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Validity of CT-Scan for the detection of malignant orbital mass among pediatric patients.

Dr Meher Angez Rahman.[1] , Salauddin Al Azad[2], Nazrul Islam[3], Sadrul Amin[4], Md Ziaul Haque[5], Mahmud Hasan Mostofa Kamal[6], Dr. Mukhdira[7], Mizanul Hasan[8]

[1]Consultant, Department of Radiology and Imaging, Anwar Khan Modern Medical College and Hospital, House 17, Road 8, Dhaka 1205, Bangladesh.
[2]Prof. Salauddin Al Azad. Department of Radiology BSMMU, Dhaka, Bangladesh.
[3]Associate Prof. Nazrul Islam, Department of Radiology & Imaging, BSMMU. Dhaka, Bangladesh
[4]Associate Prof. Sadrul Amin, Department of Radiology & Imaging, BSMMU. Dhaka, Bangladesh.
[5]Assistant. Prof. Md Ziaul Haque, previously worked at BSMMU, Dhaka, Bangladesh, now specialist radiologist at Al Gharbia Hospital,Abu Dhabi, UAE.
[6]Assistant Prof. Mahmud Hasan Mostofa Kamal, previously worked at BSMMU, Dhaka, Bangladesh.
[7]Dr. Mukhdira, lecturer, Community Based Medical College Bangladesh.
[8]Prof. Mizanul Hasan, National Institute of Nuclear Medicine & Allied Sciences, BSMMU, Dhaka, Bangladesh.
Corresponding author: ***Dr Meher Angez Rahman***

Abstract:
Background: The validity of CT-Scan for detection of orbital mass among pediatric patients is very important noninvasive radiological modality.
Objective: The purpose of the study was to find out the validity of CT-Scan to detection of orbital mass among pediatric patients with a view to develop it as an important radiological modality for the detection of orbital mass.
Methodology: This is a cross sectional study was carried out in Ophthalmology and Radiology and Imaging department of National Institute of Ophthalmology (NIO) from January 2012 to December 2013. All the patient below 18 years of age presented with suspected orbital mass at Ophthalmology and Radiology and Imaging department of NIO and performed CT- Scan of orbit for diagnosis of the disease and also done histopathology after operation was enrolled in this study.
Result: A total number of 70 patients clinically suspected cases orbital mass lesion who came in department of ophthalmology and Radiology and Imaging of National institute of ophthalmology (NIO), Dhaka, during the period of January 2012 to December 2013, were included in this study. In this present study it was observed that sensitivity 96.4%, specificity 95.2%, accuracy 95.7%, positive predictive values 93.1% and negative predictive values 97.6% of the CT scan evaluation for orbital mass lesion in pediatric population.
Conclusion: The validity of CT-Scan for detection of orbital mass among pediatric patients is very important, it is noninvasive useful method in the differentiation between benign and malignant orbital mass.

Keywords: Orbital mass; validity of CT-Scan

Introduction:

A wide spectrum of orbital pathology is seen in the paediatric population, can be categorized based on their tissue of origin, tumors of mesenchymal origin (rhabdomyosarcoma, histiocytosis, leukemia and lymphoma), neural origin tumors (retinoblastoma, optic nerve glioma, meningioma, schwannoma,

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neurofibroma and neuroblastoma) and vascular malformations or tumors (1).

Retinoblastoma is the most common intraocular tumor in. Mean age at clinical presentation is 2 years in unilateral forms (60% of cases) and 1 year in bilateral forms (2). CT detection of calcifications in retinoblastoma has a sensitivity of 81–96%, and an even higher specificity (3).

Imaging plays a crucial role in determining the local extent and for detecting associated brain abnormalities, i.e. intracranial tumor extension, possible midline intracranial primitive neuroectodermal tumor (PNET) and brain malformations (4). PNETs are associated with hereditary retinoblastoma, a combination known as trilateral retinoblastoma, which occurs in 5–15% of children in the hereditary subgroup (5).

