Vitreous Surgery for Complications of Diabetic Retinopathy

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Objectives: To present and emphasise the role of vitreous study in the management of severe complications of proliferative diabetic retinopathy.

Study design: A retrospective study of patients who had undergone vitreous surgery for complications of diabetic retinopathy during the one year period since March 1998. The importance of removal of posterior cortical vitreous is highlighted for long term success of surgery.

Setting: Vitreoretinal unit at the Salmaniya Medical Complex, Bahrain

Subjects: Twenty two eyes of twenty diabetic patients who needed vitreous surgery for various complications like vitreous haemorrhage (6 eyes), tractional retinal detachment (13 eyes) and combined tractional and rhegmatogenous retinal detachment (3 eyes).

Results: Twenty eyes (91%) showed visual improvement following vitreous surgery. Five eyes improved to 6/12 or better vision.

Conclusion: Vitreous surgery has a definite role in managing severe complications of proliferative diabetic retinopathy. Ninety one percent of the eyes showed visual improvement which otherwise would have doomed to be blind.

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Diabetic retinopathy is a frequent cause of blindness and it is the leading cause in the patients aged 20 to 64 years[1]. In fact, diabetics are 25 times more likely to become blind than the normal population.

Diabetic retinopathy can cause visual loss by several mechanisms, including

(1) Macular oedema
(2) Capillary non perfusion
(3) Optic nerve affection
(4) Complications from neovascular and fibrovascular tissue growth that produces vitreous haemorrhage, retinal detachment and traction optic neuropathy.

Laser photocoagulation forms an important aspect of the treatment of diabetic retinopathy. However, in advanced cases, vitreous surgery plays an important role. The purpose of this paper is to examine the pathogenesis of blinding complications of proliferative diabetic retinopathy, discuss surgical objectives and principles and analyse our results.

Pathophysiology and Pathoanatomy

Diabetic retinopathy presents itself in two stages: One stage is confined to intraretinal changes and is called non proliferative diabetic retinopathy (NPDR). In the second stage, neovascular and fibrovascular growth occurs resulting in extraretinal complications and is called proliferative diabetic retinopathy (PDR). Vaso-occlusive processes with resulting hypoxia and the release of hypothetical angiogenic substances are thought to play a role in the development of proliferative disease[2,3] (Fig. 1). Neovascularisation starts most commonly on the optic nerve head or along the temporal vascular arcade (Fig.2a &b). Initially, it appears on the surface of the retina and later grows along the posterior vitreous surface. Posterior vitreous surface provides the

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"scaffold" for the proliferating cells to attach and grow. Contraction of the vitreous leads to detaching of the posterior vitreous surface from the retina leading to avulsion of friable new vessels and vitreous haemorrhage. Also, the firm attachment of the fibrovascular tissue to the underlying retina and the separating posterior vitreous surface exerts a pull on the retina causing tractional retinal detachment (Fig. 3) and/or retinal tear with combined retinal detachment.

The posterior vitreous surface, therefore, is of great importance in the pathogenesis of extraretinal features of the PDR and its secondary complications[4-6]. The objective of vitreous surgery, and its long term effects are determined by the complete removal of the posterior vitreous surface.

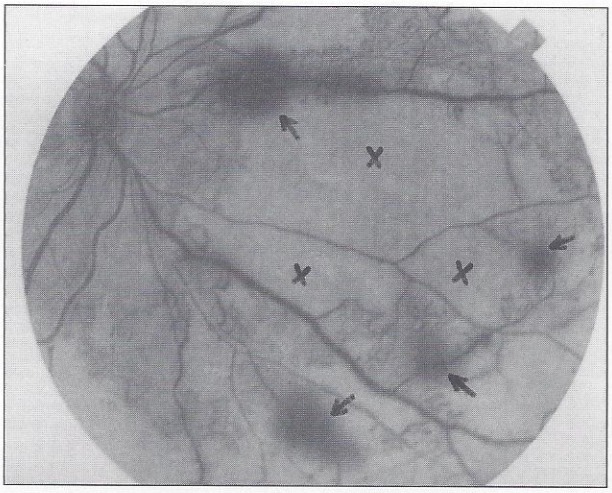

Figure 1. Fundus Fluorescein Angiogram done by injecting Sodium fluorescein (10%) in the antecubital vein and taking pictures of the retina with a special camera. This picture shows extensive area of capillary non perfusion (crosses) and dye leakage from retinal neovascularizations (arrows).

