Effect of the COVID-19 Pandemic on Progression to Glaucoma Surgery in Patients Followed Up in a Retina Unit

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ABSTRACT

Purpose: In this study, we aimed to investigate the effect of the COVID-19 on progression to glaucoma surgery in patients followed up at the retina unit of the Ophthalmology Outpatient Clinic of Health Sciences University Antalya Training and Research Hospital.

Material and Methods: The patients who were followed up at the retina unit of our hospital. The patients were divided into four periods: Group 1, March 11, 2019-September 11, 2019; Group 2, September 12, 2019-March 11, 2020; Group 3, March 12, 2020-September 11, 2020; and Group 4, September 12, 2020-March 11, 2021. Group 1 and Group 2 were pre-pandemic groups, Group 3 and Group 4 were post-pandemic groups. This study is retrospective.

Results: The ratio of the number of patients who underwent glaucoma surgery to the number of those presenting to the retina unit was found to be statistically significantly increased in Group 4 compared to the remaining three groups ($p<0.0001$ for all). The ratio of the number of patients who were followed up in the retina unit and underwent surgery due to neovascular or silicone oil-induced glaucoma to the total number of patients who presented to the retina unit was statistically significantly increased in Group 4 compared to Groups 1 and 2 ($p=0.001$ for all).

Conclusion: This study is the first to examine the effect of the COVID-19 pandemic on progression to glaucoma surgery in patients followed up at the retina unit. We think that the number of patients that required surgery for neovascular or silicone oil-induced glaucoma in Group 4 increased because the patients in Group 3 time period could not go to their regular check-ups due to COVID-19. We consider that the fear of contracting the virus, implemented lockdowns, need for social isolation, and inability to apply timely treatments due to the pandemic conditions are effective in this situation.

Keywords: COVID-19, Glaucoma, Retina, Silicone oil-induced glaucoma, Neovascular glaucoma.

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is a systemic disease that affects the whole body, especially the respiratory tract. This disease has affected hundreds of countries around the world and has been declared a pandemic by the World Health Organization.[1] The first case in Turkey was detected on March 11, 2020. Paying attention to personal hygiene, hand washing, wearing a mask, and social distancing are recommended to prevent the spread of the disease. In addition, lockdowns and home quarantine have been implemented in Turkey, as well as in many countries in the world. The necessity of social isolation created by the pandemic and lockdowns have caused a decrease in the rate of hospital visits. It has been observed that even patients who needed regular follow-up have delayed their hospital visits due to the pandemic.[2, 3]

In this study, we aimed to investigate the effect of the COVID-19 pandemic on progression to glaucoma surgery in patients followed up at the retina unit of the Ophthalmology Outpatient Clinic of Health Sciences University Antalya Training and Research Hospital.

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MATERIAL AND METHODS

Patient Selection

In this study, patients who were followed up at the retina unit of the Ophthalmology Clinic of Health Sciences University Antalya Training and Research Hospital between March 11, 2019 and March 11, 2021 were retrospectively evaluated. The patients who presented to the retina unit and underwent glaucoma surgery were evaluated in four periods as Group 1, March 11, 2019-September 11, 2019; Group 2, September 12, 2019-March 11, 2020; Group 3, March 12, 2020-September 11, 2020; and Group 4, September 12, 2020-March 11, 2021, and patient ratios were compared between these periods. The first case in Turkey being reported on March 11, 2020, increased lockdown measures being implemented for the first six months, and people's greater fear of contracting the virus were effective in determining these periods.

The detailed ophthalmological examination and retinal examination files of all the patients were reviewed. The best-corrected visual acuity (BCVA) values of the patients before and after glaucoma surgery were measured using the Early Treatment Diabetic Retinopathy Scale (ETDRS) chart. The decimal system was used to analyze visual acuities. The intraocular pressures of the patients before and after glaucoma surgery were measured with a non-contact tonometer (Nidek NT-2000 NCT, Nidek CO., LTD., Hiroishi Gamagori, Aichi, Japan). For the periods mentioned above, it was determined how many patients presented to the retina unit, how many of these patients underwent glaucoma surgery, and how many glaucoma operations were performed in the clinic. The cases that were followed up at the retina unit and progressed to glaucoma surgery were examined in two groups: silicone oil-induced glaucoma and neovascular glaucoma. Silicone oil-induced glaucoma was primarily treated with silicone tamponade removal and anti-glaucomatous treatment. In neovascular glaucoma, first anti-vascular endothelial growth factor intravitreal injection, panretinal photocoagulation, and anti-glaucomatous treatment were applied. In other glaucoma cases, anti-glaucomatous treatment was primarily applied. In patients whose intraocular pressure did not decrease despite treatments, standard trabeculectomy or Ahmed glaucoma valve surgery was performed under local anesthesia.

