Managing Traumatic Submacular Haemorrhage

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ABSTRACT

Introduction: Traumatic submacular haemorrhage can be as a result of blunt or penetrating injuries. Visual loss is immediate and profound if the blood clot is thick and involves the fovea. Prognosis of untreated SMH is variable ranging from significant visual loss to complete improvement in visual acuity. Hence, present study was undertaken to compare the clinical outcomes and efficacy of perfluoropropane gas assisted pneumatic displacement versus observation in the treatment of traumatic submacular haemorrhage.

Material and Methods: Five eyes of five patients with traumatic submacular haemorrhage. Medical Records of three patients with greater than 2.5 disc diameters of submacular haemorrhage who underwent perfluoropropane assisted pneumatic displacement were retrospectively reviewed and compared with those of two patients with less than 2.5 disc diameters of submacular haemorrhage.

Results: Periodic follow ups showed a gradual decrease in the size of haemorrhage as seen on fundus photos and OCT. At 2 weeks follow up, there was a significant visual improvement and reduction in the size of the submacular haemorrhage in the treated group. By 6 weeks the visual acuity was comparable and there was complete resolution of submacular haemorrhage. 2 patients in the treated group developed Choroidal Neovascular Membrane.

Conclusion: Submacular haemorrhage causes a significant loss of vision. This haemorrhage can be displaced by the use of a small volume of pure perfluoropropane gas injected into the vitreous, which expands to a 40% gas bubble in the eye. Final visual outcomes for pneumatic displacement of submacular haemorrhage greater than 2.5 disc diameters and observation of submacular haemorrhage lesser than 2.5 disc diameters was similar with equally effective results at the end of 6 months.

Keywords: Traumatic submacular haemorrhage, Observation, Intervention, Pneumatic displacement, Perfluoropropane gas, Visual acuity, OCT followups

INTRODUCTION

Submacular haemorrhage (SMH) is defined as accumulation of blood between the neurosensory retina and the retinal pigment epithelium (RPE) arising from the choroidal or retinal circulation at the macula.[1] It can occur due to a variety of conditions like choroidal neovascularization (CNV), trauma, inflammation of the retina/choroid, vascular malformations and as a complication of intraocular surgeries.

Traumatic submacular haemorrhage can be as a result of blunt or penetrating injuries. Visual loss is immediate and profound if the blood clot is thick and involves the fovea.[2] Prognosis of untreated SMH is variable ranging from significant visual loss to complete improvement in visual acuity.[3] Permanent damages to neurosensory retina and retinal pigment epithelium are likely and they can be attributed to[2] iron toxicity to photoreceptors from haemoglobin breakdown, photoreceptors damage due to sheering force by fibrin clots, impaired metabolic exchange between the photoreceptors and retinal pigment epithelium due to clot, subretinal fibrosis[4] and fibrocellular scar formation.[5]

Early removal of SMH from the macular area is beneficial to restore useful vision[5] before complications set in. Vitrectomy with modifications like a retinotomy, mechanical removal of subretinal clot, tissue-type plasminogen activator (tPA) and perfluorocarbon liquid use has been tried with variable final visual outcomes.[5] Poor outcome is most probably due to damage to the overlying retinal photoreceptors and underlying RPE[6] during surgical manipulation due to the tight adherence of the RPE and photoreceptors to the haemorrhagic clot.[7] A higher rate of complications was also recorded.[8]

Use of intravitreal tissue plasminogen activator (tPA) injection alongwith pneumatic displacement of blood from under the fovea with a high anatomic success rate and few complications was first described by Heriot. Other investigators had successfully displaced SMH out of the fovea using a technically simple intravitreal gas injection alone[3,9] with low rate of serious complications.[10] The present study was undertaken to evaluate and compare the clinical outcomes and efficacy of perfluoropropane gas assisted pneumatic displacement versus observation in the treatment of traumatic submacular haemorrhage.

