Is quick and minimal the way? Pneumatic displacement for submacular hemorrhage.

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Introduction

Submacular hemorrhage is a known devastating sequalae of various conditions (choroidal neovascularization - CNV, retinal macroaneurysm - MA, Valsava retinopathy, trauma, angioid streaks, etc.). Quick access to treatment is crucial because of the toxic effect of the haemorrhage to the macular photoreceptors. Our goal is to present the results from our minimally-invasive technique, as well as discuss the timing and safety of this treatment.

Method

The case series includes four patients. Aetiology of SMH was a CNV secondary to neovascular age-related macular degeneration (nAMD) in two patients and a ruptured retinal MA in the other two. All four patients had best corrected visual acuity (BCVA), intraocular pressure (IOP), OCT scans and fundus pictures taken at presentation and throughout their follow-up. Our treatment protocol, depending on aetiology, involved:

50ug in 0.05ml Alteplase IVI

+/- anti-VEGF IVI (aflibercept/ brolucizumab)

Paracentesis

0.3ml 100% C3F8 IVI

The post-operative regimen included 3 days face-down posturing and topical steroid as well as IOP-lowering medications (including oral acetazolamide for 7 days).

Results

Pneumatic displacement (PD) successfully displaced the clot in all 4 patients, including only partial displacement of the haemorrhage in one case (Case 2), where compliance to posturing was poor. One of the patients, even though the clot was successfully displaced, developed a post op full thickness macular hole which was addressed later with pars plana vitrectomy (PPV). Improved BCVA was observed in all patients.

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Case 1 - PD + tPA + brolucizumab

85 y.o. female with nAMD on aflibercept - time onset to treatment 6 days



Case 2 - PD + tPA + aflibercept

86 y.o. female with nAMD on aflibercept - time onset to treatment 16 days



Case 3 - PD + tPA

75 y.o. female with MA - time to treatment 5 days



Case 4 - PD + tPA

81 y.o. female with MA - at presentation VA 6/7.5 - fovea not affected - 2 weeks later VA 6/60 - time to treatment 2 days.

Following PD - persistent vitreous hemorrhage. 6 weeks post PD she underwent a PPV+ILM peel+C2F8 for full-thickness macular hole (FTMH). 8 weeks later she underwent a mac-on retinal detachment (RD) repair - VA 3 weeks post second vitrectomy 6/48.

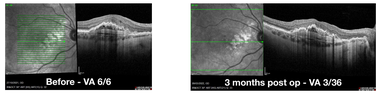


Discussion

Pneumatic displacement of SMH has been previously compared to vitrectomy with or without alteplase (IVI or subretinal) or anti-VEGF and to anti-VEGF injections alone. There is no clear consensus on best management. In the authors' opinion, there are three major issues to discuss.

Time to treatment

Subretinal blood causes damage by both mechanical separation of the neurosensory retina from the RPE, and the effect of the blood on the retinal tissue. A study on a mouse model of SMH showed that the outer nuclear layer cell death was initiated hours after subretinal blood injection and progressed rapidly in time, where at day 5 it was reduced to a single layer of cells. This was in contrast to a control group where a viscoelastic was injected instead, showing that the outer retinal degeneration after SMH was largely due to the effect of the blood constituents on the retinal tissue rather than the mechanical separation itself. Another study on a rabbit model found irreversible damage to the retina within 24 hours, and at 7 days the photoreceptor cells where almost absent.



The OCT scans above represent the Case 1 patient from our study. The anatomical appearance is very similar between before SMH and after 3/12 post PD. Despite the good anatomical outcome, the VA was significantly reduced, likely due to the effect of the blood on the retinal tissues.

Complication rate

Most of the available sources presenting results of PD for SMH show a low rate of complications requiring a secondary surgical treatment (non-clearing VH, FTMH, RD/ retinal tears). In our study, 1 in 4 patients required surgery post PD. However, a 2021 DRCR Retina Network study on pneumatic vitreolysis with C3F8 for vitreomacular traction (VMT) was terminated early due to a **12% rate of RD/tears** induced. A 2022 article by Baumann C., et al., also studying pneumatic vitreolysis for VMT, showed **8.5% RD rate** within 4 week post-op.

Posturing

Most available sources, including our case series, included posturing as part of the PD protocol. In the authors' opinion, the posturing was very bothersome to the patients and might be a limiting factor in patient selection. A study by Stopa M., et al., analyzing the forces affecting pneumatic displacement of SMH with and without an air bubble, concluded, that face-down positioning should be avoided, as the component of gravity force responsible for SMH displacement is largest when the patient is looking straightforward. Even though our experience showed that lack of posturing resulted in only partial displacement, adjusting the technique in the PD protocols to eliminate the need for posturing might help with patient cooperation and make the treatment suitable for a larger group of patients.

Conclusion

Pneumatic displacement for submacular haemorrhage is a quick treatment option that can be performed within the clinical environment. Treatment within days from onset seems to be the most beneficial, and performing it directly from the emergency clinic saves the time of waiting for theatre capacity, hence reducing the subretinal-blood-related damage. Careful patient education in regards to the prognosis and the risks of the procedure, including a high risk of secondary surgery and high complication rate, is a key part of patient selection and consent process.