Orbital rhabdomyosarcoma is the most common primary malignant orbital tumor in children and most common soft tissue malignancy of childhood. Rhabdomyosarcoma may arise in adjacent paranasal sinuses and secondarily involve the orbit through the thin bony wall with destruction of the sinus. CT can differentiate between primary orbital rhabdomyosarcoma and that arising from paranasal sinuses (6).

Cavernous haemangiomas most are located within the muscle cone. CT demonstrates the cavernous haemangiomas as a homogenously dense mass with smooth margins which shows uniform contrast enhancement. It can be easily demarcated from the adjacent optic nerve and the muscles. Lymphangioma are most often extraconal in location. On CT they are diffuse hyperdense masses with irregular margins and show mottled contrast enhancement. Orbital lymphoma , lacrimal gland is the most frequent site of involvement in the orbit. On CT the lacrimal gland lymphoma appears as a hyperdense mass in the lacrimal fossa that shows enhancement on contrast administration. It also displaces the globe medially and forwards. It responds very well to radiotherapy (7).

Dermoid most commonly located in the superotemporal and occasionally in the supranasal part of the orbit . On CT dermoid cysts have well defined margins and appear cystic, with the density of their center ranging from CSF to that of fat (8).

Langerhans cell histiocytosis often involves the orbital bones.CT appearance of a well-defined punched out lytic lesion with bevelled edges is characteristic. The associated soft tissue mass can encroach on the orbit or the brain, can be well-defined or diffusely infiltrative and has a nonspecific appearance on CT or MRI .Fibrous dysplasia occurs mainly in children and young adults and frequently involves the orbit. Plain radiograph and CT reveal characteristic ground glass appearance and expansion of the involved bone (9).

Optic nerve glioma thirty per cent cases are associated with neurofibromatosis Type 1 (NF1) (10). The tumor causes diffuse thickening, kinking or fusiform enlargement of the nerve, with moderate to marked enhancement which is generally less than that seen with meningioma (11). Subtle erosion or expansion of optic canal is better appreciated on CT while MRI is better in showing intracanalicular, chiasmatic or retrochiasmatic tumor extension (12). The differential diagnosis of optic nerve glioma on imaging includes optic nerve sheath meningioma and orbital pseudotumor (13).

Plexiform neurofibroma is the most common orbital manifestation of NF1 which typically presents during the first decade of life. On imaging it appears as an ill-defined, infiltrative, soft tissue mass which may involve the retrobulbar fat, the extraconal space including eyelid and adjacent subcutaneous tissue. The other orbital associations of NF1 include presence of optic pathway gliomas (in 15 to 40% cases) and sphenoid wing hypoplasia (13).

Orbital metastasis in children is most commonly seen with neuroblastoma, in as many as 20% cases (14). CT reveals an aggressive infiltrative soft tissue mass associated with bone destruction. Orbital metastasis may occasionally be seen in patients with Ewings sarcoma and RMS (15). Granulocytic sarcoma or chloroma results from leukemic infiltration of the soft tissue which commonly involves the orbit. Like leukemia, pediatric patients with lymphoma can have orbital, optic nerve or intraocular involvement (16).

Methodology

This was a cross-sectional study. This study was carried out in the Department of Radiology & Imaging in collaboration with department of ophthalmology of the NIO (National Institute of Ophthalmology. Period of study: January 2012 to December 2013. All the patient below 18 years of age preseented with suspected orbital mass at ophthalmology department and attending department of radiology of NIO (National Institute of Ophthalmology), Dhaka and perfomed CT scan of orbit for diagnosis of the disease and also done histopathology after operation was enrolled in this study. CT scan is preferred due to the speed and easy availability of this modality. Subtle or small calcifications are well shown, and artifact from eye motion is minimized. Iodinated intravenous contrast may be used to assist in characterizing a mass, although it is not usually necessary as intraorbital fat provides excellent natural contrast. CT scan should be

