

Ocular Melanoma: Detection Using Iodine-123-Iodoamphetamine and SPECT Imaging

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Uptake of iodine-123-iodoamphetamine has been demonstrated in malignant melanoma using planar imaging techniques and has been used to detect an ocular melanoma at 12 hr postinjection. Using SPECT technique, an ocular melanoma is identified in a 64-yr-old male at 1 hr postinjection.

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Although the principal clinical application of iodine-123 (^{123}I) iodoamphetamine (IMP) is the evaluation of cerebral vascular and degenerative disorders (1, 2), recent reports have demonstrated its potential for detecting primary and secondary cutaneous melanomas (3) and ocular choroidal melanomas (4) using planar imaging techniques. In this report, we describe the detection of an ocular melanoma at one-hour postinjection using SPECT techniques, and review the contemporary methods of confirming the diagnosis of such choroidal melanomas.

CASE REPORT

This 64-yr-old white male presented in October 1988, with a chief complaint of painless and progressive loss of vision in his right eye over the preceding six months. The patient had a documented visual acuity of 20/40 right eye and 20/20 left eye near the time of onset of his symptoms. Past medical history was significant for neurosurgical ligation of an intracranial aneurysm following its rupture in 1976, an event associated with subsequent loss of short-term memory. In addition, the patient was being followed in the urology clinic for stage D2 adenocarcinoma of the prostate. Treatment for this problem had included a trans-urethral prostatic resection for obstructive symptoms, and a bilateral orchiectomy.

His best corrected visual acuity was hand-motion only, right eye, and 20/20 left eye. The right pupil, measured 6 mm, was minimally reactive to direct light, and exhibited a prominent Marcus-Gunn phenomenon to consensual testing. The left pupil measured 5 mm and was briskly reactive to direct light. Muscle balance examination demonstrated a sensory

exotropia of 10–15 prism diopters in primary gaze. Slit lamp and fundoscopic examinations of the right eye revealed a large pigmented retrolental mass, which occupied approximately half of the vitreous cavity, and a secondary total retinal detachment was present. Ultrasonography demonstrated that the mass measured 17 mm in elevation and was internally homogenous. Based on the clinical and ultrasonographic findings, the lesion was believed to represent a large choroidal melanoma, and enucleation was recommended.

Results of a pre-operative evaluation for metastatic disease included a normal chest x-ray and bone scintigraphy, which demonstrated soft-tissue localization of technetium-99m ($^{99\text{m}}\text{Tc}$) methylene diphosphonate (MDP) in the region of the liver. Hepatic ultrasound demonstrated four complex, echogenic intrahepatic lesions, which were most consistent with metastatic disease rather than hemangiomas. The patient has declined biopsy of the hepatic masses.

Cranial SPECT (Fig. 1) and whole body tomography (Fig. 2) were subsequently performed following i.v. injection of 3 mCi of iodine-123- (^{123}I) iodoamphetamine (IMP). SPECT imaging at one, three and five hours, and planar tomography at six hours postinjection demonstrated uptake in the right eye. No uptake was seen in the left eye.

The patient underwent uneventful enucleation of the affected eye using a “no-touch” technique. Gross examination (Fig. 3) showed the tumor to measure 16 mm in diameter;

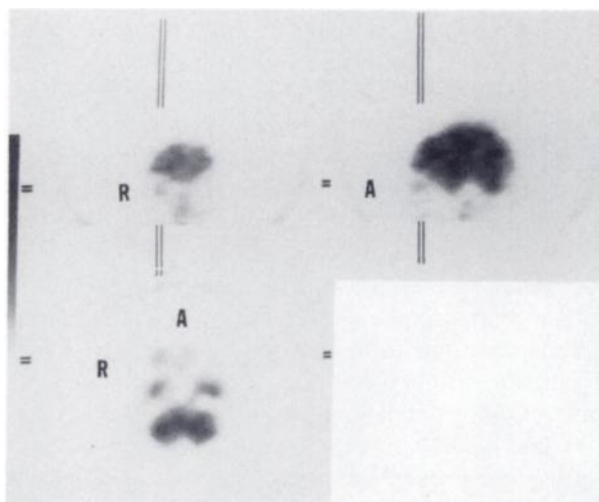


FIGURE 1
Selected coronal, sagittal, and transaxial sections from cranial SPECT performed one hour following [^{123}I]IMP injection demonstrate abnormal localization in the right orbit (A = anterior, R = right).

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FIGURE 2

Planar tomographic views obtained six hours following [^{123}I]IMP injection demonstrate normal homogenous uptake throughout the liver, cerebral cortex, unblocked thyroid, and lung fields. Abnormal, asymmetrical uptake is present in the right ocular tumor. While a small amount of bladder activity is noted, there is no testicular uptake, consistent with the patient's history of an orchiectomy.

histologic evaluation demonstrated it was a mixed-cell type choroidal melanoma.

