• Brief Report •

Combined aqueous misdirection and persistent choroidal effusions following implantation of a Preserflo MicroShunt

Huzaifa Malick[1], *Craig Wilde*[2], *Richard E Stead*[2]

[1]University Hospitals of Leicester, Leicester Royal Infirmary, Infirmary Square, Leicester, LE1 5WW, 03003031573, United Kingdom

[2]Queens Medical Centre, Derby Road, Nottingham NG7 2UH, United Kingdom

Correspondence to: Huzaifa Malick. University Hospitals of Leicester, Leicester Royal Infirmary, Infirmary Square, Leicester, LE1 5WW, 03003031573, United Kingdom. h.malick@nhs.net

Received: 2022-11-03 Accepted: 2023-03-03

Abstract

● **AIM:** To describe a case of aqueous misdirection complicated by subsequent persistent choroidal effusions following implantation of a Preserflo MicroShunt (PMS) device to treat advanced closed angle glaucoma.

● **METHODS:** A 67-year-old caucasian female with advanced primary angle-closure glaucoma on four medications with an intraocular pressure (IOP) of 26 mm Hg was listed for a PMS insertion with mitomycin C (MMC).

● **RESULTS:** Past ocular history was significant for pseudophakia and previous yttrium aluminum garnet (YAG) peripheral iridotomy. Surgery was uneventful but on the first postoperative day, she developed aqueous misdirection complicated by subsequent development of persistent uveal effusions. Conventional treatment strategies including atropine drops, YAG hyaloidotomy and choroidal effusion drainage proved ineffective. A combination of oral steroids and pars plana vitrectomy (PPV) along with an irido-zonulo-hyloidectomy (IZH) proved efficacious.

● **CONCLUSION:** To the best of the author's knowledge, this is the first published case of aqueous misdirection complicated with the presence of significant, unresolving choroidal effusions, highlighting the possibility and sequelae of comorbid pathology in nanophthalmic eyes.

● **KEYWORDS:** combined; aqueous; misdirections; persistent; choroidal; effusions

DOI:10.18240/ijo.2023.04.21

Citation: Malick H, Wilde C, Stead RE. Combined aqueous misdirection and persistent choroidal effusions following implantation of a Preserflo MicroShunt. *Int J Ophthalmol* 2023;16(4):652-655

INTRODUCTION

We describe a case of aqueous misdirection immediately following implantation of a Preserflo MicroShunt (PMS) device to treat advanced closed angle glaucoma, complicated by subsequent development of persistent uveal effusions. Conventional treatment strategies including atropine drops, yttrium aluminum garnet (YAG) hyaloidotomy and effusion drainage proved ineffective. This case provides details of potential complications and treatment strategies when implanting the microshunt in smaller eyes.

SUBJECTS AND METHODS

Ethical Approval Consent for publication of this paper and images has been gathered from the patient.

A 67-year-old Caucasian female with advanced primary angle-closure glaucoma on four medications with an intraocular pressure (IOP) of 26 mm Hg was listed for a PMS with mitomycin C (MMC). Previous ophthalmic history was significant for bilateral peripheral iridotomies (PI; which remained patent) and bilateral pseudophakia, both of which were uneventful. The left eye had also undergone selective laser trabeculoplasty prior to the patient's presentation at our eye unit. Refraction of the left eye was +0.75/-0.75×95 with a pre-operative visual acuity (VA) of 0.0 (logMAR). The central corneal thickness was 565 μm with an axial length of 19.6 mm. Visual field testing showed a worsening superior field defect (mean deviation -12.13 at listing) with corresponding optical coherence tomography (OCT) retinal nerve fibre layer changes. She underwent an uneventful PMS insertion under peribulbar anaesthesia (5 mL of combined 2% lidocaine/0.5% levobupivacaine) with superior placement of the shunt. The surgical technique involved a superior fornix based conjunctival peritomy followed by MMC application (0.4 mg/mL) using three corneal light shields (polyvinyl acetate) for 3min. The PMS was inserted *via* a scleral tunnel 3 mm from the surgical limbus with the fins secured in the

