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Case report

Radiation optic neuropathy and retinopathy with low dose (20 Gy) radiation treatment

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ABSTRACT

Purpose: To report a case of optic neuropathy and retinopathy from a dose of radiation traditionally thought to be safe to the visual system and discuss strategies for preventing vision loss when using radiation to treat intraocular tumors.

Observations: A 44-year-old woman presented with new, painless vision loss in the left eye eighteen months after receiving proton beam radiotherapy (20 Gy dose delivered in two 10 Gy fractions) for a uveal metastasis of lung cancer. The dilated funduscopic examination revealed optic disc swelling and retinal hemorrhages and an MRI of the brain and orbits demonstrated enhancement of the left optic nerve head, findings consistent with radiation optic neuropathy (RON) and retinopathy. Risk factors for developing RON included coincident use of oral chemotherapy and relatively large fractionated doses of radiation.

Conclusions and importance: Though cumulative radiation doses to the anterior visual pathway of less than 50 Gy are traditionally felt to be safe, it is important to consider not just the total exposure but also the size of individual fractions. The single-dose threshold for RON in proton beam treatment has yet to be defined. Our case suggests that fractions of less than 10 Gy should be delivered to minimize the risk of optic nerve injury.

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1. Introduction

Ionizing radiation is frequently used in the treatment of brain, sinus, orbital, and intraocular tumors, and a small percentage of patients develop vision loss as a consequence of bystander injury to the anterior visual pathway. Radiation optic neuropathy (RON) is thought to result from dysfunction of the vascular endothelium, with endothelial cell loss leading to breakdown of the blood-brain barrier and subsequent exudation, vascular occlusion, and hypoxia.[1–6] Vision loss from radiation is typically delayed, occurring an average of 18 months following treatment.[5,6]

Fortunately, the risk of RON is thought to be low at cumulative radiation doses of less than 50 Gy, though this threshold may be lower in patients receiving concurrent chemotherapy or with tumors compressing the optic nerves or chiasm.[5–7] We report a case of a patient who developed RON and retinopathy from a relatively low dose (20 Gy) of proton beam radiation, delivered in two 10 Gy fractions.

2. Case report

A 44-year-old woman with a history of non-small cell lung cancer (NSCLC) with uveal metastases – treated 18 months prior with a 20 Gy dose of proton beam radiotherapy to the left macula (Fig. 1), delivered in two 10 Gy fractions – presented with a three-day history of new, painless vision loss in the left eye. Visual acuity was 20/20, right eye and 20/40, left eye. There was dyschromatopsia and an afferent pupillary defect on the left. Intraocular pressures were normal bilaterally and the anterior segment examination was unremarkable.

Ophthalmoscopy revealed swelling of the left optic nerve with adjacent nerve fiber layer hemorrhage and scattered dot-blot hemorrhages throughout the macula (Fig. 2). Also clearly apparent on the funduscopic examination were several small, white subretinal lesions along the vascular arcades in the peripheral retina of the right eye and a larger chorioretinal scar in the

