

## Letter to the Journal

Sir;

### Does Vitrectomy Increase Trans-Scleral Water Movement?

It is known that the outward movement of tracer molecules from the vitreous cavity greatly exceeds their inward movement.<sup>1-4</sup> A proportion of the vitreal water cleared posteriorly across the retina may leave the eye trans-sclerally under the action of the hydrostatic pressure difference which exists between the vitreous cavity and the orbit<sup>5,6-7</sup> although the major portion is cleared via the blood in the choroid.<sup>8-10</sup> Vitrectomy has been shown to result in a more rapid clearance from the vitreous cavity of tracers such as carboxy-fluorescein<sup>11</sup> or amphotericin.<sup>12</sup> Further evidence for the trans-scleral movement of water posteriorly after vitrectomy comes from observations of the behaviour of the sclera during the local resection of choroidal melanomas.

Choroidal melanomas are frequently managed in Glasgow by local surgical resection.<sup>13</sup> The technique has been described elsewhere<sup>14</sup> but consists of a lamellar dissection of sclera over the tumour and subsequent removal of the tumour together with the deep scleral lamella and a surround of healthy choroid, the surgery being carried out under hypotensive anaesthesia. Usually the sclera remains dry during the lamellar dissection suggesting that very little water is passing through it from the interior of the eye. Recently the technique for local resection of choroidal tumours has been modified by the inclusion of a pars plana vitrectomy at the start of the operation. The purpose of this intervention is twofold. Firstly by replacing much of the vitreous body with saline large changes in ocular volume can easily be achieved by removing fluid from the vitreous cavity using a syringe attached to the infusion line via a 3-way tap. This allows the eye to be kept firm during the scleral dissection and the volume to be reduced during choroidectomy and delivery of the tumour from the eye. The vitrectomy is also thought

to limit the risks of intraocular cellular proliferation which may be provoked by post-operative bleeding.

Since the introduction of this modification to the technique it has become apparent that during lamellar dissection the sclera is noticeably wet, water constantly oozing into the operative field in spite of frequent mopping. Additionally it has been noted that fluid seepage through the sclera remains absent over the site of the tumour and indeed the sclera over the tumour may dehydrate becoming darker and transparent in the process so that the site of the tumour under the sclera may be marked by an exact representation on the overlying sclera of the underlying tumour while the surrounding sclera remains moist and white (Fig. 1).

There is good evidence that radioactive water and other tracers introduced into the



**Fig. 1** Per-operative photograph taken during local resection of a choroidal melanoma. A half thickness scleral flap (A) has been raised leaving a half thickness deep scleral lamella in situ (B). This deep lamella remains hydrated and white except over the site of an intraocular melanoma (C) where the sclera is dehydrated and dark in colour. D indicates the position of the upper lid.

vitreous cavity are largely cleared posteriorly to the bloodstream in the choroid across the retina and RPE.<sup>10</sup> This outward movement is counteracted by a much lesser inward diffusion from the choroid.<sup>3</sup> Vitrectomy increases the rate of outward movement across the retina probably by removing the hyaluronic acid of the vitreous gel, for depolymerisation of the hyaluronic acid in the vitreous also increases the rate of clearance of tritiated water from the vitreous to the choroid.<sup>15</sup>

About 4 per cent of intravitreally injected tritiated water leaves the eye across the sclera<sup>7</sup> being driven by the hydrostatic pressure difference existing between the vitreous cavity and the orbit. The flow-conductivity of the sclera is known<sup>16,17</sup> and the resistance to the passage of fluid across the sclera is influenced by the scleral thickness.

It has been suggested in cases of malignant melanoma of the choroid treated by local resection that one reason why the retina even if detached pre-operatively settles down on to bare sclera in the absence of RPE or choroid is the outward movement of water across the retina and from the potential subretinal space through the overlying sclera which has been reduced to half thickness following the surgical procedure.<sup>18</sup> The observation noted in this communication tends to support this view. Trans-scleral water movement under the conditions described will undoubtedly be increased during the scleral dissection not only because the scleral thickness has been reduced by half but because the intraocular pressure is also maintained at an elevated level of around 30 mmHg by a suitable positioning of the reservoir to make the dissection easier. Under the unusual circumstances of raised intraocular pressure and reduced scleral thickness it is no great surprise that aqueous-like fluid should flow through the thinned sclera. Its origin is undoubtedly the vitreous cavity and the infusion line. The retina and RPE are intact during this part of the operation however and the trans-scleral fluid must have passed through retina, RPE and sclera. The presence of the tumour in the choroid undoubtedly prevents or reduces fluid movement through the affected area so that the sclera over the tumour remains dry and indeed may dehydrate in sharp contrast to the

surrounding rather wet sclera which remains fully hydrated.