MATERIAL AND METHODS

This retrospective, comparative study included 5 eyes of 5 patients (1 female, 4 male) with traumatic submacular haemorrhage who underwent either intravitreal perfluoropropane assisted pneumatic displacement or observation as treatment for the same. We retrospectively reviewed medical records at JSS Medical College and Hospital, JSS University from September 2014 to March 2016. Inclusion criteria were cases from records with SMH of less than 15 days duration and at least 2.0 disc diameter (range 2.0–4) involving the central macula associated with a complaint of acute drop in vision. All five cases in the study were subsequent to blunt trauma. The first group i.e, the intervention group comprised of 3 cases that underwent pneumatic displacement of SMH, the largest diameter of haemorrhage was more than 2.5 disc diameters. The second group i.e, the observation group consisted of the 4th and 5th cases wherein the longest diameter was between 2.0 and 2.5 disc diameters. All procedures were performed under topical anaesthesia in the operating room after obtaining a written informed consent from the patients. 2 patients who had less than 2.5 disc diameters of SMH were observed with

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no active intervention. Each patient underwent a complete ophthalmological examination including visual acuity using a Snellen chart and converted to LogMAR as per visual acuity measurement standard; slit-lamp biomicroscopy, intraocular pressure (IOP) measurement, indirect ophthalmoscopy, fundus photography and optical coherence tomography (OCT) to evaluate the size of the haemorrhage at presentation and at 2, 4, 6, 8 and 12 weeks later. OCT machine used was Optovue –iVue system. Retinal thickness (distance between RPE to the ILM), location of haemorrhage (subretinal or subRPE), and thickness of submacular haemorrhage were measured manually on a high resolution raster image. For subretinal haemorrhage, thickness was equal to the distance between the RPE and the first high reflectivity line within the retina representing the junction between inner and outer segment of photoreceptors (IS/OS line). The length, width and thickness of SMH measured in microns were used for volume calculation.

All procedures were performed under topical anaesthesia. Following the antiseptic cleaning, a site 3.5mm from limbus in infero-temporalquadrant was marked as injection site using callipers. 0.3 ml pure perfluoropropane gas was injected into the vitreous cavity with a 30-gauge needle. Anterior chamber paracentesis was done to regulate the IOP. Indirect Ophthalmoscopy was done to rule out circulatory compromise. Antibiotic eye drops were instilled and eye padded. Strict face-down positioning for a week was required from the patients post- operatively.

STATISTICAL ANALYSIS

Since the numbers are very less, no inferential statistics were attempted. Only descriptive statistics have been presented with the help of Microsoft office 2007.

RESULTS

Description of cases is given in table 1. Periodic follow ups showed a gradual decrease in the size of haemorrhage as seen on fundus photos and OCT. At 2 weeks follow up, there was a significant visual improvement and reduction in the size of the submacular haemorrhage in the treated group. By 6 weeks the visual acuity was comparable and there was complete resolution of submacular haemorrhage. 2 patients in the treated group developed Choroidal Neovascular Membrane (CNVM). Figure 1 and table 2 shows comparison of mean visual acuity in LogMAR at presentation, 2 weeks and 6weeks in both the groups.

Figure 2 and table 3 shows mean optical coherence tomography (OCT) values (in cu mm) and standard deviation in both the groups at presentation, 2weeks and 6weeks

DISCUSSION

The natural course of untreated SMH is variable.[3] As there is no medical therapy available, surgical measures in some cases can stabilize and even improve vision. Surgical benefits most probably occur in patients who had good visual acuity before the haemorrhage, duration of haemorrhage is less than 2 weeks and size larger than 3 disc diameters in greatest linear dimension.[4] Large retinotomies result in retinal pigment epithelium and photoreceptor loss with ensuing areas of RPE atrophy and retinal detachments (30 to 37%).[7] Therefore a less traumatic method of clearing SMH from the fovea is sought.[6]

In 1996, Kamei et al[11] proposed usage of subretinal rtPA and perfluoropropane gas to displace haemorrhage out of the subretinal space. Claes and Zivojnovic combined rtPA injection with large retinotomy for evacuation of SMH. The Submacular Surgery Trials showed that in comparison with observation there was no apparent visual benefit from surgery at 36 months follow-up, hence efforts to displace rather than evacuate SMH gained wide popularity.

