 30 years. J Yan et al[6] found a strong male preponderance in their study with 70% of the patients being males. 4 of the 11 cases (32.7%) were bilateral and all the 4 lesions were associated with systemic disease. 17 % of the cases were bilateral in study by J Yan et al[6]. 4 (36.3%) out of the 11 patients showed signs of inflammation along with proptosis, while 7 (73.7%) patients presented with proptosis and diminished vision. Thus patients with pseudo tumors are more likely to present with inflammatory symptoms than patients with lymphoma which is consistent with their findings.

The location of the tumors was as follows: 4 (36.3%) affected only the extra ocular muscles , 3 (27.2 %) diffusely involved the orbit including retro orbital fat, extra and intra conal compartment and prebulbar portions (figures 3 & 4), 3 (27.2 %) showed involvement of both intra conal and extraconal compartments, 3 involved the lacrimal gland with only 1 (0.9%) affecting only the lacrimal glands.

The signal intensities were nonspecific with all the tumors appeared isointense with muscles on T1W imaging, while 10 out of 11 (90%) were isointense to muscle on T2W imaging and 9 (81.1%) were hyperintense to fat on T2W imaging. The intensity of 2 (18.1%) tumor decreased on T2W compared to T1W imaging, rest all were iso-hyper on T2W compared with T1W imaging. These findings are similar to those of J Yan et al[6] and Cytryn et al[8]. Enhancement was seen in all the lesions and 6 of the 11 tumors (54.5%) enhanced intensely on post contrast fat saturated T1W images. The histopathological characterization of the lymphoproliferative lesions showed 8 (72.7%) lesions to be malignant and 3 (27.3%) lesions to be benign. Of the 8, 5 (45.5%) were B cell lymphomas, 1 (0.9%) was a T cell lymphoma, 2 (18.1%) were plasmacytomas in seropositive patients and 3 (27.3%) were reactive lymphoid proliferation. The distribution is similar to that seen in study by J Yan et al[6]. Intracranial extension and bony changes were seen in 4 out of the 11 patients (i.e. 36.3%).

Cavernous Hemangioma :

In the present study, there were 8 cases of cavernous hemangioma constituting about 16% of total tumors in the orbit.

Out of 8 cases 5 were males and 3 were females so the gender ratio was 1.6:1. However data collected by Harris GJ et al[11] shows that females are more frequently affected than males. This could be due to a small sample size of 8 cases against data collected by them from 66 patients.

In our study 4 of the 8 cases were intra conal (figure 11), while 3 were extra conal (figure 7); 1 case with a predominantly intra conal lesion with extra conal extension. 7 of the 8 lesions were well-defined oval to round. In a study of 8 cases by Thorn Kany et al[9] 7 were well defined intra conal lesions.

Multiple small internal septations were seen in 4 out of the 8 lesions; while foci of blooming were seen on gradient imaging in 5 out of the 8 lesions which were confirmed as calcifications on CT (figure 7). One of the lesions showed multiple T1 hyper intense lesions suggestive of hemorrhage, which prompted a diagnosis of lymphangioma, but histopathological diagnosis was cavernous hemangioma.

Of the 8 cases, 6 were isointense on T1 weighted images and hyper intense on T2 weighted images with mild to moderate contrast enhancement in all cases. Hemangioma was diagnosed in 7 out of 8 cases without dynamic contrast study.

Retinoblastoma

In our study out of 50 cases, there were four cases of retinoblastoma. All were in the first decade youngest of age 4 months and oldest of age 6 years. There were three males and one female patient. Thus we found a sex ratio of 3:1, but in study by Graaf et al[12], they have found a ratio of 1:1; however theirs was a much larger sample of 58 retinoblastomas in 56 eyes. Three cases were unilateral while 1 was bilateral i.e. 5 eyes with retinoblastoma were found. 25 % bilateralism was thus found as compared to 32 % in their study. Out of the 5, one was an atypical case. Of the other 4 cases, 2 showed an exophytic growth pattern and 2 showed both endophytic as well as exophytic growth pattern, a purely endophytic growth pattern was not found. Graaf et al[12] found 46% to be exophytic, 42% endophytic and 12% to be combined. Retinal detachment was seen in 2 out of 5 cases (40%); vitreous hemorrhage was seen only in 1 case (20%). Their results showed retinal detachment in 69% and vitreous hemorrhage in 4%. Optic nerve involvement was seen in 3 cases out of 5 (60%) comparable to their results (64%). One patient with unilateral retinoblastoma also had a supra sellar mass.

