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Role of Multidetector Computerised Tomography in Evaluation of Proptosis

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ABSTRACT

Introduction: Proptosis is defined as bulging of eye anteriorly out of the orbit. Our main objective was to analyze the pattern of computerised tomographic findings in evaluation of proptosis. Computerised tomography (CT) is noninvasive, easily accessible, affordable and reliable imaging which helps in early diagnosis and prompt treatment.

Methods: A descriptive cross sectional study of total 58 patients presenting with proptosis referred to our department of radiology for computerised tomography evaluation during one year period were undertaken into study. The clinical information provided by ophthalmologist also helped our study to derive into conclusion. SPSS version 20 software was used for statistical data analysis.

Results: Out of 58 patients, the most common cause of proptosis was neoplasm constituting of 25 cases (43.1%). Retinoblastoma was the commonest orbital tumor. Out of remaining cases, 15 (25.8%) were infective, 14 (24.1%) were inflammatory, two (3.44%) were traumatic and remaining two cases (3.44%) had no definitive cause for proptosis. Bilateral proptosis was commonly associated with thyroid ophthalmopathy. Among the subjects 32 were male, 26 were female. Male: Female ratio was 1:1.23. Age group was ranging from 1 month to 73 years. Mean age was 26.4 ± 22 years.

Conclusions: Computerised tomography has an important role in distinguishing the different types of lesions based on their characteristics, location and extension prior to undertaking definitive surgical and medical treatment. Overall accuracy of CT in our study was 81%, sensitivity of 82.6%, specificity of 80.6%, positive predictive value of 76% and negative predictive value of 86.2%.

Keywords: *Graves Ophthalmopathy; Orbital Neoplasms; Radiography*

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INTRODUCTION

Proptosis is defined as bulging of eye anteriorly out of the orbit. If the distance between corneal apex and anterior to lateral orbital rim is more than 21mm or a difference of 2mm between the two globes position is termed proptosis.[1] The shape of the orbit is like a quadrilateral pyramid with only anterior opening and the rigidity of the bony orbit explains that expansion of any of the orbital contents will displace the eyeball forward.[2] Computerised tomography is easy, noninvasive, cost effective, easily accessible diagnostic modality of investigation in proptosis and has excellent spatial resolution with speed. CT is preferred over MRI in detection of calcification and for bony details. Excellent resolution of CT is due to orbital fat and varied attenuation coefficient structures within the confined space of orbit. CT is helpful in knowing the location, extent and characterizing the lesion including any calcification/cystic changes. Contrast study may further aid in characterising orbital tumors, vascular malformation and inflammatory pathologies. Rapid post processing of CT images provides 3D picture and bony details of orbital pathologies. Multiplanar reformation allows a lesion to be assessed in relation to neighbouring structure including adjacent bone, sinus and central nervous structures. This helps clinician not only in diagnosis but also for treatment planning and follow up monitoring.[3]

METHODS

A descriptive cross sectional study was conducted to 58 patients referring for evaluation of protosis by computerised tomography in Radiology department of Kathmandu Medical College from September 2018 to August 2019. Detailed history including age, sex, and laterality clinical picture including ocular examination, laboratory parameters and indications of CT were properly documented. Multidetector 64 slice Aquilion CT with multiplanar (MPR) and 3D reconstruction images with volumetric scan was used. Lateral and anteroposterior scannogram with patient supine and contiguous axial, coronal 3-5mm sections with slice thickness of 3mm and interslice gap of 3mm were obtained. The plane of the study was parallel to the head of the optic nerve and the lens. All the patient had to look forward with eyes opened without eye movement. Firstly plain CT was done and in clinically indicated cases, nonionicintravenous contrast was given. Images were evaluated both on soft tissue and bone window settings. On axial section, an interzygomatic line is drawn, which is a straight line connecting the anterior margins of zygomatic processes. All patients with globe protrusion >21mm anterior to the interzygomatic line on axial scans at the level of lens were termed proptosis and evaluated further. Final diagnosis was made on the basis of clinical findings, laboratory investigations, histopathological, operative findings or response to treatment, whichever is feasible in individual cases.

RESULTS

In our descriptive cross sectional study, 58 patients between the age group from 1 month to 73 years were enrolled. Mean age of the patients was 26.4 ± 22 years. There was male predominance comprising of 32 males and 26 females with male: female ratio of 1:1.23. Maximum cases (25) were below 15 years which constituted 43% of the study population. Unilateral proptosis (50 cases) was more common than bilateral (8 cases). The most predominant side was the left comprising of 27 patients and right side accounted for 23 cases. Involvement of more than one compartment (19 cases) was the most common location of orbital lesions (Figure 1). There were various lesions causing proptosis (Table 1). The commonest etiology was orbital tumors (Table 2).