Perfluoropropane (C3F8) is a colourless, odourless and inert gas with high surface tension.[12] Interfacial tension at the gas-vitreous interface was responsible for the displacement of sub-retinal fluid. Gravity may also play a role in sub-retinal fluid displacement with appropriateia positioning of the patient.[13] This facilitates reattachment of the retina.[11] The volume to be injected was first measured in a standard plastic disposable sterile syringe with millipore filter and then injected through the pars plana via a 30G needle. After injection into the vitreous cavity, unlike air, pure C3F8 gas expands. When gas enters the vitreous cavity, three phases can be distinguished: expansion, equilibrium and dissolution. The initial rapid expansion of the gas bubble in the first 6 to 8 hours occurs due to absorption of nitrogen, oxygen and carbon dioxide from the surrounding tissue fluid. This is followed by the equilibrium phase, when the partial pressures in the gas bubble and vitreous equilibrate. Diffusion of nitrogen into the bubble is balanced by the diffusion of gas into the surrounding fluid. Finally, the dissolution stage when gases exit, as they are ultimately absorbed into the bloodstream.[12] A pure C3F8 bubble can expand to 4 times of its original volume within 72 to 96 hours, persisting in the vitreous cavity for 6 to 8 weeks. It is important to distinguish Submacular haemorrhage from sub RPE haemorrhage as the later are difficult to displace by gas. Apart from strict face down positioning, post-operative instructions include advice against air travel or travel to high altitudes and deep sea diving to prevent further expansion of the gas. Complications of pneumatic displacement include vitreous haemorrhage, suprachoroidal gas displacement, endophthalmitis, iatrogenic retinal break, retinal detachment, glaucoma, and recurrent haemorrhage.[9]

All five cases in the study were subsequent to blunt trauma. In the first group i.e, the intervention group who underwent pneumatic displacement of SMH, the largest diameter of haemorrhage was more than 2.5 disc diameters. The second group i.e, the observation group consisted of the 4th and 5th cases wherein the longest diameter was between 2.0 and 2.5 disc diameters. Mean age was 34 years and 32 years in the first and second group respectively. Our retrospective comparative study showed a significant visual improvement in eyes following the pneumatic displacement of SMH within two weeks and at four weeks in the observation group. Pneumatic displacement eyes had an average gain of atleast 3 lines of vision compared to the observation group at the end of 6weeks. As the patients were all Post Traumatic, the better pre-operative status of RPE and the early presentation of within 2 weeks of trauma attributed to the better visual outcome. Apart from the subjective improvement, we also showed an objective evidence of decrease in the size of submacular haemorrhage as seen in periodic fundus photos and OCT images, thus proving a functional and structural improvement.

