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ORIGINAL ARTICLE

Magnetic Resonance Imaging in Non-traumatic Orbital Pathologies: An Observational Cross Sectional Study

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Abstract

Orbital lesions form a wide range of pathologies, that create challenges in diagnosis, management and treatment. The high resolution soft tissue detail provided by magnetic resonance imaging (MRI) has allowed for better lesion characterization. MRI is also important in the detection of extent and localization of orbital diseases. The aim of the study was to evaluate the profile of orbital lesions on MRI in non traumatic orbital pathologies. The objectives of this study were to examine the MRI characteristics of common diseases arising from or extending into the orbit to aid in the correct diagnosis of orbital lesions. **Material and Methods:** The patient data was collected from GMC Jammu over a period of one year. The study comprises of 50 patients with symptoms of proptosis, orbital swelling, diminution of vision; referred from ophthalmology department of GMC Jammu. MRI examination was performed on Siemens Magnetom Symphony 1.5 Tesla machine and the cases were studied to determine the imaging features of various orbital pathologies on MRI. All patients were evaluated for the clinical symptoms and were also subjected to other routine investigations. **Results:** The most common presenting symptom was diminution of vision (66%) followed by proptosis (50%). Most commonly encountered lesions were infective and inflammatory lesions, contributing 60% of total lesions. Various other lesions encountered were coloboma, orbital lymphoma, vascular hemangiomas and thyroid ophthalmopathy. **Conclusion:** MRI is valuable for determining the extent of disease, describing its exact localisation and detecting involved orbital compartments. A compartmental approach to evaluating orbital disease can guide the differential diagnosis.

Key Words

MRI, Orbital mass, Gobe, Intraconal, Extraconal

Introduction

There is a wide spectrum of orbital lesions that pose challenges in diagnosis, management and treatment. The soft tissue detail provided by magnetic resonance imaging allows for better lesion characterization. A common diagnostic strategy for the correct diagnosis of orbital pathology is the localization of the pathology into the four main orbital compartments: the ocular compartment or globe, the muscle cone, the intraconal and the extraconal spaces. The muscle cone contains recti muscles and their fasciae; on its base, the globe is present, and the optic canal figures the apex. The globe is encircled by the Tenon's capsule, which has three layers: the sclera, uvea and retina. The extraconal space includes the superior and inferior oblique muscles, levator muscle complex, the lacrimal gland and the orbital fat.[1]

Material & Methods

The patient data was collected from GMC Jammu over a period of one year. MRI examination was performed on Siemens Magnetom Symphony 1.5 Tesla machine. The study comprises of 50 patients with symptoms of proptosis, orbital swelling, diminution of vision; referred from ophthalmology department of GMC Jammu. Patients with suspected involvement of the orbit due to any systemic illness like malignancy, infection and

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inflammation were also included. Various scanning planes included T1 weighted and T2 weighted oblique axial and sagittal images along the optic nerve and true coronal T2 weighted images. Three dimensional VIBE sequence was also obtained. Diffusion weighted sequences were also obtained whereever deemed nescessary. Intravenous gadolinium contrast was given at dose of 0.1 m mol/kg (0.2ml/kg) body weight after taking informed consent from patients. Post gadolinium axial and coronal fat suppressed T1 weighted gradient echo (VIBE) sequences were taken. The Institutional ethics committee of GMC, Jammu has approved this study vide registration number C-44/20.

All patients were evaluated for the clinical symptoms and were also subjected to other routine investigations.

Study Design: Cross sectional observational study

Aim & Objectives: The aim of the study was to evaluate the profile of orbital lesions on MRI in non traumatic orbital pathologies. The objectives of this study were to examine the MRI characteristics of common diseases arising from or extending into the orbit to aid in the correct diagnosis of orbital lesions.

Inclusion Criteria: Patients with diplopia, proptosis and palpable orbital masses with or without diminution of vision.

Exclusion Criteria: Patients with suspected trauma/ foreign body to the eye; with any contraindication to MR imaging; with ferromagnetic implants, claustrophobia; with suspected pregnancy or any previous surgery involving orbit were excluded from the study.

Results

The present study "Role of MRI in evaluation of non-traumatic orbital lesions" was carried out in the Department of Radio diagnosis at our hospital. 50 patients with various orbital pathologies were included in the study.

Out of the 50 patients, majority of the patients were in the age group of 41-60 years (46%). Out of total patients, 29 (58%) patients were male and 21 (42%) patients were female.

