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Adventitial sheathotomy for decompression of recent onset branch retinal vein occlusion

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Abstract Interesting results have been reported on the use of pars plana vitrectomy with adventitial sheathotomy for the decompression of branch retinal vein occlusions (BRVO). Recent onset BRVO responsible for a visual acuity of 20/40 or less have been estimated to be good candidates for this procedure. We report on the results of the prospective evaluation of three eyes (in three patients) with recent onset BRVO which underwent surgical decompression. Three men, aged 40, 50, and 68 years presenting with BRVO for 4, 4, and 3 weeks respectively, underwent surgical decompression. Initial visual acuity was 20/80, 20/80, and 20/200. After 11, 10, and 9 months follow-up, visual acuity was 20/80, 20/200, and 20/200. In two eyes, an increase of the area of retinal non-perfusion was treated with peripheral laser photocoagulation. No cataract, retinal tears or retinal detachment were observed. *Conclusion:* although feasible, sheathotomy did not lead to a significant visual improvement in our patients. Dissection of the arteriovenous crossing could have induced vascular trauma. Furthermore, vitrectomy with posterior hyaloid detachment alone could be of benefit in the treatment of branched retinal vein occlusions. A prospective randomised trial is needed to assess the effectiveness and the safety of this procedure and to determine the best candidates for surgery.

Introduction

Branch retinal vein occlusion (BRVO) is the second most common vascular disorder of the retina and usually leads to some degree of visual loss due to intra-retinal haemorrhage, macular oedema or secondary neovascularisation [2, 3, 4, 12]. BRVO occurs typically at an arteriovenous crossing where the artery passes anterior to the vein [5, 6, 10, 18, 19]. Histological studies suggest that, at the site of crossing, a common adventitia binds the artery and vein and that the thickened and rigid arteriosclerotic arterial wall compresses the vein, resulting in turbulence of blood flow and endothelial cell damage, which could lead to thrombus formation and vein occlusion [8]. Vein blood flow impairment may extend to the capillary bed. The visual prognosis of BRVO is most closely related to the extent of perifoveal capillary damage and retinal ischaemia [5].

The management of BRVO calls for laser therapy as recommended by the BVO Study Group; however, the natural history of BRVO in eyes with a visual acuity of 20/200 or worse secondary to macular oedema remains unfavourable [2, 3,4].

Arteriovenous crossing decompression has been described as an alternative approach that could restore venous blood flow and defuse the pathogenic mechanism of BRVO, improving retinal perfusion and resolving intra-retinal haemorrhage and oedema. Retinal neovascularisation and vitreous haemorrhage may well also be prevented [11, 13, 14]. Here, we report the 1 year follow-up of three patients (three eyes) with BRVO and poor vision secondary to macular oedema consecutively treated with adventitial sheathotomy.

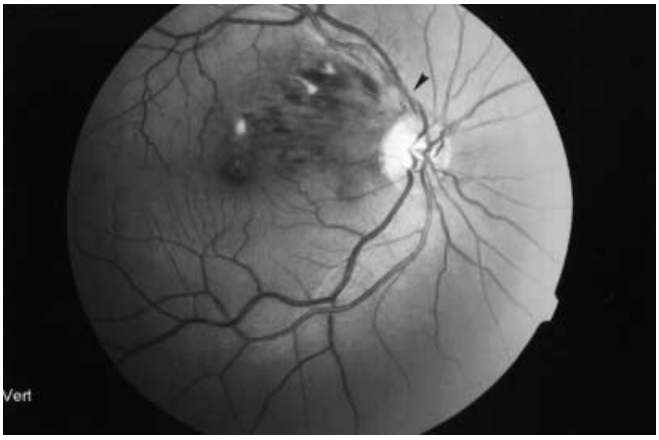

Fig. 1 Case 1, right eye. Preoperative red-free frame. Occlusion of a superotemporal macular branch retinal vein with cotton-wool spots and macular haemorrhage. The *arrow* shows the responsible arteriovenous crossing, site of the adventitial sheathotomy