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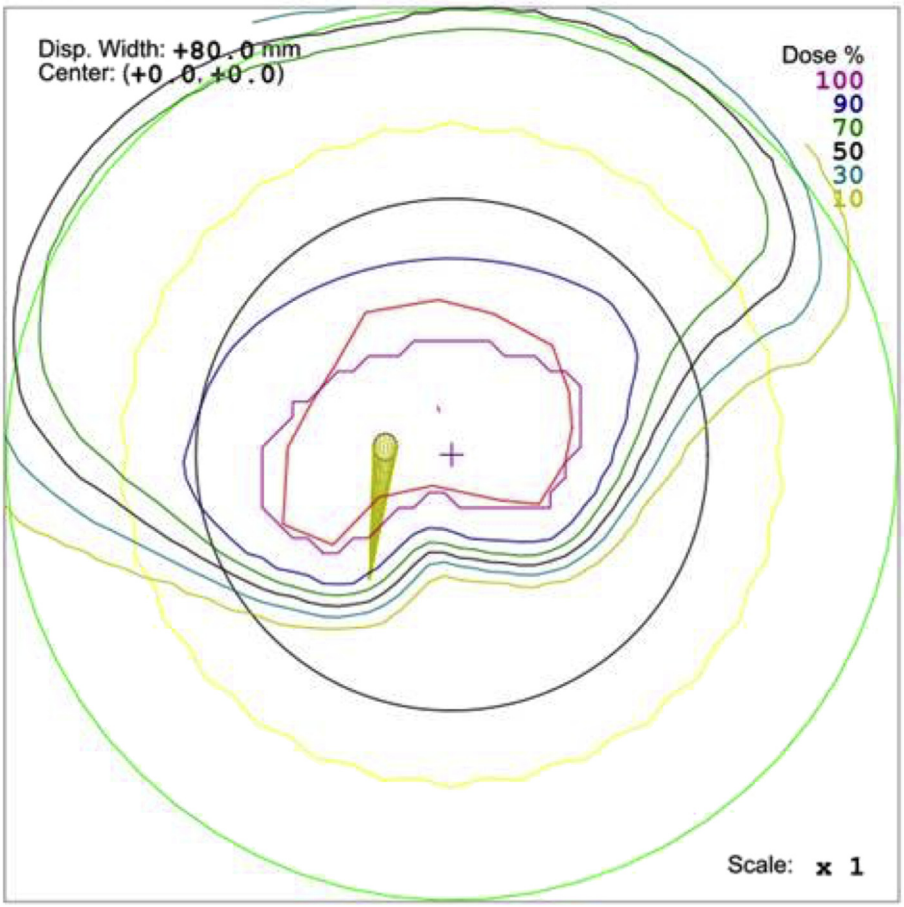

Fig. 1. Radiation dosage map. The red outline indicates the tumor, the cross is the fovea, and the yellow disc is the optic nerve head, which received 100% of the treatment dose. The black circle represents the equator, the yellow circle is the ora serrata, and the green circle is the limbus. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

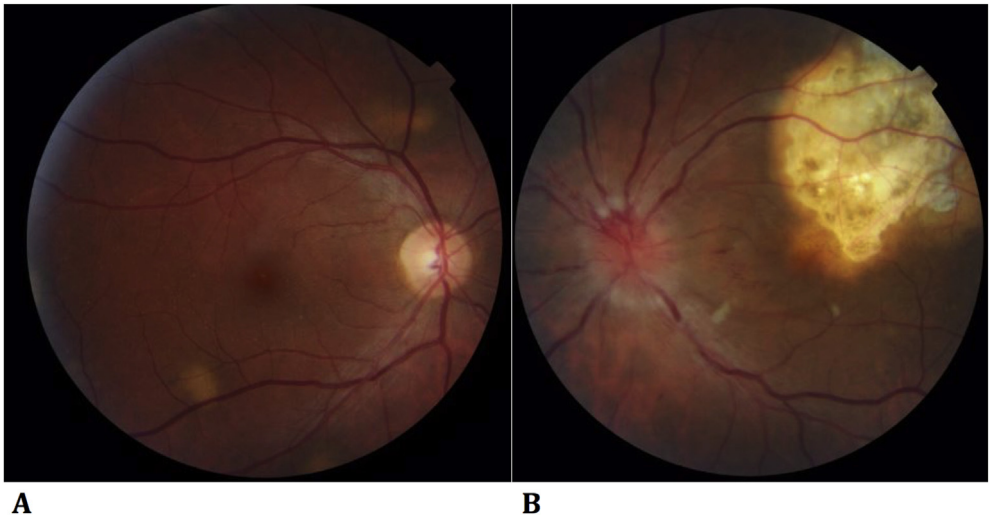

Fig. 2. Fundus photos on presentation. A. Peripheral subretinal lesions in the right fundus. B. Optic disc edema, retinal hemorrhages, and a macular scar in the left fundus.

superior macula on the left, corresponding to the patient's previously diagnosed uveal metastases. Comparison to prior fundus photographs demonstrated stability of these lesions since the time of proton beam treatment and initiation of maintenance oral chemotherapy (crizotinib) 18 months earlier.

Humphrey visual field testing revealed an area of inferonasal depression near fixation in the left eye corresponding to the macular scar. MRI of the brain and orbits with gadolinium demonstrated enhancement at the left optic nerve head consistent with RON (Fig. 3). Her new visual symptoms, optic nerve swelling, and

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