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Comparison of Sonography and Computed Tomography in the Study of Orbital Space-Occupying Lesions

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Seventy cases of space-occupying lesions in the eyeball and 140 extraocular masses in the orbit were explored by both sonography and computed tomography (CT). The merits of each method were demonstrated relative to defining the location, extension, and nature of the lesion. In adults with ocular masses, sonography is usually sufficient. For retinoblastoma, CT is usually necessary to rule out an extraocular extension. When an orbital process is involved, greater diagnostic accuracy can be achieved if the two methods are combined.

Computed tomography (CT) and sonography routinely are performed to explore a space-occupying lesion of the orbit, but few reports have considered the relative merits of each technique [1-4]. Other authors have used first-generation equipment, which is no longer applicable [5-7]. We attempted to determine the contributions of each technique and to define the condition in which each technique improves the understanding of the nature and topography of the lesion.

Subjects and Methods

We studied 210 cases: 70 had space-occupying lesions primarily involving the eyeball, and 140 had extraocular masses involving the orbit. For all these cases, the final diagnosis was established either by histology (surgery, biopsy, or specimen) or by a clinical follow-up when there was medical treatment.

All cases were studied by real-time sonography (A and B modes, 7.5 MHz, Sonnel 400 CGR) and a third-generation CT scanner (CE 1000 CGR). In all cases, axial and coronal 2-mm-thick sections were obtained every 4 mm before and after injection of contrast material. Each patient had all studies on the same day. The studies were interpreted by two different radiologists, who were aware of the clinical findings but not of the other procedure.

Results

Space-Occupying Lesions of the Eyeball

The diagnostic approach is different for adults and children. In children, the primary problem is retinoblastomas; in adults, melanomas and metastases are more common.

In our adult population, there were 42 masses in the eyeball: 38 melanomas (three of them with an extraocular extension), two metastases, one hematoma, and one angioma (table 1). The masses were recognized by sonography in 100% of cases, but by CT in only 73%. Extraocular extension was detected by both sonography and CT in two of three cases. The type of lesion was identified by sonography in 95% of cases, but by CT in only 65%. In adults, intraocular masses were identified more accurately by sonography than by CT (fig. 1).

In children, the most common clinical finding was leukokoria (white pupil), and we tried to rule out or confirm retinoblastoma (table 2). We found 28 cases of

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retinoblastoma, three with extraocular extension and two with brain dissemination; three cases of Coats disease; one angioma; and four phthisis bulbi from a variety of causes. The recognition of a mass in the eyeball was accomplished by both CT and sonography in all cases, and identification of lesion type was equal for both procedures. Intraorbital extension was recognized equally by both examinations, but brain extension of retinoblastoma was recognized by CT only. In our total series of 76 retinoblastomas studied by CT, nine had brain extension.

Intraorbital Extraocular Space-Occupying Lesions

One hundred forty patients had intraorbital extraocular space-occupying lesions. These included 14 optic nerve lesions (meningiomas, gliomas, cystic colobomas); 31 vascular masses (17 angiomas, nine varices, and five carotid cavernous fistulas); seven tumors of nervous origin; 12 metastases; 10 lymphomas; 12 idiopathic pseudotumors; four cellulitis; seven Graves disease; 16 cystic lesions (mostly dermoid cysts); 11 tumors of the lacrimal gland; and six miscellaneous.

There were 114 benign and 26 malignant lesions; 56 lesions had associated bony lesions. In cases of suspected masses in the orbit, CT was performed before sonography. Masses that were evaluated adequately by CT did not undergo sonography; these included orbital sphenoidal meningiomas and carcinomas originating from the sinuses or nasopharynx.

Surgery was performed in 112 cases, and allowed an exact tomographic and histologic diagnosis. Biopsy was performed before treatment (medical, surgical, or radiation) in 11 cases to assess a doubtful diagnosis. In cases of lymphoma, pseu-

dotumor, Graves disease, and cellulitis (31 cases), diagnosis was assessed by a clinical follow-up after medical treatment.

In our 140 cases, recognition and location of the mass relative to the eyeball and muscle cone were achieved with the same accuracy by both studies. The exact location of the lesion relative to the optic nerve was identified slightly better with sonography, because it could detect a small layer of fat between the mass and the nerve that could not be demon-

TABLE 2: Sonography and CT for Studying Masses in the Eyeballs of Children

| Parameter Considered | No. (%) | |
|---|------------|----------|
| | Sonography | CT |
| Recognition of mass (<i>n</i> = 28) | 28 (100) | 28 (100) |
| Recognition of extension: | | |
| Extraocular (<i>n</i> = 3) | 3 | 3 |
| Brain (<i>n</i> = 2) | 0 | 2 |
| Identification of nature (<i>n</i> = 28) | 24 (85) | 24 (85) |

