RADIO-IMAGING DIAGNOSIS OF THE OCULAR AND ORBITAL TUMORS

Simona Dunărițănu 1, F. Bîrsășteanu 1, D. Oneț 1, Magda Păscuț 1, D. Costea 2, Maria Mogoșeanu 1

ABSTRACT. BACKGROUND: The orbital tumors may involve or arise from any of the orbital structures (ocular globe, muscles, optic nerve and orbital cranial nerves, blood vessels).

OBJECTIVE: The purpose of this study was to evaluate the contribution of the radio-imaging investigations at diagnosis of the orbital tumors and to establish clinical-radio-imaging and histopathological correlations. MATERIALS AND METHODS: We studied 151 patients (79 female - 52.31 % and 72 male - 47.68%), with age between 1-82 years old, who were diagnosed with orbital tumors and were admitted in the Clinic of Neurosurgery, County Hospital Timișoara, during January 1998 until 2007. The patients were examined clinic, fundoscopic and using ultrasonography, computerized tomography (CT) and magnetic resonance imaging (MRI) with and without contrast material. Postoperative, histopathological examinations were evaluated.

RESULTS AND DISCUSSIONS: The left orbital tumors were predominant in 79 cases (52.31%) and the right orbital tumors in 57 cases (37.74%). Exophthalmia was the most important clinical symptom found in 95 cases (62.91%). Left exophthalmia was found in 55 cases (57.89%) and right exophthalmia in 40 cases (42.10%). We classified the orbital tumors: primitive orbital tumors 114 (75.49 %), propagated secondary orbital tumors 33 (21.95 %) and secondary metastatic orbital tumors 4 (2.64 %). The most frequent histopathological type of primitive orbital tumors was meningiomas (14.56%), hemangiomas and lymphomas. CONCLUSIONS: US is a convenient ophthalmological screening which need to be supplemented with more advanced imaging techniques (CT and MRI). Both CT and MRI are important modalities for diagnosis of orbital tumors. CT is better for evaluation of bones and detection of calcifications. MRI provide better soft tissue discrimination and offers better multiplanar examinations. MRI is superior for imaging the visual pathways. These, two modalities (CT and MRI), either alone or in combination, will provide an exact diagnosis.

Keywords: orbital tumors, orbital neoplasm, orbital mass, retrobulbar mass.

DIAGNOSTICUL RADIO-IMAGISTIC AL TUMORILOR OCULO-ORBITARE

REZUMAT. Scopul lucrării Urmărirea aportului investigaţiilor radio-imagistice la diagnosticul tumoralor orbitare şi stabilirea unor corelaţii clinic-radio-imagistice şi anatomo-patologice.

Material şi metodă: Am studiat un număr de 151 bolnavi diagnosticaci cu tumori orbitare, internaţi în Clinica de Neurochirurgie a Spitalului Județean Timişoara, în perioada ianuarie 1998-ianuarie 2007. Bolnavii au fost urmaţi clinic, paracentric (F.O, imagistic: echografie orbitară, CT, RMN) si anatomo-patologic. Rezultate: Am investigat un număr de 79 femei (52.31%) şi 72 bărbaţi (37.74%). Grupa de vârstă cea mai frecvent afectată a fost cea între 51-70 ani (42,38%). Localizarea tumorală orbitară stângă a predominat în 79 din cazuri (53,52%). Exoftalmia a fost simptomul clinic major în 95 din cazuri (62,91 %), cea stângă fiind întâlnită în 55 din cazuri. Am întâlnit 114 tumeori primitive orbitare (80,28%), 33 tumori secundare orbitare propagate (15,49%) şi 4 tumori orbitare metastatice (4,22%). Cele mai frecvente tipuri tumoreale din punct de vedere histologic au fost meningioamele (24,56%), urmate de pseudotumorele inflamatorii, hemangiome şi limfoame. Concluzii: Tumorile orbitare reprezintă o patologie importantă cu implicare pluridisciplinară. Echografia oculară este o metodă de screening oftalmologic care necesită a fi suplementată de tehnici imagistice moderne - CT şi IRM. Ambele examinări CT şi IRM furnizează informaţii pentru diagnostic. CT defineşte suprafaţa în evidenţierea calcificărilor şi a structurilor osoase. RMN evidenţiază bine poziţia intracraniană şi intracraniană a nervului optic, apexul orbitar, sinusul cavernous chisma optică, ţaua turcică. Pentru un diagnostic preoperator corect sugerăm asocierea metodelor!