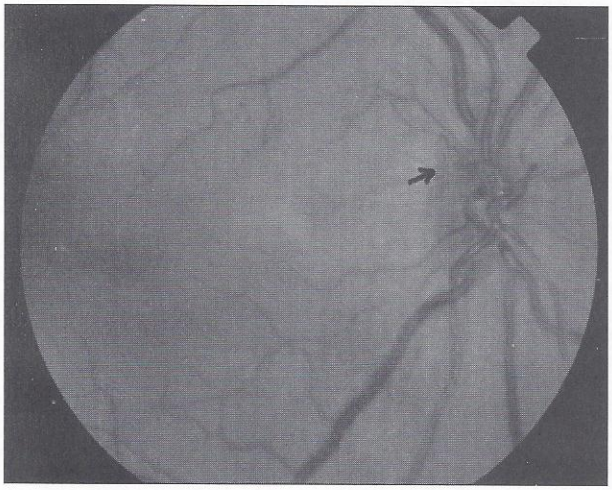

Figure 2 a. Neovascularization of disc (NVD). Early stages of optic nerve head neovascularization (arrow)

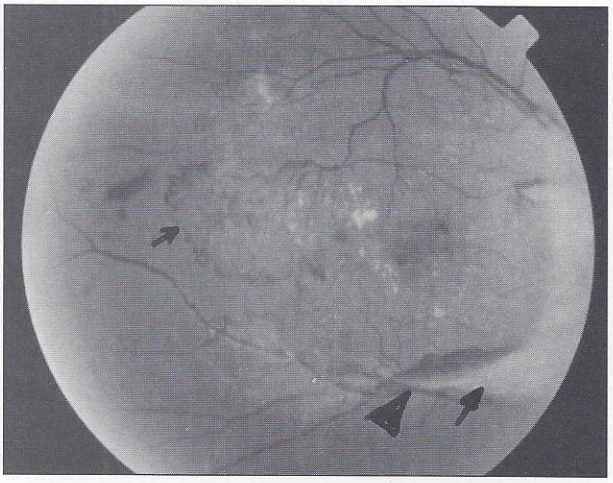

Figure 2 b. Neovascularization elsewhere (NVE). Neovascularization along supero-temporal arcade (arrow) with mild vitreous haemorrhage (arrowhead)

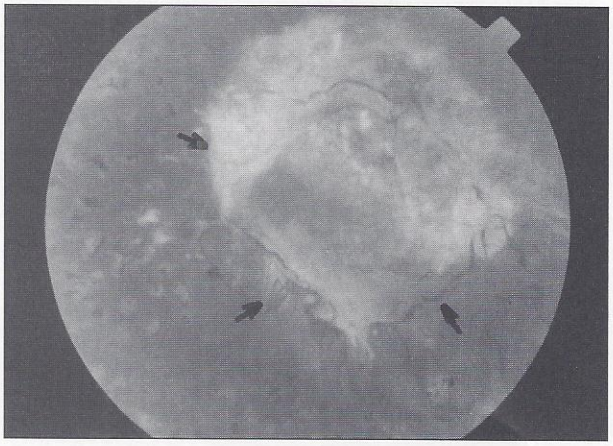

Figure 3. Extensive fibrovascular growth pulling underlying macula and causing tractional retinal detachment (arrows). Laser photocoagulation scars are also seen.

Indications for vitreous surgery

Vitreous surgery is indicated in several situations to counteract the damaging effect of the fibrovascular growth on the delicate structures of the eye like retina and the optic nerve. Common indications are:

1. Vitreous haemorrhage
2. Tractional retinal detachment
3. Combined tractional and rhegmatogenous retinal detachment

Other less common indications include: Severe progressive fibrovascular proliferation, anterior hyaloidal fibrovascular proliferation and macular oedema with posterior hyaloid traction.

Vitreous haemorrhage

Vitreous haemorrhage occurs mainly from active neovascularization. Depending on the severity of vitreous haemorrhage, vision is affected mildly or severely. The patient notices "black spots, lines or cob webs" in front of the eye and if the bleeding is severe, the patient will complain of loss of vision. Mild vitreous haemorrhage will respond to conservative treatment of restricting physical activity and laser treatment if possible. Massive vitreous haemorrhage obscuring the view of the retina, may be observed for few months. However, the natural history of such haemorrhage is not good[7-9]. If it does not resolve then vitreous surgery is indicated. Early vitreous surgery is indicated in eyes with vitreous haemorrhage associated with retinal detachment, iris neovascularization, premacular haemorrhage and one eyed patient. Vitreous surgery leads to improvement in visual acuity in about 80% of eyes[5,10-13].