Signal intensities in 4 out of the 5 cases were typical with T1 hyper intensity and T2 hypo intensity as compared to vitreous (figure 10). All the lesions showed enhancement on post gadolinium study. In study by Graaf et al[12] all the cases had typical signal intensity as described above.

1 case was atypical of that of a 4 year female with a large mass in the left eye (figure 12); the eye globe could not be identified separately. Optic nerve involvement was seen. The growth pattern, involvement of choroid, retinal detachment, vitreous hemorrhage

could not be therefore commented on. Signal intensity was also atypical with isointense on T1 and hyperintense on T2 with hypointense area within with a fluid fluid level was seen. Enhancement was seen on post contrast study. Such signal intensities are not seen in studies by Graaf et al[12], Scheuler et al[14] and Barkhof et al[13].

Optic Nerve sheath meningioma:

Out of 50 cases, there were 4 optic nerve sheath meningiomas. Two of the patients were in their fourth decade, one in third decade and one in seventh decade. There were 3 females and 1 male. The mean age of the patients in a series of 6 patients by Castel and De Potter et al[15] was 40 years and in a series of 25 patients by Karp et al[16] was 31 years; whereas the sex ratios were 1.2:1 and 5:1 in favor of females respectively. Intracranial/ intracanalicular extension was seen in 2 out of 4 patients in our study accounting for 50% and in study by Castel et al[15] the percentage was same. Also all the cases were unilateral.

Among the symptoms, pain was complained by 3 patients (75 %), decreased vision (100%), proptosis (75 %) and motility loss in 1 patient (25%). Disc edema was seen in 2 patients (50%) and disc atrophy in 2 patients (50%). In study by Castel et al[15], 50% of the patients presented with pain, 100% with diminished vision and none with proptosis or loss of motility. 50% of the patients had disc edema and 50% had disc pallor. These differences are probably due to larger size of lesions in our cases.

All the tumors were isointense on TW1, iso-hyper intense on T2W and showed intense enhancement on post contrast study with the tram track type of enhancement seen in all the patients (figure 8). The findings of Castel et al[15] were identical.

Optic Nerve Glioma:

In our study, there were three patients with optic nerve glioma. There were two males and one female. All patients were within the second decade and 2 out of the three patients were under 8 years. According to Alvord et al[17], 90% of patients are within the second decade and 50% of the tumors are intra orbital and the rest are intracranial and intra canalicular. In our study, however, all the cases were intra orbital. All the cases presented with changes in visual acuity and proptosis which is again consistent with the findings of Alvord et al[17].

MRI findings in all the cases were buckling and enlargement of the optic nerve and the tumor appeared isointense on T1W and iso-hyperintense on T2W images. These findings are consistent with findings of Hendrix et al[18]. However in their study, the cases did not show any enhancement on post gadolinium study, while 2 out of the 3 optic gliomas showed enhancement in our study .

Uveal Melanoma

We found 2 cases of melanoma, a 55 year old female and a 70 year old male. Lemke et al[19] in their study of 42 patients with melanoma found a sex ratio of 1.2:1 and mean age 62 years. The typical signal intensities of the melanoma i.e. hyper intense on T1W and hypo intense on T2W images were found in both the patients (Figure 13). These findings were endorsed by Lemke et al[19] and Mafee et al[20]. Both the melanomas were seen to be arising posterior to the equator and retinal detachment was seen in both the patients. Retinal detachment was seen in 93% of cases of Lemke et al[19] and 62% melanomas were posterior to the equator. A mushroom shaped mass was seen in 50% of their cases, while 31% had a mound shaped and 19% lesions were flat. Both the cases in our study had a mushroom shaped mass.

Metastases:

There were two cases of metastases; one a 60 year old female and other 54 year old female. Both were known cases of Ca breast. One patient showed diffuse enlargement of the medial rectus muscle which showed typical signal intensity of T1 isointense and T2 hyperintense and intense enhancement on post contrast study (figure 18). Holland D et al[120] in their study of 20 patients with metastases to the orbit found mean age of presentation to be 64 years and extra ocular muscle involvement was seen in 35% of their patients with medial and lateral rectus being the most common muscles to be involved. Breast was the most common site of primary neoplasm in their study. The other patient had a uveal metastasis with a small lesion in the choroid posteriorly. It appeared isointense to vitreous on T1W and T2W images and showed enhancement on post contrast study. Jooyong Lee et al[126] in their study found lung and breast as the most common site of primary neoplasm in case of uveal metastases. Majority of their patients had sub retinal fluid accumulation and location of the lesion in choroid was posterior to the equator in 57% patients.

