The accuracy of radiological imaging in the diagnosis of orbital lesions in a regional hospital

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Abstract

Aim: To compare the accuracy of radiological imaging with pathological findings in patients with orbital space-occupying lesions.
Patients and methods: This was a retrospective review of the records of consecutive patients who underwent orbitotomy for orbital masses in a regional hospital during 1998 to 2002. Only records with preoperative radiological reports and postoperative histopathological reports available were reviewed.
Results: Thirty two patients' records were reviewed. The overall diagnostic accuracy of radiological imaging for specific groups of lesions was 78.1%. The accuracy of radiological imaging for the diagnosis of cystic lesions, vascular lesions, lacrimal lesions, neurogenic lesions, and lymphoid lesions was 100.0%, 83.3%, 60.0%, 50.0%, and 28.6%, respectively. In terms of accuracy of detecting malignancy, 17.6% of the lesions diagnosed as benign by imaging studies were malignant by histology. However, 50.0% of the lesions diagnosed as malignant by imaging studies were benign by histology.
Conclusions: Radiological investigations have a high specificity (0.92) and low sensitivity (0.28) for detecting malignancy. Radiology has a high negative-predictive value (0.82) and low positive-predictive value (0.50) for malignant lesions. Radiological reports from the studied regional hospital are accurate for ruling out malignant lesions and are relatively accurate for diagnosing cystic and vascular lesions.

Key words: Histology, Orbital neoplasms, Radiology

Introduction

A variety of space-occupying lesions may involve the orbit.[1] The pathology of these lesions ranges from benign to malignant.[2] Most, if not all, patients presenting with suspected space-occupying lesions will be advised to undergo radiological investigations for primary evaluation. Thus, the management of patients with orbital masses heavily relies on the radiological findings. Using advanced imaging technology of computed tomography (CT) and magnetic resonance imaging (MRI), clinicians should be able to make an accurate diagnosis for most patients. Many benign tumors, such as capillary hemangioma, lymphangioma, optic nerve glioma, optic nerve sheath meningioma, and asymptomatic orbital cavernous hemangioma, no longer require surgery.[3] However, information about the accuracy of the radiological findings, correlated with the pathological or histological findings as a reference, is useful for the management of orbital lesions. The aim of this study was to evaluate the accuracy of the radiological findings compared with the pathological or histological findings for patients with orbital space-occupying lesions.

Patients and methods

This retrospective study reviewed the records of consecutive patients who underwent orbitotomy for orbital masses in a regional hospital between 1998 and 2002. Only records with preoperative radiological reports (CT and/or MRI) and pathological or histological reports were assessed. The radiological findings were reviewed and the radiological diagnosis for each patient was defined by the conclusive diagnosis given on the radiological report after CT or MRI. If there was no conclusive diagnosis, the 'most likely' diagnosis was the first of the differential diagnoses.

Table 1. Accuracy of radiological imaging for the diagnosis of orbital lesions.

Orbital lesion	Accuracy of imaging (%)
Cystic	100.0
Vascular	83.3
Lacrimal	60.0
Neurogenic	50.0
Lymphoid	28.6

The nature of the lesions reported by the radiologists (whether benign or malignant) was also noted. Seven radiologists were involved in reporting the CT or MRI films. In general, the CT scans included axial and coronal images with 5-mm or finer slice thicknesses. This method was chosen according to Hammerschlag et al, who reported that a slice thickness of 5 mm was optimal for most orbital scanning to provide adequate resolution of the small structures.[4]

MRI was undertaken only if CT yielded insufficient information for making the diagnosis or insufficient anatomical detail for future surgical management. When MRI was required, the radiologist determined the protocol. The basic MRI orbital protocol consisted of the following:

- T1- and T2-weighted axial images through the orbits using a 14- to 16-mm field of view and 3-mm thick slices with 1-mm interspaces
- a similar fat-suppressed axial T1-weighted image with or without a contrast-enhanced axial image
- coronal and/or parasagittal oblique fat-suppressed T1-weighted images with identical fields of view and slice settings.[5]

The use of contrast agent was decided by the radiologists. The references for the accuracy of the radiological findings were the histopathological results of the biopsy taken at the time of orbitotomy.

