Chapter 1

Vitreous Surgery in the Complications of Diabetic Retinopathy

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Abstract

The interest for diabetic retinopathy is justified by the significant increase in the number of diabetics worldwide. Thus, between 2000-2030, the number of diabetics within the general population will double, from 171 millions, to 366 millions, respectively. The complications related to diabetic retinopathy lead to blindness, if not addressed accordingly. In this context, vitreous surgery plays a major role in preventing visual loss. In this paper, we aimed to present the indications, technical peculiarities and results of pars plana vitrectomy in the complications of diabetic retinopathy.

Epidemiological Data

In the year 2000, there were 171 millions of diabetics worldwide. It is estimated that by the year 2030, the number of diabetics will reach 366 millions worldwide. Diabetic retinopathy is the main cause of visual impairment in the active population. Diabetic macular edema is the main cause of visual impairment, but the complications generated by proliferative diabetic retinopathy cause visual loss [1].

Indications of Pars Plana Vitrectomy in Diabetic Retinopathy

Historically, vitreous hemorrhage in a diabetic patient was the first indication for pars plana vitrectomy (PPV), in 1976 [2,3,4]. The indications of PPV in a diabetic patient can be summarized in two categories:
• **Optical**: vitreous hemorrhage that fails to clear, premacular hemorrhage.

• **Mechanical**: tractional and combined retinal detachment, aggressive fibro-vascular proliferation, some types of macular edema.

**Vitreous hemorrhage** in a diabetic patient was the first indication for PPV. Its goals are

- **optical and diagnostic**: to identify and treat the cause. The moment of PPV is subject for debate.

- The simple situation is when the patient is known and was previously treated by panretinal laser photocoagulation (PRP).

- The difficult situation is when the hemorrhage reveals the diabetes. In this latter situation, the examination of the fellow eye offers important clues.

**Tips:**

- Frequently, visual acuity is better than the visualization of the retina. If not, macular involvement must be suspected.

- Intraocular pressure and rubeosis iridis have to be checked before pupil dilation.

- The condition of the lens is difficult to assess, due to the lack of retroillumination.

- The examination of the retina is hindered by the vitreous hemorrhage. If the hemorrhage is not dense, the visualization of retinal sectors offers valuable information about the severity of the diabetic retinopathy.

**Preoperative Investigations**

Ultrasound examination offers crucial information:

- In presence of total retinal detachment (RD), PPV must be performed immediately, as it proves indirectly, the presence of a retinal tear. A tractional retinal detachment (TRD) is never total. When a retinal break is present, the detached retina has a convex shape, whereas the TRD is always concave.

- It offers information on the location and extent of the posterior proliferation.

Evaluation of the diabetes and of the risk factors is important for the prognosis. If vitreous hemorrhage is the first acute complication of diabetes, it is a good reason for the patient to understand the severity of the disease.

**Surgical Decision**

The surgical decision relies on various factors: visual acuity, condition of the fellow eye, condition of the retina (PRP, RD, massive proliferation), evolution [2,4]. In vitreous hemorrhages caused by diabetes, there are two options:
• Urgent surgery;
• Close follow up, for some weeks.

In the following circumstances, surgery must be carried out as urgently as possible:
• RD (combined or rhegmatogenous, not tractional alone);
• Monophthalmic patient;
• No laser treatment prior the occurrence of vitreous hemorrhage;
• Frequent recurrence of the hemorrhage;
• No tendency to clear within a month;
• Documented proliferation;
• Rubeosis iridis.

**Close follow up (weeks)** is recommended in the following circumstances:
• The patient has a good PRP;
• The condition of the fellow eye is good;
• There are no associated conditions;
• The first hemorrhage.

**Surgical Technique**

PPV is carried out according to the following steps:
• Removal of the central vitreous;
• Removal of the posterior hyaloid and of the vitreo-retinal tractions;
• Peripheral vitrectomy;
• Specific treatment of the proliferation.

Surgery must be concluded with the laser photocoagulation of the retina, either complete (if the patient had no laser prior to surgery, or added to the previous laser).

**Premacular Hemorrhage**

When the blood in front of the macula is liquid (horizontal level), opening the posterior hyaloid with the YAG laser can be tempted.

When in front of the macula there is a clot, the high risk of premacular fibrosis that develops within weeks, requires for PPV.

**Surgical Technique**

Surgery consists in the following steps:
• Central vitrectomy;
• Opening of the posterior hyaloid;
Aspiration of the preretinal blood;
Removal of the entire posterior hyaloid and of the proliferation.