Tractional retinal detachment

When tractional retinal detachment involves the macula, an early vitreous surgery is indicated to relieve the traction and re-attach the retina. Delay in surgery will result in irreversible visual loss. If vitreous haemorrhage prevents visualization of the retina then ultrasonography should be done to detect any retinal detachment. If vitrectomy is done at an appropriate time then improvement in vision occurs in 70%-80% of eyes[14,15].

Combined tractional and rhegmatogenous retinal detachment

It occurs when fibrovascular proliferation exerts a pull on the retina and besides elevating the retina, causes retinal tear. This tear allows entry of vitreous fluid into the subretinal space and leads to rapid and extensive retinal detachment. It requires urgent vitreous surgery irrespective of involvement of the macula. The vitreous surgery is more difficult and visual results are less favorable[16].

Surgical objectives

The purpose of vitreous surgery is twofold: to reverse preexisting blinding complications of the proliferative retinopathy by removing any visually significant intravitreal opacities and to relieve the traction on the retina. The second objective is to stabilize the eye by preventing further progression of the disease by removing the posterior vitreous "scaffold" on which abnormal fibrovascular tissue mainly grows.

Surgical technique

Since the first vitrectomy for diabetic vitreous haemorrhage was reported by Machemer in 1970[17], there has been tremendous advancement in the instrumentation and the surgical technique. Vitreous surgery is a highly complex and exacting surgery requiring a motivated surgeon and a good team work. As diabetes is a multisystem disease, a thorough preoperative medical assessment is mandatory. For the same reason, we prefer to do the surgery under local anaesthesia where possible.

We prefer to do three port pars plana vitrectomy. Three openings of 20 gauge needle size are made in the pars plana region 3mm to 4mm posterior to the limbus. Through the inferotemporal opening, an infusion cannula is fixed which infuses BSS in the eye as the vitreous is removed. Through the other two sclerotomies in the superotemporal and superonasal area, vitreous cutter and light pipe are introduced. Vitreous cutter provides high cutting blades to remove vitreous in small bits without applying any traction on the retina. Light pipe provides internal illumination to the desired area. Additional instruments like vitreous scissors, endodiathermy, forceps etc. are used in special situations.

Surgical steps and technique varies in different cases. But, generally, surgical sequence includes removal of vitreous haemorrhage and truncation of the cone formed by the posterior vitreous surface with its attachment to the vitreous base peripherally and the retina posteriorly. This relieves the anteroposterior traction on the retina. Then, fibrovascular membranes on the retina are removed by special technique called delamination and segmentation whereby tangential traction is relieved. All bleeding vessels are treated with endodiathermy. Endolaser is applied in a scatter manner to prevent recurrence of proliferation. In certain situations intraocular gas or silicon oil is used as internal tamponade.

The patient remains in the hospital for 1 to 2 days and then is followed up in the clinic. By 6 to 8 weeks the eye stabilizes and final glasses are given.

RESULTS

We have compiled and presented our results of surgery done at Salmaniya Medical Complex for one year since March 1998. Seventy four eyes underwent vitreous surgeries during this period. Approximately one third, 22 eyes (30%) had vitreous surgeries for

complications of diabetic retinopathy. Sixteen were male and 6 females. The youngest patient was 32 years and oldest 73 years. Out of 22 eyes, 6 eyes had only vitreous haemorrhage, 13 eyes had tractional retinal detachment associated with or without vitreous haemorrhage and 3 eyes had combined tractional and rhegmatogenous retinal detachment . Preoperative visual acuity was perception of light (PL) in 19 eyes, counting fingers in 2 eyes and 6/60 in 1 eye. Postoperatively, 20 eyes (91%) showed improvement in vision, 13 eyes improved to 6/60 or better, 5 eyes improving to 6/12 or better and 7 eyes had count fingers vision. Two eyes vision did not improve due to optic atrophy and retinal ischemia. Additional surgery was done in 3 eyes; 2 eyes underwent silicon oil removal and 1 eye needed removal of recurrent vitreous haemorrhage.

