Analysis of Prognostic Factors in Non-Traumatic and Non-Diabetic Retinopathy Patients Undergoing Vitrectomy

Ann. Ital. Chir., 2024 95, 3: 322–329
https://doi.org/10.62713/aic.3279

Mingxia Dong[1], Qing Xiao[1], Chenwei Liu[1], Baoliang Fan[1], Ru Han[1]

[1]Department of Endophthalmology, Tangshan Ophthalmology Hospital, 063000 Tangshan, Hebei, China

AIM: Vitrectomy is one of the crucial therapeutic interventions for non-traumatic and non-diabetic retinal diseases. However, the prognosis of patients undergoing this procedure and the factors affecting prognosis remain to be clarified. The aim of this study was to analyze the prognostic factors of non-traumatic and non-diabetic retinopathy complicated by vitreous hemorrhage.

METHODS: A retrospective study was conducted on 352 patients, including 152 (43.18%) females, who underwent vitrectomy in our hospital from March 2018 to December 2022, divided into Group A (postoperative complications) and Group B (no complications) according to whether complications occurred during postoperative follow-up. General and clinical data of the two groups were collected and compared. Binary logistic regression was used to analyze the main factors affecting prognosis.

RESULTS: All patients were followed up for 12 months. A total of 87 patients had postoperative complications, accounting for 24.72% (87/352), and were classified as Group A. A total of 265 patients who had no postoperative complications, accounting for 75.28% (265/352), were classified as Group B. There were significant differences in preoperative visual acuity, time of surgical intervention, preoperative fundus condition, stage of retinopathy, preoperative intraocular pressure and age between the two groups ($p < 0.05$), and these indices were identified as independent risk factors affecting the prognosis of patients (odds ratio >1).

CONCLUSIONS: Preoperative visual acuity, time of surgical intervention, preoperative fundus condition, stage of retinopathy, preoperative intraocular pressure and age are all factors affecting the prognosis of patients with non-traumatic and non-diabetic retinopathy while undergoing vitrectomy. Personalized care is required to improve the surgical outcome for these patients.

Keywords: non-traumatic and non-diabetic retinopathy; vitrectomy; etiology; vitreous hemorrhage

Introduction

Non-traumatic and non-diabetic retinopathy is a clinically important ophthalmic disease, associated with a variety of pathological conditions, such as macular degeneration and retinal vein obstruction [1, 2, 3]. These lesions often lead to hemorrhage in the retina and vitreous cavity, affecting patients' vision and quality of life [4, 5, 6].

Vitreous hemorrhage is one of the most common causes of acutely or subacutely decreased vision or even blindness [7, 8]. Vitrectomy is an important therapeutic means for clearing the bleeding in the vitreous cavity, repairing the retinal structure, and improving the visual function of patients [9, 10, 11, 12]. However, more in-depth research and analysis are warranted for investigating postoperative prognosis of these patients and the factors affecting the prognosis.

Most of the studies on retinopathy and vitrectomy published in recent years focus on diabetic retinopathy, but those focusing on patients with non-traumatic and non-diabetic retinopathy remain scarce [13, 14, 15, 16, 17]. Therefore, it is necessary to gain an in-depth understanding of this specific patient group and clarify the clinical prognosis of surgery to better guide doctors' treatment decisions.

The purpose of this study was to analyze the clinical features and prognosis of patients with non-traumatic and non-diabetic retinopathy after vitrectomy, and to further explore the related factors affecting the prognosis.

Correspondence to: Mingxia Dong, Department of Endophthalmology, Tangshan Ophthalmology Hospital, 063000 Tangshan, Hebei, China (e-mail: m15127571086_2@163.com).

Materials and Methods

Study Participants

For this case-control study, patients who underwent vitrectomy were recruited at Tangshan Ophthalmology Hospital from March 2018 to December 2022. A total of 352 patients, including 152 (43.18%) females, who were ultimately enrolled in this retrospective study based on the minimum inclusion criteria. This study was conducted in accordance with the Helsinki Declaration.

The inclusion criteria were (1) patients with confirmed diagnosis of non-traumatic and non-diabetic retinopathy, who had undergone vitrectomy; (2) patients with no history of eye trauma or diabetes; (3) patients with monocular retinopathy and vitreous hemorrhage; (4) patients with complete clinical data, including relevant data before, during and after surgery, and with complete follow-up data; (5) patients aged $\geq$18 years old; and (6) patients who had had successful surgery.