Aggressive Fibro-Vascular Proliferation

In proliferative diabetic retinopathy with aggressive fibro-vascular proliferation, vitrectomy offers a mechanical solution for a mechanical problem. The following situations can be encountered in practice: complete posterior vitreous detachment (PVD), partial PVD, no PVD, TRD, combined RD.

We are going to discuss 3 situations: TRD, combined RD and aggressive fibro-vascular proliferation without RD.

TRD

Indications

Surgery is indicated when TRD reaches or threatens the macular area. Knowing the evolution over time is often essential for the planning of surgery. When visual acuity decreases, surgery is indicated.

Objectives

PPV has the following objectives:

- To remove the vitreous opacities;
- To remove the “scaffold” for proliferation;
- To remove the fibro-vascular proliferation;
- To remove the tangential and antero-posterior vitreo-retinal tractions;
- To stop the bleeding.

Technique

The surgery includes two main steps:
1. Complete central and peripheral vitrectomy
2. Dissection of the membranes

Three dissection techniques are possible:

Segmentation: cutting the fibrous preretinal “bridges”;

Delamination: vitrectomy and dissection along a cleavage plane;

“en-bloc” resection: dissection between the vitreous and the retina, followed by complete vitrectomy.

Intraoperative Haemostasis

Ceasing the intraoperative bleeding can be achieved in two ways [2,3,4]:

1. Endodiathermy: it must be applied directly, on each source of hemorrhage. It is efficient, but dangerous for the optic nerve.
2. **Compression on the bleeding points**: it is efficient intraoperatively, but re-bleeding can occur postoperatively.

**Postoperative Haemostasis**

It is accomplished by silicone oil tamponade.

**Combined RD (Rhegmatogenous and Tractional)**

The diagnosis is easy, if the RD is bullous. Sometimes, it is an intraoperative finding. In most cases, the retinal breaks are located posteriorly.

Combined RD represents a clear indication for PPV, without waiting for the macular involvement. Dissection must eliminate all the tractions, segmentation is not an option. Perfluorocarbon liquids (PFCL) are necessary almost in all cases with combined RD [5,6].

At the end of dissection, PRP must be completed, followed by the exchange of PFCL with the final tamponade agent. Some authors claim that gas is better than silicone oil, as it is associated with a lower re-proliferation rate in the postoperative period [5,6].

Usually, the visual results are poor in these cases.

**Aggressive Fibro-Vascular Proliferation without RD**

In these situations, PPV can prevent more severe complications, even if the visual acuity is relatively good. PPV must not replace PRP, but waiting too long for surgery is not desirable either. In most instances, PPV in young diabetic patients with aggressive fibro-vascular proliferation is very difficult, because the vitreo-retinal adhesion is very strong. Preoperative intravitreal administration of an anti-VEGF agent is very helpful, as it decreases considerably, the risk of intraoperative bleeding [7].

**Diabetic Macular Edema**

In selected cases of diabetic macular edema (DME), PPV can be efficient [8]. The preoperative factors associated with best outcome fall into the next categories:

- Undetached, thick posterior hyaloid;
- Recent onset macular edema;
- No pre-retinal proliferation.

One debate concerns the necessity of internal limiting membrane (ILM) peeling for DME. There is no consensus regarding this issue. If ILM is peeled, OCT results are better, but the functional results are similar, regardless its association or not.
Anti-VEGF and PPV in Diabetic Patients

Intravitreal anti-VEGF is a useful tool, if used properly. In cases with rubeosis iridis, preoperative anti-VEGF is mandatory. Intravitreal injection is recommended to be performed 1-3 days prior to surgery. In cases with strong vitreo-retinal tractions, intravitreal anti-VEGF is indicated only if we are sure that surgery will be performed the next day, because of the high risk of TRD associated with anti-VEGF therapy [7].

One of the worse scenarios in clinical practice

Sometimes, facing a diabetic patient, we have to solve a dilemma: operating first the bad eye or the worse fellow eye. If we operate first the bad eye, the patient may lose sight in the “better” eye. If we operate first the very bad eye, the chances for visual function improvement are very low and the patient will lose motivation to operate the fellow eye, that carries better chances for recovery.

Personal experience with PPV in treating diabetes related complications

Between January 2010-July 31st 2014, we performed 285 PPVs, in 259 patients, for ocular complications of diabetes mellitus. In 26 patients, PPV was bilateral. Reoperations were necessary in 9 eyes, in 7 of them, for the recurrence of vitreous hemorrhage and in 2 of them, for RD.