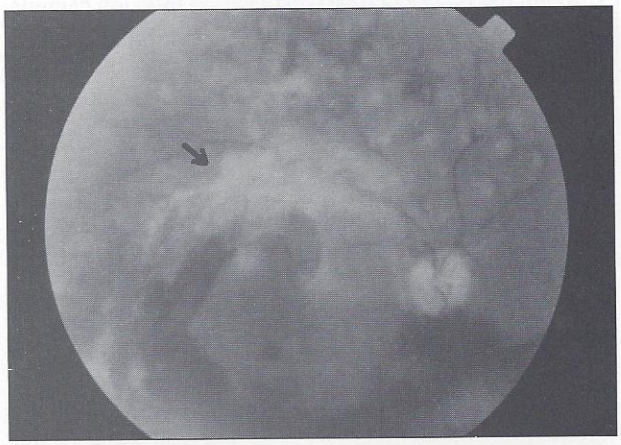

Figure 4a. Vitreous haemorrhage with tractional retinal detachment. Red vitreous haemorrhage is seen with scar tissue pulling the retina (arrow).

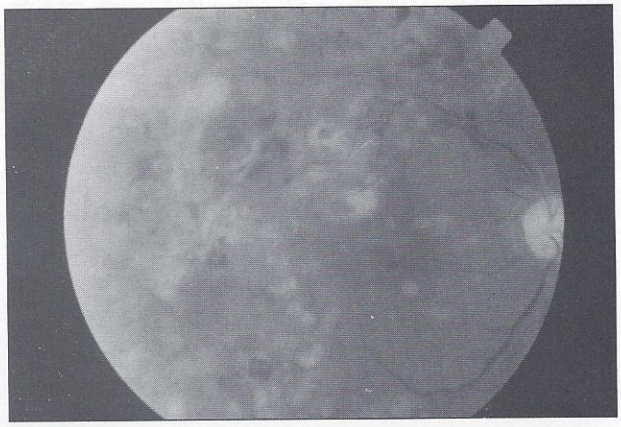

Figure 4b. Post vitreous surgery. Vitreous haemorrhage and scar tissue has been nicely removed and macula is placed back in its normal position. Vision has improved to 6/18 from light perception.

Figures 4a and b are representative cases showing the surgical results of various clinical situations.

DISCUSSION

Laser photocoagulation is the initial choice of treatment in eyes with PDR with the high risk characteristic defined by the diabetic retinopathy study[18]. Most of the eyes can be stabilized by laser treatment. However, in some eyes inspite of the laser treatment, disease progresses and leads to vitreous haemorrhage and retinal detachment. Also, there are patients, who present to us very late and the disease has progressed to a stage where laser treatment is ineffective. In such situations vitreous surgery is indicated.

Vitreous surgery provides an important new capability to treat certain blinding complications of PDR. The objectives of surgery are based on the pathologic changes causing visual loss and this objective consists of removal of intravitreal opacities like vitreous haemorrhage and/or excision of posterior vitreous surface which is the scaffold for the proliferative tissue. After a successful vitreous surgery, visual improvement will depend on the health of the macula and the optic nerve. Hence, early vitreous surgery, before irreversible retinal damage occur may provide better results. Once the posterior vitreous surface is removed the disease does not progress or recur.

In our series of 22 eyes, 20 eyes (91%) showed improvement in visual acuity and 5 eyes (22.7%) regained 6/12 or better visual acuity. Our results are comparable to results published in the literature[5,10-15]. It is important to note that none of the eyes were lost due to surgery related complications. However, there is a real risk of total loss of vision due to surgical complications. Additional surgery is a real possibility, however in our series only 3 eyes (13.6%) needed additional surgery.

With better understanding of the pathophysiologic changes in diabetic retinopathy and improvement in the instrumentation and surgical technique, visual results have improved. With the present expertise, vitreous surgery is even considered in the very advanced cases. Hence, truly, vitreous surgery has provided succor to the patient with the severe blinding complications of diabetic retinopathy.

CONCLUSION

Diabetic retinopathy is one of the leading cause of blindness. Laser photocoagulation is very effective in treating majority of eyes with complications of diabetic retinopathy. However, in advanced and

severe cases of diabetic retinopathy including, vitreous haemorrhage, tractional and combined retinal detachment, vitreous surgery is the only modality of treatment available. Vitreous surgery is very exacting and complex surgery requiring thorough understanding of the pathophysiology of the disease and state of art equipments. Properly executed surgery results in a desirable outcome and ensures long term stability of the eye.

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