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SHORT COMMUNICATION

Late effect of external eye irradiation on choroidal circulation

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PURPOSE. *To report two cases of atypical late onset radiation chorioretinopathy occurring 15 and 25 years post exposure and the indocyanine green (ICG) angiographic findings in these patients.*

METHODS. *Clinical examination and imaging including fluorescein and ICG angiography were performed.*

RESULT. *Fundus examination of the first patient revealed microangiopathy with intraretinal hemorrhages, lipid exudation, telangiectatic and aneurysmal capillary changes. Indocyanine green angiography showed an apparent chorioretinal anastomosis and delayed perfusion of the choriocapillaris. Fundus examination of the second patient revealed a pigment epithelial detachment and retinal pigment epithelial changes. Indocyanine green angiography showed atypical, tortuous, dilated, choroidal vessels as well as areas of hypoperfusion. Both patients had multiple dot-like hyperfluorescent spots in the midphase of the ICG angiogram.*

CONCLUSIONS. *External radiation exposure may lead to both retinal and choroidal alterations which may be independent events and which may manifest after a long period of quiescence. Furthermore, ICG angiography appears to be a useful diagnostic tool to study the alterations of the choroid following external eye irradiation. (Eur J Ophthalmol 2006; 16: 637-40)*

KEY WORDS. *Radiation, Radiation retinopathy, Choroid, ICG angiography*

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INTRODUCTION

Early or late complications of external radiation of the maxilla in the anterior or posterior segment of the eye have previously been documented (1). Retinopathy following external irradiation therapy has also been described (2, 3) with visual loss being one of the most important complications. Effects on the choroid following this form of radiation, however, are less well described (4).

The specific risk factors for developing late complications after external irradiation of the eye are unknown; however, total dose irradiation, dose fraction, and surface irradiated seem to be strong predictive factors (2). We report two cases of atypically late onset radiation chorioretinopathy 15 and 25 years later and the indocyanine green (ICG) angiographic findings in these patients.

Case reports

Case 1

A 56-year-old woman was seen for evaluation of retinal changes in her right eye, diagnosed a few weeks after cataract extraction. Twenty-five years previously her left orbit had been treated with a radioactive plaque (total dose unknown) for a giant cell tumor of the maxilla. The left eye was enucleated subsequently due to phthisis following irradiation. The patient's history was positive for untreated hypercholesterolemia; there was no history of hypertension, diabetes, or heart disease. Her visual acuity in the right eye was 20/25. Fundus examination revealed an area of microangiopathy superior to the disc consisting of ischemia, intraretinal hemorrhages, lipid exudation, telangiectatic and aneurysmal capillary changes, and a

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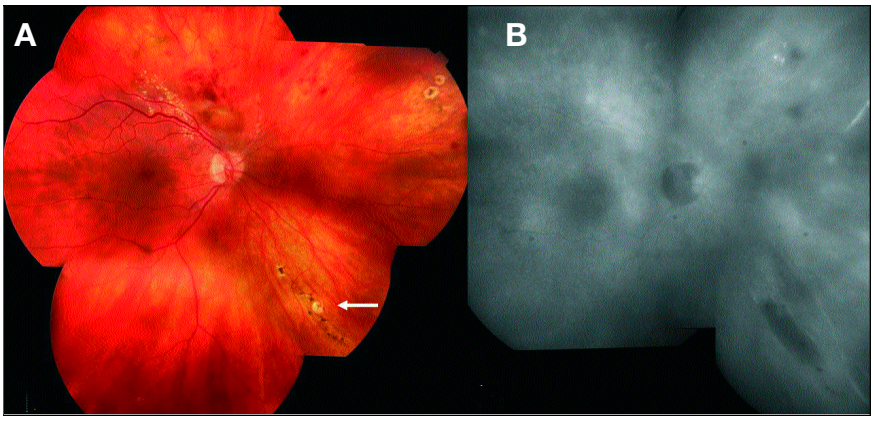

Fig. 1 - (A) *Color montage of right eye of Patient 1 shows all the alteration consistent in the retinopathy. A pigmented streak is well evident in the inferonasal midperiphery (white arrow).* **(B)** *The indocyanine green montage on the late frames confirmed the ischemic nature of the choroidal bed. Some hyperfluorescent spots present in the midphase are still evident.*