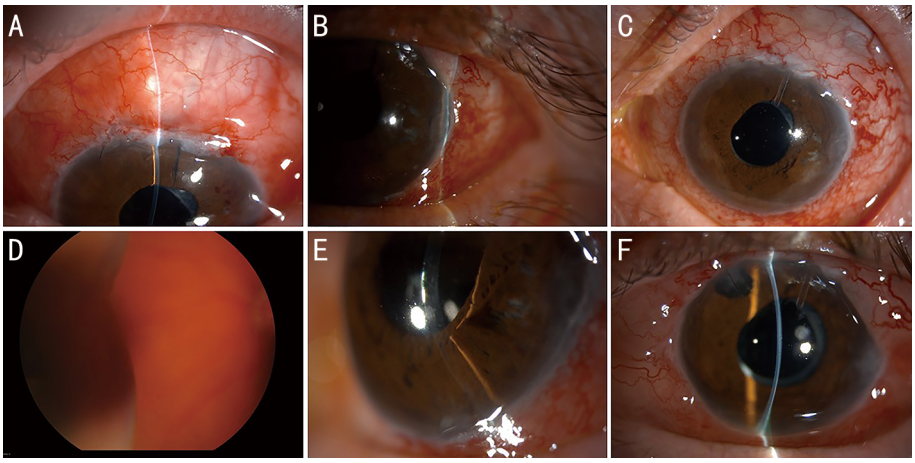

Figure 1 Post-operative pictures after PMS insertion A: Shallow AC and bleb 1wk post PMS; B: Shallow peripheral AC post PMS; C: Resolution of misdirection post YAG hyaloid; D: Choroidal effusions post PMS needling; E: Resumption of misdirection episode post needling; F: Resolution of misdirection post PPV/IZH. AC: Anterior chamber; PMS: Preserflo MicroShunt; PPV: Pars plana vitrectomy; IZH: Irido zonulo-hyloidectomy.

tunnel exit. Approximately 1 mm of the shunt was visible in the anterior chamber (AC). Cohesive viscoelastic was used to assist seperation of the Tenons tissue from the PMS tip after which Tenons and conjunctiva were carefully opposed to limbal scleral tissue using 10-0 nylon sutures. Viscoat 0.1 mL was injected into the AC through a paracentesis to reduce the chances of hypotony in the early postoperative period after which subconjunctival dexamenthasone 0.1% and cefuroxime were injected inferiorly.

On the first postoperative day, the VA was count fingers (CF) with an IOP of 18 mm Hg, a formed but shallow bleb and a very shallow AC both centrally and peripherally, along with a 0.5 mm hyphema (Figure 1A, 1B). Posterior segment examination including B-scan ultrasonography showed no signs of bleeding or effusion after which a diagnosis of aqueous misdirection was made. Oral prednisolone tablets were commenced at 30 mg tapering down by 10 mg every 3d with the dexamethasone preservative free (PF) drop frequency increased to hourly (from two hourly) along with atropine 1% drops twice daily. Review at 1wk showed some improvement in the AC depth, which remained shallow. The vision had improved to 0.30 with an IOP of 22 mm Hg and a formed bleb and clearance of the hyphema. YAG laser hyaloidotomy was performed, with no immediate change in the clinical appearance. However, review at 1wk post YAG laser showed significant deepening of the AC, with VA of 0.3 and IOP of 29 mm Hg (Figure 1C). The bleb looked injected and a subconjunctival injection of 0.2 mL betamethasone was given adjacent to the bleb. The patient was asked to use dexamethasone drops 2 hourly and to continue the atropine 1% drops as well as dorzolamide/timolol twice daily. Review 1wk later showed a VA of 0.0 of and an IOP of 30 mm Hg with a flat, inflamed bleb. The AC remained deep. Needling at the slit lamp was performed along with a further injection of 0.1 mL betamethasone adjacent to the bleb. IOP after 15min was 26 mm Hg and thus the following week the patient underwent needling in theatre. A 25G needle was used to dissect over and under the tip of the PMS followed by an injection of 0.2 mL of MMC (diluted to 0.2 mg/mL) behind the forming bleb. Dexamethasone PF 0.1% drops were continued at 1 hourly along with chloramphenciol 0.5% drops four times daily. Atropine and dorzolamide/timolol drops were stopped.