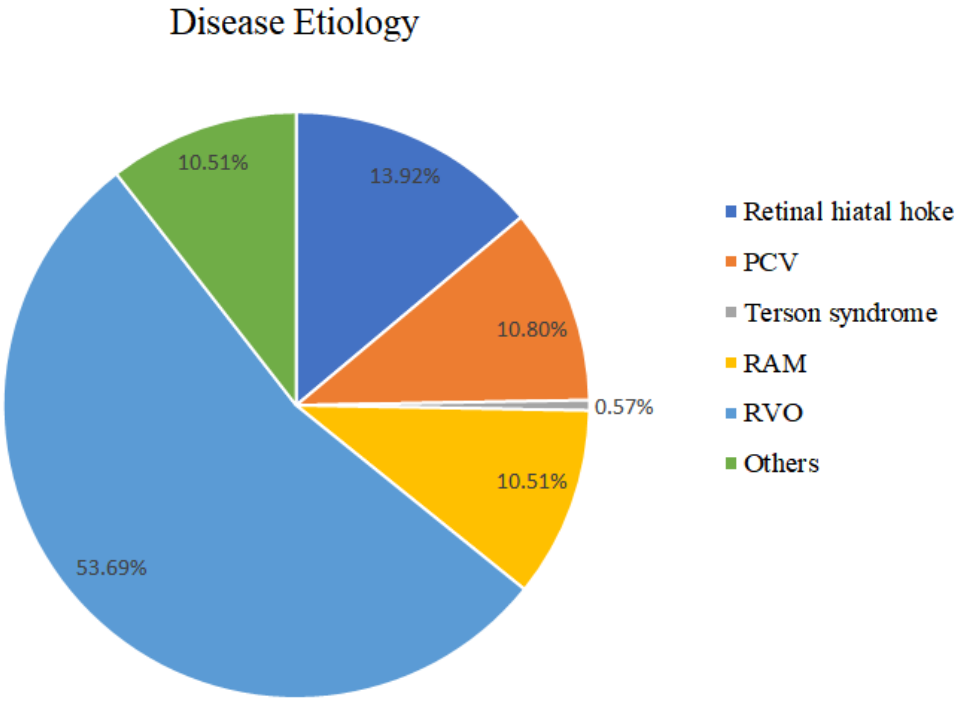

Fig. 1. Distribution of etiology of non-traumatic and non-diabetic retinopathy. PCV, polypoid choroidal vasculopathy; RAM, retinal arterial microaneurysm; RVO, retinal vein obstruction.

The exclusion criteria were (1) diabetic patients; (2) patients with traumatic lesions; (3) patients with severely impaired vision before surgery; (4) patients with clinical conditions complicated by uveitis, conjunctival, scleral scar, etc.; (5) patients with a medical history of macular disease, retinopathy and other relevant diseases; (6) patients with infectious diseases; (7) patients who had previously underwent ophthalmic surgery; (8) patients with severe hypertension, blood diseases, and severe lens opacity; and (9) patients with tumors or severe diseases of other organs.

This study was approved by the Ethics Committee of Tangshan Ophthalmology Hospital (YKYY-LL-2023-08) and complies with the Tangshan Ophthalmology Hospital ethical guidelines. Informed consent was obtained from all participants before the study began.

Vitrectomy Procedure

Vitrectomy was performed on all patients included in this study. The specific surgical procedure is as follows: Periocular anesthesia and retrobulbar anesthesia were applied by administering with 2 mL of 7.5 g/L bupivacaine (Shanghai Hefeng Pharmaceutical Co., Ltd., approval number: H31022839, Shanghai, China) and 20 mL of lidocaine hydrochloride (Shanghai Chaohui Pharmaceutical Co., Ltd., approval number: H31021073, Shanghai, China), respectively, for eye surgery. The eyelid of each patient was opened with an eyelid opening device, and the conjunctival incision made was stretched to ensure that the scleral incision and conjunctival incision were misplaced. The puncture was performed at about 4 mm behind the corneal limbus with a 23G piercing bayonet. The bayonet was maintained with an angle of 10° from the tangential line of the patient's sclera. A tunnel puncture was made into the scleral incision of the patient, and the glass cavity was placed vertically on the surface of the eyeball. The vitreous incision was performed using an infusion tube placed below the temporal surface, and the cannula was removed after completion. Absorbable thread can be used for stitching. After surgery the eyes were routinely cleaned and disinfected and tobramycin and dexamethasone eye cream was applied (Qilu Pharmaceutical Co., Ltd., specification 3.5 g, approval number H20020496, Jinan, China) and tobramycin and dexamethasone eyedrops (Qilu Pharmaceutical Co., Ltd., specification 5 mL, approval number H20020497, Jinan, China).

