

Urgent and emergent glaucoma care during the COVID-19 pandemic: An analysis at a tertiary care hospital in South India

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Purpose: To describe the demographic profiles, clinical characteristics, and clinical outcomes of patients presenting with glaucoma emergencies during the COVID-19 lockdown in India. **Methods:** This retrospective, cross-sectional, observational case series involved review of medical records of all patients presenting to the glaucoma service during the COVID-19 lockdown period and comparison with the previous year (March 23 to June 23, 2020 Vs 2019) in a tertiary center in India. **Results:** We found a 78.9% reduction in overall outpatient visits (54,345 vs. 257,339; $P < 0.001$) and 80.9% reduction in the number of glaucoma outpatient visits (4,788 vs. 25,083; $P < 0.001$). Additionally, the proportion of true glaucoma emergency visits significantly increased by 62.4% in 2020 Vs 2019 (1,408/4,788 (29.4%) vs. 4,542/25,083 (18.1%); $P < 0.001$). Lens-induced glaucomas were the most common glaucoma surgical emergency (13.4%) in 2020. Moreover, comparison of procedures demonstrated a proportionate decrease in incisional glaucoma surgeries (70/115 (60.86%) vs. 806/939 (85.83%); $P < 0.001$) and an increase in the proportion of emergency cataract surgeries (129/475 (27.15%) vs. 170/2715 (6.26%); $P < 0.001$) and transscleral cyclophotocoagulation (45/115 (39.13%) vs. 133/939 (14.16%); $P = 0.0001$) during 2020 vs. 2019. **Conclusion:** Our study demonstrated a 62% increase in the proportion of visits that were true glaucoma emergencies. Additionally, the proportions of emergency cataract surgeries increased by 4.3 times and the proportion of transscleral cyclophotocoagulation increased by 2.8 times during the pandemic. More nonincisional procedures and less diagnostic testing were performed to minimize postoperative visits and virus transmission. Further understanding of the profile of emergencies may help in developing novel strategies to anticipate future challenges in managing glaucoma care during subsequent waves of the pandemic.

Key words: Coronavirus, COVID-19, SARS-CoV-2

Severe acute respiratory syndrome coronavirus 2 emerged in December 2019 in Wuhan, China, and led to the coronavirus disease (COVID-19) pandemic. COVID-19 continues to have an unprecedented global impact, affecting more than 39 million individuals.^[1] India, like nations across the world, implemented mass quarantines, travel restrictions, the closure of religious institutions, schools, and nonessential businesses, and the delay of elective surgery and routine health maintenance visits.^[2-4] The various stages of India's lockdown included specific restrictions and privileges that may have influenced the health-seeking behavior of patients.^[5-10]

India has a high prevalence of glaucoma^[11-13] and other blinding eye diseases.^[14] While access to eye care can be a substantial issue even without COVID-19, the accommodation of millions of patients in the midst of a pandemic has been challenging.^[15-18] The implementation of strict social distancing protocols has limited the number of patients that could be seen in clinic and travel restrictions prevented patients in need of care from leaving their local districts and using public transport

services. In turn, healthcare providers modified usual practice patterns to allow for teleconsultation and home visits in an effort to overcome barriers to healthcare access. However, these modifications led to additional challenges as resources to utilize online consultation were limited in developing countries.^[19] Finally, the employment rate in India declined to 26.1% during the lockdown; this worsening economic status may have had a bearing on payment for medications and hospital visits.^[20,21]

While routine follow-up visits and elective procedures such as surgery were delayed during the lockdown, emergent glaucoma care continued to be necessary in order to prevent permanent blindness. This study aimed to describe the demographic and clinical profile of patients presenting with acute glaucoma emergencies during the lockdown period (March 23, 2020 to June 23, 2020), as compared to the same period in the previous calendar year (March 23, 2019 to June 23, 2019).

