Vitreous hemorrhage is defined as bleeding into the space outlined by the internal limiting membrane of the retina posteriorly and posterior laterally, the non pigmented epithelium of the ciliary body laterally and the lens zonules and the posterior lens capsule anteriorly. The incidence of vitreous hemorrhage is approximately seven cases per 100,000 population.

**Causes of Vitreous Hemorrhage**

The most common causes of vitreous hemorrhage are proliferative diabetic retinopathy (31-54%), vascular occlusions (4-16%), retinal tear (11-44%) and trauma (12-19%). In young the most common cause is trauma. Vitreous hemorrhage can also occur in CNVM, polypoidal choridovascularopathy, retinal macro aneurysm, secondary to subarachnoid hemorrhage (Terson’s syndrome) and various vasculopathies causing neovascularisation. Bleeding from a vascularised snow bank can occur in parsplanitis. Other rare cases are blood dyscrasias, Valsalva retinopathy, and intraocular tumors.

In newborn the causes are trauma during spontaneous vaginal delivery, ROP, and shaken baby syndrome. In children trauma is the most common cause. Retinoblastoma, leukemia and other coagulopathies can also cause hemorrhage in children.

**Pathophysiology**

Traction exerted by vitreous on the retinal vessels, either normal or pathologic, leads to bleeding into the vitreous gel or the sub hyaloid space. The blood in sub hyaloid space has a boat shape configuration.

The spontaneous rupture of a retinal macro aneurysm, bleeding from a retinal angioma, rupture of venules in Valsalva retinopathy etc are causes of vitreous hemorrhage without any vitreous traction.

Break through of sub retinal hemorrhage as in CNVM, PCV, Choroidal malignant melanoma is another mechanism responsible for vitreous hemorrhage.

In Terson’s syndrome the hemorrhage is a result of rupture of retinal venules due to sudden increase in intracranial pressure.

**Course of Vitreous Hemorrhage**

Spontaneous clearance of hemorrhage from vitreous cavity can occur in conditions where there is no recurrent bleed. Erythrocyte in the vitreous may exit through the trabecular meshwork or may undergo hemolysis or phagocytosis or persist in the vitreous for many years. The blood that breaks in to the vitreous cavity clots rapidly and often clears slowly at about 1% per day. The clearance is faster in vitrectomised eyes and eyes with syneretic vitreous. If the hemorrhage does not clear, it may lead to hemosiderosis bulbi, fibrovascular proliferation and glaucomas (hemolytic, ghost cell, hemosiderotic glaucomas).

**Clinical Features**

Symptoms: Patients often present with sudden painless loss of vision. The symptoms may range from floaters to sudden black out of vision. Flashes that precede the onset of symptoms often suggest posterior vitreous detachment with or without retinal tear formation. Acute PVD with vitreous hemorrhage is associated with 70% incidence of retinal tears compared to 2-4% incidence in acute PVD without hemorrhage.

**Evaluation of Patients With Vitreous Hemorrhage**

History of trauma, flashes, diabetes, hypertension, dyslipidemia, and any bleeding disorders may be elicited to establish the possible etiology of vitreous hemorrhage. A hypertensive can develop a vascular occlusion with proliferative changes or at times develop vitreous hemorrhage from macro aneurysm rupture. Vision has to be recorded and varies depending on the severity of hemorrhage.

Pupillary reaction may be normal unless there is an underlying optic nerve or large macular lesion. Long standing retinal detachment can also cause a RAPD.

Slit lamp examination helps to pick up iris or angle neovascularisation which suggests an underlying ischemic cause like proliferative diabetic retinopathy, carotid ischemia or vascular occlusion. Keratic precipitates may suggest an inflammatory etiology. Tell tale signs of trauma may be picked up during slit lamp examination. An iris hole or a localized cataract may suggest an intraocular foreign body.

Dilated fundus examination will be helpful to establish the cause of vitreous hemorrhage when hemorrhage is not dense. Examination of the other eye is important, since conditions like diabetic retinopathy, retinal vasculitis, FEVR, retinoschisis are bilateral. Unilateral hemorrhage in the absence of findings in the other eye could be due to trauma.
posterior vitreous detachment with or without retinal tear, vascular occlusion, tumors, CNVM or PCV. In patients with history of flashes, if the media clarity permits, attempt should be made to locate a tear.