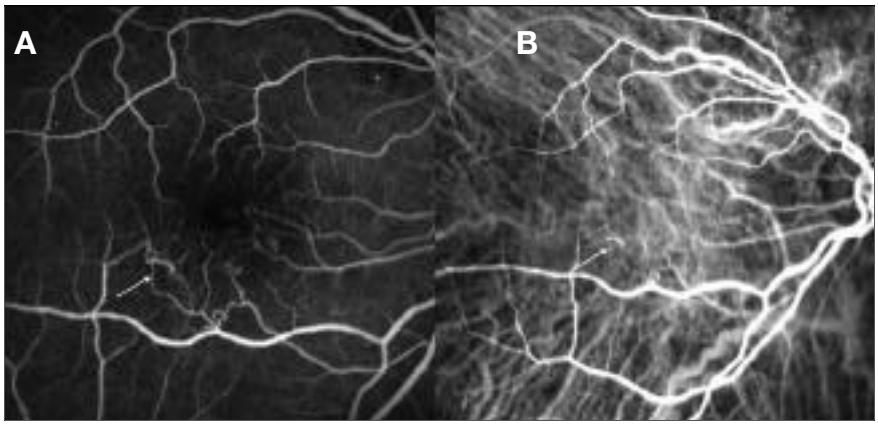

Fig. 2 - (A) *High-speed fluorescein angiogram of right eye of Patient 1 showing remodulation of the paramacular vessels with arrow highlighting the chorioretinal anastomosis.* **(B)** *Corresponding high-speed indocyanine green angiogram with arrow highlighting the chorioretinal anastomosis.*

glistening plaque in an arteriole. A hyperpigmented line with some irregular atrophy was present in the inferonasal midperiphery (Fig. 1A).

Fluorescein angiography (FA) confirmed the ischemic nature of the retinal manifestations and highlighted the presence of prominent capillaries above the optic disk and in the inferior macula. An apparent chorioretinal anastomosis was noted in the inferior paramacular region. ICG confirmed the presence of the paramacular chorioretinal anastomosis (Fig. 2). The area superior to the disc showed delayed perfusion of the choriocapillaris in the early frames and dot-like hyperfluorescent spots in the midphase. Additional choroidal involvement characterized by vascular leakage in the late frames was present in the inferior and nasal periphery (Fig. 1B).

Case 2

A 57-year-old woman, who received a total dose of 2400 cGy to both eyes for a bilateral lachrymal gland lymphoid hyperplasia 15 years before, presented with distortion in the inferior field of her right eye. Visual acuity was 20/20 in the right eye and 20/25 in the left, intraocular pressure was 16 mmHg bilaterally.

Ocular examination of the right eye revealed a pigment epithelial detachment (PED) superior to the macula, an area of retinal pigment epithelium (RPE) irregularity temporal to the macula, and some drusen-like spots in the midperiphery (Fig. 3A).

The left eye demonstrated some RPE pigmentary alterations inferotemporal to fixation, blister-like RPE changes superotemporally, and some yellowish-white drusen in the midperiphery (Fig. 3B).

FA confirmed the presence of the PED in the right eye (Fig. 3C) and some window defects of the RPE were noted in both eyes (Fig. 3D).

An ICG angiogram was subsequently performed. The ICG study was remarkable for irregular, tortuous, and dilated atypical appearing choroidal veins in addition to hypoperfused areas, which became evident in the early phases of the study (Fig. 3, E and F). There was also some generalized irregularity of the overall choroidal architecture in the posterior pole.

By the midphase of the angiogram, there was slight staining in the right macula and the RPE elevation was ev-

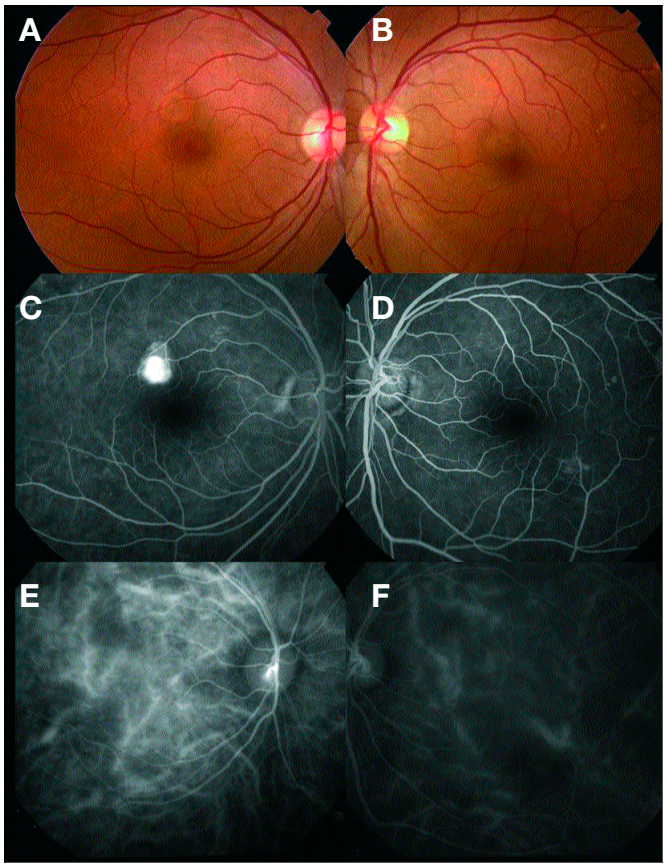

Fig. 3 - (A, B) *The color pictures of Patient 2 visualize a pigment epithelial detachment superior to the macula in the right eye and some spots in both eyes.* **(C, D)** *Fluorescein midphase angiograms demonstrates the presence of the retinal pigment epithelium detachment in the right eye and some window defect in the left.* **(E, F)** *The early phase indocyanine green frames show the irregularity of the flow pattern in the choroid with dilatation of some large vessels around to the hypoperfused areas.*

ident without neovascularization.