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Methods

This is a retrospective, cross-sectional, observational study conducted at a tertiary eye care center in Madurai district of South India between July, 2020 and September, 2020. Our time period of interest was the lockdown period (March 23, 2020 to June 23, 2020) in India and the same period in the previous calendar year (March 23, 2019 to June 23, 2019). The study was approved by the Institutional Review Board (RET202000289) and adhered to the tenets of the Declaration of Helsinki. A general consent from patients, explaining the potential exposure risk to COVID-19 during the clinic visit was obtained. We have obtained approval from the ethics committee of our hospital on 31st August 2020.

We reviewed the electronic medical records for glaucoma patients undergoing emergent or urgent care between March 23, 2020 and June 23, 2020. The following types of visits were included in this study: 1) acute emergencies or urgencies that presented to the glaucoma service, 2) scheduled postoperative visits, and 3) referrals for primary angle closure disease requiring laser peripheral iridotomy (LPI) or cataract surgery.^[22] Ocular disorders were categorized as emergent, urgent, or routine categories based on the criteria published by the All India Ophthalmic Society (AIOS) – Indian Journal of Ophthalmology guidelines during the COVID-19 pandemic.^[23] Additionally, our clinic followed AIOS guidelines by restricting aerosol-generating procedures and engaged in the minimum use of diagnostic tests such as automated perimetry, optical coherence tomography, and ultrasound biomicroscopy.^[23,24]

We collected demographic data including age, sex, occupation, socioeconomic status, and distance from the clinic; standardized definitions were used to describe these.^[14] Patients' subjective visual perceptions were used to define defective vision. We recorded prior ophthalmic history including presenting complaints, duration of illness, time of presentation, and prior treatment as well as the examination data including best-corrected visual acuity (BCVA), intraocular pressure (IOP), pupillary function, slit-lamp biomicroscopy, gonioscopy, and fundus examination.

We classified patients' addresses as greater than or less than 100 km from the base hospital. Out-of-state residents were classified as such. BCVA was classified according to the WHO guidelines.^[25] All glaucoma clinic patients were additionally stratified according to the severity and risk of progression: risk categories (E1, E2, E3) based on BCVA, disc appearance, and the need for more frequent visits. Category E1 contained monocular patients, BCVA <6/60, IOP >30 mmHg, cup-to-disc ratio >0.85, and those requiring close IOP monitoring to avoid progression. Category E2 included moderate to advanced glaucoma patients, with CDR between 0.7 and 0.85, IOP >30 mmHg; those on multiple antiglaucoma medications requiring follow-up visits every 4 months. Category E3 included ocular hypertensives, glaucoma suspects, and stable patients on medications requiring routine or less frequent follow-up visits.

Statistical analysis

We reviewed data from electronic medical records and entered it into a Microsoft Excel spreadsheet. Statistical analysis was performed using STATA statistical software, Version 14.0 (StataCorp, College Station, Texas, USA). Continuous variables were expressed as mean \pm standard

deviation or median (interquartile range), and categorical variables are presented with frequency (percentage). The normality of the data is checked using Shapiro–Wilk's test. Chi-square tests/Fisher's exact tests were used to assess the association of categorical variables and for the comparison of five lockdown periods between March 23, 2020 to June 23, 2020. Two sample proportion tests are used to compare the frequencies between the groups. Two sample *t*-tests/Mann–Whitney U-test are applied for the comparison of visual acuity and IOP measures between 2019 and 2020. Paired *t*-tests/Wilcoxon signed-rank tests are applied for the comparison of BCVA before and after laser or surgery. *P* values < 0.05 were considered as statistically significant.

Results

Patient characteristics

Table 1 provides a comparison of demographic details of glaucoma patient visits during the lockdown and the same time period in the year prior. Comparison (3/23/2020–6/23/2020 vs. 3/23/2019–6/23/2019) revealed a similar mean age of patients seeking an emergency glaucoma consultation (52.3 ± 18.0 years vs. 50.46 ± 17.6 years; $P < 0.001$) and similar sex distribution with a male preponderance (64.8% males vs. 69.1% males; $P = 0.003$).

Proportions of patients presenting as glaucoma emergencies to the base hospital from within 100 km distance were significantly higher than those over 100 km distance during the lockdown (1140 (81.5%) vs. 258 (18.5%); $P < 0.001$).