Amongst 25 cases of neoplasm, orbital tumor constitute about 23 of cases and rest 2 cases accounted for paraorbital tumor.

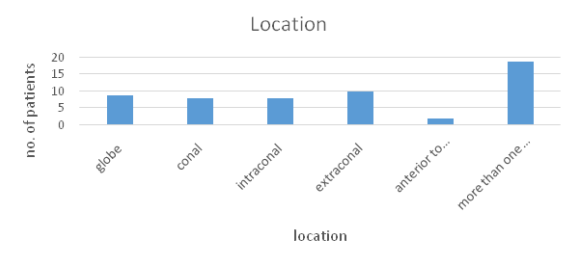

Figure 1: *Location of the lesion.*

Table 1: Etiology of proptosis

Cause	Frequency	Percentage
Neoplastic	25	43.11
Infective	15	25.87
Inflammation	14	24.14
Trauma	2	3.44
No definitive cause	2	3.44
Total	58	100

Table 2: Lesions causing proptosis

Lesions	Frequency	Percentage
Periorbital/ orbital cellulitis/ endophthalmitis	12	20.68
Retinoblastoma	10	17.24
Graves' disease	7	12.06
Pseudotumor	6	10.44
Orbital lymphoma	3	5.17
Haemangioma	3	5.17
Lymphangioma	2	3.44
Optic nerve sheath meningioma	2	3.44
Frontoethmoidal mucocele	2	3.44
Trauma	2	3.44
Lacrimal gland neoplasm	1	1.72
Maxillary sinus carcinoma	1	1.72
Frontal sinus carcinoma	1	1.72
Metastasis	1	1.72
Myocysticercosis	1	1.72
Tolasha Hunt Syndrome	1	1.72
No definitive cause	2	3.44
Total	58	100

Table 3: Distribution of orbital Tumors

Cause	Frequency	Percentage
Retinoblastoma	10	43.47
Orbital lymphoma	3	13.04
Cavernous haemangioma	3	13.04
Optic nerve sheath meningioma	2	8.69
Lymphangioma	2	8.69
Optic nerve glioma	1	4.34
Lacrimal gland tumor	1	4.34
Metastasis	1	4.34
Total	23	100

Orbital tumors:

Among orbital tumors, retinoblastoma was the commonest (43.4%). All cases of retinoblastoma appeared as calcified, soft tissue density lesion in posterior chamber of globe. Extraocular orbital extension into preseptal and retrobulbar compartment was evident in two of the cases. In other hand, orbital lymphoma appeared ashomogenously enhancing lobulated lesion predominantly involving extraconal superolateral quadrant of orbit. Out of three cases, two had both intra and extraconal involvement.

All three cases of haemangioma appeared as well defined, mildly enhancing homogenous mass lesion in lateral aspect of intraconal space of orbit. Only one showed fleck of calcification. Lymphangioma appeared as a heterogenous lesion with predominantly cystic areas and infiltrative border involving both intraconal and extraconal compartment of orbit.

CT imaging of optic nerve sheath meningioma appeared as a large densely calcified mass lesion with enhancing soft tissue component in intraconal space surrounding the less dense center of compressed optic nerve. One case had intracranial extension and another had extension up to optic canal associated with sclerotic changes in adjacent bone.

In our prospective study, fusiformly enlarged, elongated left optic nerve with mild homogenous enhancement on contrast study was reported as optic nerve glioma. A case accounted for pleomorphic adenoma of

lacrimal gland in our study which on imaging showed heterogeneously enhancing soft tissue density lesion involving lacrimal gland with no associated bony destruction. Our study, revealed a case of metastasis as bony destruction of orbital wall with soft tissue component in lateral extraconal space with intracranial extension.

Paraorbital tumors:
Paranasal sinus carcinoma appeared as mass lesion with bone destruction and orbital extension.