The indications of PPV in our series are summarized in table 1.

**Table 1: Indications of PPV in our diabetic patients.**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number of eyes</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitreous hemorrhage</td>
<td>195</td>
<td>68.42</td>
</tr>
<tr>
<td>Vitreous hemorrhage + ERM</td>
<td>50</td>
<td>17.54</td>
</tr>
<tr>
<td>TRD</td>
<td>22</td>
<td>7.71</td>
</tr>
<tr>
<td>Aggressive PDR</td>
<td>13</td>
<td>4.56</td>
</tr>
<tr>
<td>Combined RD</td>
<td>3</td>
<td>1.05</td>
</tr>
<tr>
<td>Macular edema</td>
<td>2</td>
<td>0.70</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>285</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**Vitreous hemorrhage** was the most common indication for PPV in our series, totalizing 195 of the 285 vitrectomies (68%). In many instances, in the unknown patients, the condition of the retina can be evaluated only intraoperatively, after having cleaned the vitreous. In all cases, after having completed the vitrectomy, laser photocoagulation of the retina was performed, in order to prevent rebleeding. Starting the year 2011, in every case we used intravitreal bevacizumab, 3 - 5 days pre-operatively. Clinical data proved that this attitude led to a significant decrease of the intraoperative bleeding risk. The eyes were
left under silicone oil tamponade in 45 cases (23.07%), under air, in 15 cases (7.69%) and under saline, in 135 cases (69.23%). Vitreous hemorrhage recurred in 7 cases, all within the eyes left under saline. Reoperation was performed and silicone oil was injected in all these recurrent cases. In one case, RD developed postoperatively, due to a iatrogenic retinal tear located in the meridian of the superior sclerotomy. Cryotherapy around the tear and silicone oil tamponade for 3 months were performed, with final attachment of the retina, after the removal of the tamponade agent.

Vitreous hemorrhage with epiretinal membranes was the second indication within our series: 50 eyes. The difference, as compared to the previous group, was represented by the necessity to complete surgery with the dissection of the epiretinal membranes following vitrectomy. For the dissection, we used the vitreo-cutter in most instances, as the small gauge of the instrument allowed us to work very close to the retina, with low risk to injure it [9,10]. However, in 10 of the 50 cases, we had to use the forceps for the dissection, as the adherence between the membrane and the retina was very high. In this setting, we created 5 iatrogenic retinal breaks, but we treated them promptly with laser around the break and silicone oil tamponade. None of these cases developed retinal detachment following PPV.

**TRD and combined (tractional and rhegmatogenous)** RD represented the indications for PPV in 25 eyes. This was the most technically challenging situation in our diabetic patients. In all the combined RDs, we used perfluorocarbon liquids, in order to stabilize the retina and dissect the membranes from its detached, mobile surface. In 7 of the 25 eyes, we created iatrogenic retinal tears during surgery. In this category, we obtained the worse functional results, with final visual acuities below 1/10 in all cases.

**Aggressive PDR** represents 13 eyes within this series. In this condition, vitreous hemorrhage and retinal detachment were not yet present, but the thick hyaloid prevented us to perform proper laser treatment and the vitreo-retinal adherence was high. Since laser treatment could not be performed, it was no point to wait for the complications, therefore we proceeded with PPV. We were able to detach the vitreous from the retina and to conclude the surgery with PRP, in all cases. We left all the eyes within this subgroup, under saline, as we had no intraoperative complication. Postoperatively, all the 13 eyes reached visual acuities above 5/10.

**Macular edema** itself was the indication for PPV only in 2 of the eyes within this series. Preoperative visual acuity was below 1/10 in both cases and the postoperative result was not significant: visual acuity remained the same.
Conclusion

Vitreous surgery is a valuable tool to preserve the visual function in patients with advanced stages of diabetic retinopathy. In our series, we obtained the best functional results in patients with aggressive proliferative diabetic retinopathy, with no vitreous hemorrhage and/or retinal detachment. This observation is in favor of early vitrectomy in diabetic patients. The second best results were reached within the subgroup of patients with vitreous hemorrhage, without retinal detachment. The worse outcome belongs to the patients with combined retinal detachment (tractional and rhegmatogenous). The presence of the retinal detachment proves a long standing suffering of the retina that prevents the obtaining of a satisfactory result.

Apart from the objective situation itself, prognosis depends on: the accuracy of the technique, the systemic condition of the patient and the preoperative laser treatment. PRP makes surgery easier and it is associated with better functional outcomes.

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References

Diabetic Retinopathy