Table 2. Radiological and histological findings of 32 lesions reviewed.

Sex	Age (years)	Imaging study	Radiological diagnosis		Histological diagnosis	
Female	59	CT	Pseudotumor	Benign	Lymphoma	Malignant
Female	37	CT/MRI	Pseudotumor	Benign	Lymphoma	Malignant
Female	55	CT	Pseudotumor	Benign	Lymphoma	Malignant
Male	64	CT	Pseudotumor	Benign	Lymphoma	Malignant
Female	71	CT	Pseudotumor	Benign	Lymphoma	Malignant
Male	66	CT	Lymphoma	Malignant	Lymphoma	Malignant
Female	50	CT	Lymphoma	Malignant	Lymphoma	Malignant
Female	4	CT	Cyst	Benign	Epidermal cyst	Benign
Male	4	CT	Cyst	Benign	Dermoid cyst	Benign
Female	2	CT/MRI	Cyst	Benign	Dermoid cyst	Benign
Female	73	CT	Meningioma	Benign	Cavernous hemangioma	Benign
Male	66	CT	Lymphoma	Malignant	Cavernous hemangioma	Benign
Male	43	CT	Cavernous hemangioma	Benign	Cavernous hemangioma	Benign
Female	39	CT/MRI	Cavernous hemangioma	Benign	Cavernous hemangioma	Benign
Female	51	CT	Cavernous hemangioma	Benign	Cavernous hemangioma	Benign
Female	36	CT	Cavernous hemangioma	Benign	Cavernous hemangioma	Benign
Female	39	CT	Cavernous hemangioma	Benign	Cavernous hemangioma	Benign
Female	43	CT	Cavernous hemangioma	Benign	Cavernous hemangioma	Benign
Male	69	CT	Cavernous hemangioma	Benign	Cavernous hemangioma	Benign
Female	44	CT	Cavernous hemangioma	Benign	Cavernous hemangioma	Benign
Female	50	CT	Cavernous hemangioma	Benign	Cavernous hemangioma	Benign
Female	54	CT/MRI	Cavernous hemangioma	Benign	Cavernous hemangioma	Benign
Female	5	CT	Mixed adenoma	Benign	Cyst of lacrimal gland	Benign
Female	72	CT/MRI	Metastasis of malignancy	Malignant	Normal lacrimal gland	Benign
Male	57	CT	Pleomorphic adenoma	Benign	Lymphoepitheloid tumor	Benign
Female	66	CT	Pleomorphic adenoma	Benign	Pleomorphic adenoma	Benign
Female	63	CT	Pleomorphic adenoma	Benign	Pleomorphic adenoma	Benign
Male	64	CT	Nerve sheath tumor	Benign	Neurilemmoma	Benign
Female	76	CT	Hemangioma	Benign	Schwannoma	Benign
Male	37	CT	Fat	Benign	Fat	Benign
Male	72	CT	Lipoma	Benign	Lipoma	Benign
Male	6	CT	Lipoma	Benign	Lipoma	Benign

Abbreviations: CT = computed tomography; MRI = magnetic resonance imaging.

Results

Thirty two patients' records were reviewed. Eleven patients were men and 21 were women. The ages ranged from 2 to 76 years. The lesions were categorized according to the imaging diagnoses (density, intensity, and site of the lesions). Vascular lesions accounted for 37.5% of all lesions, lymphoid lesions accounted for 21.9%, cystic lesions accounted for 18.8%, lacrimal lesions accounted for 15.6%, and neurogenic lesions accounted for 6.3%.

The overall accuracy in terms of specific groups of lesions was 78.1% (25 of 32 diagnoses were correctly made by radiological investigations). The accuracy of radiological imaging for the diagnosis of cystic lesions, vascular lesions, lacrimal lesions, neurogenic lesions, and lymphoid lesions was 100.0%, 83.3%, 60.0%, 50.0%, and 28.6%, respectively (**Table 1**).