Data Collection

All patient data were collected by reviewing electronic medical records:

(i) General demographic data: sex, age, body mass index, employment status, chronic disease, education level, monthly income, smoking history, and alcohol consumption.

(ii) Etiology of vitreous hemorrhage: retinal hiatus, poly-

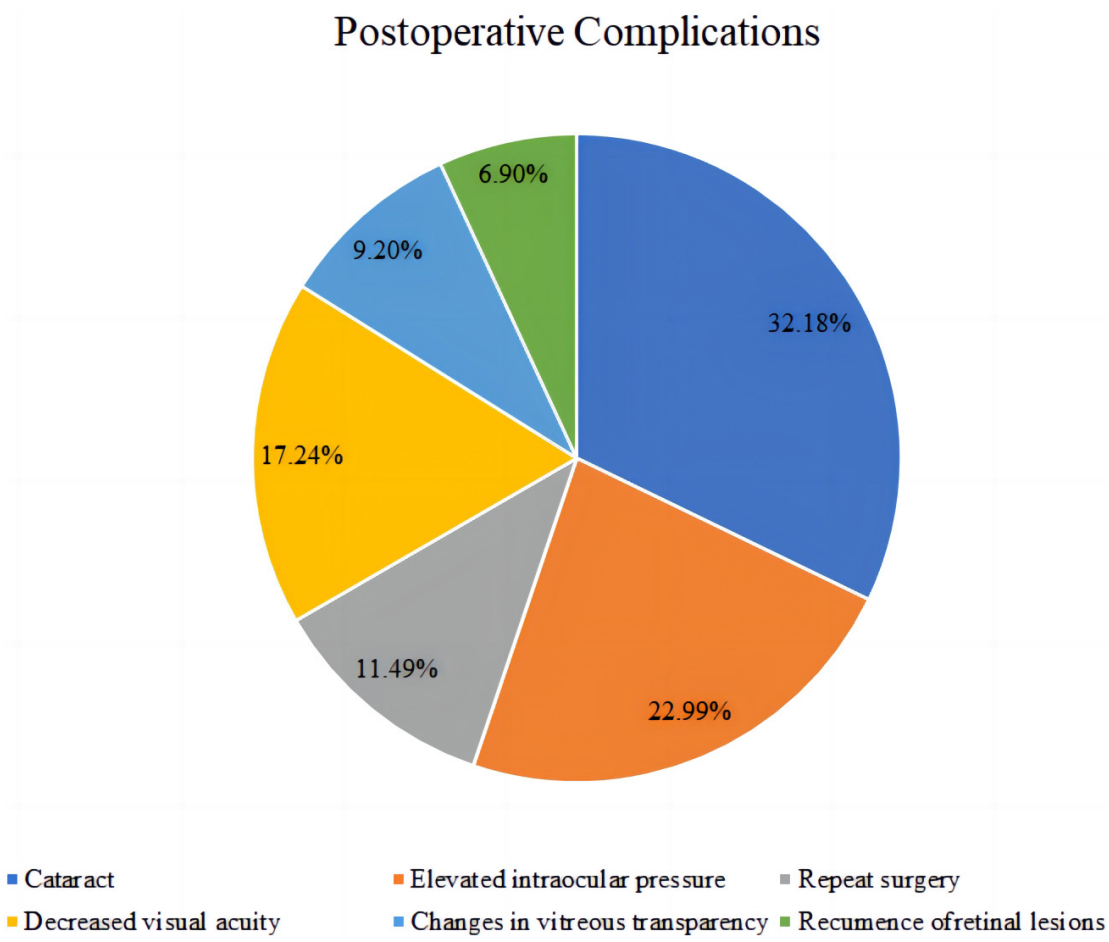

Fig. 2. Proportion of postoperative complications in Group A (postoperative complications) (n = 87).

poid choroidal vasculopathy (PCV), Terson syndrome, retinal arterial microaneurysm (RAM), retinal vein obstruction (RVO), and other causes.

