ECRONICON OPEN ACCESS

EC OPHTHALMOLOGY
Research Article

Vitrectomy in Diabetic Patients with Chronic Kidney Disease and Diabetic Retinopathy

Fiorella Salvador Salvador[1]*, Renata García Franco[2], Diego Valera Cornejo[1], Ximena Mira Lorenzo[2], Paulina Ramírez Neria[2], Yolanda Villalpando Gómez[2], Miguel Vázquez Membrillo[2] and Marlon García Roa[2]

[1]Retina Fellow, Mexican Institute of Ophthalmology, Queretaro, Mexico

[2]Retina Service, Mexican Institute of Ophthalmology, Queretaro, Mexico

***Corresponding Author:** Fiorella Salvador Salvador, Retina Fellow, Mexican Institute of Ophthalmology, Queretaro, Mexico.

Received: November 28, 2018; **Published:** January 02, 2019

Abstract

Purpose: To describe the anatomic and functional outcomes in patients with chronic kidney disease who underwent pars plana vitrectomy for proliferative diabetic retinopathy.

Methods: We retrospectively reviewed the medical records of patients with chronic kidney disease who underwent 25-gauge vitrectomy for diabetic vitreous hemorrhage and/or tractional retinal detachment between January 2017 and March 2018. Visual outcome, intraocular pressure and complications were documented.**Results:** The postoperative refractive error calculated by A-scan was -0.72 ± 0.96 diopters and that calculated by optic biometry was -0.13 ± 0.83 diopters in patients with age-related macular degeneration. Higher myopic shifts were observed with A-scan measurements than with optical biometry measurements.

Results: 68 eyes of 57 patients. The median GFR was 19.9 ml/min/1.73m2 (IQR: 7.45 - 41.65). Preoperative best corrected visual acuity was ≤ 20/400 in 53 (77.94%) eyes. Postoperative BCVA at the end of the follow-up was ≥ 20/200 in 28 (41.17%) eyes, and ≥ 20/40 in 3 (4.41%) eyes. Main intraoperative complications were retinotomies in 14 (20.58%) eyes and active bleeding in 3 (4.42%) eyes. Main postoperative complications were postoperative vitreous cavity hemorrhage in 14 (20.59%) eyes, ocular hypertension in 9 (13.24%) eyes, and corneal epithelial defect in 9 (13.24%) eyes.

Conclusion: Vitrectomy in patients with chronic kidney disease and diabetic retinopathy can be performed with favorable anatomical and functional results.

Keywords: *Diabetes Mellitus; Proliferative Diabetic Retinopathy; Chronic Kidney Disease; Pars Plana Vitrectomy' Best Corrected Visual Acuity*

Abbreviations

DM: Diabetes Mellitus; CKD: Chronic Kidney Disease; ADA: American Diabetes Association; DR: Diabetic Retinopathy; GFR: Glomerular Filtration Rate; KDIGO: Kidney Disease Improving Global Outcome; VEGF: Vascular Endothelial Growth Factor; BCVA: Best Corrected Visual Acuity; IOP: Intraocular Pressure; SD: Standard Deviation; IQR: Interquartile Range; PVCH: Postoperative Vitreous Cavity Hemorrhage; SAH: Systemic Arterial Hypertension; PPV: Pars Plana Vitrectomy; SF6: Sulfur Hexafluoride

Introduction

The prevalence of diabetes mellitus (DM) worldwide has reached epidemic proportions. The global prevalence of diabetes was 8.4% (425 million people) in 2017, and it was expected to increase to 9.9% (629 million people) by 2045. In Mexico, these values were estimated to be 14.8% and 18.9%, respectively [1].

Chronic kidney disease (CKD) is defined as abnormalities of kidney structure or function, present for > 3 months, with implications for health [2]. According to the American Diabetes Association (ADA), CKD attributed to diabetes occurs in 20 - 40% of diabetic patients [3]. In Mexico, this figure was reported by Obrador., *et al.* in 14 - 24% [4]. CKD may be asymptomatic in its earlier stages. However, it has been demonstrated that a more rapid rate of loss of kidney function was associated with an increased risk of adverse clinical outcomes including death and vascular related events [2].