Regarding accuracy of the diagnosis of malignancy, 5 of 28 lesions (17.6%) were diagnosed as benign at imaging but were malignant according to histology. Two of 4 lesions (50.0%) were diagnosed as malignant at imaging but were benign according to histology (**Table 2**). The 5 lesions that were radiologically diagnosed as benign and were found to be malignant by histology were initially radiologically diagnosed as pseudotumor. However, 3 lesions did not respond to high-dose steroid as expected and 2 lesions responded with a small decrease in size in subsequent weeks. All 5 patients underwent orbitotomy resulting in a pathological diagnosis of malignant lymphoma. One patient with radiologically diagnosed malignant lymphoma underwent orbitotomy for debulking of the mass. The pathological diagnosis was reactive mature lymphocytes and was more likely to be pseudotumor. The second patient with radiologically diagnosed malignant lacrimal tumor (thought to be a case of metastasis according to the clinical history) underwent surgery for confirmation of the diagnosis. Pathology showed normal lacrimal tissue.

Discussion

The diagnosis of an orbital lesion may be made according to the imaging appearance.[6] For example, the location of a lesion within the orbit may serve as a clue to the diagnosis. Certain lesions have a predilection for either the intraconal or extraconal space. Whether an orbital disease is unilateral or bilateral is also important. For example, pseudotumor and metastases tend to involve the orbit bilaterally. Multicentricity of lesions would suggest metastases, pseudotumor, or lymphoma. Specific lesion characteristics such as the appearance of the margin may be helpful — lesions with well-defined margins are often benign, whereas vague, poorly defined margins suggest an infiltrative process such as lymphoma or pseudotumor. The shape of the lesion also aids the diagnosis, especially vascular lesions that possess components of a characteristic tubular shape. Cystic lesions are recognized by a capsule that is of higher density than the central contents. Calcification may be found in mixed