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performed with contiguous thin section (2-3mm) axial, and thicker section (4-5mm) coronal images, displayed in both soft-tissue and bone windows. Alternatively, coronal and oblique sagittal projections may be reformatted from axial images; the resultant image quality is improved by using overlapping sections to avoid `stair-step' artifact (e.g. 3mm thick, 2mm table increments). Evaluation of the orbital apex may require very thin section overlapping coronal images (1.5mm) thick, with 1 mm table motion), so that 3D reconstructions may be made. Spiral CT scanning, if available may also be used to provide the same data set for subsequent reconstructions. For this study 3rd generation Siemens 6 slice CT scan machine is used. Slice thickness is 2-3mm ,axial cut with sagittal and coronal reconstructions are done.

Results

A total number of 70 patients clinically suspected cases orbital mass lesion who came in department of ophthalmology and Radiology and Imaging of National institute of ophthalmology (NIO), Dhaka, during the period of January 2012 to December 2013, were included in this study.

Table I: Distribution of the study patients by CT scan (n=70)

CT scan	Number of patients	Percentage
Malignant		
Retinoblastoma	9	12.9
Optic nerve glioma D/D meningioma/ haemangioma	8	11.4
Rhabdomyosarcoma D/D eosinophilic granuloma, sarcoma	2	2.8
Rhabdomyosarcoma D/D Lymphoma	2	2.8
Lymphoma	3	4.3
Eosinophilic granuloma D/D haemangio -pericytoma	2	2.8
Haemangioma D/D haemangio-pericytoma, ,eosinophilic granuloma	1	1.4
Sarcoidosis D/D peudotumour	2	2.8
Benign		
Dermoid	15	21.4
Neurofibroma	9	12.9
Pseudo tumour D/D Sarcoidosis	3	7.1
Haemangioma D/D schwannoma	3	7.1
Schwannoma D/D maningioma	1	1.4
Peudotumour	2	2.8
Meningioma D/D Haemangioma	3	4.3
Haemangioma D/D meningioma	3	4.3
Schwannoma D/D haemangioma	2	2.8

Table I shows CT scan of the study patients it was observed that, in malignant cases majority 9(12.9%) patients done retinoblastoma followed by 8(11.1%) optic nerve glioma D/D meningioma, haemangioma. In benign cases, 15(21.4%) patients have dermoid followed by 9(12.9%) patients have-neurofibroma.

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Table II: Distribution of the study patients by histopathology (n=70)

Histopathology	Number of patients	Percentage
Malignant		
Retinoblastoma	9	12.9
Optic nerve glioma	8	11.4
Rhabdomyosarcoma	5	7.1
Non hodgkin lymphoma	3	4.3
Eosinophilic granuloma	2	2.8
Haemangio pericytoma	1	1.4
Benign		
Dermoid	15	21.4
Neurofibroma	9	12.9
Pseudotumour	7	10.0
Haemangioma	6	8.6
Schwannoma	5	7.1

Table II shows histopathology of the study patients it was observed that, in malignant cases 9(12.9%) patients had retinoblastoma, 8(11.4%) had optic nerve glioma and 5(7.1%) had rhabdomyosarcoma.
In benign cases, 15(21.4%) patients had dermoid, 7(10.0%) had psedotumour, 6(8.6%) had haemangioma and 5(7.1%) had schwannoma.

Table III: Comparison between CT scan and Histopathology (n=70)

		Histopathology			
CT scan		**Malignant (n=28)**		**Benign (n=42)**	
		N	**%**	**N**	**%**
Malignant	n=29	27	96.4	2	4.8
Benign	n= 41	1	3.6	40	95.2

Table III shows CT scan malignant was found 27(96.2%) in malignant histopathology and 2(4.8%) in benign histopathology. CT scan benign was found 1 (3.8%) in malignant histopathology and 40(95.2%) in benign histopathology.