In our study, 7 patients had bilateral disease, while 23 patients had involvement of left orbit and 20 patients had involvement of right orbit. The most common presenting symptom was diminution of vision in 66% patients followed by proptosis (50 %). Orbital swelling (32%), restriction of eye movement and nystagmus (46%) and watery eyes (24%) were the other complaints.In the present study, 48% (n=24) lesions were located in the extraconal compartment, 40% (n=20) in intraconal compartment while 12% (n=6) involved both the compartments.The spectrum of orbital pathologies included inflammatory / infective (60%), congenital (6%), vascular (10%), neoplastic etiologies (24%). The most common orbital lesion was inflammatory and infective followed by neoplastic. Among the inflammatory and infective pathologies, there were 3 cases of orbital cellulitis. Proptosis and pain were the most common complaints of these patients and two cases had associated sinusitis.There were 5 cases of orbital fungal infection, which were proved to be cases of mucormycosis. Two of these patients had history of uncontrolled diabetes mellitus while the other three were immunocompromised post Covid infection.There were 10 cases of orbital pseudo tumor, two cases of optic neuritis,7 patients of Graves' Ophthalmopathy and two patients with cavernous sinus thrombosis in this study.This study also comprised of 3 cases of congenital and developmental anomalies including 1 case of dermoid cyst and 2 cases of coloboma cyst. Among the vascular pathologies, there were 5 patients of orbital hemangioma.

There were 11 cases of various tumors, out of which 73% (n=8) were malignant including histopathologically proven cases of rhabdomyosarcoma, sinonasal malignancy and lymphoma while 27% (n=3) were benign including nasopharyngeal angiofibroma and optic nerve glioma.

Discussion

The present study was undertaken to study the "Role of MRI in evaluation of non- traumatic orbital lesions" and the imaging findings were correlated with histopathological and or clinical/surgical findings as applicable. A total of 50 patients were evaluated. Majority of the patients were in the age group of 41-60 years. Similar results were seen in a study by Kaup and Venkategowda[2] in which nearly half of the patients were in the age group of 41-60 years. In the present study the most common orbital lesion is inflammatory and infective followed by neoplastic. Our results were consistent with the study by Arvind *et al*[3] which reported that most common orbital lesion is inflammatory (34.1%).

Among the congenital cases, coloboma is presented as microphthalmia appearing on MRI as a well-defined cystic lesion in the retrobulbar region closely abutting the globe which is T1 hypointense and T2 hyperintense. Similar findings were seen in the study by Kim *et al*[4].

Proptosis and pain were the most common complaints in cases of orbital cellulitis and two cases had associated sinusitis. A study by Jyani *et al*[5], also concluded that sinusitis was the most common predisposing factor for orbital cellulitis and that MRI is the imaging modality of choice in the evaluation of orbital cellulitis because of its superior soft tissue and contrast resolution. It is vital to evaluate the extent of the orbital infection, underlying paranasal sinus involvement, as well as to detect complications of orbital cellulitis, especially intracranial

Fig 1: MRI Image of Orbital Lymphoma

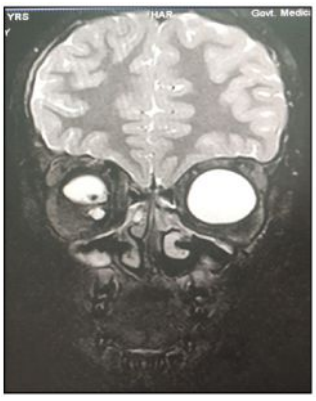
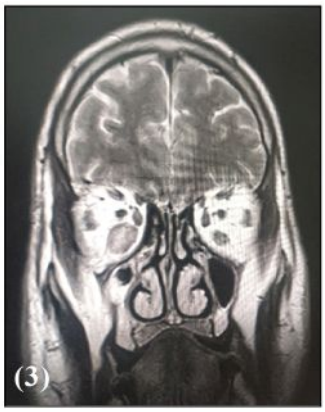


Fig 2: MRI Image of Ocular Coloboma



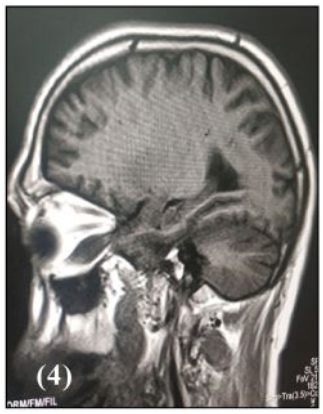


Fig 3 & 4: MRI Images of Orbital Pseudotumor

spread and may also identify any abscess that requires surgical intervention. Cellulitis of preseptal space and orbital soft tissue is best evaluated on contrast enhanced T1 weighted sequence with fat suppression, where the most common finding is poorly defined periorbital enhancement enveloping the globe and extending into post-septal fat. Our findings were consistent with the study by Costa *et al*[6].Uncontrolled diabetes mellitus and the use of corticosteroids are the possible etiological factors[7] for orbital fungal infections. Taylor[8] *et al* reported diffuse nodular mucosal enhancement within the sinuses and nonenhancement of nasal turbinates (black turbinate sign) with perineural extension along infraorbital nerve and inflammation of inferior rectus muscle. These results were similar to our study.In orbital pseudotumor, contrast enhanced T1 MRI with fat suppression best visualizes inflammation of the muscles, tendons, and surrounding fat, which is seen as swelling of the tendon and belly of the extraocular muscles. None of the lesion showed bone destruction or intracranial extension. On T2 weighted sequence, infectious cellulitis appears as hyperintense lesion while orbital pseudotumor lesions range from hypo to hyperintense. Similar conclusions were drawn in a study by Pakdaman *et al*[9]. Optic neuritis, in the acute stage demonstrates diffuse swelling of the optic nerve with focal plaques of T2 hyperintensity on MRI. When intraorbital inflammation extends along the optic nerve and nerve sheath, it is termed perineuritis.