In those patients where the posterior segment details are not clear an ultrasound scan is indicated. This helps to pick up an underlying retinal tear, posterior vitreous detachment, retinal detachment and tumors. It has to be remembered that fresh dispersed hemorrhage in the vitreous may be picked up only by scanning at a high gain. Clotted hemorrhage can be seen as opacities with varying reflectivity in the vitreous cavity, denser inferiorly. Associated sub hyaloid hemorrhage may be seen as multiple dot echoes between the retina and posterior hyaloid. In an elderly individual with drusens in the body if foreign body is clinically suspected and is not seen on ultrasound imaging. CT scan may be done to rule out an intraocular foreign body. Observation can be continued for up to 2-3 months. In cases of traumatic vitreous hemorrhage with intraocular foreign body is another indication for emergency vitrectomy. The LASER treatment through hemorrhage may require an indirect LASER delivery system.

Management

Management of vitreous hemorrhage depends on the etiology, the media clarity, the other eye status, duration of hemorrhage, presence of NVI, NVA etc. The options available in the management of vitreous hemorrhage are,

1. Observation
2. Laser photocoagulation
3. Intravitreal anti VEGF injections
4. Pars plana vitrectomy.
5. Enzymatic vitreolysis

Observation

All vitreous hemorrhages are not surgical emergencies. If there is no associated retinal detachment, retinal break, intraocular tumor, neovascularization of the iris or the angle, observation can be tried initially. If the retina is attached the patient is asked to rest with the head in an elevated position and is reevaluated at 3-4 weeks intervals. Retinal detachment has to be ruled out with the help of ultrasonography at each visit, if the retinal details cannot be made out. The blood gravitates to the bottom of the vitreous cavity with rest and the underlying cause which becomes visible is then treated. Observation can be continued for up to 2-3 months.

Laser Photocoagulation

Where the primary cause is visible through the hemorrhage, at presentation, or after a period of observation (like PDR changes, vascular occlusion), prompt LASER treatment may help in clearing of vitreous hemorrhage. The successful resolution of the primary cause prevents rebleeding and the blood already in the vitreous cavity will be taken care of by the natural mechanisms. The posterior vitreous detachment induced retinal breaks also have to be surrounded by confluent laser to prevent retinal detachment. The LASER delivery system.

Intravitreal Anti VEGF Injections

Intravitreal Bevacizumab (avastin) has been used to treat vitreous hemorrhage secondary to vascular retinopathies like PDR, vascular occlusion, Eale’s disease. This may result in the resolution of neovascularisation preventing further bleeding and improvement in the media clarity to allow LASER treatment. But the injection can also worsen the tractional detachments due to contraction of the fibro vascular proliferations associated with the vascular retinopathies. Hence if the hemorrhage does not clear, or the retinal status seems to be under threat, immediate surgery as early as within 7 days of injection is advised.

Pars Plana Vitrectomy

Urgent vitrectomy is warranted when vitreous hemorrhage is associated with retinal detachment, CNVM, PCV, and any condition which is likely to progress fast if left untreated. Traumatic vitreous hemorrhage with intraocular foreign body is another indication for emergency vitrectomy. Bilateral vitreous hemorrhage where the patient wants early visual rehabilitation is also an indication for early surgery.

Vitrectomy is indicated for all cases of nonclearing vitreous hemorrhage. Type 1 diabetic patients with vitreous hemorrhage are reported to have a poorer prognosis with delayed vitrectomy by Diabetic Retinopathy Vitrectomy Study. Type 1 diabetics are advised surgery within 1 month of onset of symptoms; type 2 patients may wait up to 2-3 months for spontaneous clearance before undergoing surgery. During the period of observation serial monitoring with ultrasound to rule out a tractional retinal detachment involving the macula is recommended. With the widespread use of anti VEGF agents these guidelines are not strictly adhered to and more and more patients are receiving intravitreal injections and undergoing surgery.
A Meta analysis on the role of preoperative intravitreal avastin on the surgical out comes in diabetic retinopathy has observed that there is a significant reduction in the incidence intraoperative bleeding and frequency of endodiathermy in the IVB (intra vitreal Bevacizumab/avastin) pretreatment group than in the vitrectomy alone group16. The IVB pretreatment group took significantly less surgical time than the control group16. It also reduced the incidence of post operative recurrent hemorrhage with better visual outcomes compared to vitrectomy alone group16. Also the use of 23 g suture less vitrectomy systems with high speed vitrectors with ports close to the tip helping complete dissection of the membranes obviating the need for extra instrumentation, wide angle lenses, and chandelier light systems allowing bimanual dissection have all made the surgical results better and hence a more aggressive approach is being practiced.