Infections:
Periorbital cellulitis manifested as increased soft tissue densities anterior to the orbital septum whereas orbital cellulitis had inflammatory soft tissue stranding in the postseptal compartment. One had localized collection within extraconal space. Other had subperiosteal fluid collection at the medial aspect of the orbital wall. Concurrent involvement of maxillaryand ethmoidal sinusitis was evident. Endophthalmitis appeared as diffusely enhancing scleral thickening with associated soft tissue stranding in preseptal/ postseptal comparatment along with increased density of vitreous chamber. Two cases of endophthalmitis showed evidence of intraocular foreign body in posterior chamber.
Frontoethmoidal mucocele had expansile hypoattenuating lesion involving frontal, ethmoidal sinus and frontoethmoidal recess. There was intraorbital extension with areas of pressure erosion in lamina papyracea. One patient had a cystic lesion involving medial rectus muscle associated with minimal adjacent soft tissue inflammatory changes and was reported as myocysticercosis.

Inflammatory lesions:
Bilateral involvement was more common in thyroid ophthalomopathy (five out of total seven cases). There was sparing of tendinous insertion with predominant involvement of inferior rectus muscle followed by medial, superior and lateral rectus muscle. Amongst six patients of pseudotumor, one case had lacrimal involvement and rest five cases had diffuse multi compartmental orbital involvement. All the cases were unilateral. A rare case of Tolasha Hunt Syndrome presented as milldy enhancing soft tissue density lesion in cavernous sinus with involvement of superior orbital fissure, orbital apex and intrasellar extension of the mass lesion.

Trauma:
One patient had subperiosteal haematoma in extraconal space. Another traumatic case had foreign body within intraconal space surrounded by hyperdense collection.
No demonstrable cause of proptosis were found in two of our cases. The patient were high myopic on clinical examination
After proper follow up, histopathological, operative findings correlation, our study showed sensitivity of 82.6%, specificity of 80.6%, positive predictive value of 76%, and negative predictive value of 86.2% and accuracy of 81%.

DISCUSSION

Prominence of eyes can occur in high myopia, extraocular muscle palsy, stimulation of muller muscle by cocaine and idiosyncracy especially in obese people.[4] Amongst the various causes of proptosis, space occupying lesions within the orbit are commonest. Due to presence of rigid bony wall, orbital tumors are surgical inaccessible for biopsy purpose.[2] Advanced cases have poorer prognosis and if not appropriately treated, may even require enucleation of the orbit. Thus timely accurate diagnosis has to be made by CT whenever possible.
The most common etiology of proptosis in our prospective study was tumor constituting of 43.1% of cases. Our findings correlated well with the study done by Naveen KG et al.[5] who reported tumours (46%) as the commonest cause, of which 65% were orbital tumours and 35% were para-orbital tumours. On the other hand, Ogbeide E et al.[6] found tumours to be much more in frequency (81.8%) than

our study with majority (70.4%) of all tumors were from adjacent structures with secondary involvement of the orbit as compared to the primarily intraorbital neoplasms which constituted 29.6%.[6] In our study, primary intraorbital tumor accounted for 92% among all tumors which is higher than the study conducted by Naveen KG et al.[5] and Ogbeide E et al.[6] This could be due to less number of cases of paraorbital tumor patients attending our hospital due to referral to cancer centers.

In our study, lymphoma was seen in 5.1% patients of proptosis which was similar to Sharma P et al.[7] who found lymphoma accounting 6.7% of cases of proptosis. Lymphoma represents 6% to 8% of orbital tumor as stated by Kapur et al.[8] Whereas in our study, lymphoma constituted around 13% among all orbital tumors. In our study, only one case had bilateral involvement although bilateral disease is common.[9] Margo CE et al.[10] and Naveen KG et al.[5] reported orbital lymphoma to be the most common malignant orbital tumours. In contrary, our study found retinoblastoma as the most common orbital tumor accounting for 43.4% among primary orbital malignancies. Our study revealed two cases of bilateral retinoblastoma (20%) out of ten cases. Zimmerman RA et al.[11] reported that tumour was bilateral in 25-33% of patients on presentation.

One case of metastasis was present in our study. Sambasivarao K et al.[12] had two out of 80 cases of proptosis. Generally, the most frequent metastases to the orbit are from: breast, lung, prostate, melanoma, carcinoid, GI, renal cell, neuroblastomas and rhabdomyosarcomas.[13]

In a study done by Sharma P et al.[7] meningioma was reported in 6.7% of patients with proptosis which was near towards similar to our study of 8.6% of cases. They commonly occur in women between third and fifth decade of life.[14] Out of two cases, we had a female at third decade. Optic nerve glioma constituted about 4.3% among orbital tumors in our study which is lesser than Sambasivarao K et al.[12] accounting for 22.5%. We had a case of 18 year old male in our study. The peak incidence is usually in 2-8 year old but can occur at any age and has been reported up to 79 years of age. Females are generally more affected than males.[15]

Our study revealed 13% cases of haemangioma which was comparatively higher than Sharma P et al.[7] accounting for 6.7%. Haemangiomas usually do not deform the globe. The most commonly affected age group is middle aged females.[16] Out of three cases, we had a female at fifth decade.