Dermoid:

We found 1 case of dermoid in the study. It was a 27 year old male patient with extra conal mass anteriorly in the superolateral quadrant. It was a well defined rounded lesion. It was heterogeneous in signal intensity with a hyper intense area on T1W images which was suppressed on fat saturated T1 and STIR images representing fat.Mild scalloping of the adjacent bone was seen. This typical location and signal intensity of dermoid have been described by Kaufman et al[127] in their article.

Pleomorphic adenoma of the lacrimal gland

1 case of pleomorphic adenoma of lacrimal gland was found. A 52 year old male patient came with history of painless proptosis lobulated extra conal lesion in the lateral quadrant. The lacrimal gland was not seen separately. The lesion was predominantly isointense on T1W and hyper intense on T2W images with intense inhomogeneous enhancement on post contrast study. No bony destruction was seen. Mafee et al[128] also found that pleomorphic adenoma are seen in 4th to 5th decade, are usually painless extraconal lesions which appear iso-hypointense on T1W and hyperintense on T2W images with heterogeneous enhancement and are usually well circumscribed lobulated lesions.

Hemangiopericytoma:

1 case of hemangiopericytoma was found. A 47 year old male came with a large lesion in the superiolateral quadrant intra conal with extra conal extension. It was isointense on T1W images and iso-hyper on T2W images with intense enhancement on post contrast study. Linear flow voids were seen in the lesion and adjacent bony destruction with intra cranial extension was also noted (Figure 15). These findings draw resemblance to the typical features described by Wendy R. K. Smoker et al[129] in their article.

Lymphangioma:

1 case of lymphangioma was found in the study. An 18 year male came with a large mass lesion occupying the orbit and a large intra cranial component. According to Kalisa P et al[22], usually patients are within the second decade of life. It was heterogeneous in signal intensity with areas of hemorrhage and fluid-fluid levels and intense heterogeneous enhancement on post contrast study .Bony destruction and extension into the sinonasal cavity was also seen. Linear flow voids were also seen. Bond JB et al[21], in a study of 12 patients, found that magnetic resonance imaging delineated clearly the internal structure of subacute and chronic hemorrhagic cysts, and differentiated between these tumors because of the different paramagnetic qualities of subacute hemorrhage compared to chronic hemorrhage. In two patients, MRI detected large tumor feeding vessels by the flow void phenomenon.

Orbital schwannoma:

A 17 year old male patient with history of seizures and headache came for MRI. An extra axial dumb bell shaped lesion in the temporal region with an extension into the orbital apex was seen. It was isointense on T1 with a hypo intense area in its center and central hyper intense area on T2 with heterogeneous enhancement on post contrast study. Wang et al[23] in a study of 62 patients found majority

of lesions conical in shape (26%) followed by dumb bell shaped lesions (16%). Similar signal intensity findings were also seen with a central hypo intense area on T1W imaging.

Adenosquamous carcinoma :

A case of 40 year old male with painful proptosis and loss of vision was seen. A large heterogeneous lesion occupying the intraconal and extra conal compartments of the orbit with intracranial extension, involvement of the ipsilateral ethmoid sinuses, bony destruction involving the roof and medial wall and displacement of the globe was seen. Extreme stretching of the optic nerve was also seen. Calvarial destruction was seen with enhancing soft tissue. The lesion appeared isointense on T1W and T2W images with intense enhancement on post contrast study (Figure 16). An area of hemorrhage was also seen within. The histopathological diagnosis came to be adenosquamous carcinoma. A similar aggressive lesion was reported by Som P et al[24]. A 62-year-old woman had proptosis of the right eye, decreased visual acuity of the left eye and grand mal seizure showed extensive bone destruction of the margins of the right orbit, the floor of the middle cranial fossa, the right cavernous sinus, and much of the calvaria. There was considerable dural disease and tumor in the right orbit, paranasal sinuses, and scalp, as well as mucoceles of the left ethmoidal sinus with desiccated secretions. The signal intensity was also similar. The histopathological diagnosis in this case was also given as adenosquamous carcinoma.

SUMMARY AND CONCLUSIONS

The present study was aimed at evaluating MRI findings in orbital tumors and to assess the diagnostic accuracy of MRI in the characterization of the orbital tumors. This was done by correlating the MRI and histopathological features.

Total 50 patients referred to radiology department in a tertiary care hospital were evaluated for the study.