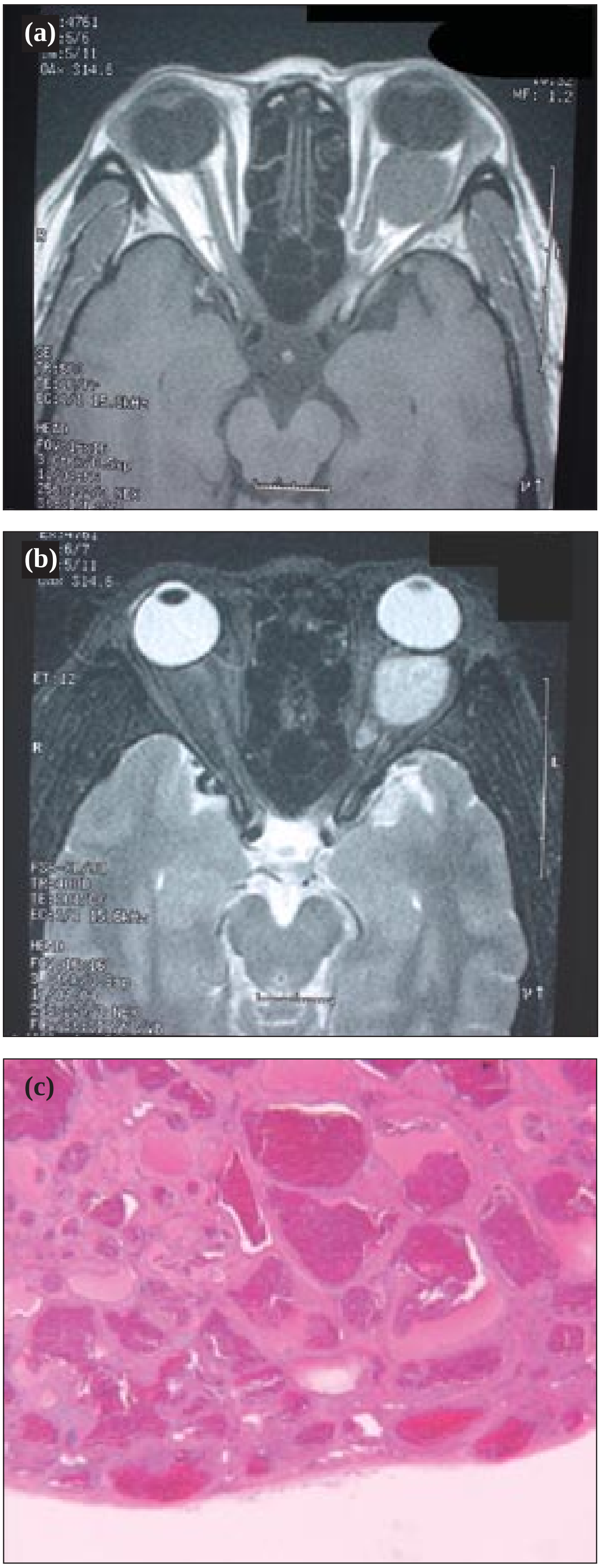

Figure 1. (a and b) Magnetic resonance images of the orbit of a 44-year-old woman showing a mildly lobulated oval T1 isointense and T2 hyperintense soft-tissue mass with homogenous contrast enhancement. The diagnosis was cavernous hemangioma. (c) A well-circumscribed lesion consisting of irregular blood-containing spaces. (Hematoxylin and eosin stain; original magnification, x 16.)

tumors of the lacrimal glands, cavernous hemangiomas, retinoblastomas, orbital varices, the capsule of dermoids, optic nerve sheath meningiomas, and optic gliomas. Bone destruction is an important clue to the diagnosis of orbital lesions. Frank bone destruction generally signifies an aggressive or malignant process, whereas smooth erosions or molding indicates a long-standing benign lesion. Hyperostosis is noted in fibrous dysplasias, meningiomas, and lacrimal gland tumors.[6-8]

CT is a good choice for viewing almost every lesion in the craniofacial area except for the intracanalicular optic nerve.[9] Although MRI is considered to be a superior technique for evaluating soft tissues, in the orbit, most pathologic processes are adequately demonstrated by CT.[10] Thus, in this study, not all patients required both CT and MRI scans. Only those patients for whom CT yielded insufficient information for making the diagnosis or insufficient anatomical detail for future surgical management underwent MRI.

In this series of patients, the accuracy of the diagnosis of orbital cystic, vascular, lacrimal, neurogenic, and lymphoid lesions was 100.0%, 83.3%, 60.0%, 50.0%, and 28.6%, respectively. Radiological diagnosis was most accurate for cystic and vascular lesions and was less accurate for lacrimal, lymphoid, and neurogenic lesions. This finding may be due to the fact that cystic and vascular lesions have characteristic features that are easily recognizable radiologically (**Figure 1**). On the other hand, malignant lesions such as lymphoma are particularly difficult to differentiate from benign inflammatory conditions of the orbit (**Figure 2**).

Radiological investigations were found to be accurate for ruling out malignant conditions, with a high specificity (0.92) and low sensitivity (0.28) for detecting malignancy. Radiological imaging also has a high negative-predictive value (0.82) and low positive-predictive value (0.50) for malignant lesions. This may be due to overcautiousness