TABLE 3: Sonography and CT for Studying Extraocular Masses in the Orbit

| Parameter | Total No. of Lesions | No. (%) | |
|----------------------------------|----------------------|------------|----------|
| | | Sonography | CT |
| Recognition of mass | 140 | 137 | 139 |
| Location relative to eyeball | 140 | 137 | 139 |
| Location relative to optic nerve | 140 | 132 | 126 |
| Location relative to muscle cone | 140 | 135 | 135 |
| Bony lesions | 56 | 12 (20) | 56 (100) |

TABLE 1: Sonography and CT for Studying Masses in the Eyeball of the Adult

| Parameter Considered | No. (%) | |
|--|------------|---------|
| | Sonography | CT |
| Recognition of mass (<i>n</i> = 42) | 42 (100) | 30 (73) |
| Recognition of extraocular extension (<i>n</i> = 3) | 2 | 2 |
| Identification of nature (<i>n</i> = 42) | 40 (95) | 65 (27) |

TABLE 4: Sonography and CT in Identifying Benign and Malignant Extraocular Masses in the Orbit

| Lesion | Total No. | No. (%) Detected by: | | |
|-----------|-----------|----------------------|---------|-----------------|
| | | Sonography | CT | Sonography + CT |
| Benign | 114 | 90 (79) | 92 (81) | 100 (87) |
| Malignant | 26 | 14 (54) | 13 (50) | 20 (77) |

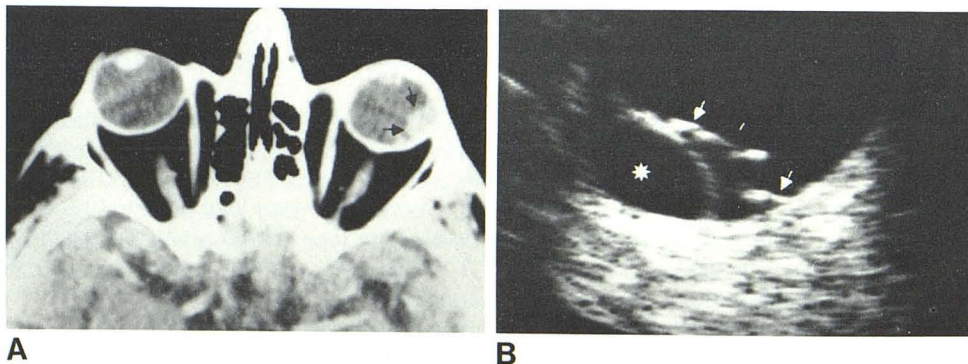


Fig. 1.—Choroidal hematoma. A, Axial CT scan. Superotemporal mass in left eye (*arrows*) enhances after injection of contrast material, probably because of rich vascularization of choroid and partial volume effect, even with thin section. B, B-mode sonogram. Anechoic appearance of lesion (*) could have been interpreted as melanoma rather than hematoma. Detached retina (*arrows*) above choroid.

Fig. 2.—Metastasis from lung carcinoma. **A**, Axial CT scan. Left exophthalmos from intraconal retrobulbar mass. Homogeneous, well delineated appearance of process. **B**, A- and B-mode sonograms. Poor delineation of process and heterogeneous echo structure suggest malignant lesion.