The patients were referred with strong clinical suspicion and prior CT scan showing orbital mass.

Following is the summary of our study:

- Orbital tumors are more common in the fifth and sixth decade of life. Males were more commonly affected than females with male: female ratio being 3:2
- Proptosis and diminution of vision were most common clinical complaints followed by pain and decreased motility. Inflammatory symptoms are seen in cases of pseudotumor and lymphoma.
- Good correlation was obtained for clinical complaints and size and extent of the lesions in orbital tumors.
- Gadolinium enhanced scans were used to delineate the extent of the lesion accurately and pattern of enhancement of lesions.
- The most common orbital tumor detected was lymphoma followed by pseudo tumor comprising of 21(42%) out of 50 cases. Lymphoma was more common in 5^{th} to 7^{th} decade and there was a slight male preponderance. Pseudo tumors occurred mainly in the fourth to sixth decade and were more common in males with sex ratio 2.3:1. Extra ocular muscle involvement (myositis) was most common in pseudotumors followed by diffuse orbital involvement in our study Lymphomas are more likely to be bilateral than pseudotumors. The T2W signal intensity with respect to orbital fat combined with inflammatory symptoms can be used to differentiate between pseudo tumors and lymphoma tumors in most cases.
- The next most common abnormality detected was cavernous hemangioma (8 cases -16%). Most common occurrence was noted in fifth decade of life and we found a slight male preponderance with a ratio of 1.6:1. Intraconal hemangiomas were more common than extraconal. Calcification could be seen as blooming on gradient imaging and internal septations were seen in half of the lesions. Majority of the lesions were isointense on T1W and hyperintense on T2W images. Typical pattern of delayed enhancement was seen on post contrast study.
- Third most common were retinoblastoma and meningioma (4 cases-8%). All the patients of retinoblastoma were under the age of 6 years with 3 of the patients being male. An exophytic or endophytic growth pattern, optic nerve involvement, associated retinal detachment and vitreous hemorrhage could be identified. Typical signal intensity pattern was T1 hyperintense and T2 hypointense with respect to vitreous.
- Meningiomas were commonly seen in middle aged to old females . Half of the lesions showed intracanalicular or intracranial extension. Pain, proptosis and diminished vision were chief symptoms. Optic atrophy or papilledema may be present. The lesions were isointense on T1W and iso-hyperintense on T2W imaging and typical tram track type of enhancement was seen.
- Next most common pathology was optic nerve glioma (3 cases-6%). All the patients were within second decade, with 2 out of 3 males. All the cases were intraorbital and buckling and enlargement of the optic nerve was seen. Typical signal intensities are isointense on T1W and iso-hyperintense on T2W images. Contrast enhancement may be seen.
- Two cases of uveal melanoma were seen. Intra ocular mushroom shaped lesions with retinal detachment were seen in old aged male patients which were hyperintense on T1W and hypointense on T2W images.
- A variety of other tumors may be seen including orbital schwannoma, pleomorphic adenoma of lacrimal gland, dermoid, lymphangioma, hemangiopericytoma, and secondary tumors like orbital metastases and extension of adenoid and squamous carcinomas. But in a sample size of 50 patients, adequate number of cases of each tumor were not found to draw definitive conclusions.

Thus we assessed the MR imaging characteristics of 50 histopathologically proved orbital tumors. Lymphoma, pseudotumor and hemangioma, retinoblastoma and optic nerve sheath meningioma constituted 74% of the lesions in our series. In our study, MRI was precise in histopathological typing of orbital tumors in 84% cases. Most of the ambiguity was in distinguishing between pseudo tumor and lymphoma.

Hence, finally to conclude:

- A wide variety of tumors is seen in the orbital and ocular region in all age groups with various clinical and imaging characteristics.
- An appropriate imaging protocol is necessary with both plain and fat saturated T1W imaging as it is necessary for proper anatomical delineation of tumors. Though gradient sequences detect calcification and hemorrhage as blooming, MR is not a very sensitive modality for detection of calcification.
- MR imaging characteristics and signal intensities allow distinction between most of the orbital tumors. However pseudo tumor and lymphoma cannot be adequately differentiated on the basis of imaging alone. Clinical correlation and trial of corticosteroid can be used to further distinguish between them accurately.
- Other characteristics such as intra conal versus extra conal location, intra cranial or extra orbital extension, nature of contrast material enhancement and clinical findings permit further differentiation among the various other abnormalities. The superior resolution and multiplanar capacity of MR imaging best depicts the extent of orbital tumors.

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