Diabetic retinopathy (DR) is the main cause of vision loss in working-age adults. In 2010, out of an estimated 285 million people with diabetes worldwide, over one-third had signs of DR, and a third of them had an advanced form of the disease that threatened vision [5]. In Mexico, the prevalence of DR was reported in 38.9% to 41.1% [6,7].

Diabetic retinopathy is often accompanied by end stage CKD. In one study, DR was present in 88.3% of the cases with CKD related to diabetes [8]. In addition, more severe grades of DR have been detected with increasing severity of kidney disease [8-10].

Proliferative diabetic retinopathy such as vitreous hemorrhage and/or tractional retinal detachment can be treated successfully with vitrectomy. Given the comorbid conditions of these patients, surgery could be highly risky [11] and there are few reports about anatomical and functional outcomes of patients with DR and CKD undergoing pars plana vitrectomy.

Material and Methods

Study design

This was a retrospective, single-arm, cohort study. It was carried out at the Mexican Institute of Ophthalmology in Queretaro, Mexico. We studied patients with diabetic retinopathy and chronic kidney disease who underwent vitrectomy for proliferative diabetic retinopathy between January 2017 and March 2018. The study complied with the Declaration of Helsinki. The ethics committee of the Mexican Institute of Ophthalmology approved this study.

Eligibility and exclusion criteria

The key inclusion criteria were > 18 years of age; diagnosis of DM type 1 or 2; proliferative DR requiring 25-gauge pars plana vitrectomy alone or associated with cataract surgery in one or both eyes; and glomerular filtration rate (GFR) < 60 ml/min/1.73m^2 (categories G3a, G3b, G4 y G5 according to Kidney Disease Improving Global Outcome [KDIGO] guidelines) for > 3 months. The key exclusion criteria were GFR ≥ 60 ml/min/1.73m^2 (categories G1, G2 according KDIGO guidelines); GFR < 60 ml/min/1.73m^2 for ≤ 3 months; non-diabetic proliferative retinopathy; and follow-up time of less than 6 months.

Subjects, follow up and measure outcome

By reviewing the medical records; we obtained preoperative data such as GFR, comorbidities, glycosylated hemoglobin levels, ophthalmological history (previous surgeries and laser treatment), use of preoperative intravitreal injection of anti-vascular endothelial growth factor (VEGF) agents as adjuvant therapy (3 to 5 days before surgery), and ophthalmological examination including best corrected visual acuity (BCVA) in Snellen, intraocular pressure (IOP) measured by Goldmann applanation tonometry, slit-lamp biomicroscopy and fundoscopy.

In addition, we obtained data from surgery such as type of surgery performed (25-gauge pars plana vitrectomy with or without cataract surgery), operated eye, use of intraocular tamponade, complications and use of injection of intravitreal anti-VEGF agent. Among the postoperative data, we collected data from ophthalmological examination and complications at 1, 30, 90 and 180 days after surgery.

Surgery procedure

The procedure was carried out using the Constellation Vision System (Alcon Laboratories, Fort Worth, Texas, USA) in all the cases.

Surgeries were performed under retrobulbar anesthesia. Anesthesia was induced by an equal mixture of 2% lidocaine and 0.75% bupivacaine. For patients with cataract, the lens was removed via a corneal tunnel incision (2.2 mm) by continuous circular capsulorhexis, and then intracapsular phacoemulsification. A foldable intraocular lens was implanted into the capsular bag. The posterior capsular membrane was kept intact. All patients underwent a standard 3-port 25-gauge pars plana vitrectomy. Pan-retinal photocoagulation was performed during the procedure. After surgery, dexamethasone (5 mg) was periorbitally injected. Postoperative topical antibiotics and corticosteroids eye drops were initially applied 4 times a day, with the number of applications gradually reduced when intraocular inflammation was controlled.

Statistical analysis

A database was created in the Microsoft Excel 2010 program. A descriptive statistical analysis was carried out using the Stata 14 statistical package. Qualitative variables are shown as percentages and simple frequencies. Quantitative variables are presented as means with standard deviations (SD) or medians with interquartile ranges (IQR), according to the normality of the variable evaluated by the Shapiro-Wilk test.