DISCUSSION

Localization of IMP by melanomas is a result of its incorporation into cells actively producing melanin (5). This has been demonstrated in cell cultures of both melanotic and amelanotic melanoma tumor cells of mice (5) and humans (3), with the pigmented lines exhibiting the most intense IMP uptake. In clinical application, Cohen (3) successfully identified the primary tumor in six of seven patients with melanotic melanomas (the seventh patient having a large, necrotic primary lesion), and metastatic lesions as small as four millimeters using IMP, but he was unable to scintigraphically identify the primary tumor in three patients with amelanotic melanomas.

Melanin-producing cells in the human eye arise from two separate lines of embryologic precursors. The cells of the retinal pigment epithelium (RPE) arise from the neuroectoderm forming the outer layer of the optic cup. These cells begin differentiation during the fifth week of gestation, and by the end of the sixth week will have completed melanization (6). Under adverse conditions,

RPE cells tend to have a hyperplastic rather than neoplastic response. Melanocytes of the uvea (choroid, ciliary body and iris) and conjunctiva arise from the neural crest and migrate along the forming optic vesicle before it invaginates to form the optic cup. Melanin production begins between the twenty-fourth and twenty-seventh weeks, and by birth, few immature melanosomes are present in the choroidal melanocytes (6). Injury to cells in this population is more likely to result in a neoplastic response (7).

Because of the intense concentration of melanin-producing pigmented ocular tissues in animal models, IMP localization has been observed in the eyes of species from mice to monkeys (1,5). IMP uptake in the normal adult human eye has not been observed, presumably because active pigmentation is completed prior to birth (5,7) or in the perinatal period (7). Further studies have been suggested to clarify this finding (5).

Melanomas are the most common primary malignancy of the adult eye (9). They arise from uveal melanocytes, most commonly in the choroid, and although they display a wide range of pigmentation, even predominately amelanotic tumors will contain some

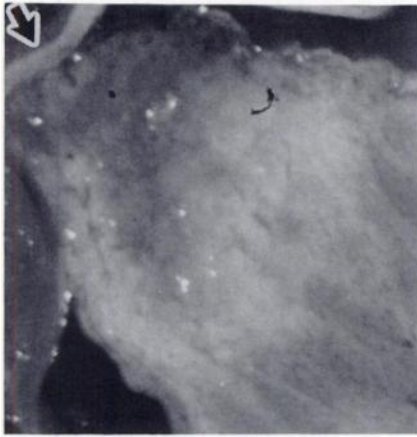


FIGURE 3
Photograph of the horizontal cut section of the patient's enucleated right eye, with the anterior aspect oriented to the left. The large, dome-shaped brown tumor present in the vitreous cavity is a mixed cell-type choroidal melanoma measuring 16 mm in diameter. The thin whitish membrane between the tumor and the lens is the surrounding total retinal detachment (arrows).

melanosomes (9). A number of benign lesions can simulate ocular melanomas (Table 1), and the use of techniques such as ocular ultrasonography, fluorescein angiography and radioactive phosphorus has greatly improved diagnostic accuracy (10). None of these tests are, however, specific for melanoma, and a significant misdiagnosis rate still exists. Shields et al. found that over one-half of patients referred to the Wills Eye Institute Oncology Unit with the diagnosis of posterior uveal melanoma actually had benign lesions (11) and Chang et al. found a misdiagnosis rate of 6.4% in a review of 744 eyes with clear ocular media submitted to the Armed Forces Institute of Pathology with the clinical diagnosis of malignant melanoma (12). Diagnosis of such lesions is compounded in eyes with opaque ocular media (13).

Using planar imaging, Ono (4) was able to identify [¹²³I]IMP uptake by a pigmented ocular melanoma 12 hr following injection. The current report confirms his observation of IMP uptake by ocular melanomas, and demonstrates that with SPECT imaging uptake may be seen as early as 1 hr postinjection. Whether IMP will localize the benign ocular lesions which are melanin-containing, such as choroidal nevi or regions of RPE hyperplasia, is unknown. However, it is reasonable to speculate that processes in which pigmentation is not due to melanin, such as subretinal hemorrhages, will not localize IMP. We believe [¹²³I]IMP localization with SPECT imaging has the potential to become a clinically useful tool in the battery of tests now available for diagnosing ocular melanomas.

TABLE 1
Benign Lesions Simulating Ocular Melanomas*

Suspicious choroidal nevi
Central disciform degeneration
Peripheral disciform degeneration
Congenital retinal pigment epithelial hypertrophy
Reactive retinal pigment epithelial hyperplasia
Retinal detachment
Choroidal hemangioma
Choroidal detachment
Melanocytoma
Others

* See References 9 and 12.

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