Ethical permissions of this study were approved by both the Republic of Turkey Ministry of Health COVID-19 Scientific Research Evaluation Commission and the Health Sciences University Antalya Training And Research Hospital (Date: 19.08.21 No:12/3)

Statistical Analysis

Descriptive statistics were presented as mean, standard deviation, and ratio values. The two-proportion z-test was used to compare the ratios between two groups. The relationship between numerical variables was examined with the Spearman correlation test. The analysis of the data was performed using SPSS v. 23.0 software package program. P values of <0.05 were considered statistically significant.

RESULTS

Table 1 presents the distribution of the number of patients who presented to the retina unit of our hospital and the number of those who underwent glaucoma surgery according to the groups in terms of their demographic characteristics.

The glaucoma classification of the patients who underwent glaucoma surgery is shown in Table 2. Neovascular glaucoma developed due to ischemic central retinal vein occlusion in one patient in Group 1, diabetic retinopathy in two patients and ischemic central retinal vein occlusion in one patient in Group 2, and diabetic retinopathy in five

Table 1: *Demographic characteristics of the patients*

Variable	Group 1	Group 2	Group 3	Group 4
Number of patients presenting to the retina unit	4477	5356	1936	1946
Female/male ratio in glaucoma surgery	1/7	4/6	0/1	5/14
Mean age in glaucoma surgery (mean ± SD)	62.50 ± 7.80	60.50 ± 12.57	40	59.10 ± 12.19
Number of glaucoma operations performed	8	10	1	19
Number of patients with neovascular glaucoma	1	3	0	7
Number of patients with silicone oil-induced glaucoma	2	1	0	8

SD: Standard deviation

Table 2: *Glaucoma classification of the patients undergoing glaucoma surgery*				
Type of glaucoma	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Primary open angle glaucoma	3	4	0	2
Primary angle closure glaucoma	0	0	1	1
Pseudoexfoliative glaucoma	0	1	0	0
Uveitic glaucoma	0	1	0	0
Iridocorneal endothelial syndrome	1	0	0	1
Silicone oil-induced glaucoma	2	1	0	8
Neovascular glaucoma	1	3	0	7
Total	8	10	1	19

patients and ischemic retinal vein occlusion in two patients in Group 4.

A total of 38 glaucoma operations were performed in four groups. Of the 38 individuals that underwent glaucoma surgery, 28 were women and 10 were men. The mean average age (±SD) was 59.68 ± 11.61 years, with the mean average age (±SD) of women and men being calculated as 53.60 ± 10.65 and 61.85 ± 11.32, respectively. Trabeculectomy was applied to 35 patients. Ahmed glaucoma valve was inserted in two patients with neovascular glaucoma in Group 4 who had a history of trabeculectomy surgery and was observed to have developed filtration failure during his current examination. One patient with uveitic glaucoma in Group 2 required re-glaucoma surgery after trabeculectomy. Table 3 shows the mean preoperative BCVA, postoperative BCVA, preoperative intraocular pressure, postoperative intraocular pressure, follow-up time, number of intravitreal injections in cases of neovascular glaucoma, and duration of silicone tamponade stay in the eye in cases of silicone oil-induced glaucoma according to the study groups.

Table 4 shows the comparison of the ratio of the number of patients who underwent glaucoma surgery to the total

Table 3: *Distribution of the characteristics of patients who underwent glaucoma surgery according to study groups*				
Variable	**Group 1 (Mean ± SD)**	**Group 2 (Mean ± SD)**	**Group 3 (Mean ± SD)**	**Group 4 (Mean ± SD)**
Number of patients	8	10	1	19
Age	62.52 ± 7.80	60.50 ± 12.57	40	59.10 ± 12.19
Preoperative BCVA	0.14 ± 0.16	0.13 ± 0.15	0.20	0.07 ± 0.11
Postoperative BCVA	0.19 ± 0.20	0.20 ± 0.19	0.40	0.10 ± 0.15
Preoperative IOP (mm Hg)	31.63 ± 5.32	35.20 ± 5.33	35	38.42 ± 6.83
Postoperative IOP (mm Hg)	17.25 ± 2.82	15.20 ± 2.20	16	15.95 ± 4.21
Follow-up time (months)	44.13 ±13.74	38.40 ±16.18	16	26.74 ± 8.61
Number of intravitreal injections	8	13.66 ± 6.02	0	7.14 ± 4.91
Duration of silicone tamponade stay (months)	11 ± 2.82	12	0	23 ± 4.56
BCVA: Best-corrected visual acuity, IOP: Intraocular pressure, SD: Standard deviation				

Table 4: *Distribution of the ratio of the number of patients who underwent glaucoma surgery to the total number of patients presenting to the retina unit according to the study groups*					
Variable	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**P value**
G/R	8/4477		1/1936		0.06
G/R		10/5356	1/1936		0.042
G/R	8/4477			19/1946	<0.0001
G/R		10/5356		19/1946	<0.0001
G/R			1/1936	19/1946	<0.0001
G/R: Ratio of the number of patients that underwent glaucoma surgery to the total number of patients that presented to the retina unit					

number of patients who presented to the retina unit between the study groups. There was no statistically significant difference in this ratio between Group 1 and Group 3 (p = 0.06). However, this ratio was statistically significantly decreased in Group 3 compared to Group 2 (p = 0.042). A statistically significant increase was observed in this ratio in Group 4 when compared to the remaining three groups (p < 0.0001 for all).