Review at day 1 post needling showed a VA 0.40 of and an IOP of 18 mm Hg with a diffuse, formed bleb. However, the AC was very shallow again, with no posterior segment pathology and a diagnosis of recurrent aqueous misdirection was made. A repeat YAG hyaloidotomy was performed and dexamethasone drops increased to hourly with re-commencement of atropine 1% drops twice daily. Oral prednisolone was also recommenced at 30 mg tapering down by 10 mg every 3d. However, review at 1wk showed no improvement in the AC depth and now posterior segment review showed 270 degree anterior choroidal effusions (Figure 1D, 1E). We felt this picture was possibly driven by inflammation at this point, and the oral prednisolone dose was increased to 60 mg with appropriate gastric protection with continuation of dexamethasone 0.1% drops every two hours. Review at 1wk showed significant improvement in the choroidal effusions with only a small nasal choroidal effusion still present. The AC was also much deeper with VA 0.18 of and IOP of 20 mm Hg. Despite this, further review at 1wk showed a very shallow AC again with worsening of the choroidal effusions, with VA of 0.40 and IOP of 22 mm Hg. The patient underwent choroidal effusion drainage with an inferonasal linear sclerostomy, with significant drainage of straw-coloured fluid. The sclerostomy was extended and cauterised, and overlying conjunctiva closed with an 8-0 vicryl suture. Review at day 1 showed resolution of most of the choroidal effusion. However, the AC remained

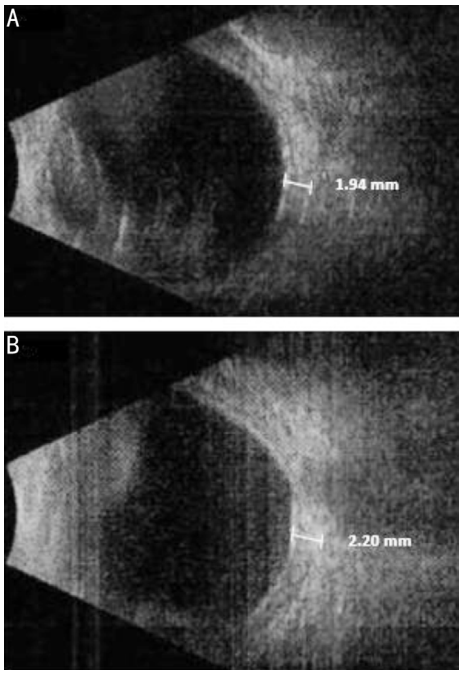

Figure 2 Increased retino-choroidal-scleral thickness measurements on B scan ultrasonography.

very shallow. A further YAG hyaloidotomy was performed, along with enlarging of the previous YAG peripheral iridotomy, but this had no effect on the clinical picture. She subsequently underwent a pars plana vitrectomy (PPV) along with an irido-zonulo-hyloidectomy (IZH) under the vitreoretinal team. The surgeon noted an instant reformation of the AC at this point in the surgery. At 1wk post PPV/IZH, her VA was 0.4 logMAR with an IOP of 17 mm Hg on three glaucoma drops and prednisolone 5 mg (Figure 1F). Her AC was deep and posterior segment exam showed complete resolution of the choroidal effusions. At her most recent visit four weeks post PPV/IZH (6mo post Preserflo) she had vision of 0.0 with IOP 23 mm Hg on four drops. The intraocular lens remained stable and in a central position.

