Demarcation laser photocoagulation extinguished PET/CT avidity for choroidal melanoma

Introduction

Positron emission tomography/computed tomography (PET/CT) is a radiologic imaging technique that puts form (CT) and function (PET) on the same diagnostic page.[1–4] PET uses 2-deoxy-[^{18}F]fluoro-2-D-glucose (^{18}F-FDG), which accumulates in benign and malignant hypermetabolic tissues throughout the body. While CT defines the anatomy and thus localizes the hypo- and hypermetabolic tissues, combining PET hypermetabolism with CT localization helps discriminate between benign and malignant tumours. Further, PET uses serum uptake values (SUVs) to grade the intensity or avidity.[1,3] For example, untreated hypermetabolic cancers absorb ^{18}F-FDG and exhibit high SUVs, whereas treated cancers show decreased or extinguished SUVs.[4]

In treatment of choroidal melanoma, failure of local control has been found to be associated with a hazard ratio that is 6.3 times greater for the development of metastatic disease. While ophthalmoscopy, photography, optical coherence tomography, angiography, ultrasonography, and radiologic imaging have been used to detect or assess failure of uveal melanoma treatment, PET SUVs have emerged as a way to quantify uveal melanoma metabolic activity.[3]

Herein we present a case in which PET/CT was used evaluate the metabolic activity of a choroidal melanoma found to enlarge after ophthalmic plaque radiation therapy. This resulted in the use of a transpupillary thermotherapy (TTT) laser for eye salvage.[5]

This case conforms to the tenets of the Declaration of Helsinki and the U.S. Health Insurance Privacy and Portability Act. A 59-year-old female referred for flashing lights and floaters was found to have an anterior choroidal melanoma in her right eye, which was measured to have 20/20 vision. There was neither iris neovascularization nor anterior-segment manifestation of tumour. The pigmented mass was centred in the superonasal quadrant (Fig. 1A). Ultrasonography showed a dome-shaped tumour with moderately low internal reflectivity and no extrascleral extension (Fig. 1B). Ultrasonographically based measurements revealed basal dimensions of 12.9 × 12.0 mm and an apical height of 4.8 mm (a cT2a choroidal melanoma according to the eighth edition of the *AJCC Cancer Staging Manual*). Fluorescein angiography revealed mottled, progressively increased tumour hyperfluorescence. Optical coherence tomography showed no subretinal fluid. Systemic staging including whole-body PET/CT imaging was negative for nodes or metastasis (AJCC, N0M0, stage IIA). PET/CT also revealed a hypermetabolic (SUV = 4.8) choroidal melanoma (Fig. 2A). After a discussion of relative risks and known benefits of observation, radiation (plaque and proton), and enucleation, shared decision making led us to choose plaque brachytherapy.[7]

Treatment involved insertion and removal of an 18 mm diameter gold COMS-type plaque containing 21 ^{103}Pd seeds (Theragenics, Buford, Ga.). Plaque positioning included 2–3 mm margins around the tumour's base. Plaque positioning involved tumour localization by transillumination and intraoperative ultrasonography. A radiation dose of 80 Gy to the tumour apex and 240.5 Gy to its base was delivered over 7 days.

Three months after brachytherapy, the tumour's basal diameter remained unchanged (Fig. 1C). However, its height increased 21% to 5.8 mm (Fig. 1D). Continued observation was employed, and the tumour's height decreased but remained greater than prior to treatment for 4 additional months (Fig. 1, graph below). Then, 7 months after treatment, though apical shrinkage to near baseline was noted, the possibility of local treatment failure was considered. Therefore, instead of more typical magnetic resonance imaging of the abdomen, total-body PET/CT was obtained and revealed that the melanoma's SUV had increased from a pretreatment 4.8 to 5.7.

After further discussion considering observation versus intervention, adjuvant TTT laser was employed to create white full-thickness demarcation around the posterior 180 degrees of the tumour's base. The aim was to cut off or reduce the tumour's circulation. Two sessions were required using a 3 mm spot size at 1000 MW and 90-msec durations. Three months after laser demarcation, a third PET/CT revealed a tumour SUV of 0 (Fig. 2B). At the last follow-up, 14 years after ^{103}Pd plaque brachytherapy, the choroidal melanoma remains controlled with a 37% reduction in tumour thickness (original 4.8 to 3.1 mm; Fig. 1, graph below). There is no clinically evident radiation retinopathy, maculopathy, scleropathy, optic neuropathy, or metastatic disease. The patient's visual acuity remains 20/20.