(iii) Surgery-related indicators: time of surgical intervention, and intraocular fillers (intraocular infusion fluid, gas, silicone oil, etc.).

(iv) Pathological characteristics: preoperative visual acuity, preoperative fundus condition, stage of retinopathy, and preoperative intraocular pressure (IOP).

(v) Postoperative complications: cataract, increased IOP, repeat surgery, visual impairment, vitreous transparency change, recurrence of retinopathy, etc.

Follow-up

All patients who underwent surgery were followed up for 12 months; these patients were followed up in outpatient clinics. Patients who developed postoperative complications, including cataracts, increased IOP, repeat surgery, visual impairment, changes in vitreous transparency and recurrence of retinopathy, during follow-up were classified as Group A (postoperative complications) while those who did not develop any of these complications during follow-up were classified as Group B (no postoperative complications).

Data Management and Quality Control

Microsoft Excel software (Microsoft Corporation, Redmond, WA, USA) version 2016 was used to ensure the accuracy and completeness of data. A special quality control team was set up to conduct data monitoring and quality assessment, and to correct possible errors in time. Data collection was carried out in strict accordance with predetermined standards and procedures to ensure the credibility and scientific nature of the data. In addition, all surgeries were performed by the same doctor.

Statistical Analysis

The research data were processed by IBM SPSS Statistics for Windows, version 23.0 (IBM Corp., Armonk, NY, USA). Categorical data are expressed as count (percentage) and analyzed by Chi-squared test. Quantitative data conforming to the normal distribution are expressed as mean ± standard deviation and analyzed using *t*-test. On the contrary, data not conforming to the normal distribution are expressed as median and analyzed using nonparametric test methods such as Mann–Whitney U test (Wilcoxon rank sum test). Analysis of variance (ANOVA) was utilized to compare the quantitative data among multiple groups, and indicators showing statistically significant differences between

Table 1. Comparison of baseline data between the two groups.

Parameters		Group A (postoperative complications) (n = 87)	Group B (no postoperative complications) (n = 265)	χ^2	p
Sex	Male	50 (57.47)	150 (56.60)	0.020	0.887
	Female	37 (42.53)	115 (43.40)		
Age	18–59 years	42 (48.28)	170 (64.15)	6.891	0.009
	≥60 years	45 (51.72)	95 (35.85)		
Employment status	Employed	38 (43.68)	120 (45.28)	0.068	0.794
	Others	49 (56.32)	145 (54.72)		
Body mass index	18.50–23.90 kg/m^2	40 (45.98)	130 (49.06)	0.249	0.618
	≥24 kg/m^2	47 (54.02)	135 (50.94)		
History of chronic cardiovascular and cerebrovascular diseases	Yes	20 (22.99)	65 (24.53)	0.085	0.771
	No	67 (77.01)	200 (75.47)		
Education level	Junior high school and below	35 (40.23)	100 (37.74)	0.172	0.678
	High school and above	52 (59.77)	165 (62.26)		
Monthly income	<3000 CNY	38 (43.68)	125 (47.17)	0.321	0.571
	≥3000 CNY	49 (56.32)	140 (52.83)		
Smoking history	Yes	50 (57.47)	160 (60.38)	0.353	0.553
	No	37 (42.53)	105 (39.62)		
Alcohol consumption	Yes	40 (45.98)	120 (45.28)	0.013	0.910
	No	47 (54.02)	145 (54.72)		

CNY, Chinese Yuan; Exchange rate: 1 CNY = 0.14 USD

All data are reported as number (percentage).

Group A and Group B were selected for binary logistic regression analysis. $p < 0.05$ was considered statistically significant.

Results

Comparison of Disease Etiology

Clinical diagnoses for all patients were confirmed before surgery. In this sample, non-traumatic and non-diabetic retinopathy was caused by retinal hiatal hole in 49 cases, PCV in 38 cases, Terson syndrome in 2 cases, RAM in 37 cases, RVO in 189 cases, and other causes in 37 cases (Fig. 1).

Comparison of Postoperative Complications

All patients who underwent surgery were followed up for 12 months. It was found that a total of 87 patients who had postoperative complications, accounting for 24.72% (87/352), were classified as Group A. A total of 265 patients who did not develop postoperative complications, accounting for 75.28% (265/352), were classified as Group B. Fig. 2 shows the postoperative complications observed in the current sample and the corresponding proportion.