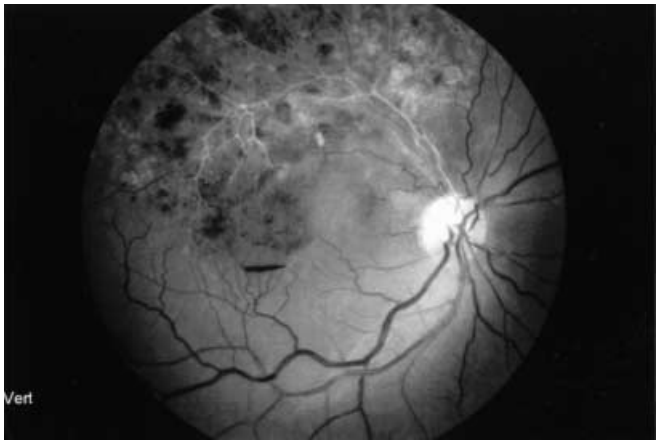

Fig. 2 Case 1 after 11 months of follow-up. Red-free frame. Complete occlusion of the superotemporal vein. Persistant macular haemorrhage and retrohyaloidal haemorrhage despite attempted posterior hyaloid removal. Note the peripheral marks of laser photocoagulation

Case reports

Case 1

A 40-year-old man, with a history of treated systemic hypertension, presented for a recent visual impairment of the right eye. Visual acuity of this eye was limited to 20/80 on an ETDRS chart. On ophthalmic examination, anterior segment and intraocular pressure (IOP) were unremarkable. Examination of the fundus revealed a tight arteriovenous crossing and an occlusion of a superotemporal macular branch vein with cotton-wool spots and macular haemorrhages (Fig.1). Fluorescein angiography confirmed the diagnosis of BRVO, revealed the location of the responsible arteriovenous crossing, and disclosed macular oedema. At that time, the peripheral retina seemed to be normal. The left eye, was unremarkable except for mild arteriovenous crossing changes.

After informed consent was obtained, the patient underwent BRVO decompression 4 weeks after the onset of the visual symptoms. The procedure consisted of a three port pars plana vitrectomy with posterior hyaloid removal. A bent MVR blade was used to open the internal limiting membrane proximal to the responsible arteriovenous crossing. The crossing was gently stripped from the nerve fibre layer and the common adventitial sheath lysed using the MVR blade. The arteriole was separated from the underlying venule which was demonstrated by the visualisation of the restoration of downstream blood flow. We avoided the use of retinal scissors since they have been incriminated in venule wall laceration [17]. The patient did not require intraocular diathermy.

Despite the fact that arteriovenous decompression seemed effective and non-traumatic to the retinal vessels, the early postoperative period was marked by a mild and transient vitreous haemorrhage. After a 3 month follow-up and the complete resorption of the vitreous haemorrhage, visual acuity of the right eye was still limited to 20/125. The fluorescein angiographic frames disclosed a persistent occlusion of the affected vein and a wide area of more than five disk diameters retinal non-perfusion in the superior periphery, which led us to perform peripheral laser photocoagulation. After an 11 month follow-up, visual acuity was 20/80 and the affected vein was completely occluded (Fig.2).

Fig. 3 Case 2, left eye. Preoperative red-free frame. Superotemporal BRVO with cotton-wool spots, macular oedema and haemorrhage. The *arrow* shows the responsible arteriovenous crossing, site of the adventitial sheathotomy

Case 2

A 50-year-old man, with a history of treated systemic hypertension, presented for a recent blurred vision of the left eye. Visual acuity of this eye was limited to 20/80. Anterior segment and IOP were unremarkable. Retinal examination of this eye revealed a superotemporal BRVO with cotton-wool spots and a macular haemorrhage (Fig.3). On fluorescein angiography, a macular oedema was also noted. No area of retinal non-perfusion was observed.

