Radiation Retinopathy: Case Report and Review

Ocular damage from radiation treatment is a well established phenomenon. Many factors are now known to influence the incidence of radiation retinopathy, including total dosage and daily fraction size. Patients who are diabetic, hypertensive or received previous chemotherapy are more susceptible to radiation retinopathy. In this article we describe a case of a young man who developed fulminant radiation retinopathy despite adequate precautions, due to the combined effects of pre-existing diabetes. We also discuss the current literature on treatment for radiation retinopathy.

Case Report
A 55 year old male was referred from the oncology department with epiphora. His medical history included Type 2 Insulin treated Diabetes Mellitus and hypertension. One year prior to presentation he had undergone a total rhinectomy with a 4 week course of post-operative radiotherapy for an aggressive squamous cell carcinoma of the nose (see figure 1). He received a total of 5250 rad to the tumour (1312.5 rad per week, 262.5 rad per session). Since treatment there had been no evidence of tumour recurrence. He had no known previous ocular history.
On examination the visual acuity was noted to be 6/36 left eye and 6/9 right eye. He had epiphora and bilateral medial lower lid ectropion. Anterior segment examination was unremarkable, intraocular pressures were 16mmHG both eyes. Posterior segment examination revealed marked retinal ischaemia present in the posterior pole and macular region of both eyes. Fundus Fluorescein Angiogram confirmed an ischaemic retina with no signs of neovascularization present (see figure 2). The appearance was not thought to be typical of diabetic changes, radiation retinopathy being the more likely diagnosis especially in view of his history. Over the next four months the vision in both eyes rapidly deteriorated to 3/60 left eye and 1/60 right eye. Clinical examination revealed bilateral vitreous haemorrhage. Fundus Fluorescein Angiogram confirmed bilateral disc neovascularisation and evidence of a grossly ischaemic retina with little viable retina now remaining (see figure 3). Bilateral pan retinal photocoagulation was thought to be appropriate treatment at this point as it was thought that the little remaining highly ischaemic retina close to the arcades may be responsible for the disc neovascularisation. A total of 2743 burns to the right eye and 1812 burns to the left eye was applied.
Figure 2- Radiation Retinopathy at initial presentation
The colour fundus photographs above show clinical evidence of marked bilateral ischaemic changes. The fluorescein photographs show evidence of masking from the haemorrhages and also areas of capillary dropout reflecting ischaemic areas.

Figure 3 - Radiation retinopathy prior to laser treatment

The photographs above show increasing severity of the radiation retinopathy with evidence of bilateral vitreous haemorrhage secondary to disc neovascularization. Severe ischaemic areas and areas of non-viable peripheral retina are visible, an area of viable ischemic retina along the arcades close to the disc is thought to be responsible for the disc noevascularisation.
Discussion

The clinical features of radiation retinopathy include microaneurysms, cotton wool spots, capillary dilation, telangiectasia, and capillary closure.\textsuperscript{1,2,3} Vascular compromise may result in retinal oedema. Ischaemia may lead to disc neovascularization which in turn can cause vitreous haemorrhage and retinal detachment. Histologically there is thickening of arteriolar and capillary walls and loss of endothelial cells.\textsuperscript{1,2,3} Histologically these findings differ from diabetic retinopathy in that there is early loss of endothelial cells in radiation retinopathy compared to diabetic retinopathy where pericytes are affected initially. There are also less number of microaneurysms present compared to diabetic retinopathy\textsuperscript{1,3}

The total dose of radiation, along with the fraction size is important in the development of retinopathy\textsuperscript{1-4}. A reported safe dose is 3000 rads, 1000 rads per week in five fractions (200 rads per session)\textsuperscript{3}, although cases have been reported with lower doses of radiotherapy\textsuperscript{2,4}. The time of onset of radiation retinopathy is between 6 months – 3 years, again it has been known to occur earlier or later\textsuperscript{2}

Factors which are known to exacerbate radiation retinopathy include chemotherapy and vascular diseases such as diabetes and hypertension.\textsuperscript{3,5,6,7} Pregnancy has been thought to accelerate radiation retinopathy\textsuperscript{8} and is also known to aggravate diabetic retinopathy\textsuperscript{9}. Spontaneous improvement can occur but this is infrequent\textsuperscript{10}. Mostly treatment with pan retinal photocoagulation is implemented when neovascularization is visible\textsuperscript{1}. One study
found 91% of patients treated with PRP for proliferative radiation retinopathy had regression of new vessels\textsuperscript{11}.