Branch retinal vein occlusion may lead to vitreous hemorrhage and if the blood does not clear up in 2-4 months, surgery is indicated. Early surgery may be required if there is a tractional detachment threatening the macula. Vascular retinopathies in young patients like Eale's disease also require vitrectomy if the hemorrhage does not clear in 2-3 months. But as for diabetic vitreous hemorrhage intravitreal anti VEGF injections and early surgery are being done for these indications also.8,9,17.

In traumatic vitreous hemorrhage with no intraocular foreign body or retinal detachment, surgery may be delayed up to 2-3 weeks for the posterior vitreous detachment (PVD) to develop1. Similarly one can wait for posterior vitreous detachment to develop before vitrectomy, in eyes with Terson’s syndrome, post cataract surgery vitreous hemorrhage (not due to retinal breaks or accidental globe perforation) and vitreous hemorrhage in bleeding diathesis1. This helps to avoid the step of induction of PVD which may be difficult especially if the patient is young.

**Enzymatic Vitreolysis -Intravitreal Hyaluronidase**

Ovine Hyaluronidase (vitrase) when given intravitreally facilitates the clearance of vitreous hemorrhage by inducing liquefaction of the vitreous which allows for red blood cell lysis and phagocytosis18. Results from randomized control trials have shown that single intravitreal injection of ovine Hyaluronidase helped in visualization of the underlying pathology and treatment of the underlying pathology in a significant number of patients receiving the injection compared to the placebo10. Also > 3 line improvement in BCVA, hemorrhage density reduction was achieved in a significant proportion of patients receiving vitrase injection19. These injections are considered safe except for the occurrence of mild iritis20. A model based on reduction in total hemorrhage point score has been developed to predict the patients who are most likely to have the vitreous hemorrhage cleared by a single intravitreous injection of Ovine Hyaluronidase18.

**Recurrent Hemorrhage after Vitrectomy For Diabetic Vitrectomy**

Post operative vitreous hemorrhage following diabetic vitrectomy has an incidence varying between 29-75%21. The causes of early vitreous hemorrhage are dispersed blood from the peripheral vitreous skirt, oozing from the cut end of vessels, hypotony etc22. This may clear on its own in 2-3 weeks and may be managed by fluid air exchange if it persists. Intraocular tamponade with 10% C3F8 in vitrectomy for proliferative diabetic retinopathy has been reported to be associated with reduction of early postoperative vitreous hemorrhage23. Preoperative avastin helps in diabetic vitrectomy and reduces the need for extensive segmentation and delamination, decreasing the chance of significant early vitreous hemorrhage21. Another study comparing effect of intravitreal avastin before surgery with intra operative avastin at the end of surgery has reported that, the incidence of early post operative vitreous hemorrhage occurring in less than 4 weeks is 10.8 % in group treated with avastin at the end of vitrectomy, compared to 22.8 % in pre surgery avastin group24.

Late recurrent hemorrhage is due to fibrovascular ingrowth (FVIG) at the sclerotomy sites, anterior hyaloidal proliferation, neovascularisation of residual fibrovascular tissue; angle or iris22. This can be treated with intravitreal Bevacizumab28, vitreous lavage with additional laser, anterior retinal cryo therapy (ARC) and in severe cases dissection of the vascular membranes followed by laser cryo and tamponade25. Fibrovascular ingrowth has been reported to be the cause of 57%-87.5%22 of recurrent hemorrhage. It is often indicated by a dilated episcleral vessel entering the previous sclerotomy site25. UBM of the sclerotomy site may show a large and low reflecting trapezoidal image indicating its presence26. Anterior peripheral retinal cryotherapy combined with cryotherapy of sclerotomy sites in patients undergoing diabetic vitrectomy has been advised for inhibition of FVIG and prevention of recurrent vitreous hemorrhage27.

With early detection and timely treatment of conditions predisposing to vitreous hemorrhage, the incidence of hemorrhage can be reduced. Even in those patients developing hemorrhage, prompt evaluation and implementation of proper treatment can go a long way in providing better visual results

**References**