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Table IV: Sensitivity, specificity, accuracy, positive and negative predictive values of the CT scan evaluation for orbital mass lesion in pediatric population

Validity test	Percentage
Sensitivity	96.4
Specificity	95.2
Accuracy	95.7
Positive predictive value	93.1
Negative predictive value	97.6

Table IV shows the validity of CT scan for orbital mass lesion correlated by calculating sensitivity, specificity, accuracy, positive and negative predictive values.

Discussion:

This cross sectional study was carried out with an aim to evaluate the patients having orbital mass lesion in pediatric population and to evaluate the association between CT scan finding with histopathological correlation and along with its validity tests by calculating sensitivity, specificity, accuracy, positive predictive value (PPV) and negative predictive value (NPV) respectively of CT scan in diagnosis of pathological variety of orbital mass.

A total of 70 patients under 18 years of age presented with suspected orbital mass at ophthalmology department and attending Department of Radiology of National Institute of Ophthalmology (NIO), Dhaka during January 2012 to December 2013, were included in this study. Patients above 18 years of age, patient's not undergoing histopathology and patients' guardian not given consent were excluded from the study. CT scan evaluation of orbit for diagnosis of the disease and all patients underwent histopathology after operation. The present study findings were discussed and compared with previously published relevant studies.

In this study it was observed that CT scan identified 29 malignant cases, among them 12.9% patients had retinoblastoma followed by 11.1% optic nerve glioma D/D meningioma, haemangioma, 4.3% had Lymphoma and others malignant varied from 1.4% to 2.8%. In benign cases, 21.4% patients had dermoid and 12.9% had neurofibroma(Table I). Lecompte and Langelier (1994) present in their study that the most commonly encountered tumours: uveal melanoma (observed in 50 cases), lymphoma (in 8), optic glioma (in 6), meningioma (in 6), dermoid cyst (in 5) and metastasis (in 5).

In this present series it was observed that histopathology identified 28 malignant cases, among them 12.9% had retinoblastoma, 11.4% had optic nerve glioma and 7.1% had rhabdomyosarcoma. A total of 42 benign cases was identified by histopathology among them 21.4% patients had dermoid, 10.0% had psedotumour, 8.6% had haemangioma and 7.1% had schwannoma (Table II).

In this current series it was observed that a total of 29 cases identified as malignant evaluated by CT, among them 27 cases were true positive and 2 cases were false positive. Benign was found in 41 cases evaluated by CT scan, out of which 1 false negative and 40 case were true negative(Table III).

In this present study it was observed that sensitivity 96.4%, specificity 95.2%, accuracy 95.7%, positive predictive values 93.1% and negative predictive values 97.6% of the CT scan evaluation for orbital mass lesion in pediatric population(Table IV). On CT, retinoblastoma is typically a mass of high density compared with the vitreous body, usually calcified and moderately enhancing after iodinated contrast medium administration. Beets-Tan et al. (1994) mentioned in this study that CT detection of calcifications in retinoblastoma has a sensitivity of 81–96%, and an even higher specificity (3). In another study (Eisen et al. 2000) reported that six or more positive criteria predicted invasion with 67% sensitivity and 80% specificity with an accuracy of72% (17). CT was more accurate than MRI. Invasion of the nasolacrimal system was predicted accurately (89%). Features such as panorbital involvement, orbital fat, frontal sinus opacity, molding around orbital structures, perineural involvement, and fat stranding had specificity of 97% to 100%, but low sensitivity (18). The above study findings are closely resumbled with the current study.

Conclusion

This study was undertaken to evaluate the CT scan finding of orbital mass in pediatric population with histopathological correlation. It can be concluded that

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CT scan is a useful method in the differentiation between benign and malignant orbital mass. Moreover CT scan is cost effective, available, not time consuming and real time image. White eye, lacrimation, proptosis eye ball, extra ocular muscle and retina lesions are best seen in CT, which help surgeon for operative plan and decreases patient's morbidity and mortality.

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