The most common paraorbital tumor invading the orbit was maxillary carcinoma (5%) in the study by Sambasivarao K et al.[12] similar to that described by Johnson LN et al.[17] Since we had only two cases of paraorbital tumor, one case was of maxillary carcinoma. The thin osseous wall separating the orbit from the adjacent paranasal sinuses usually offer little resistance to the direct spread of tumour 40-50% of paranasal sinus carcinoma can involve the orbit.[18]

In our study, pseudotumor accounted for 10.3% of cases. In a study done by Sharma P et al.[7] pseudotumor accounted for higher frequency of about 30% of cases. This could be due to small sample size or the referral of tumor patients to the cancer hospital as stated by authors. Pseudotumor are mostly unilateral but can be bilateral in 25% of cases.[9] In our study none of the cases had bilateral involvement. All patients of pseudotumor in our study were diagnosed on the basis of non-specific radiological findings after exclusion of other causes and who responded well with steroid.

Tolasha Hunt Syndrome constituted about 1.7% in our study which was similar to Sharma P et al.[7] who accounted for 3%. It is an idiopathic inflammatory condition that involves the cavernous sinus and orbital apex. Clinically, immediate response to steroid therapy is a hallmark of the condition.[19] 12 % of cases were reported as Graves disease in our study. Similarly, Sabharwal KK et al.[2] and Sharma P et al.[7] reported 13.3% of cases of proptosis with graves ophthalomopathy. Correct diagnosis of Graves disease was made in 5 out of 7 (71%) in our study while 6 out

of 8 (75%) patients in the study conducted by Sambasivarao K et al.[12] In our study, inferior rectus muscle was most commonly involved followed by medial rectus and superior rectus which was similar to the study by Murakami et al.[20] CT was also useful for evaluating result of orbital decompression surgery.

In our present study, infective pathology accounted for 27.5% of cases which was higher than the study conducted by Sambasivarao K et al.[12] (15%). Bony changes, concomitant sinus involvement and also intracerebral extension of orbital abscess was also very well shown by CT.

Traumatic lesions was reported as 3.4% of cases of proptosis in our study which correlated well with Sharma P et al.[7] which accounted of 3.3 % of cases of proptosis. Fracture, herniation of orbital contents into the roof of the maxillary sinus as well as collection in the paranasal sinuses, retrobulbar/preseptal haemorrhage was accurately depicted by CT. We had cases of foreign body within posterior chamber and intraconal compartment of orbit. Low density foreign bodies missed by X-ray along with lens disruption, vitreous haemorrhage, ruptured globe and other orbital traumatic sequalae was clearly demonstrated by CT and thus helped ophthalomologist in surgical planning.

After proper follow up, clinical outcome and histopathological, operative findings correlation, the accuracy of CT was 81% in our study which was similar to Sabharwal KK et al.[2] (82%) and Mashud et al.[24] (80%). Our accuracy was slightly lesser than Sharma P et al.[7] (86.6%). PK Shah et al.[21] had sensitivity of 95.65% and specificity of 96% in his study.[21] Simon GJ et al.[22] reported that features of molding around orbital structures, fat stranding, panorbital / perineural involvement had specificity of 97% to 100%, and the latter had a positive predictive value of 100% in diagnosing malignancy.[22] Our study had sensitivity, specificity, positive predictive value and negative predictive value of 82.6 %, 80.6%, 76% and 86.2% respectively which were lower than PK Shah et al.[21] and Guy J. Ben Simon et al.[22]

CONCLUSIONS:

CT is an indispensable imaging tool for evaluation of proptosis as it is noninvasive, cost effective, and easily accessible, has fastest speed of examination and can clearly demonstrate the exact location, characteristics, and extension and follow up monitoring of the lesion. Overall accuracy of CT in our study was 81%. Sensitivity and specificity were 82.6 % and 80.6% respectively. Neoplastic lesion was found to be the most common cause of proptosis in our setting. However needs to be evaluated further with higher level of study with larger sample size.

CONFLICT OF INTEREST

None

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None

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