DISCUSSION

Aqueous misdirection is a form of secondary angle closure, commonly presenting unilaterally in the early post-operative period after incisional surgery, with an incidence of 0.5%-4%[1-2]. In the primary Tube Versus Trabeculectomy (TVT) study, 3/107 patients undergoing tube surgery developed misdirection, two of which required PPV[3]. It presents more commonly in smaller eyes and those with a history of angle closure. Several theories exist as to the exact pathophysiology, with a generally accepted view that shallowing of the anterior segment in these eyes causes anterior ciliary body rotation and subsequent misdirection of aqueous into the anterior vitreous. Chandler and Grant[4], and later Shaffer[5] proposed that aqueous is misdirected and pooled in the posterior segment, leading to anterior displacement of the lens/iris diaphragm. Quigley, more recently, introduced the concept of choroidal expansion along with poor vitreous fluid conductivity as a means of anterior movement of the lens iris diaphragm and AC shallowing[6]. Irrespective of the exact mechanism, the resulting clinical picture is commonly an elevated IOP along with significant shallowing of the peripheral and central AC, in the presence of a patent iridotomy.

The PMS is an inert styrene-block-isobutylene-block-styrene (SIBS) based device used in the management of glaucoma refractory to medical and laser treatment. It measures 8.5 mm in length and, in contrast to conventional tube shunts, has no plate. It is also valveless but a combination of its length and lumen diameter protects the patient from hypotony. Several studies have found it to be both safe and effective, comparable in IOP lowering to trabeculectomy[7-8], with one study reporting a significant reduction in the need for post-operative intervention[9]. To the best of our knowledge, there are only two cases reported in the literature of misdirection following this novel Microshunt[10-11]. The first case underwent YAG IZH with temporary success, until the Preserflo was revised due to tube encapsulation, with recurrence of aqueous misdirection on the first post-operative day. PPV with lens extraction and surgical IZH proved efficacious with no recurrence of misdirection at the last follow up at 8mo[11]. There are no similar details available of the second case. We also attempted YAG IZH with only temporary benefit. Drainage of choroidal effusions also provided only temporary benefit probably because of a combination of rotation of ciliary processes and only partial interruption of the anterior hyaloid face during YAG, thus not fully breaking the cycle of cause and effect. Of note, our patient was pseudophakic with a patent iridotomy pre-Preserflo. Cyclodiode laser has also been reported as a means to break the cycle by posterior rotation of ciliary processes. We avoided this as we felt there was a risk of causing increased inflammation which may have contributed to worsening of the effusions and possibly the misdirection.

Unusually, our case also showed evidence of worsening of the choroidal effusions one week post bleb needling despite the pressure being elevated in this period. We felt this probably reflected scleral impedence seen with uveal effusion syndrome, possibly triggered following a potential period of hypotony post-needling. We felt the effusions then worsened as a result of both inflammation and scleral impedence. Indeed, there was some initial improvement noted with commencement of oral steroids. To further corroborate this hypothesis, the choroid was noted to be thick on B-scan imaging (Figure 2). Initially we felt the effusions may be causing forward rotation of the ciliary apparatus although this proved incorrect when they were drained (the AC deepened on the table) and the AC was shallow the following day. However, we felt the PPV and IZH procedure was significantly safer in the absence

of large choroidal effusions, which can cause difficulty with port placement, risking retinal trauma and subretinal infusion placement. This case highlights the rare possibility of co-morbid aqueous misdirection and uveal effusions in nanophthalmic eyes. Traditionally, to meet the diagnostic criteria for aqueous misdirection a patent PI and absence of other causes of secondary angle closure glaucomas are required. This case highlights that where, after successful drainage of choroidal effusions, the AC remains persistently shallow or flat in the presence of a patent iridotomy, it is important to consider aqueous misdirection as a comorbid or even primary aetiology in the mechanism of the secondary angle closure. Failure to do so could result in progression and sight loss.