Results

68 eyes of 57 patients were included. The preoperative clinical characteristics are summarized in table 1. The median GFR in general was 19.9 ml/min/1.73m^2 (IQR: 7.45 - 41.65). The median GFRs in the 3a, 3b, 4 and 5 categories were 50 ml/min/1.73m^2 (IQR: 46.65 - 55.4), 31.50 ml/min/1.73m^2 (IQR: 31- 37.7), 20 ml/min/1.73m^2 (IQR: 18.8 - 22) and 6.55 ml/min/1.73m^2 (IQR: 7.2 - 8.2), respectively. According to the category of GFR, the sample was distributed as shown in figure 1.

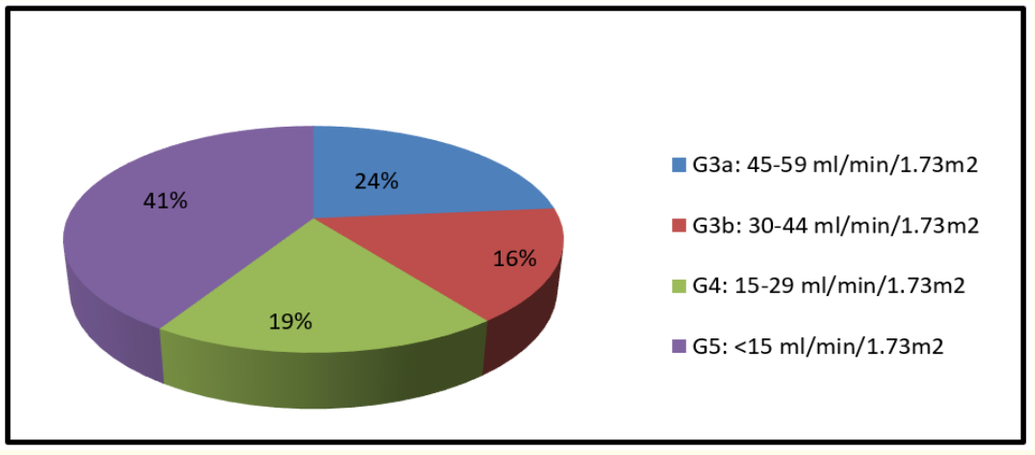

Figure 1: *Distribution of the sample according to GFR in KDIGO categories.*
GFR: Glomerular Filtration Rate. G3a, G3b, G4, G5: Categories of GFR according Kidney Disease Improving Global Outcome (KDIGO) guidelines.

Characteristics	Patients (n = 57)
Age (mean ± SD), years	54.51 ± 9.98
Sex, n (%)	
Male	30 (52.63%)
Female	27 (47.37%)
Comorbidities, n (%)	
SAH	45 (78.95%)
Dyslipidemia	10 (17.54%)
Heart disease	5 (8.77%)
Hyperuricemia	2 (3.51%)

Table 1: *Preoperative clinical characteristics of the sample.*
SD: Standard Deviation; SAH: Systemic Arterial Hypertension.

38.24% (26) of the cases did not receive any treatment for CKD, 25% received pharmacological management, 14.71% peritoneal dialysis y 22.05% were in hemodialysis. The distribution of the sample according to GRF's categories and treatment in each category is shown in table 2.

	G3a	G3b	G4	G5
No treatment, n(%)	11 (68.75%)	6 (54.54%)	7 (53.85%)	2 (7.14%)
Pharmacological treatment, n (%)	4 (25%)	5 (45.46%)	5 (38.46%)	3 (10.71%)
Peritoneal dialysis, n (%)	-	-	-	10 (35.72%)
Hemodialysis, n (%)	1 (6.25%)	-	1 (7.69%)	13 (46.43%)
Total,	16	11	13	28

Table 2: *Distribution of treatment according to CKD's categories.*
G3a, G3b, G4 and G5: Glomerular filtration rate according Kidney Disease Improving Global Outcome (KDIGO) guidelines.

13.24% (9) of the eyes presented glaucoma (6 of them were neovascular), and 63.24% (43) had received prior treatment for DR with laser photocoagulation.

Characteristics related to surgery are shown in table 3.