Comparison of General Data of Patients

There were no significant differences between the Group A and Group B in sex, employment status, body mass index, chronic cardiovascular disease, education level, monthly income, smoking history and alcohol consumption ($p > 0.05$). However, significant difference in age was detected ($p < 0.05$), as shown in Table 1.

Comparison of Clinical Data of Patients

There were no significant differences in intraocular fillers between Group A and Group B ($p > 0.05$), but significant differences in preoperative visual acuity, time of surgical intervention, preoperative fundus condition, stage of retinopathy and preoperative IOP were detected between them ($p < 0.05$), as shown in Table 2.

Stage of retinopathy: (i) stage I retinopathy refers to the presence of small blood spots in the retina; (ii) stage II retinopathy is accompanied by yellow hard exudate and yellow lesions; (iii) stage III retinopathy is characterized by the appearance of cotton wool spots, retinal edema, and white lesions; (iv) stage IV retinopathy features neovascularization; (v) stage V retinopathy features the occurrence of retinal proliferation or vitreous proliferation; (vi) stage VI retinopathy is accompanied by proliferative membrane traction, retinal detachment.

Argument Assignment Table

The occurrence of postoperative complications in patients with vitreous hemorrhage were treated as dependent variable (denoted as Y), while the preoperative complications such as preoperative visual acuity, time of surgical intervention, preoperative fundus condition, stage of retinopathy, preoperative IOP and age were taken as independent variables (denoted as X_1, X_2, X_3, X_4, X_5 and X_6, respectively), as shown in Table 3.

Table 2. Comparison of clinical data of patients.

Parameters		Group A (postoperative complications) (n = 87)	Group B (no postoperative complications) (n = 265)	χ^2	p
Stage of retinopathy (n, %)	Stage I–II	32 (36.78)	145 (54.72)	8.428	0.004
	Stage III–VI	55 (63.22)	120 (45.28)		
Intraocular fillers	Intraocular perfusion	46 (52.87)	141 (53.21)	0.012	0.977
	Gas	34 (39.08)	105 (39.62)		
	Silicone oil	7 (8.05)	19 (7.17)		
Time of surgical intervention	Early stage (course of disease ≤30 days)	30 (34.48)	142 (53.58)	9.565	0.002
	Middle and advanced stage (course of disease >30 days)	57 (65.52)	123 (46.42)		
Preoperative fundus condition	Peripheral visibility	35 (40.23)	150 (56.60)	7.042	0.008
	Complete invisibility	52 (59.77)	115 (43.40)		
Preoperative intraocular pressure	12.00–16.80 mmHg	36 (41.38)	159 (60.00)	9.191	0.002
	>16.80 mmHg	51 (58.62)	106 (40.00)		
Preoperative vision (n, %)	0.02–0.2	47 (54.02)	93 (35.09)	9.797	0.002
	>0.2	40 (45.98)	172 (64.91)		

All data are reported as number (percentage).

Table 3. Assignment table of argument variables.

Variables	Correlative factors	Definition and assign values
Y	Occurrence of postoperative complications	0 = did not occur, 1 = occurred
X_1	Preoperative vision	0 = >0.2, 1 = 0.02–0.2
X_2	Time of surgical intervention	0 = early stage (course of disease ≤30 days), 1 = middle and advanced stage (course of disease >30 days)
X_3	Preoperative fundus condition	0 = peripheral visibility, 1 = completely invisibility
X_4	Stage of retinopathy	0 = stage I–II, 1 = stage III–VI
X_5	Preoperative intraocular pressure	0 = 12.00–16.80 mmHg, 1 = >16.80 mmHg
X_6	Age	0 = 18–59 years, 1 = ≥60 years

Logistic Regression Analysis of Prognostic Factors after Vitrectomy

The logistic regression equation was used to calculate the difference items, and it was found that preoperative visual acuity, time of surgical intervention, preoperative fundus condition, stage of retinopathy, preoperative IOP and age were the main factors affecting the surgical prognosis of patients with non-traumatic and non-diabetic retinopathy as well as vitreous hemorrhage, with odds ratio (OR) values all greater than 1, as shown in Table 4.

Discussion

In this study, we performed vitrectomy in patients with non-traumatic and non-diabetic retinal diseases, and analyzed factors influencing their surgical outcomes. The results revealed that factors such as preoperative visual acuity, time of surgical intervention, preoperative fundus condition, retinal lesion staging, preoperative IOP, and age played a crucial role in predicting surgical outcomes.