In this case it was apparent that there was a sudden gush of fluid from the vitrectomized cavity into the AC following localised removal of the iris, zonules and anterior hyaloid with the vitreous cutter. The AC instantly uniformly deepened. The intraocular lens and capsular bag resumed a normal anatomical position intraoperatively (and in the several months of postoperative follow up) with no evidence of zonular weakness/lens subluxation as you would expect to see in a case of secondary angle closure from a uveal effusion/ haemorrhage causing loosening of the zonules and a forward lens displacement with anterior rotation of the ciliary body. Early involvement of a vitreoretinal specialist for further surgical intervention should be sought in such rare instances, particularly in nanophthalmic eyes. Some vitreoretinal surgeons may be less likely to intervene in the presence of uveal effusions, citing them as the potential cause of the secondary angle closure glaucoma. To avoid a delay in appropriate management, other etiologies including the recognition of comorbid aqueous misdirection must be considered and discussed. The authors emphasise that drainage of the choroidal effusions should be the first surgical intervention in such cases. This ensures that, with failure to reform the AC following drainage, aqueous misdirection can be considered as the primary aetiological factor in nanophthalmic eyes. It also makes the vitrectomy surgery safer, with a reduced chance of subretinal infusion or retinal trauma during trocar placement.

Further to this, we also provide further evidence that the definitive treatment of choice for aqueous misdirection is PPV + IZH. Removing as much vitreous as possible anteriorly and creating a well sized surgical IZH allows direct communication between anterior and posterior segments. In this case, removing the intraocular lens was not required. To the best of the author's knowledge, this is the first published case of aqueous misdirection complicated with the presence of significant, unresolving choroidal effusions, highlighting the possibility and sequelae of comorbid pathology in nanophthalmic eyes.

ACKNOWLEDGEMENTS

Conflicts of Interest: Malick H, None; **Wilde C,** None; **Stead R,** None.

REFERENCES

1 Chandler PA, Simmons RJ, Grant WM. Malignant glaucoma. Medical and surgical treatment. *Am J Ophthalmol* 1968;66(3):495-502.

2 Debrouwere V, Stalmans P, Van Calster J, Spileers W, Zeyen T, Stalmans I. Outcomes of different management options for malignant glaucoma: a retrospective study. *Graefes Arch Clin Exp Ophthalmol* 2012;250(1):131-141.

3 Gedde SJ, Herndon LW, Brandt JD, Budenz DL, Feuer WJ, Schiffman JC, Group TVTS. Postoperative complications in the Tube Versus Trabeculectomy (TVT) study during five years of follow-up. *Am J Ophthalmol* 2012;153(5):804-814.e1.

4 Chandler PA, Grant WM. Mydriatic-cycloplegic treatment in malignant glaucoma. *Arch Ophthalmol* 1962;68:353-359.

5 Shaffer RN. The role of vitreous detachment in aphakic and malignant glaucoma. *Trans Am Acad Ophthalmol Otolaryngol* 1954;58(2):217-231.

6 Quigley HA, Friedman DS, Congdon NG. Possible mechanisms of primary angle-closure and malignant glaucoma. *J Glaucoma* 2003;12(2):167-180.

7 Sadruddin O, Pinchuk L, Angeles R, Palmberg P. Ab externo implantation of the MicroShunt, a poly (styrene- block-isobutylene-block-styrene) surgical device for the treatment of primary open-angle glaucoma: a review. *Eye Vis* (*Lond*) 2019;6:36.

8 Batlle JF, Fantes F, Riss I, Pinchuk L, Alburquerque R, Kato YP, Arrieta E, Peralta AC, Palmberg P, Parrish RK 2nd, Weber BA, Parel JM. Three-year follow-up of a novel aqueous humor MicroShunt. *J Glaucoma* 2016;25(2):e58-e65.

9 Pillunat KR, Herber R, Haase MA, Jamke M, Jasper CS, Pillunat LE. PRESERFLO™ MicroShunt versus trabeculectomy: first results on efficacy and safety. *Acta Ophthalmol* 2022;100(3):e779-e790.

10 Stangos A, Sunaric-Megevand G. Sub-conjunctival microshunt (PRESERFLO™) vs canaloplasty for open-angle glaucoma: comparison of short-term complication and revision rates. *Invest Ophthalmol Vis Sci* 2020; 61: 3130.

11 Gizzi C, Costa G, Servadei R, Abed E, Ning B, Sharma A, Barton K. A case of malignant glaucoma following insertion of Preserflo™ MicroShunt. *Eur J Ophthalmol* 2022;32(4):NP115-NP119.