This case demonstrates that PET/CT SUVs can be used to assess the metabolic activity in choroidal melanoma suspected of failure of local control. SUV resolution was documented shortly after TTT laser treatment of the posterior feeder blood vessels as well as 12.5 years of local control after PET/CT resolution. Intraocular melanomas may enlarge after radiation therapy. In these cases, eye cancer specialists always question intratumoural hemorrhage, edema, inflammation, or failure of local control. Differentiating clues include the presence of visible hemorrhage, vitritis, and marginal progression. These etiologies may be differentiated using observation over time, in that both

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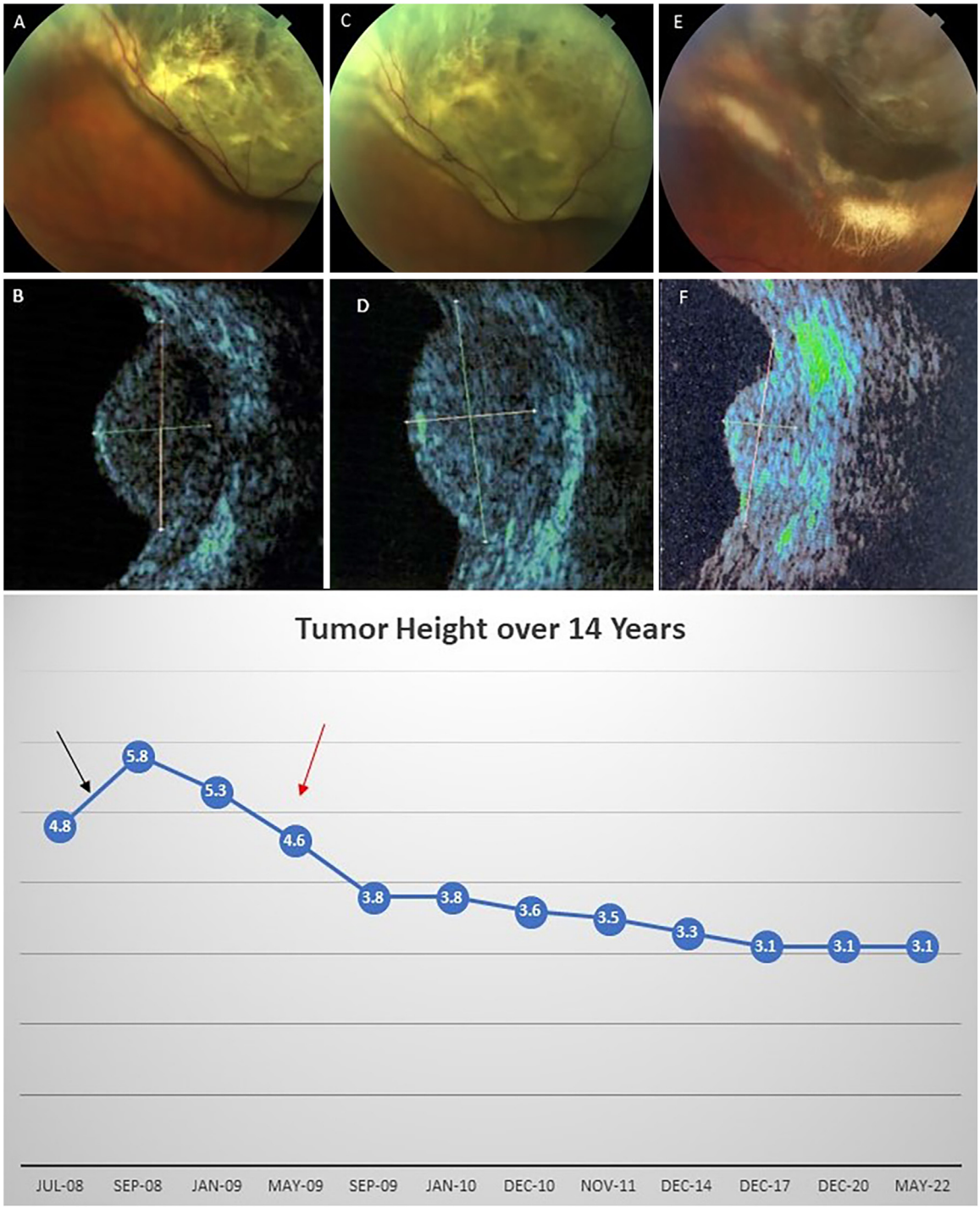