After a 12-month postoperative follow-up, a total of 87 patients (24.72%) developed postoperative complications. We observed that the preoperative visual acuity had a significant impact on surgical outcomes, with a lower complication rate in patients with preoperative visual acuity of >0.2. This result aligns with findings by Liu *et al.* [18], emphasizing the critical role of preoperative visual acuity in surgical success and patient recovery. Better preoperative visual acuity is an indicator of having healthy and normal ocular structures, with 0.2 on the Snellen visual acuity chart typically corresponding to better vision, which allows patients to see smaller letters or objects [19].

Additionally, the influence of preoperative fundus conditions was confirmed in our study. Complete opaqueness of the fundus may indicate significant limitations in the surgical field of view, increasing the difficulty and risk of surgery.

Furthermore, our study identified that the time of surgical intervention or a disease course exceeding 30 days is a critical factor affecting surgical outcomes. A study by Fassbender *et al*. [20] suggested that timely surgical intervention (within 30 days) can reduce postoperative vision loss. Early vitrectomy was considered a favorable approach to improve the surgical outcomes and alleviate complication rate, according to Zhang *et al*. [21]. This is because a delayed treatment would give way to the occurrence of inflammation and tissue changes in the eye, which leads to instability in the ocular environment and an increased risk of complications during surgery.

Table 4. Analysis of multiple factors affecting prognosis after vitrectomy.

Indicators	β value	SE	p	Wald value	OR value	95% CI of OR
Preoperative vision	0.669	0.118	<0.001	32.143	1.952	1.549–2.458
Time of surgical intervention	0.699	0.126	<0.001	30.776	2.011	1.571–2.575
Preoperative fundus condition	0.457	0.124	<0.001	13.583	1.578	1.238–2.014
Stage of retinopathy	0.766	0.246	0.002	9.696	2.152	1.329–3.484
Preoperative intraocular pressure	0.573	0.114	<0.001	25.264	1.773	1.419–2.217
Age	0.622	0.189	<0.001	10.831	1.872	1.287–2.695

SE, standard error; CI, Confidence Interval; OR, odds ratio.

In the current study, preoperative IOP was also identified as a factor influencing surgical outcomes. Through a multivariate regression analysis of 238 patients, Liang *et al*. [22] pinpointed elevated preoperative IOP as a significant predictor of postoperative complications. High IOP is associated with certain eye conditions. Therefore opting for an intermediate IOP value as a cut-off point for screening for eye conditions is crucial. An IOP >16.80 mmHg, reflecting a state of high IOP may increase the risk of surgical complications [23]. High IOP may lead to increased instability in the ocular environment, potentially elevating the risk of complications such as bleeding and inflammation. A high level of IOP may also affect ocular blood perfusion, which if disrupted may increase the risk of tissue hypoxia and damage.

The present study revealed that more severe retinal lesion staging (III–VI) is associated with an increased surgical risk. Higher retinal lesion stage may also be associated with more severe vascular abnormalities, such as neovascularization, which increases the risk of intraoperative bleeding and complicates the surgical procedures.

Age was also identified as a prognostic factor in this study, with older patients exhibiting a higher incidence of postoperative complications, in contrast to findings reported in other study [24]. This discrepancy may be due to the sample in this study which is less clinically diverse than that in other studies. Existing research is more focused on investigating patients with proliferative diabetic retinopathy, while the current study primarily focused on patients with non-traumatic and non-diabetic retinal disease. Physiological aging may happen to ocular tissues such as retina, lens, and vitreous, exacerbating the fragility of intraocular structures, and thereby increasing the risk during surgery. Other systemic comorbidities, such as cardiovascular diseases in older patients may also increase the complexity of surgery and the likelihood of complications. Advancing age also weakens the immune system, rendering older patients more susceptible to infections. Particularly, older individuals are more vulnerable to the impact of postoperative infections, given the declining immunity [25].

It should be noted that despite consistency with other study results, differences in study design, sample size, and study populations may lead to some variations. Therefore, these differences should not be omitted or neglected while incorporating these findings into a comprehensive analysis, since variations in potential factors could contribute to result discrepancies.

A major strength of this study is the comprehensive analysis of multiple risk factors, which lend themselves useful in predicting the prognosis of non-traumatic and non-diabetic retinopathy in patients also affected by vitreous hemorrhage at an early stage. Our findings are also important for improving identification of patients with a poor prognosis.