Multiple dot-like hyperfluorescent spots were noted in the midphases of the ICG angiogram, similar to those noted in Patient 1, corresponding to the yellowish-white spots appreciated clinically in both eyes (Fig. 4, A and B).

DISCUSSION

Retinal hemorrhages, microangiopathic abnormalities, hard exudates, or cotton wool spots characterize the retinopathy after teletherapy and brachytherapy. Thompson et al (3) have previously described radiation retinopathy with late onset of symptoms varying between 1 year and 10 years post radiation.

However, the involvement of the choroid after those treatments was not evaluated by ICG angiography. In contrast, Midena et al (4) evaluated the effects of eye irradiation using both FA and ICG angiography. They observed that the choroidal and retinal changes are dependent on the characteristics of the treatment field. We were unable to obtain any specifics regarding the treatment pattern in our patients given the long interval prior to presentation.

However, the clinical findings of our first patient are consistent with retinopathy but the yellowish patches of the RPE and the abnormal choroidal vessel through the RPE were signs of an atypical choroidal involvement. In our second patient, no other signs of retinopathy were found with the exception of a PED and some yellowish scattered spots, clinical signs of possible dysfunction of the RPE.

Although these changes could also represent central serous chorioretinopathy, our patient was not on any corticosteroid treatment and denied any previous history of episodic visual disturbance.

In the first patient, the ICG defined the altered filling of the choriocapillaris, and enhanced the visualization of the chorioretinal anastomosis found in the inferior portion of the macula. Moreover, in the late phases of the examination, some hyperfluorescent spots were seen in the midperiphery of the posterior segment; these changes were not detectable with the FA. The ICG in the second patient again was helpful in confirming the serous nature of the PED without CNV and the early phase showed scattered

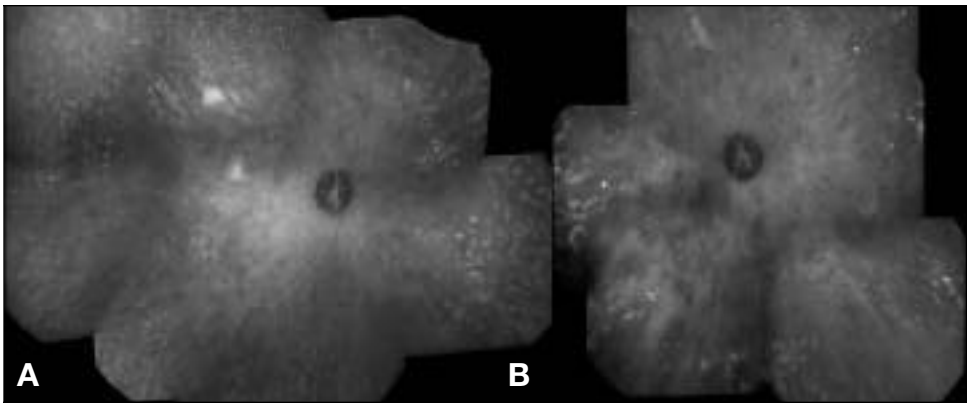

Fig. 4 - (A) *Indocyanine green montage of the right eye of Patient 2 shows the nature of the retinal pigment epithelium detachment without new vessels.* **(B)** *Multiple dot-like hyperfluorescent spots were noted in the midphases of the indocyanine green angiogram in the entire periphery in both eyes.*

hypoperfused areas of the choriocapillaris surrounded by dilated vessels of the choroid. Similar to the first patient, the hyperfluorescent spots were noted in the late phase of the examination.

It was hypothesized by Spaide et al (5) that following external radiation, the irregular vascular changes might represent a variation of idiopathic polypoidal vasculopathy. As reported by Egbert et al (6) in a histologic examination of eyes treated with teletherapy for retinoblastoma, myointimal proliferation and the partial occlusion of the posterior ciliary arteries could influence the normal pattern of the choroid. This damage to the choriocapillaris may result in secondary effects to the RPE and the pathologic response of the retinal vessels may be an independent event.

This hypothesis is, in part, supported by the findings in the second case, which showed involvement only of the choroid and the RPE and no evidence of retinopathy. It is conceivable that the low dose of irradiation in this patient played a role in this atypical presentation.

This fact, in part, may explain why the patient had no symptoms before developing the PED; the anatomic conformation of the choriocapillaris acts like a complex bed of anastomosis that can compensate for the stress of focal ischemia. Localized dilatation of some larger vessels may lead to a late onset of pathologic changes. Although many of the findings in the second case might also be seen with ARMD, the lack of distinct drusen in this 57-year-old woman makes this more likely due to a choroidopathy resulting from prior radiation therapy.

Our observations indicate that external radiation exposure may lead to both retinal and choroidal alterations which may be independent events and which may manifest after a long period of quiescence. Furthermore, ICG angiography appears to be a useful diagnostic tool to study the alterations of the choroid following external eye irradiation.

The authors have no financial interests.

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