All five patients had 6 months follow up. The second and

Case no	Patient details	History of injury	Presenting features	Fundus and OCT findings	Vision and IOP	Treatment	Post-op findings	Visual acuity
1	40 yr/F	Blunt injury right eye presented on the same day	Swelling, conjunctival congestion, chemosis, iridodonesis and phacodonesis.	-SMH -3930µm x 3270µm x 435 µm on OCT - Extrafoveal choroidal rupture	Counting fingers 1metre, 48mm of Hg. After IOP stabilized, vision was 1.0 LogMAR	Anti glaucoma measures, Intravitreal C3F8 Gas injected	Decreased SMH, vitreous strand in the anterior chamber released by YAG vitreolysis.	2 weeks later visual acuity was 0.5 LogMAR and SMH size decreased to 2000µm x 2000µm x 126 µm on OCT. At 6 months follow up VA 0.5 LogMAR
2	48 yr/M	Blunt injury to right eye one week earlier	Diminution of vision	-SMH -3770µm x 3450µmx395 µm on OCT.	Vision of 0.6LogMAR with normal anterior segment and IOP of 14mm of Hg	Intravitreal C3F8 gas injected	2 weeks later visual acuity was 0.2 LogMAR, IOP measured 12mm of Hg. SMH reduced to 2000µm x 1108µm x 200µm.	Juxtafoveal choroidal neovascular membrane (CNVM) evident at 2 months. Treated with monthly intravitreal anti-VEGF injections twice and the CNVM regressed.
3	14 yr/M	Blunt trauma to left eye presented after 1 week	Diminution of vision, few healing lid abrasions and a resolving subconjunctival haemorrhage	-SMH -Choroidal tear temporally -RPE changes nasal and temporal to the disc. -5700µm x 5500µm x 490µm on OCT	Vision of 0.8LogMAR and IOP of 10 mm Hg.	Intravitreal C3F8 gas injected	2 weeks later visual acuity was 0.3LogMAR and SMH measured 2845µm x 2500µm x 300 µm thickness on OCT.	Eye stable at 3 months follow up, extra foveal CNVM at 6 monthly checkup from the site of choroidal rupture.
4	30 yr/M	Blunt trauma one week earlier	Drop in vision.	-SMH -Two concentric choroidal ruptures inferotemporal to the foveola. -3000 µm x 2850µm x 253µm on OCT.	Visual acuity of 1.2 LogMAR, IOP was 30mm of Hg	No active intervention, antiglaucoma measures	At 2 weeks visual acuity was 0.8 LogMAR and SMH measured 1250µm x 1100µm x 145µm.	After 10 weeks, complete and spontaneous resolution of the SMH. The central retinal thickness measured 193µm with an improvement in Visual acuity to 0.3LogMAR.
5	34 yr/M	Blunt trauma	Blunt trauma one day earlier	-SMH -Lamellar macular hole -Superotemporal retinal break -3420µm x 2600µm x 265µm on OCT	Visual acuity of 1.0 logMAR IOP of 34mm of Hg	The Retinal break was lasered, antiglaucoma medication started.	At 2 weeks visual acuity was 0.8 LogMAR and SMH measured 1800µm x 1500µm x 85µm.	Complete and spontaneous resolution of SMH and vision improved to 0.3 LogMAR with central foveal thickness of 137µm.

Table-1: Description of cases with Submacular haemorrhage

	Group	Mean	Std Deviation	No. of Patients
VA at presentation	Intervention	0.9333	0.11547	3
	Observed	1.1000	0.14142	2
	Total	1.0000	0.14142	5
Va at 2 weeks	Intervention	0.4667	0.15275	3
	Observed	0.8000	0.00000	2
	Total	0.6000	0.21213	5
Va at 6weeks	Intervention	0.3333	0.15275	3
	Observed	0.3000	0.00000	2
	Total	0.3200	0.10954	5

Table-2: Showing descriptive statistics of visual acuity at presentation, 2weeks and 6weeks (in LogMar)

	Group	Mean	Std. Deviaiton	N
Initial OCT	Intervention	8.69	5.78	3
	Observed	2.26	0.14	2
	Total	6.12	5.39	5
OCT after 2weeks	Intervention	1.03	0.96	3
	Observed	1.25	1.48	2
	Total	1.11	1.01	5
OCT after 6 weeks	Intervention	0.69	0.12	3
	Observed	0.00	0.00	2
	Total	0.42	0.93	5

Table-3: Showing mean OCT values (in cu mm) and standard deviation in both the groups at presentation, 2weeks and 6weeks