Several limitations of this study should be acknowledged. Firstly, the small sample size and single-center study design employed may limit the generalization of the findings to other populations. In addition, the diversity of the clinical profile of our study sample is compromised because we exclusively studied non-traumatic and non-diabetic retinopathy patients with vitreous hemorrhage without considering retinal diseases with other etiologies. Future studies can address these limitations by adopting a more elaborate, multicenter study design, which involves a larger sample size. Such a study design allows the consideration of additional factors to enable more holistic analysis.

Conclusions

An array of factors, such as age, preoperative visual acuity, time of surgical intervention, preoperative fundus condition, stage of retinopathy and preoperative IOP, as well as vitreous hemorrhage, are prognostic factors influencing the surgical outcomes among patients with non-traumatic and non-diabetic retinopathy. Thus, more personalized nursing care should be implemented to forestall the clinical factors from deteriorating so as to improve the surgical prognosis of these patients.

Availability of Data and Materials

The datasets used or analyzed during the current study were available from the corresponding author on reasonable request.

Author Contributions

MXD and QX designed the study; all authors conducted the study; CWL and BLF collected and analyzed the data. MXD and RH participated in drafting the manuscript, and all authors contributed to critical revision of the manuscript

for important intellectual content. All authors gave final approval of the version to be published. All authors participated fully in the work, take public responsibility for appropriate portions of the content, and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or completeness of any part of the work are appropriately investigated and resolved.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of Tangshan Ophthalmology Hospital (YKYY-LL-2023-08) and complies with the Tangshan Ophthalmology Hospital ethical guidelines. Informed consent was obtained from all participants before the study began. The study is in accordance with the Declaration of Helsinki.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

References

[1] Zou M, Ke Q, Nie Q, Qi R, Zhu X, Liu W, *et al*. Inhibition of cGAS-STING by JQ1 alleviates oxidative stress-induced retina inflammation and degeneration. Cell Death and Differentiation. 2022; 29: 1816–1833.

[2] Peng YR, Shekhar K, Yan W, Herrmann D, Sappington A, Bryman GS, *et al*. Molecular Classification and Comparative Taxonomics of Foveal and Peripheral Cells in Primate Retina. Cell. 2019; 176: 1222–1237.e22.

[3] Keeling E, Chatelet DS, Tan NYT, Khan F, Richards R, Thisainathan T, *et al*. 3D-Reconstructed Retinal Pigment Epithelial Cells Provide Insights into the Anatomy of the Outer Retina. International Journal of Molecular Sciences. 2020; 21: 8408.

[4] Chen DY, Sun NH, Chen X, Gong JJ, Yuan ST, Hu ZZ, *et al*. Endothelium-derived semaphorin 3G attenuates ischemic retinopathy by coordinating β-catenin-dependent vascular remodeling. The Journal of Clinical Investigation. 2021; 131: e135296.

[5] García-O'Farrill N, Pugazhendhi S, Karth PA, Hunter AA. Radiation retinopathy intricacies and advances in management. Seminars in Ophthalmology. 2022; 37: 417–435.

[6] Zhou L, Xu Z, Oh Y, Gamuyao R, Lee G, Xie Y, *et al*. Myeloid cell modulation by a GLP-1 receptor agonist regulates retinal angiogenesis in ischemic retinopathy. JCI Insight. 2021; 6: e93382.

[7] Dos Santos FM, Ciordia S, Mesquita J, de Sousa JPC, Paradela A, Tomaz CT, *et al*. Vitreous humor proteome: unraveling the molecular mechanisms underlying proliferative and neovascular vitreoretinal diseases. Cellular and Molecular Life Sciences. 2022; 80: 22.

[8] Tram NK, Maxwell CJ, Swindle-Reilly KE. Macro- and Microscale Properties of the Vitreous Humor to Inform Substitute Design and Intravitreal Biotransport. Current Eye Research. 2021; 46: 429–444.

[9] Enghelberg M, Chalam KV. Ultra wide field angiography documented peripheral retinal eovascularization as cause of vitreous hemorrhage after scleral buckle surgery. Journal of Surgical Case Reports. 2020; 2020: rjaa142.

[10] Li Q, Shen X, Wang S, Su T, Yan K, Zhang Y, *et al*. Combined aspirin and clopidogrel therapy in phacoemulsification cataract surgery: a risk factor for ocular hemorrhage? International Ophthalmology. 2020; 40: 2023–2029.