This reported observation is further evidence for the existence of a trans-scleral movement of fluid from the eye which under some circumstances may become clinically significant.

Wallace S Foulds and Bertil E Damato

Tennent Institute of Ophthalmology  
University of Glasgow  
Western Infirmary  
Glasgow G11 6NT

#### References

- <sup>1</sup> Palestine AG and Brubaker RF: Pharmacokinetics of fluorescein in the vitreous. *Invest Ophthalmol Vis Sci* 1981, **21**: 542-9.
- <sup>2</sup> Blair NP, Zeimer RC, Rusin MM, Cunha-Vaz JG: Outward transport of fluorescein from the vitreous in normal human subjects. *Arch Ophthalmol* 1983, **101**: 1117-21.
- <sup>3</sup> Zeimer RC, Blair NP, Cunha-Vaz JG: Pharmacokinetic interpretation of vitreous fluorphotometry. *Invest Ophthalmol Vis Sci* 1983, **24**: 1374-81.
- <sup>4</sup> Ogura Y, Tsukahara Y, Saito I, Kondo T: Estimate of the permeability of the blood retinal barrier in normal individuals. *Invest Ophthalmol Vis Sci* 1985, **26**: 969-76.
- <sup>5</sup> Foulds WS: The clinical significance of trans-scleral fluid transfer. *Trans Ophthalmol Soc UK* 1976, **96**: 290-308.
- <sup>6</sup> Fatt I and Shantinath K: Flow conductivity of retina and its role in retinal adhesion. *Exp Eye Res* 1971, **12**: 218-26.
- <sup>7</sup> Moseley H, Johnson NF, Foulds WS: Vitreo-scleral fluid transfer in the rabbit. *Acta Ophthalmol* 1978, **56**: 769-76.
- <sup>8</sup> Moseley H: Studies on fluid movement in the eye. 1980. PhD Thesis, University of Glasgow.
- <sup>9</sup> Frambach DA and Marmor MF: The rate and route of fluid resorption from the subretinal space of the rabbit. *Invest Ophthalmol Vis Sci* 1982, **22**: 292-302.
- <sup>10</sup> Moseley H, Foulds WS, Allan D, Kyle PM: Routes of clearance of radioactive water from the rabbit vitreous. *Br J Ophthalmol* 1984, **68**: 145-51.
- <sup>11</sup> Cantrill HL and Pederson JE: Experimental retinal detachment. III Vitreous fluorophotometry. *Arch Ophthalmol* 1982, **100**: 1810-13.
- <sup>12</sup> Doft BH, Weiskopf J, Nilsson-Ehle I, Wingard LB: Amphotericin clearance in vitrectomised versus non-vitrectomised eyes. *Ophthalmology* 1985, **92**: 1601-5.
- <sup>13</sup> Foulds WS: Alternatives to enucleation in the management of choroidal melanoma. *Austr and NZ J Ophthalmol* 1986, **14**: 19-27.
- <sup>14</sup> Foulds WS: The local excision of uveal melanomata. *Trans Ophthalmol Soc UK* 1973, **93**: 343-6.
- <sup>15</sup> Foulds WS, Allan D, Moseley H, Kyle PM: Effect of intravitreal hyaluronidase on the clearance of tri-

tiated water from the vitreous to the choroid. *Br J Ophthalmol* 1985, **69**: 529–32.

<sup>16</sup> Fatt I and Hedbys BO: Flow of water in the sclera. *Exp Eye Res* 1970, **10**: 243–9.

<sup>17</sup> Moseley H: Mathematical analogue of the posterior

blood ocular barriers. *Trans Ophthalmol Soc UK* 1977, **97**: 565–8.

<sup>18</sup> Foulds WS: Do we need a retinal pigment epithelium (or choroid) for the maintenance of retinal apposition? *Br J Ophthalmol* 1985, **69**: 237–9.