Characteristics	Eyes (n = 68)
Operated eye, n (%)	
Right	34 (50%)
Left	34 (50%)
Performed surgery, n (%)	
25-gauge PPV	19 (27.94%)
25-gauge PPV with cataract surgery	49 (72.06%)
Preoperative anti-VEGF agent, n (%)	11 (16.17%)
Intraoperative anti-VEGF agent, n (%)	68 (100%)
Tamponade, n (%)	
Silicon oil 5000 cSt	55 (80.88%)
Air	11 (16.18 %)
SF6 20%	2 (2.94%)

Table 3: *Characteristics related to surgery.*
PPV: Pars Plana Vitrectomy; VEGF: Vascular Endothelial Growth Factor; cSt: Centistokes; SF6: Sulfur Hexafluoride.

Preoperative BCVA was ≤ 20/400 in 53 (77.94%) eyes. Postoperative BCVA at the end of the follow-up was ≥ 20/200 in 28 (41.17%) eyes, and ≥ 20/40 in 3 (4.41%) eyes. Visual outcomes are shown in figure 2.

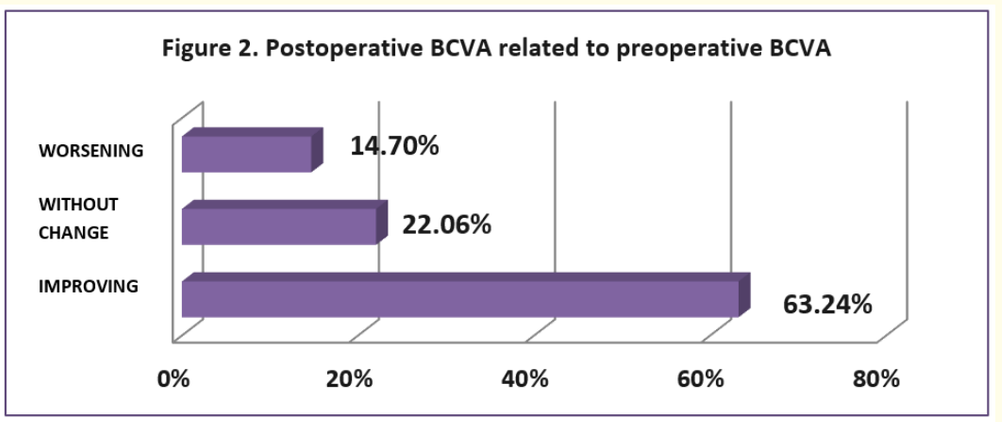

Figure 2: *Postoperative BCVA related to preoperative BCVA.*
BVCA: Best corrected visual acuity.

Intraoperative complications were present in 18 (26.47%) cases: 14 (20.58%) retinotomies, 3 (4.42%) active bleeding, and 1 (1.47%) retinal dialysis. Postoperative complications were: 14 (20.59%) postoperative vitreous cavity hemorrhage (PVCH), 9 (13.24%) ocular hypertension (8 of them were controlled with topical medication, and 1 case was treated with drainage surgery), 9 (13.24%) corneal epithelial defect, 4 (5.88%) hyphema, and 4 (5.88%) retinal redetachment.

Related to intraocular tamponades and PVCH, 11 of 55 eyes (20%) presented the complication in silicon oil group, compared to 3 of 11 eyes (27.27%) with the same complication in the air group.

16.17% (11) of the eyes received a preoperative intravitreal injection of anti-VEGF agent. Postoperative complications in this group were: 4 (36.36%) PVCH and 1 (9.09%) ocular hypertension.

In figure 3, we showed 2 cases of proliferative diabetic retinopathy before and after vitrectomy.