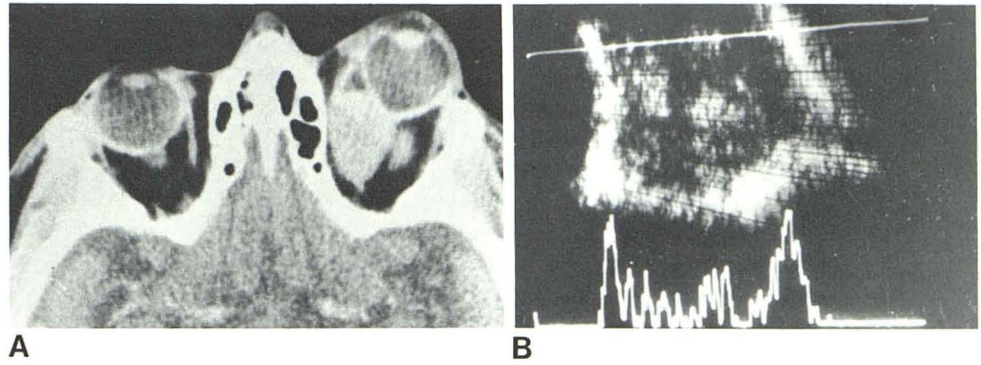
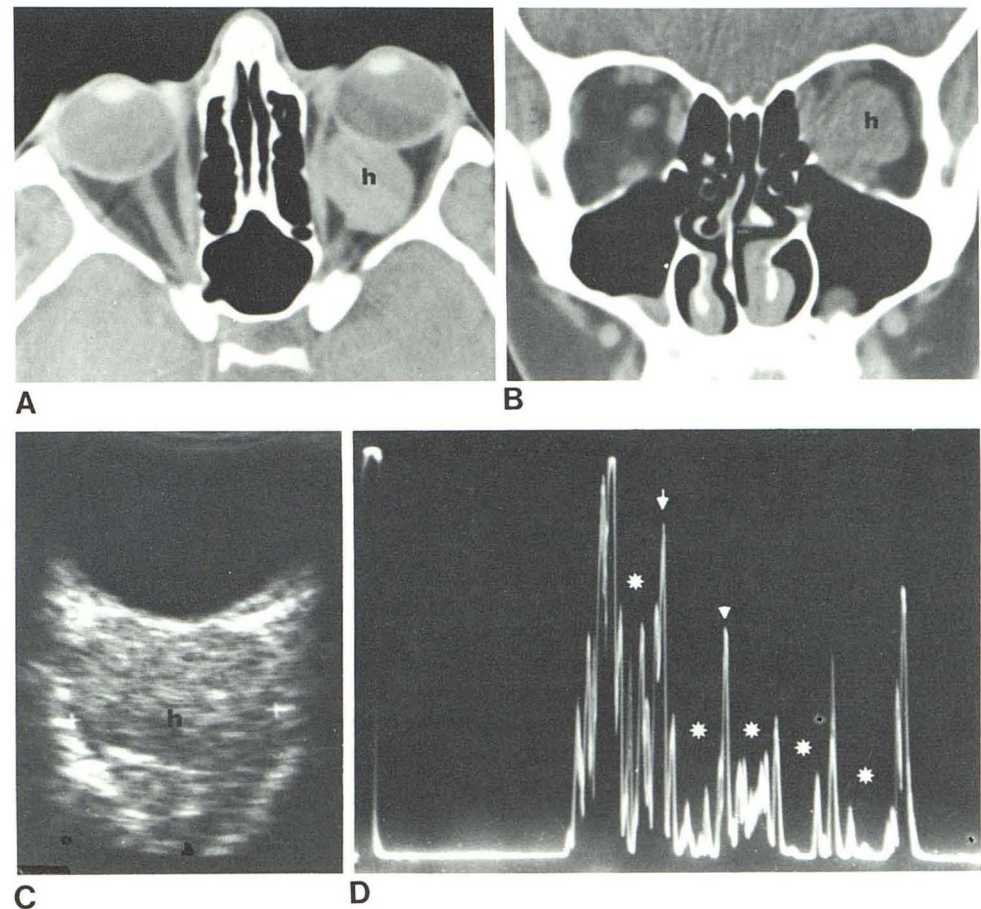


Fig. 3.—Cavernous hemangioma (h). Axial (A) and coronal (B) CT scans. Intraconal, homogeneous, well delineated lesion. In **B**, relation between optic nerve and lesion is difficult to assess. **B-** (C) and **A-** (D) mode sonograms. Good delineation of tumor in B mode corresponds to capsule of hemangioma. Honeycomb aspect of A mode is characteristic of cavernous hemangioma. High spikes (arrows) correspond to septa delimiting venous lakes (*), where echoes are low and blurred.



strated by CT in some cases of large intraorbital tumors, and because the acoustic impedance is much different between the optic nerve and any type of mass lesion. For bony lesions, CT had an accuracy of 100%, while sonography had only 20% (table 3).

CT and sonography were about equally accurate in separating benign from malignant lesions (table 4); when the findings of the two studies were combined, the accuracy increased significantly. This was especially true for metastases, which often have homogeneous, well delineated CT

features and irregular echo structures (fig. 2). For histologic identification of the lesion, sonography was sometimes more accurate than CT, but the two studies could be complementary, and so far their association has led to an increase in correct diagnoses.

For identifying vascular masses, sonography is better than CT because of its dynamic features. For cavernous angiomas, the honeycomb pattern of A-mode sonography is characteristic (fig. 3), as are the other kinetic sonographic features. In varices, enlargement of the mass during the Valsalva maneu-

ver is demonstrated more readily by sonography than by CT. But CT is better at displaying the other findings of the process, such as arteriovenous malformations and carotid cavernous fistulas (table 5).

Discussion

Ocular Masses

For adults, we believe that sonography is sufficient for diagnosing intraocular lesions because of its much better accuracy and because the lesions very seldom extend into

the orbit (fig. 4). When there is a clinical or sonographic suspicion of extraocular extension, CT is very helpful in demonstrating the extent of this orbital extension.