Ocular manifestations of radiotherapy are well known and include dry eye, epiphora, ectropion, scleral necrosis, cataract, glaucoma, optic neuropathy and retinopathy\textsuperscript{12}. Cataracts and radiation retinopathy are the most common visually limiting complications seen after ophthalmic plaque radiation therapy\textsuperscript{13}. The cataracts are amenable to surgical treatment mostly leading to improvement in vision. However, retinopathy can lead to permanent and severe visual loss. Currently no guidelines or treatment exists for radiation retinopathy. Pan Retinal Photocoagulation is performed in the proliferative stage in an attempt to prevent further visual loss, although studies have shown that earlier intervention may be more beneficial\textsuperscript{14}. There are studies which have reported a temporary improvement in vision after using intravitreal triamcinolone\textsuperscript{15,16} or focal laser treatment for cases with radiation maculopathy\textsuperscript{17}.

Recently a classification has been devised by Finger and Kurli\textsuperscript{14} which describes stages of radiation retinopathy in relation to the clinical signs seen, symptoms, location, best method of visualization and the risk of vision loss. This is important as there is a need for common language for this retinopathy for future comparative studies. Finger et al suggest that early pan retinal photocoagulation is useful in inducing regression of radiation retinopathy and also that treatment before clinically apparent radiation retinopathy is present may be more effective than treatment after its onset, especially in high risk cases. This is especially important in cases of radiation maculopathy as prevention is more
likely to preserve vision than treatment after its onset. According to this classification our patient presented with a moderate risk of visual loss and rapidly progressed, over 4 months, to stage of severe risk of visual loss.

This case highlights the importance for ophthalmologists and oncologists to be aware of the close relationship between diabetes and radiation treatment and the profound rapid impact this combination of factors may have on visual function. Radiation is being used with increasing frequency for ocular and orbital disease, because of this more cases of radiation retinopathy may become prevalent. Factors which may potentiate radiation retinopathy should be well known including, increased radiation dosage, increased fraction size, concomitant systemic vascular disease and use of chemotherapy (See Table 1). Counselling should be offered in all cases at risk of visual loss. In some cases it may not be possible to protect the eyes during radiation, in these cases one should be aware of the factors which may potentiate eye disease, the dose and area of the retina irradiated should be minimized. As no effective treatment currently exists to restore visual function, monitoring of visual acuity in all cases and early referral to the ophthalmologist as appropriate is warranted. Further studies should be performed in order to produce treatment guidelines for radiation retinopathy. Clinical trials also need to be performed to establish whether early PRP is beneficial in reducing the onset of radiation retinopathy in eyes at risk and also to determine if early PRP is useful in inducing regression of established radiation retinopathy.
Table 1- Factors potentiating radiation retinopathy

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<tr>
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<tbody>
<tr>
<td>Increased radiation dosage</td>
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<td>Increased Fraction size</td>
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<td>Systemic vascular disease</td>
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<td>Chemotherapy</td>
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References

Competing interests

No author has any financial interest in any of the products mentioned in this article

Authors contributions

AG drafted the manuscript and did a literature review.
FDS examined and managed the patient, critically analysed manuscript
AS examined and managed the patient, literature review
LY offered valuable insight into the management of this case
SC offered valuable insight into the diagnosis and treatment of this case
Additional files provided with this submission:

Additional file 2 : Abstract.doc : 25Kb
http://www.biomedcentral.com/imedia/3815328118517446/sup2.DOC
Additional file 1 : Titlepage-bmc.doc : 25Kb
http://www.biomedcentral.com/imedia/1995875921185181/sup1.DOC