Received for publication: 10.12.2007
Revised: 10.02.2008

1 - Department of Radiology and Medical Imaging,
2 - Clinic of Neurosurgery University of Medicine and Pharmacy “Vitor Babeş” Timişoara

Correspondence to: Simona Dunărițănu, e-mail: dr_simonad@yahoo.com / 0744528442
BACKGROUND

The orbital tumors may involve or arise from any of the orbital structures (ocular globe, muscles, optic nerve and orbital cranial nerves, blood vessels). (1)

Their incidence is increasing, requiring a multidisciplinary approach (ophthalmologic, radio-imaging, neurosurgery). (2)

OBJECTIVE

The purpose of this study was to evaluate the contribution of the radio-imaging investigations at diagnosis of the orbital tumors and to establish clinical-radio-imaging and histopathological correlations.

MATERIALS AND METHODS

We studied 151 patients (79 female - 52.31% and 72 male- 37.74%) with age between 1-82 years old, who were diagnosed with orbital tumors and were admitted in the Clinic of Neurosurgery, County Hospital Timișoara, during January 1998 until January 2007.

The patients were examined clinic, fundoscopic and using ultrasonography, computerized tomography and magnetic resonance imaging with and without contrast substance. Postoperative, histopathological examinations were performed.

Ocular ultrasonography can be used to visualize anterior and middle orbital lesions. Sound waves of 5-15 MHz breech orbital tissues that reflect echogenic energy captured by an oscilloscope. A-scan ultrasonography allows for a 1-dimensional description of echoes, while B-scan ultrasonography provides a 2-dimensional image.

US was performed transpalpebral for visualization the space-occupying lesion, the tumor vascularization, for evaluation of the optic nerve and ocular globe. It is useful for detecting anterior (ocular) and immediate retrobulbar lesions. Color Doppler US is used in evaluation of the vascular tumors.

CT native and with intravenous contrast is the most important technologic advance in the evaluation and management of orbital tumors. CT scan can produce detailed axial and coronal views of soft tissue and bony structures. Image windows from 1.0-3.0 mm in thickness allow for detailed evaluation of orbital masses. Contrast substance is often necessary to evaluate vascular characteristics, extraorbital extension of an orbital process, inflammatory lesions or for better visualization of optic nerve. CT is a modality of choice for bony details and for detecting calcifications. Irradiation is a disadvantage, especially in cases that require scans for monitorisation at young patients.

MRI (T1, T2, PD, STIR, T1+Gd) is a superior technique indicated for extension of the tumors. It is ideal for soft tissue evaluation, for diagnosis of posterior and apical orbital tumors or for evaluation of optic nerve and optic chiasm. Three-dimensional views can be gained, directly, in any anatomical plane offering excellent spatial resolution of orbital masses and soft-tissue enhancement. MRI presents the advantage of multiplanarity but it is contraindicated in people with ferromagnetic implants. MRI may provide excellent soft-tissue resolution, but CT scan is superior for gleaning details about orbital bony structures. MR angiography (MRA) is another advantage of MRI.

RESULTS AND DISCUSSIONS

The left orbital tumors were predominant in 79 cases (52.31%) and the right orbital tumors in 57 cases (37.74%).

![Pie chart showing distribution of age range](image)

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;71 years</td>
<td>20.52%</td>
</tr>
<tr>
<td>51-70 years</td>
<td>42.38%</td>
</tr>
<tr>
<td>31-50 years</td>
<td>19.20%</td>
</tr>
<tr>
<td>10-30 years</td>
<td>13.24%</td>
</tr>
<tr>
<td>&lt;10 years</td>
<td>4.63%</td>
</tr>
</tbody>
</table>

Table 1. Distribution from age - range
Table 2. Imaging investigations

Table 3. Classification of orbital tumors

Table 4. Histopathological classification of the primitive orbital tumors
Exophthalmia was the most important clinical symptom found in 95 cases (62.91%). Left exophthalmia was found in 55 cases (57.89%) and right exophthalmia in 40 cases (42.10%).

The most frequent adult benign tumors are: meningiomas, inflammatory pseudotumors, cavernous hemangiomas.

The most frequent adult malignant tumors are: lymphatic tumors, scuamous cell carcinoma, metastatic tumors.