For children, in whom the lesion often extends outside the eyeball and sometimes beyond the orbit, we recommend a different protocol: Sonography should be performed first to rule out other causes of leukokoria. If the diagnosis of a retinoblastoma is positive or questionable, CT should be performed to rule out possible intracranial or intraorbital extension.

Extraocular Intraorbital Masses

CT and sonography are complementary. Since the clinical diagnosis often does not suggest the exact topography and nature of the lesion (fig. 5), we believe that CT has to be performed first, often leading to an accurate final diagnosis when bony walls are involved. For other lesions, sonography (A and B modes) will complete the diagnosis as to the location (tumors close to the optic nerve and to the muscle cone) and nature of the process. Moreover, the mapping possible with CT is clearly more precise and reproducible. These images are very useful for the surgeon in deciding on the surgical approach for reference during surgery.

TABLE 5: Accuracy of Sonography and CT in Identifying Masses in the Orbit

| Finding | No. | % Detected by: | | |
|------------------------------|-----|----------------|-----|-----------------|
| | | Sonography | CT | Sonography + CT |
| Optic nerve masses | 14 | 71 | 85 | 92 |
| Vascular masses | 31 | 90 | 77 | 90 |
| Metastases | 12 | 41 | 41 | 83 |
| Lymphomas | 10 | 70 | 60 | 80 |
| Pseudotumors | 12 | 100 | 100 | 100 |
| Cystic lesions | 16 | 93 | 75 | 93 |
| Mucoceles | 8 | 100 | 100 | 100 |

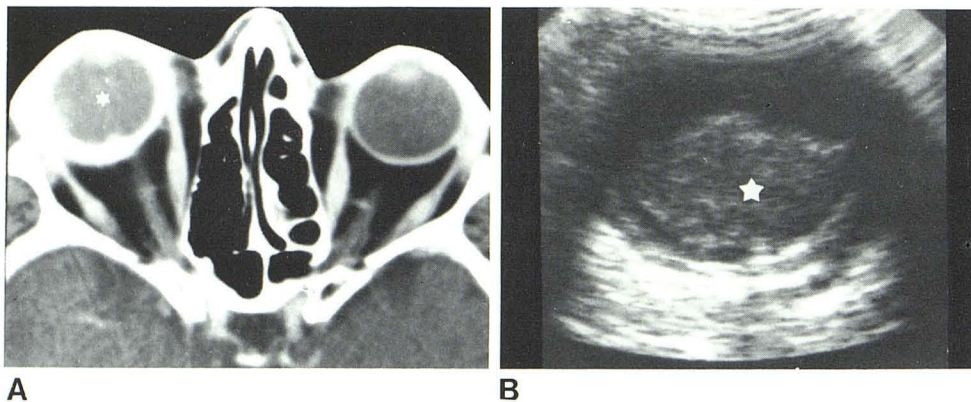


Fig. 4.—Melanoma of globe. **A**, Axial CT scan after injection of contrast material. Thickening of wall of globe and increase in density of vitreous (*). No other orbital sign; diagnosis was nonspecific. **B**, B-mode sonogram. Thickening of wall of globe demonstrates huge tumor of entire posterior segment (*). Malignant melanoma had obstructed vorticosae veins.

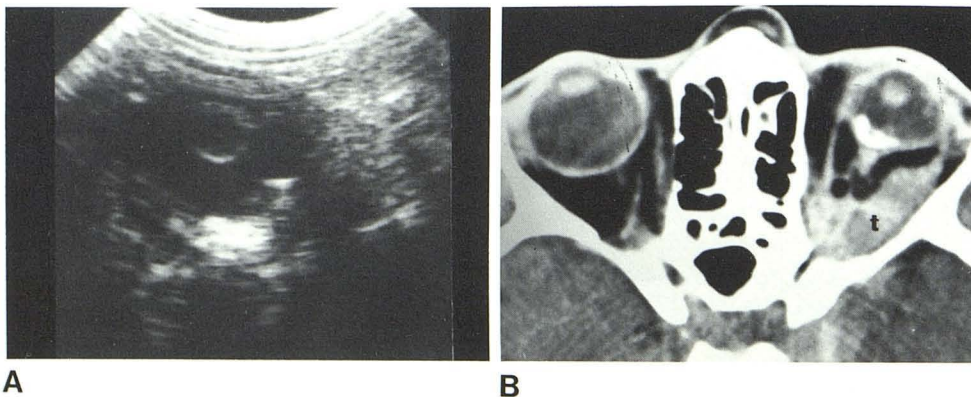


Fig. 5.—Meningioma, recurrent after irradiation. **A**, B-mode sonogram. Microphthalmos, calcifications of wall of globe, and obvious orbital space-occupying process are poorly delineated. **B**, CT scan shows ocular changes, perfectly delineates orbital process, and demonstrates intra- and extracranial (t) tumor extension.

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