Pneumatic displacement for management of traumatic macular hole with submacular hemorrhage

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Abstract:
Complications of closed-globe injury such as submacular hemorrhage (SMH) and traumatic macular hole (TMH) can be visually devastating. It is observed that TMH occurs in 1.4% of closed-globe injuries and 0.15% of open-globe injuries. There is limited data regarding the incidence of TMH with SMH, given its relatively rare occurrence. Treatment options for SMH include vitrectomy with subretinal r-tissue plasminogen activator (TPA)-assisted clot lysis, intravitreal r-TPA-assisted pneumatic displacement using an expansile gas and postoperative positioning, and finally pneumatic displacement alone. We report a unique case of a 26-year-old female with blunt trauma who developed SMH with TMH and breakthrough vitreous hemorrhage. Successful displacement of subretinal blood from the macula and resolution of the macular hole was achieved on day 1 with pneumatic displacement alone using undiluted C3F8 injection.

Keywords:
Pneumatic displacement, submacular hemorrhage, traumatic macular hole

Introduction
Rapid-onset traumatic macular hole (TMH) has varied mechanisms during blunt trauma [Table 1]. Young patients often have the greatest vitreofoveal adherence, resulting in TMH because of the sudden traction on the anatomically thin fovea.[3] Blunt trauma can also lead to choroidal ruptures and submacular hemorrhage (SMH). Untreated traumatic SMH can cause poor visual outcomes due to hematotoxicity to the photoreceptors.[4] There are numerous reports of pneumatic displacement of SMH with or without tissue plasminogen activator (TPA), most commonly in the setting of neovascular age-related macular degeneration (AMD).[5] We report the use of pneumatic displacement for the acute management of TMH with SMH.

Case Report
A 26-year-old female with no past medical history presented to the emergency clinic 2 h after sustaining blunt trauma to her right eye secondary to a fall in the bathroom. She had a lid laceration on the upper eyelid, and visual acuity measured counting fingers at half meters in the affected eye. Anterior segment demonstrated traumatic mydriasis with sphincter tears, and funduscopic examination showed vitreous hemorrhage with suspected macular hole and SMH. Swept-source-optical coherence tomography (SS-OCT) was done, which hazily revealed a full-thickness macular hole with SMH [Figures 1 and 2]. Next day, she underwent a lid repair with intravitreal injection of 0.03 cc of 100%
C3F8 gas. There was a small gas bubble migration into the anterior chamber, presumably due to zonular dehiscence. The patient was advised to maintain a prone position for 1 week. Next day, SS-OCT showed successful displacement of SMH out of the macular area and closure of TMH [Figure 3]. Three months after the intervention, fundus and SS-OCT showed subfoveal and peripapillary choroidal rupture with complete closure of TMH, as shown in Figures 4 and 5, and best-corrected visual acuity had improved up to 20/80.

**Discussion**

SMH has been shown to be damaging to the overlying photoreceptors within 1 h and causes degeneration of outer retinal layers within 3 days. Macular damage due to SMH consists of a combination of multiple mechanisms [Table 2]. Thus, it is important to intervene early and displace subfoveal hemorrhage to have a chance of achieving good vision. The pathogenesis of formation and classification of TMH has been described by many authors [Table 1]. Johnson et al. have proposed the most accepted theory, wherein blunt trauma causes anteroposterior flattening of the globe and expansion at the equator. This outward expansion of the equator is followed by flattening of the posterior pole and then posterior displacement of the posterior pole of the eye. It seems likely that with this trampoline-like movement of the posterior pole, traction forces may in fact be along the surface of the retina, that is tangential, not unlike what occurs in a more gradual manner with idiopathic macular holes. This subsequent posterior movement of the retina is the mechanism of most cases of TMH formation. OCT classification of TMH as described by Huang et al. is as follows: Types 1–5: Type 1 – macular holes with cystic edema of the neurosensory retina on both margins of the hole; Type 2 – macular holes with cystic edema of the neurosensory retina on only one margin of the hole; Type 3 – macular hole with full-thickness defect of neurosensory retina without cystic edema or detachment of the margins; Type 4 – macular hole with localized detachment of the neurosensory retina at the margin without cystic edema; and Type 5 – macular hole with thinning of the neurosensory retina.
Various treatment options for SMH have been studied including intravitreal injection of anti-vascular endothelial growth factor, photodynamic therapy, pneumatic displacement, or pars plana vitrectomy with or without adjuvant intravitreal TPA for neovascular AMD.\textsuperscript{10} However, to our knowledge, there are no controlled studies examining the use of pneumatic displacement for the treatment of TMH and SMH that have been performed.

In our case, the patient presented within 24 h of injury and had poor visual acuity at presentation with a subfoveal hemorrhage. Vitrectomy seemed to be less favorable option due to the strong vitreoretinal adhesion in the young eye and associated complications such as iatrogenic breaks. TPA injection subretinally would probably have migrated out of the subretinal space through the macular hole. Thus, the less invasive approach of pneumatic displacement alone compared to vitrectomy with subretinal TPA injection and fluid–gas exchange, provided many advantages to the patient such as decreased risk of cataract formation and recurrent hemorrhage from an acute choroidal rupture site.

### Conclusion

Within the paucity of literature for management of such cases, our patient achieved good visual outcome,\textsuperscript{8‑11} thus highlighting the potential benefit of pneumatic displacement with undiluted C3F8 gas in the treatment of acute TMH with SMH and vitreous hemorrhage.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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