After informed consent was obtained, an uneventful arteriovenous crossing was performed 4 weeks after the onset of symptoms. Neither scissors nor diathermy were used for this procedure. Despite intraoperative visualisation of bloodstream restoration, visual acuity was 20/200 at the 3 month follow-up. The affected vein was still occluded and a large area of peripheral retinal nonperfusion required laser photocoagulation. After a 10 month follow-up, visual acuity was still 20/200 and the affected vein was completely occluded (Fig.4).

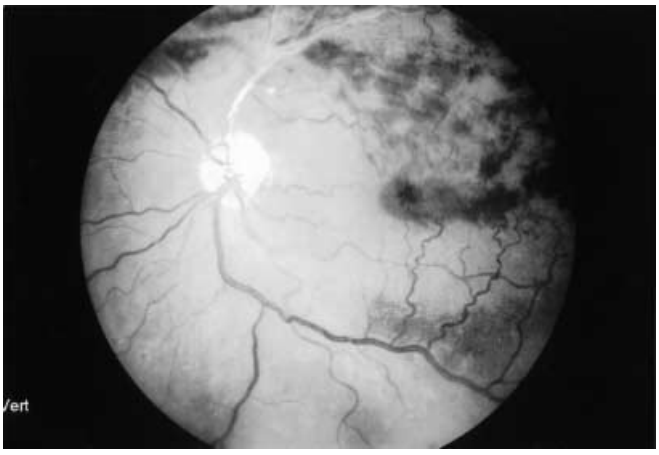

Fig. 4 Case 2 after 10 months of follow-up. Red-free frame. Complete occlusion of the superotemporal vein. Diffuse retinal haemorrhages

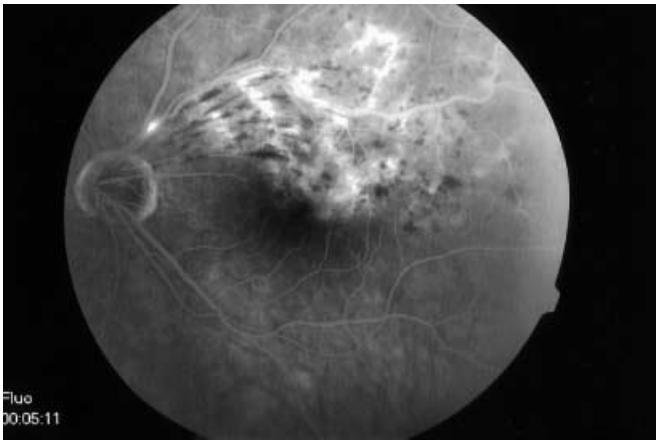

Fig. 6 Case 3. Preoperative fluorescein angiographic frame disclosing white intravascular material in the affected vein and macular diffusion

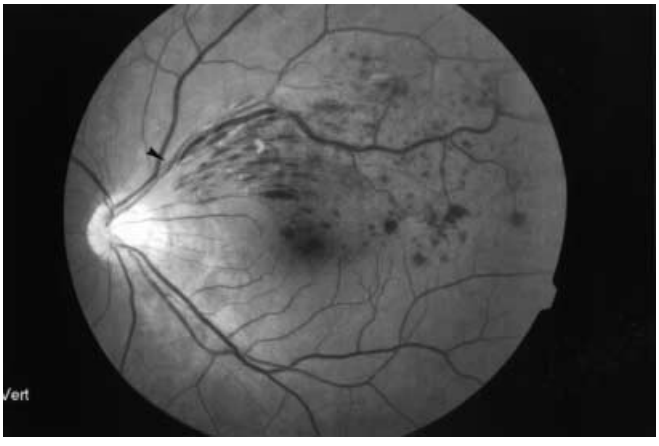

Fig. 5 Case 3, left eye. Preoperative red-free frame. Superotemporal BRVO with diffuse haemorrhage, cotton-wool spots and macular oedema and haemorrhage. The *arrow* shows the responsible arteriovenous crossing, site of the adventitial sheathotomy