Table 1. Gender and Age Wise Distribution of Cases

Age group	Male	Female	Number of patients	Percentage
<20	3(60%)	2(40%)	5	10%
21-40	7(58.3%)	5(41.7%)	12	24%
41-60	15(65.2%)	8(34.8%)	23	46%
>60	4(40%)	6(60%)	10	20%
Total	29(58%)	21(42%)	50	

The findings in our study were similar to study by Aiken *et al*[10] which stated that on imaging, optic neuritis is seen as unilateral optic nerve swelling in its retrobulbar/ intra-orbital segment, with high T2 W signal and contrast enhancement. Ding *et al*[11] stated that the classical appearance is of increased signal intensity surrounding the optic nerve, and extending into adjacent fat on post gadolinium T1 MRI with fat suppression. Muscular involvement in Graves' ophthalmopathy is often bilateral and symmetrical and typically spares the muscle tendons resulting in fusiform enlargement of the muscles- the so called 'Coca-Cola bottle' sign. On MRI apart from muscle enlargement, the other notable feature was signal intensity of enlarged muscles on T2 W images. The muscles most frequently affected are the medial and inferior recti[12].

Table 2. Spectrum of Orbital Pathologies

Inflammatory/infective	
• Thyroid eye disease	7(14%)
• Cellulitis	4(8%)
• Fungal	5(10%)
• Pseudotumor	10(20%)
• Cavernous sinus thrombosis	2(4%)
• Optic neuritis	2(4%)
Congenital	
• Coloboma	2(4%)
• Dermoid cyst	1(2%)
Vascular- orbital hemangioma	5(10%)
Neoplastic	
• Sinonasal carcinoma	3(6%)
• Rhabdomyosarcoma	2(4%)
• Juvenile angiofibroma	2(4%)
• Orbital lymphoma	4(8%)
• Optic nerve glioma	1(2%)

Cavernous sinus thrombosis clinically presented with symptoms of ophthalmoplegia and restriction of eye movements. MRI helps in identifying thrombosis either via direct visualization of the thrombus /filling defect in cavernous sinus or via indirect signs that include proptosis, dilatation of the draining tributaries and abnormal dural

enhancement, that are well demonstrated on contrast enhanced studies. Similar results were drawn in the study by Bhatia *et al* [13]. On MRI the orbital hemangiomas demonstrate isointense signal to muscle on T1 weighted images and are moderately hyperintense on T2 weighted images. Intense, persistent and homogenous enhancement is appreciated after contrast enhancement. Grech *et al* [14] reported that lobules with thin dark fibrous septa and flow voids at the periphery of or within the tumor itself are characteristic imaging features of hemangiomas. Advantages of MRI are in differentiation of the capillary hemangioma from venous lymphatic malformations and rhabdomyosarcoma. All the sino-nasal malignancy showed primary mass located in the paranasal sinus which eroded through the wall to reach the extraconal compartment with heterogeneous enhancement on contrast study. Juvenile angiofibroma are mostly seen in adolescent age group and mostly in boys. Ikubor *et al* [15], stated that angiofibroma shows typical extension superiorly along the orbital apex through the pterygopalatine fossa. It is not limited by bony margins. Characteristic post contrast intense enhancement helps in the diagnosis and similar findings were seen in our study.

On MRI, optic nerve glioma is identified as optic nerve sheath enlargement appearing T2 hyperintense and showing moderate contrast enhancement. There was extension of tumor along the optic nerve up to the orbital apex. Avery *et al* [16], stated that MRI is the method of choice and is very useful in assessing involvement of the orbital apex, optic chiasma, hypothalamus, and other intracranial structures. The lesions are typically T1 isointense and T2 iso-hyperintense with variable enhancement. Findings in present study correlate well with above described findings. Orbital lymphoma has been described as a mass with distinct margins, which shows an isointense signal on T1-weighted images and iso-hyperintense signal on T2-weighted images. There was restriction on diffusion weighted imaging with intense homogenous post contrast enhancement. Diffusion weighted imaging is perhaps the most reliable technique to distinguish lymphoma from inflammatory disease. An ADC of less than 0.92 X $10^{-3}mm^2/s$ was shown to be 100 % sensitive and specific in distinguishing lymphoma from inflammatory disease[17]. In present study lymphoma was the most prevalent tumour. The results were consistent with the study by Verma *et al* [18].

Limitations: The limitation of this study was the relatively small sample size.

Conclusion

MRI is valuable for determining the extent of disease, describing its exact localisation and detecting involved orbital compartments. A compartmental approach to evaluating orbital disease can guide the differential diagnosis.

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Conflict of Interest : Nil

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