The number of patients presenting to the retinal unit was statistically significantly decreased in Group 3 compared to Groups 1 and 2 (p < 0.0001 for both). In addition, the number of patients who presented to the retina unit was statistically significantly decreased in in Group 4 compared to Groups 1 and 2 (p < 0.0001 for both).

Table 5 presents the comparison of the ratio of the number of patients followed up in the retina unit who underwent glaucoma surgery due to neovascular or silicon oil-induced glaucoma to the total number of patients that presented to the retina unit between the groups. This ratio was statistically significantly increased in Group 4 when compared to Groups 1 and 2 (p = 0.001 for both).

Table 6 shows the comparison of the ratio of the number of patients followed up in the retina unit who underwent glaucoma surgery (neovascular or silicon oil-induced glaucoma) to the total number of patients who underwent glaucoma surgery between the study groups. There statistically significant increase in this ratio in Group 4 when compared to Groups 1 and 2 (p = 0.017 and p = 0.031, respectively).

In patients with silicone oil-induced glaucoma, a negative correlation was detected between the duration of silicone tamponade stay and preoperative BCVA (r = -0.383, p = 0.18). In addition, there was a negative correlation between the duration of silicone tamponade stay and postoperative BCVA in the same patients (r = -0.413, p = 0.10).

DISCUSSION

COVID-19 is a systemic disease that causes symptoms throughout the body. The general symptoms of COVID-19 include cough, fever, sore throat, fatigue, headache, loss of taste, loss of smell, lower back pain, and muscle pain. This disease, transmitted through droplets, has led to a global pandemic.[4] The first case in Turkey was detected on March 11, 2020. To prevent the spread of the disease, paying attention to personal hygiene, hand washing, wearing a mask, and social isolation have been recommended.[3, 5]

Many countries in the world have had to resort to additional measures to tackle the COVID-19 pandemic, with the virus spreading rapidly, infecting many people, and resulting in millions of deaths. In Turkey, various measures have been implemented, including lockdowns, home quarantine, closure of shopping centers, reduction of public transportation use, closure of certain workplaces, and transition to home office working. Both the necessity of social isolation caused by the fear of contracting the virus and implemented lockdowns have resulted in a decrease in the rates of hospital visits.[5, 6]

Units operating under ophthalmology outpatient clinics can be listed as cornea, uvea, glaucoma, retina, contact

Table 5: *Comparison of the ratio of the number of patients who were followed up in the retina unit and underwent glaucoma surgery to the total number of patients who presented to the retina unit between the study groups*

Variable	Group 1	Group 2	Group 4	P value
RG/R	3/4477		15/1946	0.001
RG/R		4/5356	15/1946	0.001

RG/R: ratio of the number of patients followed up in the retina unit who underwent glaucoma surgery (neovascular or silicon oil-induced glaucoma) to the total number of patients that presented to the retina unit

Table 6: *Comparison of the ratio of the number of patients followed up in the retina unit who underwent glaucoma surgery to the total number of patients who underwent glaucoma surgery between the study groups*

Variable	Group 1	Group 2	Group 4	P value
RG/G	3/8		15/19	0.017
RG/G		4/10	15/19	0.031

RG/T: ratio of the number of patients followed up in the retina unit who underwent glaucoma surgery to the total number of patients who underwent glaucoma surgery

lens, strabismus, and oculoplasty.[7] Among these units, the retina unit follows up patients diagnosed with retinal detachment, vitreous hemorrhage, epiretinal membrane, and macular holes, as well as those that have undergone vitreoretinal surgery due to retinal vascular diseases, such as diabetic retinopathy, retinal vein occlusion, retinal artery occlusion, and ocular ischemic syndrome. These patients should attends regular follow-up every three to six months. In patients with retinal vascular disease without follow-up, neovascularization may occur in the retina, and as a result neovascular glaucoma may develop.[8-10] If patients who have undergone vitreoretinal surgery and have had silicone tamponade inserted into the eye are not followed up regularly, and thus their silicone tamponade is not removed when necessary, it may emulsify over time and cause glaucoma by obstructing the trabecular meshwork.[11-12]