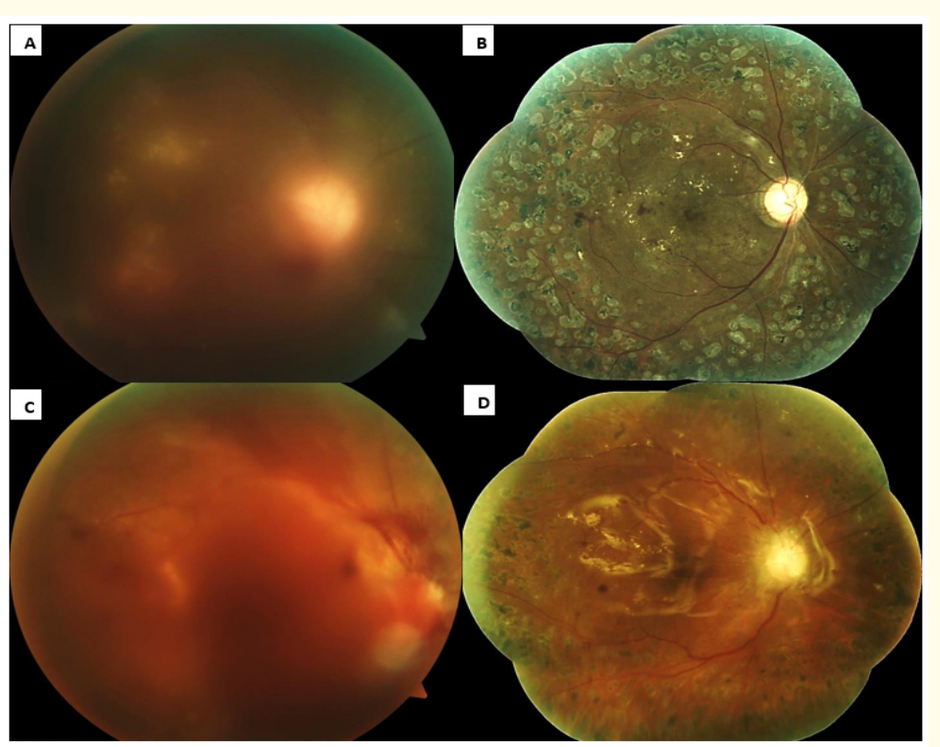

Figure 3: *Retinal fundus photographs of two patients included in the study. A: Right eye with proliferative diabetic retinopathy before surgery. B: Same patient in case in A six months after surgery (air as tamponade). C: Right eye with proliferative diabetic retinopathy before surgery. D: Same patient in case in C six months after surgery (silicon oil as tamponade).*

Discussion

Chronic kidney disease and diabetic retinopathy continue to be important causes of morbidity in our population, being both complications of DM. The long-term administration of heparin anticoagulant drugs during hemodialysis increases the risk of vitreous hemorrhage and PCHV in patients with diabetic retinopathy [12]. Despite the fact that vitrectomy is effective for the management of diabetic retinopathy, many factors can influence the outcome after the surgery.

In our study, 78.9% of the sample had systemic hypertension. This finding is consistent with some previous reports [4,5,13,14]. 60% of the patients had categories 4 and 5 of CKD, which would imply greater associated kidney damage, and 21.95% of this group did not receive any treatment for CKD at the beginning of the study.

A report in Mexico found that no more than 20% of patients who had to have renal replacement therapy actually receive it [15]. CKD care in Mexico is unequal and below the quality of international standards. The current infrastructure and resources are insufficient to satisfy the demand of renal care in our society [16].

Final visual outcome (improvement in 63%, without change in 22%, worsening in 14%), are consistent to those found by Hayashi., *et al*. [17] (improvement in 60.5%, without change in 30.5%), and Su., *et al.* [18] (improvement in 91.6%, worsening in 8.4%). In addition, we found a greater percentage of improvement and equal BCVA in the group receiving treatment for CKD (93.76%), compared to the group without treatment (88.8%) for categories 4 and 5 of GFR.

As well as our results, Su., *et al.* [18] found 25% of postoperative hemorrhage in vitreous cavity, and 18.75% of ocular hypertension.

The use of preoperative anti-VEGF agent may promote the reduction of neovascularization and decrease the rate of intraoperative hemorrhage, improving visualization during surgery, thus reducing postoperative complications [19]. However, it could also exacerbate retinal ischemia and favor membranes contraction, which would result in additional tractional-induced retinal breaks [20]. In our study, 36.36% of those who received preoperative intravitreal injection of anti-VEGF agent had PVCH, compared to 17.54% of those who did not receive it. This result can be explained by the selection criteria for the administration of preoperative anti-VEGF, since this was decided in cases with proliferative diabetic retinopathy with greater complexity (no previous laser treatment, tractional retinal detachment with active neovascular membranes, rubeosis iridis).

Long-acting tamponade, such as silicone oil, was associated with less PVCH (20%), compared to patients in whom air was used as internal tamponade (27.2%). Silicone oil facilitates retinal reattachment by providing extended intraocular tamponade. Silicone oil may compartmentalize the eye and may have a role in inhibiting progressive neovascularization in the anterior segment by preventing the diffusion of angiogenic substances. However, there are few reports about postoperative complications and the use of different internal tamponades in this group of patients.