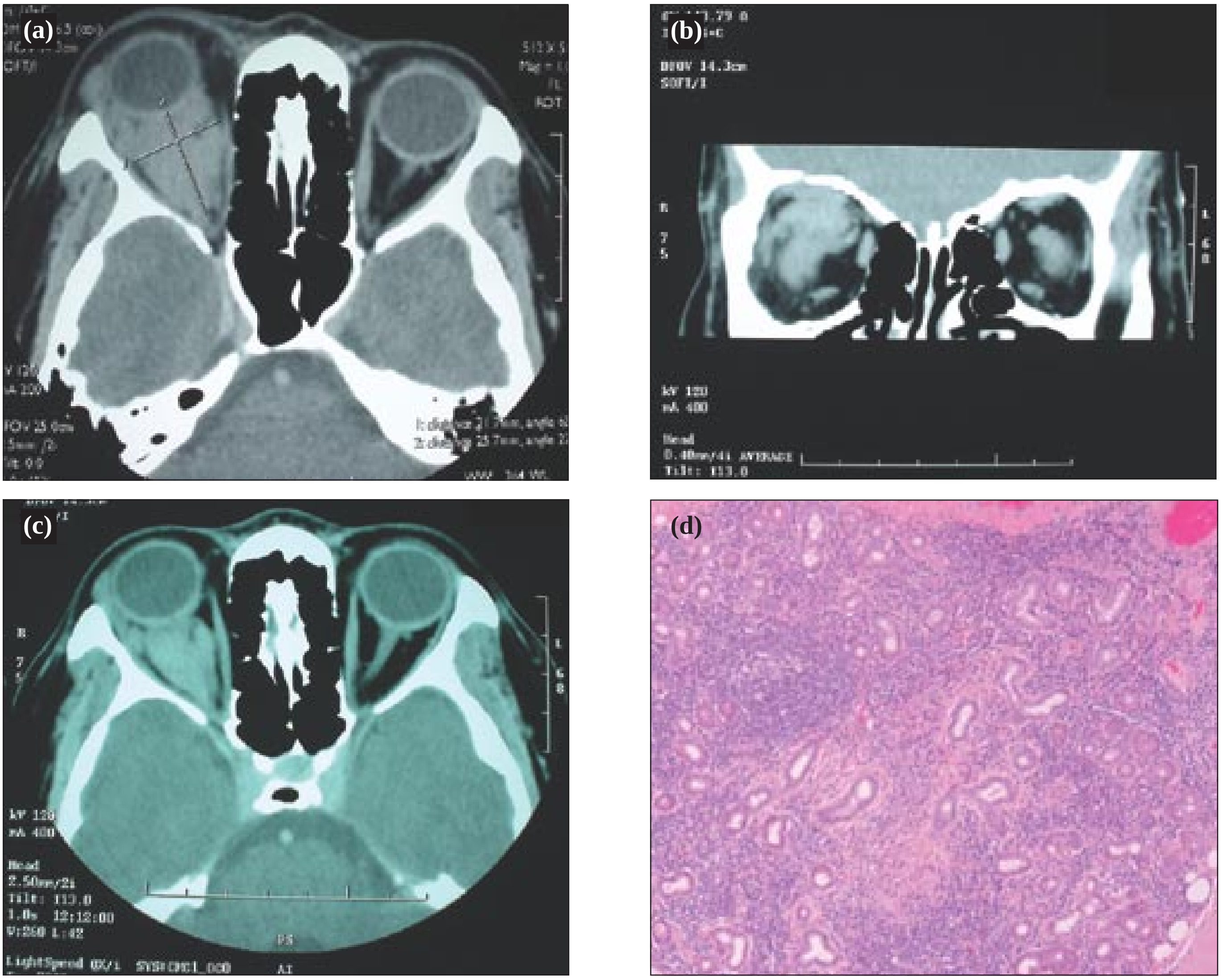

Figure 2. (a and b) Computed tomograms of the orbit of a 59-year-old woman showing a hyperdense mass in the retrobulbar area of the right orbit, slightly superior to the globe. No bony erosion was seen. The finding was suggestive of pseudotumor. (c) Repeat computed tomogram showing no obvious decrease in the size of the mass after systemic steroid was given for 3 weeks. A malignant lesion was suspected. (d) Malignant lymphoma showing sheets of abnormal small lymphoid cells, many of which possess small amounts of pale cytoplasm. (Hematoxylin and eosin stain; original magnification, x 200.)

in ruling out a malignant lesion. However, there were 7 radiologists involved in commenting on the films, which minimized the likelihood of overcautious practice by a single radiologist.

The results of this series have shown that radiological findings are accurate for diagnosing non-malignant lesions and are relatively accurate when the lesions are either cystic or vascular. This preoperative information assists the management decision. As orbitotomy is not without risks, an accurate preoperative diagnosis by radiological investigation is essential for managing patients with orbital masses. Clinical information given on the radiology request forms by the ophthalmologists can facilitate the diagnosis. Collaboration and discussion between clinicians and radiologists are therefore essential for making accurate radiological diagnoses.

This study aimed to provide an idea of the accuracy of radiological reports for the management of orbital lesions. The study was limited by a relatively small sample size, observer bias (each radiological report was commented by only 1 radiologist), and selection bias (only those patients who underwent orbitotomy were recruited, thus excluding all patients who did not undergo surgery). Therefore, the occurrence of different orbital tumors in this series was not comparable to a recent survey of patients with orbital tumors and simulating lesions.[3] However, radiological reports were found to be accurate for ruling out malignant lesions and were relatively accurate for diagnosing cystic and vascular lesions.

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