Argon laser and xenon arc coagulation of malignant choroidal melanomata: histological findings in 6 cases

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SUMMARY The histological findings in 6 choroidal melanomata which had been treated by photocoagulation are reported. Bruch's membrane had been ruptured in 5 cases. Vitreous haemorrhage and seeding of tumour cells in the vitreous were observed in 3 cases. Little histological evidence of interference with tumour blood supply was found.

In recent years the management of small malignant melanomata of the choroid has been a controversial subject. Conservative measures are particularly desirable in cases in which there is a small tumour not interfering with visual acuity in the only good eye. The measures advocated to avoid enucleation are photocoagulation, radiotherapy, cryotherapy, diathermy, and local excision. Photocoagulation as a means of treatment of malignant melanoma of the choroid was introduced by Meyer-Schwickerath in 1952. The technique aimed at surrounding the tumour with a scar which both limited its spread and deprived it of its blood supply. Subsequently the tumour itself was ablated by direct treatment.

The present paper reports the histological findings in 6 eyes containing melanomata which had been treated by photocoagulation.

Materials and methods

CASES
The 6 eyes studied had been treated by argon laser coagulation, xenon arc coagulation, or a combination of the two. Case 2 also received radiotherapy. The clinical details are given in Table 1. For comparative purposes the histological findings in 100 consecutive globes enucleated for malignant melanoma were reviewed.

HISTOLOGICAL FINDINGS
The histological findings in the 6 treated cases are summarised in Table 2. Three of the tumours (cases 1, 5, and 6) were low to intermediate grade malignancy (spindle B) and 3 (cases 2, 3, and 4) contained a significant epithelioid component (mixed).

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The retina overlying the tumour was destroyed in all cases, and Bruch's membrane was ruptured in all except case 5. In case 3 5 separate breaks through which tufts of tumour protruded were present in one plane of section (Fig. 1). In case 6 there was a wide gap in Bruch's membrane but little protrusion of the tumour through it (Fig. 2). In cases 1 and 6 the inner surface of the tumour was separated from the vitreous by a fibroglial band (Fig. 3), while in cases 2, 3, and 4 the tumour was in direct contact with the vitreous and there was exfoliation of tumour cells (Fig. 4) and haemorrhage into the vitreous.

The frequency of rupture of Bruch's membrane is much greater in the tumours treated by photocoagulation than in the untreated cases. Of the 100 untreated cases reviewed rupture of Bruch's membrane was seen in 35. Of these, 22 were reported as anaplastic (containing a significant epithelioid component) and only 4 were of low to intermediate grade malignancy (spindle B). The amount of choroidal scarring adjacent to the tumours was variable and always more conspicuous at one margin than the other. When a scar was present, blood vessels could usually be seen in it, and often the adjacent choroidal vessels appeared dilated (Fig. 5). Apart from this an occasional sclerosed but nevertheless patent choroidal vessel could be seen.

Discussion

There was no obvious difference between the findings in the 3 cases treated with the argon laser alone and the 2 cases treated by a combination of argon laser and xenon arc. Case 5, which was treated by xenon arc alone, is discussed later. Case 2 was treated additionally by x-radiation, but showed no special features attributable to this. Previous reports.
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**Table 1  Clinical details**

<table>
<thead>
<tr>
<th>Case</th>
<th>Age at presentation and sex</th>
<th>Visual acuity</th>
<th>Size at presentation (disc diameters)</th>
<th>Type of treatment</th>
<th>No. of treatments*</th>
<th>Interval between last treatment and enucleation (mths)</th>
<th>Duration (mths) of treatment</th>
<th>Reason for treatment</th>
<th>Reason for enucleation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>47, F 6/9 6/24</td>
<td>3½</td>
<td>Xenon arc Argon laser Argon laser Radiotherapy</td>
<td>1 3 (427)</td>
<td>11 19</td>
<td>Refused enucleation initially</td>
<td></td>
<td></td>
<td>Continued growth</td>
</tr>
<tr>
<td>2</td>
<td>39, M 6/5 NPL</td>
<td>3</td>
<td>Xenon arc Argon laser Argon laser Radiotherapy</td>
<td>2 5 (756)</td>
<td>22 39</td>
<td>Retinal malformation in fellow eye</td>
<td></td>
<td></td>
<td>Vitreous haemorrhage Raised intraocular pressure Continued growth</td>
</tr>
<tr>
<td>4</td>
<td>54, M 6/9 6/24</td>
<td>4</td>
<td>Argon laser Argon laser Radiotherapy</td>
<td>6 (1408)</td>
<td>19 1</td>
<td>Other eye amblyopic</td>
<td></td>
<td></td>
<td>Continued growth</td>
</tr>
<tr>
<td>5</td>
<td>37, F 6/5 6/5</td>
<td>4</td>
<td>Xenon arc Argon laser Radiotherapy</td>
<td>2 9 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pain</td>
</tr>
<tr>
<td>6</td>
<td>62, M 6/9 6/36</td>
<td>1</td>
<td>Argon laser Argon laser Radiotherapy</td>
<td>6 (1782)</td>
<td>3 13</td>
<td>Considered suitable</td>
<td></td>
<td></td>
<td>Vitreous haemorrhage</td>
</tr>
</tbody>
</table>