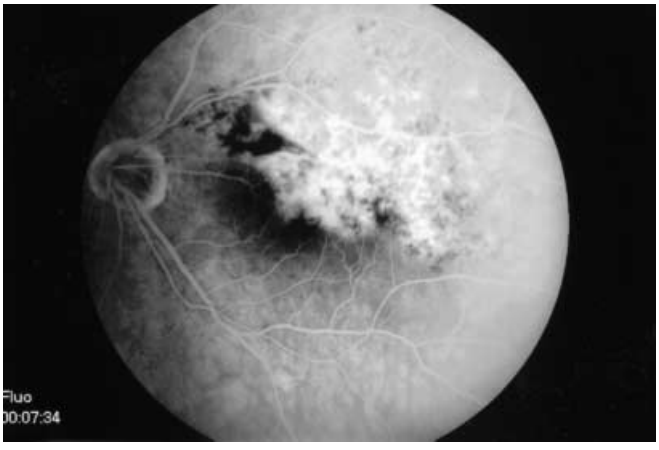

Fig. 7 Case 3, after 9 months of follow-up. Persistent macular diffusion on the fluorescein angiographic frame

Case 3

A 68-year-old man, with a history of treated systemic hypertension, presented for a recent visual impairment of the left eye. Visual acuity of this eye was 20/200. Anterior segment and IOP of the left eye were unremarkable. Fundoscopic examination revealed a superotemporal BRVO with diffuse retinal haemorrhages and cotton-wool spots (Fig.5). Fluorescein angiography also showed macular diffusion and the presence of some white intravascular material in the affected vein suggesting that the cause of the occlusion was the presence of a thrombus (Fig.6).

After informed consent was obtained, surgical decompression of the responsible arteriovenous crossing was undertaken 3 weeks after the onset of the symptoms. This procedure also seemed to be successful and uneventful. The early post-operative period was marked by a transient vitreous haemorrhage which completely resolved within 2 weeks. Although blood flow in the affected vein did not seem to be altered on fluorescein angiography at 3, 6, and 9 months respectively, no functional improvement occurred, visual acuity remained stable at 20/200, and a major macular diffusion persisted (Fig.7).

Discussion

The BVO Study Group has shown that argon laser photocoagulation improved the visual outcome to a significant degree in eyes with BRVO in which the perifoveal capillary perfusion was intact and in which macular oedema had reduced vision to 20/40–20/200 [2, 3, 4]. Unfortunately, laser therapy has not been efficacious in patients who presented with initially poor visual acuity or with permanent structural alterations caused by cen-

tral retinal capillary shutdown. Surgical sheathotomy may be a logical approach to the latter subgroup of patients; only a few reports have addressed the subject [11, 13, 14].

In 1988, Osterloh and Charles [13] first reported the technique of surgical sheathotomy in a patient with BRVO. They experimented the technique in animals, then eye bank and inoperable eyes. The patient was a 54-year-old woman with BRVO and a history of 2 to 3 weeks of distorted vision; she had a visual acuity improvement from 20/200 to 20/25 8 months after surgery. For technical reasons, sheathotomy was to be performed preferably on crossings concerning first- or second-order arterioles. Despite this relative success, the authors did not describe any further similar attempts. In 1999, Opremcak and Bruce [11] reported a prospective non-randomised study of 15 patients in whom they performed the arteriovenous crossing sheathotomy. The duration of visual symptoms due to BRVO ranged from 1 to 12 months, with an average of 3.3 months. The average follow-up period was 5 months (range 5–12 months). They reported a constant post-operative reduction of the ischaemic area. Of their patients, 53% showed clinical improvement of more than two Snellen lines and 20% lost two or more Snellen lines. Final post-operative visual acuity was better than 20/200 in 60% and better than 20/50 in 27% of patients. They did not observe a correlation between duration of the BRVO, severity of intraretinal haemorrhage, oedema, or ischemia, and final visual acuity. Lessening of the capillary non-perfusion was observed in all cases but not substantially analysed. In 2000, Shah et al. [14] reported the long-term follow-up of five patients (five eyes) with visual acuity of less than 20/200 presenting with macular oedema secondary to BRVO. In four of the five eyes, vision improved to 20/40–20/70 at 12 months and to 20/30–20/70 at 7 years of follow-up. In the remaining eye, visual acuity remained at finger counting secondary to macular ischaemia.