[11] Iwase T, Baba T, Saito Y, Nizawa T, Yokouchi H, Kubota-Taniai M, *et al*. Surgical outcomes of vitrectomy for breakthrough vitreous hemorrhage in eyes with exudative age-related macular degeneration. International Ophthalmology. 2021; 41: 1835–1844.

[12] Kim TY, Kang HG, Choi EY, Koh HJ, Kim SS, Lee JH, *et al*. Prognostic Factors and Long-term Surgical Outcomes for Exudative Age-related Macular Degeneration with Breakthrough Vitreous Hemorrhage. Korean Journal of Ophthalmology. 2020; 34: 281–289.

[13] Herat LY, Matthews JR, Rakoczy EP, Schlaich MP, Matthews VB. Comparing and Contrasting the Effects of the SGLT Inhibitors Canagliflozin and Empagliflozin on the Progression of Retinopathy. Frontiers in Bioscience (Landmark Edition). 2023; 28: 83.

[14] El-Boghdadly K, Cook TM, Goodacre T, Kua J, Blake L, Denmark S, *et al*. SARS-CoV-2 infection, COVID-19 and timing of elective surgery: A multidisciplinary consensus statement on behalf of the Association of Anaesthetists, the Centre for Peri-operative Care, the Federation of Surgical Specialty Associations, the Royal College of Anaesthetists and the Royal College of Surgeons of England. Anaesthesia. 2021; 76: 940–946.

[15] Chan JKK, Aquilina AL, Lewis SR, Rodrigues JN, Griffin XL, Nanchahal J. Timing of antibiotic administration, wound debridement, and the stages of reconstructive surgery for open long bone fractures of the upper and lower limbs. The Cochrane Database of Systematic Reviews. 2022; 4: CD013555.

[16] Onishi S, Kaji T, Nakame K, Yamada K, Murakami M, Sugita K, *et al*. Optimal timing of definitive surgery for Hirschsprung's disease to achieve better long-term bowel function. Surgery Today. 2022; 52: 92–97.

[17] Lee SH, Dai T, Phan PH, Moran N, Stonemetz J. The Association Between Timing of Elective Surgery Scheduling and Operating Theater Utilization: A Cross-Sectional Retrospective Study. Anesthesia and Analgesia. 2022; 134: 455–462.

[18] Liu ZW, Peng J, Chen CL, Cui XH, Zhao PQ. Analysis of the etiologies, treatments and prognoses in children and adolescent vitreous hemorrhage. International Journal of Ophthalmology. 2021; 14: 299–305.

[19] Azzam D, Ronquillo Y. Snellen Chart. StatPearls: Treasure Island (FL). 2023.
[20] Fassbender JM, Ozkok A, Canter H, Schaal S. A Comparison of Immediate and Delayed Vitrectomy for the Management of Vitreous Hemorrhage due to Proliferative Diabetic Retinopathy. Ophthalmic Surgery, Lasers & Imaging Retina. 2016; 47: 35–41.
[21] Zhang T, Zhang J, Sun X, Tian J, Shi W, Yuan G. Early vitrectomy for dense vitreous hemorrhage in adults with non-traumatic and non-diabetic retinopathy. The Journal of International Medical Research. 2017; 45: 2065–2071.
[22] Liang X, Zhang Y, Li YP, Huang WR, Wang JX, Li X. Frequency and Risk Factors for Neovascular Glaucoma After Vitrectomy in Eyes with Diabetic Retinopathy: An Observational Study. Diabetes Therapy: Research, Treatment and Education of Diabetes and Related Disorders. 2019; 10: 1801–1809.
[23] Koeller AU, Boehm AG, Paul D, Pillunat LE. Frequency of intraocular pressure spikes in primary open angle glaucoma patients. Investigative Ophthalmology & Visual Science. 2004; 45: 953–953.
[24] Liao M, Wang X, Yu J, Meng X, Liu Y, Dong X, *et al*. Characteristics and outcomes of vitrectomy for proliferative diabetic retinopathy in young versus senior patients. BMC Ophthalmology. 2020; 20: 416.
[25] Sun Y, Han XD, Liu XD. Research advances in immunosenescence and inflammation in lung diseases. Zhonghua Jie he he Hu Xi Za Zhi = Zhonghua Jiehe he Huxi Zazhi = Chinese Journal of Tuberculosis and Respiratory Diseases. 2024; 47: 178–182. (In Chinese)