*Number of burns in parentheses. NPL = no perception of light.

have indicated that the change observed in melanomata treated by transscleral irradiation are similar to those found in tumours treated by photocoagulation. There is damage to Bruch’s membrane and the pigment epithelium, with destruction of the overlying retina in the majority of cases, and vitreous haemorrhage is common.

The histological changes in the retina overlying photocoagulated melanomata have previously been reported. In the case reported by Apple et al. the argon laser was used; in all the others xenon arc coagulation had been employed. These studies report destruction of the retina with fibroglial scarring and pigment proliferation. We found similar changes, and Okun and Collins have demonstrated that after severe retinal burns in the dog’s eye by light coagulation most of the retina is replaced by a thin pigmented glial band after about a month.

Rupture of Bruch’s membrane had occurred in 5 of the 6 present cases. In cases 1 and 6 the tumours were small and of a low to intermediate grade of malignancy. Such tumours do not commonly break through Bruch’s membrane while still relatively small. Of the 35 untreated cases in which rupture had occurred only 4 were of a comparable grade of malignancy. That the increased frequency of rupture is due simply to delay in enucleation is possible but unlikely. In case 3 there were 5 separate ruptures in one level through which the tumour appeared to be sprouting vigorously. Multiple ruptures were not seen in the

**Table 2  Histological findings**

<table>
<thead>
<tr>
<th>Case</th>
<th>Cross-sectional area mm²*</th>
<th>Tumour type</th>
<th>Pigmentation</th>
<th>Vascularity</th>
<th>Reticulin</th>
<th>Necrosis</th>
<th>Scleral invasion</th>
<th>Extra-scleral spread</th>
<th>Adjacent choroidal vessels</th>
<th>Bruch’s membrane ruptured</th>
<th>Iris Haemorrhage</th>
<th>Vitreous Haemorrhage</th>
<th>Tumour cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28</td>
<td>Spindle B</td>
<td>++</td>
<td>++</td>
<td>–</td>
<td>–</td>
<td>Normal</td>
<td>Normal</td>
<td>No</td>
<td>Yes</td>
<td>New vessels, hyphaema Normal</td>
<td>Normal</td>
<td>–</td>
</tr>
<tr>
<td>2</td>
<td>49</td>
<td>Mixed</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>Focal</td>
<td>Normal</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>3</td>
<td>38</td>
<td>Mixed</td>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>Focal</td>
<td>Normal</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Post-necrotic atrophy Post-necrotic atrophy</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>4</td>
<td>65</td>
<td>Mixed</td>
<td>+++</td>
<td>+</td>
<td>–</td>
<td>Normal</td>
<td>Minimal sclerosis Yes</td>
<td>Normal</td>
<td>Yes</td>
<td>No</td>
<td>Post-necrotic atrophy Post-necrotic atrophy</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>5</td>
<td>39</td>
<td>Spindle B</td>
<td>+</td>
<td>++</td>
<td>–</td>
<td>–</td>
<td>Minimal sclerosis Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Post-necrotic atrophy Post-necrotic atrophy</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>Spindle B</td>
<td>++</td>
<td>+++</td>
<td>+</td>
<td>–</td>
<td>Minimal sclerosis Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Post-necrotic atrophy Post-necrotic atrophy</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