The most frequent pediatric benign tumors are: capillary hemangiomas, dermoid cysts, optic nerve gliomas.

The most frequent pediatric malignant tumors are: retinoblastomas, rhabdomyosarcomas, metastatic tumors.

In adults, cavernous hemangiomas are the most common de novo orbital tumefaction. CT scan reveals a round, encapsulated, well-defined orbital lesion. At MRI meningiomas, frequently sphenoorbital meningiomas, 7 cases with recurrent sphenoorbital meningiomas.

Orbital secondary invasive lesions have an important rate in our study (15.49%).

We propose an algorithm to interpret orbital imaging studies, based on 5 major characteristics including anatomic location, content, soft tissue and bone characteristics and associated features.

Regarding anatomic location we found: ocular location, orbital, retrobulbar location divided in intraconal space, including optic nerve and extraconal space with orbital fat, lacrimal fossa, sphenoid wing.

Bone characteristics include: hyperostosis, status of primary bone, erosions.

Content of tumoral mass CT and MRI aspect help in diagnosis. Soft tissue characteristics: regular-oval shape, diffuse, molding, circumscribed, irregular. Associated features: fat stranding, perineural involvement, nerve distribution.

Case examples:

- 45-year-old male patient with left discreet but inductible exophthalmus. MRI shows retrobulbar, intraconal space-occupying lesion, well demarcated, heterogeneously, in hyposignal T1, isosignal T2, 23/11 mm, located between lateral rectus muscle and optic nerve with heterogeneously aspect native and after contrast administration.
- 59-year-old male patient with slowly progressing loss of vision and right exophthalmus. MRI shows heterogeneously large mass (solid and

![Fig. 1. Cavernous hemangioma](image.png)
cystic) with tumoral nodules. It is situated between lateral and medial rectus muscle; the optic nerve can not be delineated. Marked contrast enhancement of the solid part.

- 32-year-old female patient with left progressive exophthalmus, motility disorders and headache. Endoteliomatous meningioma reoperated 2 years ago.
- CT - extensive tumoral mass with strong characteristic enhancement. Characteristic hyperostosis is showed in CT with bone window. MRI - extensive mass zygomatico-fronto-orbital in T1, T2, with strong enhancement. Porencephalic cavity left temporal pole.
- 53-year-old female patient with loss of visual acuity and cerebelar findings. MRI shows large partially necrotic ethmoidal sinus tumor extending into the adjacent right orbit. The tumor has metastases at the level of pons and in the right cerebelar lobe.
- 58-year-old male patient with VI cranial nerve paresis, left exoftalmus progressive and palpable mass in supero-externo angle of the left orbit. MRI shows in the area of lacrimal gland a smooth,
encapsulated, in isosignal T1 like the muscles, and
discrete hipersignal T2, with contrast
elevation predominantly capsular, that
produce lacrimal gland enlargement.

Statistical classification of primitive oculo-
orbital tumors:
- Inflammatory pseudotumors 12 (7.94%)
- Cavernous hemangiomas 9 (5.96%)
- Retinoblastomas 9 (5.96%)
- Optic nerve glioma 8 (5.29%)
- Orbital lymphoma 7 (4.63%)
- Osteomas 7 (4.63%)

- Orbital varix 6 (3.97%)
- Optic nerve meningiomas 6 (3.97%)
- Capillary hemangiomas 5 (3.31%)
- Lacrimal gland adenoma 5 (3.31%)
- Coroidal melanomas 4 (2.64%)
- Neurofibromas 4 (2.64%)
- Dermoid cysts 4 (2.64%)
- Orbital leucemic infiltrate 4 (2.64%)
- Lymphoma of lacrimal gland 3 (1.98%)
  - Unilateral 2
  - Bilateral 1
- Mixed tumors of lacrimal gland 3 (1.98%)
CONCLUSIONS

US is a convenient ophthalmological screening that needs to be supplemented with more advanced imaging techniques (CT and MRI).

Both CT and MRI are important modalities for diagnosis of orbital tumors.

CT is better for evaluation of bones and detection of calcifications.

MRI provide better soft tissue discrimination and offers better multiplanar examinations.

MRI is superior for imaging of the visual pathways.

These, two modalities (CT and MRI), either alone or in combination, will provide an exact diagnosis.

REFERENCES:
3. Thomas M. Aaberg, Jr. MD. - B Scan Ocular US , Emedicine, 2005
REFERENCES (continued):