When comparing the months of lockdown to the same months in the prior year (3/23/2020–6/23/2020 vs. 3/23/2019–6/23/2019), we found a 78.9% reduction in overall outpatient visits (54,345 vs. 257,339; $P < 0.001$) and 80.9% reduction in the number of glaucoma outpatient visits (4,788 vs. 25,083; $P < 0.001$). Additionally, within glaucoma outpatient visits, the proportion of true emergency visits significantly increased by 62.4% during the lockdown period vs. the same period in the prior year (1,408/4,788 (29.4%) vs. 4,542/25,083 (18.1%); $P < 0.001$), though the actual numbers were much lower than the previous year.

Reasons for hospital visit and diagnoses

Despite a decrease in the total number of patient visits, the proportion of new patients presenting with glaucoma emergencies increased during the lockdown period as compared to the year prior (198/1408 (14.1%) vs. 430/4542 (9.5%); $P < 0.001$). Additionally, among risk categories, a significant increase in high-risk (E1) patients was seen in 2020 vs. 2019 (390/1408 (27.87%) vs. 844/4545 (18.6%); $P < 0.001$). [Table 1].

There were significant decrease in office procedures (laser suturelysis, goniopuncture, iridoplasty, suture removal) (108/1408 (7.7%) vs. 437/4542 (9.6%); $P < 0.001$) and glaucoma testing (visual fields, optical coherence tomography) (10/1408 (0.7%) vs. 108/4542 (2.4%); $P < 0.001$) in 2020 vs 2019 [Table 1].

The number of patients presenting for emergency visits reached a maximum in the most recent fifth lockdown period ($n = 782$) with a significant difference compared to the initial phases of lockdown (L1–L3) ($n = 353$) ($P < 0.001$). A stepwise increase in emergency visits was seen since in the first lockdown, suggesting an association between various lockdowns and lockdown reversals on the patient flow [Fig. 1].

Table 1: Comparison of demographic and clinical characteristics of patients presenting to the glaucoma outpatient service between March 23 and June 23, 2019 and March 23 and June 23, 2020

Parameters	2019 (n=4542) n (%)	2020 (n=1408) n (%)	Mean difference (95% CI)	Percentage change (%) and P
Glaucoma outpatients/Total outpatients	25083/257339	4788/54345	0.0093 (0.0067 to 0.0120)	80.91 (D) <0.0001^P
Glaucoma emergency patients	4542/25083 (18.1)	1408/4788 (29.4)	-0.112 (-0.126 to -0.0992)	62.40 (I) <0.001^P
Mean age, years (SD)	50.46±17.6	52.3±18.0	-1.79 (-2.85 to -0.73)	<0.0001^T
Sex, male/female	3139/1403	913/495	-	0.003^C
Patient type, new/review	430/4112	198/1210	-0.045 (-0.066 to -0.025) 0.045 (0.025 to 0.066)	48.42 (I)/5.08 (D) <0.001^C
Reasons for hospital visit, Scheduled visit	2848 (62.7)	840 (59.6)	0.030 (0.001 to 0.059)	0.0398^P
Procedures [®]	437 (9.6)	108 (7.7)	0.019 (0.003 to 0.035)	0.0266^P
Investigations [§]	108 (2.4)	10 (0.7)	0.016 (0.01 to 0.023)	0.0001^P
Others [*]	1149 (25.29)	450 (31.96)	-0.066 (-0.094 to -0.039)	<0.001^P
Baseline glaucoma severity				
E1-High risk for progression	844 (18.6)	390 (27.7)	-0.091 (-0.117 to -0.065)	48.92 (I)
E2-Moderate risk for progression	1162 (25.6)	279 (19.8)	0.057 (0.033 to 0.082)	22.65 (D)
E3-No risk	2536 (55.8)	739 (52.5)	0.033 (0.003 to 0.063)	5.91 (D) <0.001^C
Distance to hospital from patient's home:				
Within 100 km in Tamil Nadu	3291 (94.3)	1140 (81.5)	0.127 (0.105 to 0.149)	13.57 (D)
Outside 100 km in Tamil Nadu	199 (5.7)	258 (18.5)	-0.127 (-0.149 to -0.105)	224.56 (I)
Total	3490 (100%)	1398 (100%)		<0.001^C