*At plane of section showing largest.
untreated tumours. In case 6, which was a comparatively small low-grade (spindle B) tumour, there was a wide gap in Bruch's membrane but no evidence of the aggressive growth of tumour through the gap which is normally seen when rupture occurs spontaneously. Rupture of Bruch's membrane and concomitant destruction of the overlying retina may allow eruption of the tumour into the vitreous as seen in cases 2, 3, and 4. These were the more anaplastic (mixed) tumours. Some reservation must therefore be expressed at the suggestion that the cell type of the tumour seems to be of no importance concerning the prognosis and effectiveness of light coagulation therapy. The seeding of tumour cells in the vitreous may have no prognostic significance, but vitreous haemorrhage makes enucleation necessary because further observation of the progress of the tumour becomes impossible. Vitreous haemorrhage has been one of the commonest events leading to enucleation in previous series.

Surprisingly, previous authors appear not to have commented on damage to Bruch's membrane, though Lund illustrates a treated tumour with 2 apparent ruptures. Vogel specifically stated that he had not found any evidence of seeding of tumour cells in the vitreous. A possible explanation is that previous series had been treated mainly by xenon arc photocoagulation and François et al. have commented that damage to Bruch's membrane in macular lesions treated by photocoagulation is more likely to occur.
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with the argon laser than with the xenon arc. In this respect it is noteworthy that in the present series the only tumour treated by xenon arc alone (case 5) was the only case in which rupture of Bruch’s membrane did not occur. With the exception of the case reported by Boniuk and Girard,14 previous studies have reported necrosis.13 15–18 20 21

Necrosis in superficial parts of the tumour in globes enucleated shortly after treatment may be a direct effect of the photocoagulation.12 16–20 25 Necrosis occurring at longer intervals after treatment has been attributed to vascular deprivation resulting from choroidal scarring.12 17 18 and narrowed choroidal vessels were observed in the scarred area by Hepler et al.19 In the present series some focal necrosis was seen in cases 2 and 4. This was clearly unrelated to the treatment, as the interval between treatment and enucleation was too long.

Like Curtin and Norton25 we were unable to find evidence of significant occlusion of the choroidal vessels adjacent to the tumour in these or, indeed, any of the cases. We did observe variable choroidal scarring at the margin of the tumours, but the scarring, when present, did not appear to be restricting access to the choroidal blood supply, probably because the tumour was able to grow beyond the scar (Fig. 5). Makley et al.16 similarly reported that the choroidal vessels adjacent to the tumour were patent in one of their cases. However, combined fluorescein and histological studies by Apple et al.26 of eyes enucleated within 24 hours of treatment by the argon laser showed leaky, necrotic choroidal vessels occluded by fused erythrocytes adjacent to the tumour. Chan et al.27 were able to produce occlusion of the choroidal circu-

![Fig. 3 Case 5, showing tumour separated from vitreous by a fibroglial band. (Haematoxylin and eosin, ×126).](image1)

![Fig. 4 Case 4, showing tumour in direct contact with vitreous, with cells exfoliating. (Haematoxylin and eosin, ×126).](image2)

![Fig. 5 Margin of tumour in case 4 showing choroidal scar (above arrow) and dilated vessels in choroid (below arrow). The choriocapillaris (tip of arrow) is intact peripheral to the scar. (Gordon and Sweet’s stain for reticulin, ×32).](image3)
photocoagulation. The evidence of choroidal vascular sclerosis may therefore indicate inadequacy of the treatment or reversibility of the damage.

Since in 5 of our 6 cases the tumours failed, for reasons other than their estimated size in disc diameters, to conform to the criteria laid down by Meyer-Schwickerath and François as suitable for treatment by photocoagulation, their failure to respond satisfactorily cannot be held to reflect on the efficacy of the method in suitable cases. However, on the basis of our findings the advisability of treating tumours which do not conform to the criteria is questionable, especially in patients who refuse enucleation, because (1) there is no evidence that the vascular supply was significantly affected; (2) the damage to the retina and Bruch's membrane allows seeding of the tumour into the vitreous; and (3) vitreous haemorrhage is likely to make enucleation inevitable.

We thank the ophthalmic surgeons who kindly furnished details of treatment given to their cases and Miss K. Hughes and Mrs C. M. Worsley for skilled technical assistance.

References