Trabeculectomy is the gold standard surgical treatment in patients with glaucoma. This surgery aims to reduce intraocular pressure by creating a fistula between the subconjunctival area and the anterior chamber.[13, 14] The Ahmed glaucoma valve is a drainage device that uses a venturi valve mechanism to control excessive aqueous drainage into the posterior episcleral or subconjunctival area. It allows the aqueous to flow slowly through a chamber, and when intraocular pressure reaches the threshold value, the valve allows the fluid to exit the silicone tube, thus lowering intraocular pressure.[15, 16]

In this study, we found a decrease in the total number of patients who presented to the retina unit and underwent glaucoma surgery in Group 3 compared to Groups 1 and 2. In addition, there was a decrease in the number of patients presenting to the retina unit in Group 4 compared to Groups 1 and 2. This decrease was due to the patients not attending their regular follow-up. We consider that the fear of contracting COVID-19 and dying, restrictions implemented to prevent the spread of the virus, and need for social isolation are effective in this situation.

Although the number of patients who presented to our retina unit was statistically significantly decreased in Group 4 compared to Groups 1 and 2, the number of those that underwent glaucoma surgery was higher. The ratio of the number of patients that underwent glaucoma surgery to the total number of those presenting to the retinal unit was statistically significantly higher in Group 4 than all the remaining groups. The number of glaucoma operations being higher in Group 4 compared to the remaining groups may be because many patients did not attend their necessary follow-up after March 11, 2020, when the first case of COVID-19 was reported in Turkey, and therefore they were not able to undergo timely interventions, such as anti-glaucomatous treatment, intravitreal injections, argon laser photocoagulation, and removal of silicone tamponade.

In Group 4, 42.10% (8/19) of the glaucoma operations were due to neovascular glaucoma and 36.84% (7/19) were due to silicone oil occluding the trabecular meshwork. The ratio of the number of patients who underwent glaucoma surgery due to neovascular glaucoma and silicon oil-induced glaucoma to the total number of patients who underwent glaucoma surgery, and the ratio of the number of patients who underwent glaucoma surgery due to neovascular glaucoma and silicon oil-induced glaucoma to the total number of patients who presented to the retina unit were statistically significantly higher in Group 4 compared to Groups 1 and 2. We consider that the increase in the number of patients with neovascular glaucoma may be due to the patients with retinal vascular disease not receiving intravitreal injections, argon laser photocoagulation, and anti-glaucomatous drug therapy on time because they did not attend their follow-up. Similarly, the increase in the number of patients with silicone oil-induced glaucoma is probably because the patients who had undergone vitreoretinal surgery did not attend follow-up and did not realize that the silicone had emulsified, and therefore they did not receive anti-glaucomatous and silicone removal treatment in a timely manner.

Although studies in the literature suggest that the main cause of silicone oil-induced glaucoma is the emulsification of the silicone, it has been stated that the duration of silicone tamponade stay in the eye may also be effective in the development of glaucoma. It has been shown that as the duration of silicone stay in the eye increases, the rate of emulsified silicone increases, and accordingly there is a greater possibility of glaucoma development due to various reasons, such as silicone transfer to the anterior chamber, angle closure, and rubeosis iridis.[17] The development of silicone oil-induced glaucoma occurs after an average of five to 24 months postoperatively.[18] However, it has also been reported that silicone oil-induced glaucoma can occur even in the postoperative first month.[19] It has also been determined that the decrease in postoperative BCVA is associated with the duration of silicone tamponade stay in the eye.[20]

Similar to the above-mentioned studies, we found that the duration of silicone tamponade stay in the eye

had a negative correlation with the preoperative and postoperative BCVA values of the patients who underwent glaucoma surgery due to silicone oil-induced glaucoma. Accordingly, the preoperative and postoperative BCVA values decreased as the duration of silicone stay increased. The longer the silicone remains in the eye, the higher the emulsification rate, resulting in glaucoma and eventually retinal nerve fiber and vision loss. In our study, the mean duration of silicone tamponade stay was significantly longer significantly in Group 4 compared to the remaining groups, which was attributed to the patients not visiting the hospital for their follow-up due to the pandemic.

Considering the limitations of this study, these patients in the retina unit may have lost follow-up or died due to their comorbid diseases. Also, the variation in the parameters may also be coincidental considering the and multiple other confounders involved in the measurements.

CONCLUSION

This study is the first to examine the effect of the COVID-19 pandemic on progression to glaucoma surgery in patients followed up at the retina unit. The COVID-19 pandemic has had negative effects on various aspects of life. In this study, we detected an increase in the number of patients with neovascular glaucoma and silicone oil-induced glaucoma, and those undergoing glaucoma surgery among the patients that had not attended their regular follow-up in the retina unit due to the pandemic. We consider that the fear of contracting the virus, implemented lockdowns, need for social isolation, and inability to apply timely treatments due to the pandemic conditions are effective in this situation.

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