Our series is dissimilar to these reports which demonstrated that visual acuity can improve after sheathotomy: None of our three patients improved his visual acuity. In two eyes, the visual acuity remained the same (20/80 and 20/200 respectively); in the third eye with unremitting macular oedema, the visual acuity was 20/200 after 11 months of follow-up.

In two eyes, we observed a transient vitreous haemorrhage on the 1st post-operative day. Although, arteriovenous decompression seemed uneventful in the three cases and we did not observe any intraoperative bleeding or vascular dilaceration, a vascular trauma is the most likely explanation for these vitreous haemorrhages. Likewise, in cases 1 and 2, a complete occlusion of the affected vein was present at the end of follow-up, which could also be the result of a vascular trauma. In fact, one must keep in mind that the common wall between the artery and the vein at the site of crossing can be as thin as 15 µm [17]. Thus, with actual surgical instruments vascular trauma can be very difficult to prevent, even for skilful vitreoretinal surgeons. Furthermore, all novel techniques have a learning curve and may, in part, explain the surgical trauma to the affected vein. Conversely, none of the potential complications of vitrectomy including cataract, retinal tear, and retinal detachment, occurred in our patients during the 11 months of follow-up. Whether the enlargement of retinal non-perfusion area in our patients was the result of the procedure or of a poor natural history remains questionable.

The literature must be interpreted with extreme caution due to its lack of substantial analysis. The assessment of any surgical technique remains very difficult and must take into consideration the fact that spontaneous improvement can usually be expected to a certain extent [2, 3, 4, 7,12]. The BVO Study reported that overall, 50%–60% of patients with BRVO will maintain visual acuity of 20/40 or better after 1 year. In the untreated subgroup of eyes with BRVO and intact foveal vascularity and in which macular oedema reduced vision to 20/40–20/200, 37% of eyes gained two lines of visual acuity and 34% had a 20/40 or better vision at 3 years follow-up [2]. Finkelstein [7] reported a series of untreated ischaemic macular oedema (capillary non-perfusion) secondary to BRVO in which 91% of the 23 included eyes improved in visual acuity after a mean follow-up of 39 months: The median initial visual acuity was 20/80 and the median final visual acuity was 20/30. Furthermore, posterior vitreous detachment and vitrectomy per se may affect the prognosis of BRVO by means of delaying neovascularisation and preventing persistent macular oedema [1, 9, 15,16]. In fact, after the onset of BRVO, the clinical course can be determined by the collateral drainage capacity from the area with compromised venous drainage to the adjacent areas of intact venous drainage. This collateral maturation occurs over a period of 6 to 24 months [5]. Thus, for eyes with macular oedema, it is suggested that photocoagulation therapy be delayed for at least 3 months to permit the maximum spontaneous resolution of oedema and intraretinal blood. Conversely, it has been speculated by some authors [11,13] that early surgical decompression might theoretically lead to less haemorrhage, ischaemia, and oedema, with a shorter recovery time. This issue is debatable, based on spontaneous recovery discussed above, and in the absence of clear-cut benefit of a potentially iatrogenic procedure. The additional risks of retinal vascular sheathotomy are indeed numerous: full-thickness retinal tear and detachment, vascular bleeding and vitreous haemorrhage, nerve fibre layer defect and scotoma, postoperative gliosis and traction, and direct vascular injury [17].

Surgical decompression of BRVO is a technically feasible procedure. Whether sheathotomy is beneficial in the treatment of macular oedema secondary to BRVO or

whether it succeeds in recanalisation of occluded retinal vasculature have to be further investigated. Additionally, patient selection criteria and time of intervention have yet to be determined. The different series from the literature are very difficult to compare because many parameters are not standardised. Until selection criteria and time of intervention are established and until a prospective, randomised, double-masked clinical trial is performed, this new surgical technique cannot be recommended as a routine procedure.

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