Limitations on the Study

There are several limitations on this study due to the retrospective nature of it, for example there are variables that were not controlled, and that could influence the results; such as cardiac function, anemia and metabolic control during follow-up. Controlled trials are needed to obtain better results.

Conclusion

It seems that vitrectomy in patients with chronic kidney disease and diabetic retinopathy has favorable anatomical and functional results.

Conflict of Interest

The authors declare that they have no conflict of interests.

Bibliography

1. Cho NH., *et al*. "IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045". *Diabetes Research and Clinical Practice* 138 (2018): 271-281.

2. Kasiske BL., *et al*. "KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease" (2012).

3. "10. Microvascular Complications and Foot Care: Standards of Medical Care in Diabetes-2018". *Diabetes Care* 41.1 (2018): S105-S118.

4. Obrador GT., *et al*. "Longitudinal analysis of participants in the KEEP Mexico's chronic kidney disease screening program". *Archives of Medical Research* 44.8 (2013): 650-654.

5. Lee R., *et al*. "Epidemiology of diabetic retinopathy, diabetic macular edema and related vision loss". *Eye and Vision* 2 (2015): 17.

6. López-Ramos A., *et al*. "Rapid assessment of avoidable blindness: Prevalence of blindness, visual impairment and diabetes in Nuevo Leon, Mexico 2014". *Ophthalmic Epidemiology* 25.5-6 (2018): 412-418.

7. Polack S., *et al*. "Rapid assessment of avoidable blindness and diabetic retinopathy in Chiapas, Mexico". *Ophthalmology* 119.5 (2012): 1033-1040.

8. Bajracharya L., *et al*. "Ocular evaluation in patients with chronic renal failure--a hospital based study". *Nepal Medical College Journal: NMCJ* 10.4 (2008): 209-214.

9. Song YS., *et al*. "Systemic Risk Factors in Bilateral Proliferative Diabetic Retinopathy Requiring Vitrectomy". *Retina* 36.7 (2016): 1309-1313.

10. Shukla D., *et al*. "Macular ischaemia as a marker for nephropathy in diabetic retinopathy". *Indian Journal of Ophthalmology* 52.3 (2004): 205-210.

11. Mullaem G., *et al.* "Ocular problems in the patient with end-stage renal disease". *Seminars in Dialysis* 25.4 (2012): 403-407.

12. Wang TJ., *et al*. "Increased risk of co-morbid eye disease in patients with chronic renal failure: a population-based study". *Ophthalmic Epidemiology* 19.3 (2012): 137-143.

13. Yau JW., *et al.* "Global Prevalence and Major Risk Factors of Diabetic Retinopathy". *Diabetes Care* 35.3 (2012): 556-564.

14. Fran RN. "Diabetic Retinopathy and Systemic Factors". *Middle East African Journal of Ophthalmology* 22.2 (2015): 151-156.

15. Amato D., *et al*. "Prevalence of chronic kidney disease in an urban Mexican population". *Kidney International Supplement* 97 (2005): S11-S17.

16. García-García G., *et al*. "The Tragedy of Having ESRD in Mexico". *Kidney International Reports* 3.5 (2018): 1027-1029.

17. Hayashi H., *et al*. "Vitrectomy for diabetic retinopathy in patients undergoing hemodialysis for associated end-stage renal failure". *Retina* 18.2 (1998): 156-159.

18. Su L., *et al*. "A clinical analysis of vitrectomy for severe vitreoretinopathy in patients with chronic renal". *BMC Ophthalmology* 18.1 (2018): 34.

19. Zaman Y., *et al*. "Intravitreal Avastin as an adjunct in patients with proliferative diabetic retinopathy undergoing pars plana vitrectomy". *Pakistan Journal of Medical Sciences* 29.2 (2013): 590-592.

20. Arevalo JF., *et al*. "Tractional retinal detachment following intravitreal bevacizumab (Avastin) in patients with severe proliferative diabetic retinopathy". *The British Journal of Ophthalmology* 92.2 (2008): 213-216.

Volume 10 Issue 1 January 2019