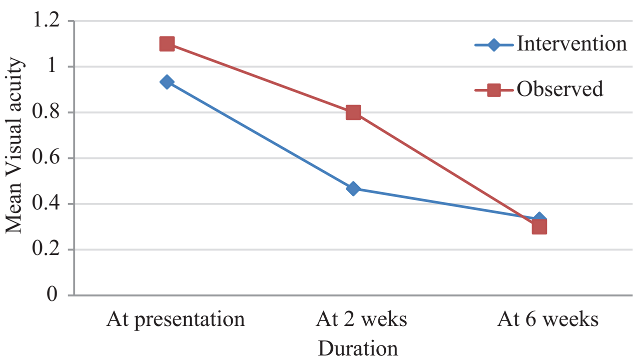

Figure-1: Comparing the mean visual acuity of the patients at presentation, 2 weeks and 6 weeks

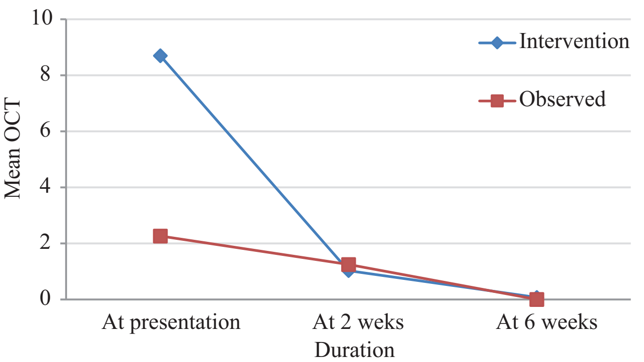

Figure-2: Showing mean OCT changes in both the groups at presentation, 2 weeks and 6 weeks

third patients developed juxtafoveal and extrafoveal choroidal neovascular membranes respectively. The second patient underwent two intravitreal anti-VEGF injections with regression of the CNVM. The third patient refused further intervention. There have been few case reports of spontaneous resolution of traumatic submacular haemorrhage with no intervention as reported by Chaudhry NA et al.[14] Recently, Lee JP et al[15] evaluated the visual and anatomical outcomes for neovascular age-related macular degeneration with submacular hemorrhage after intravitreal injections of tenecteplase (TNK), anti-vascular endothelial growth factor (VEGF) and expansile gas and reported that a triple injection of TNK, anti-VEGF, and a gas appears to be safe and effective for the treatment of submacular hemorrhage secondary to neovascular age-related macular degeneration.

Unlike the poor prognosis associated with untreated SMH and the high risk of complications associated with surgical interventions, Pneumatic Displacement is a lesser invasive procedure with good visual prognosis. Pneumatic displacement is cost effective and quicker when compared to a vitrectomy. Observation has also shown gradual resolution of the submacular haemorrhage with foveal thinning in the two cases in our study. The limitation of the present study was small sample size. We could not compare the foveal thickness since the case no.5 had a lamellar hole. Hemorrhages with duration of 2 weeks or less and eyes with a good visual acuity prior to the hemorrhage are known to have a good visual prognosis. Eyes with relatively thick hemorrhages at the fovea, extending larger than three or more disc areas in greatest linear dimension, and eyes with AMD are known to be associated with poorer visual outcomes.[5]

CONCLUSION

Clearance of submacular haemorrhage from the fovea is essential to improve foveal function. Clearance with an intervention less traumatic to the sensory retina and retinal pigment epithelium helps in restoring foveal function. Pneumatic displacement has proved to be an effective treatment modality for Traumatic Submacular haemorrhage. It may be considered as first line management in Traumatic Submacular haemorrhage as it provides good visual outcome with a minimally invasive and safe procedure in cases where the size of the SMH is greater than 2.5 disc diameters. The smaller and thinner SMH resolved spontaneously. In this retrospective comparative study, final visual outcomes for pneumatic displacement of Submacular haemorrhage greater than 2.5 disc diameters and observation of Submacular haemorrhage between 2.0 and 2.5 disc diameters was equally effective at the end of 6 months.

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