Fig. 1—(A) Fundus photograph shows the choroidal melanoma before brachytherapy. (B) Ultrasound imaging reveals a dome-shaped tumour with an apical tumour height 4.8 mm. (C) Fundus photography reveals the melanoma 7 months after brachytherapy. (D) Ultrasound imaging reveals a globally enlarged dome-shaped tumour with an apical tumour height of 5.3 mm. (E) Fundus photography documents a markedly darkened and shrunken choroidal melanoma at 14 years after brachytherapy with subsequent demarcation transpupillary thermotherapy. (F) The corresponding ultrasound image reveals a persistently dome-shaped choroid tumour with a markedly reduced tumour height of 3.1 mm. (Graph below) Tumour height over 14 years. The tumour was noted to increase 21% in thickness during the first 3 months after plaque brachytherapy. Observation for an additional 4 months revealed persistently increased (albeit slightly smaller) elevation as well as increased PET avidity (original SUV of 4.8–5.7) suggesting local treatment failure. Therefore, 7 months after plaque brachytherapy, transpupillary thermotherapy laser was employed (red arrow) and was followed by reductions in tumour height to stabilization.

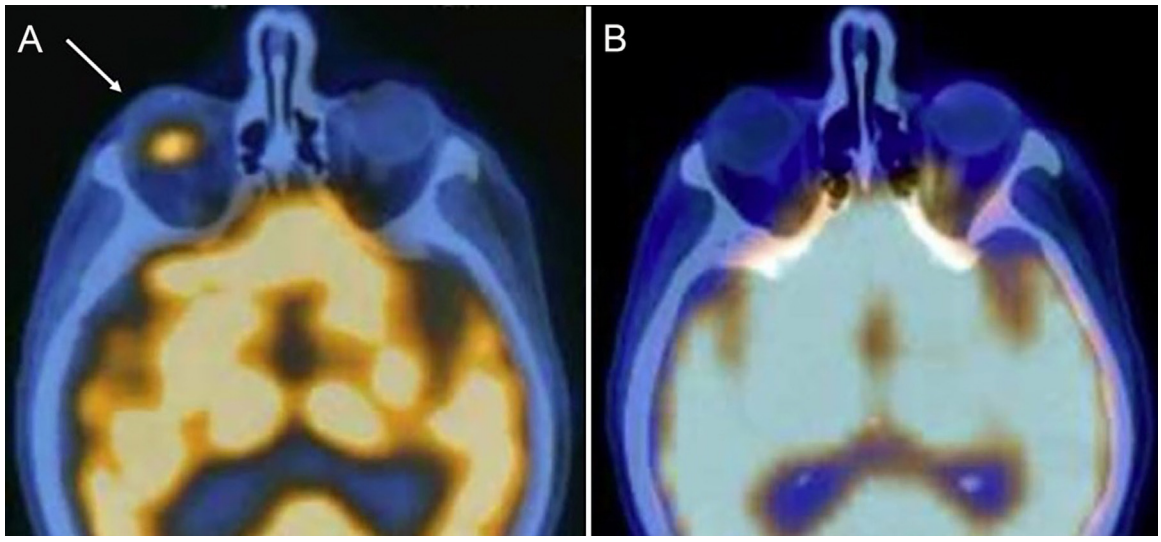

Fig. 2—(A) Positron emission tomography/computed tomography prior to radiation plaque shows a hypermetabolic choroidal melanoma in the right eye (arrow) with a serum uptake value of 4.8. (B) Follow-up positron emission tomography/computed tomography imaging 3 months after transpupillary thermotherapy demarcation laser revealed that the serum uptake value avidity has been extinguished.

blood and inflammation typically resolve within 12 weeks of brachytherapy. In contrast, the tumour height remained increased, and even the 7-month PET/CT SUV was higher than prior to plaque brachytherapy. Though these findings did not differentiate between failure of local control or post-irradiation tumour inflammation, treatment with a TTT laser that closed tumour feeder blood vessels resulted in rapid shrinkage, decreased tumour leakage on fluorescein angiography, and total loss of SUV avidity on PET/CT. Lastly, in that a TTT laser was employed, we will never know what might have happened if it was not. This case suggests that when failure of local tumour control is suspected, PET/CT can be considered as additional evidence suggesting tumour viability, which, in turn, may reduce the rates of second irradiation and enucleation. A larger study, perhaps involving multicentre data pooling, would be helpful to determine the value of PET/CT SUVs in assessing local treatment failure, the effect of tumour inflammation on PET avidity, and the success of secondary treatments.

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Footnotes and Disclosure

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