^PProportion test; ^CChi-square test; ^TTwo-sample t-test; D-Percentage decrease; I-Percentage increase; Bolded P are significant (P<0.05); *Others - Defective vision, pain, trauma, and referral; [§]4.3 times more in 2020; [†]1.9 times more in 2020; [®]Laser suturelysis, goniotomy, iridoplasty, and suture removal; [§]HFA, OCT, and Fundus photo; [§]939 glaucoma surgeries in 2019; [†]115 glaucoma surgeries in 2020

Comparison of clinical characteristics

Table 2 provides a comparison of clinical characteristics of emergent glaucoma patient visits between the lockdown and the same time period in the year prior. During the lockdown period compared to the prior year, patients presented with worse mean uncorrected VA (logMar 1.6 ± 1.1 vs. 1.4 ± 1.0; P < 0.001) and higher mean IOP (26.9 ± 15.9 mm Hg vs. 23.0 ± 13.3 mm Hg; P < 0.001). Comparison between the two time periods revealed that the proportion of phakic people presenting with emergencies was higher during the lockdown (448/1555 (28.8%) vs. 1135/5139 (22.1%); P < 0.001).

Comparison of procedures, indications for laser iridotomy, and emergency diagnosis

Comparison of procedures (3/23/2020–6/23/2020 vs. 3/23/2019–6/23/2019) revealed a decrease in the number of overall procedures (lasers and incisional surgeries) by 82.5% during the pandemic. A decrease in the proportion of LPI (231/475 (48.6%) vs. 1606/2,715 (59.2%); P < 0.001) in 2020 was seen. An increase in the proportions of transscleral diode cyclophotocoagulation (45/115 (39.13%) vs. 133/939 (14.16%); P = 0.0001) and a decrease in proportions of incisional glaucoma surgeries (70/115 (60.86%) vs. 806/939 (85.83%); P < 0.001) were observed during the pandemic. However, the proportion of patients undergoing emergency cataract surgeries was significantly higher during the lockdown as compared to the same time period the year prior (129/475 (27.2%) vs. 170/2,715 (6.3%); P < 0.001). However, the actual numbers of these procedures was much lower than the prior year [Table 3].

Small-incision cataract surgery was the most common type of emergency cataract surgery in 2020 with significant improvement in postoperative BCVA and IOP

reduction (P < 0.001 for both). However, a decrease in combined triple surgery, glaucoma tubes, and trabeculectomies by 53.2, 8.4, and 3.4% with P < 0.0001, P = 0.7352, and P = 0.8787, respectively, were seen in 2020 compared to 2019, suggesting a paradigm change in glaucoma management during the pandemic [Table 3].

The most common glaucoma diagnoses seen during the lockdown were secondary open-angle glaucoma (36.4%), neovascular glaucoma (23.8%), and phacomorphic glaucoma (8.1%). During the lockdown, a higher proportion of patients received laser PI for acute-angle closure emergencies (21/231 (9.1%) vs. 25/1606 (1.6%); P < 0.0001) and secondary glaucoma (14/231 (6.1%) vs. 19/1606 (1.2%); P < 0.0001) compared to 2019 [Table 3].

Comparison of postoperative follow-up visits

Comparison (3/2020 vs. 2/2020) of scheduled postoperative follow-up visits revealed that on date follow-up (presenting on the date of scheduled postoperative follow-up visits) decreased by 43.9%, from 106 patients (65.0%) in February 2020 to 61 patients (36.5%) in March 2020 (P < 0.0001). Additionally, a 1193.9% increase was seen in loss to follow-up with four patients (2.4%) in February 2020 to 53 patients (31.7%) in March 2020 (P < 0.0001) [Fig. 2].

Discussion

Our study compared glaucoma emergency care during the COVID-19 pandemic and its related 3-month shutdown in India as compared to the same time period the year prior. As compared to 2019, we observed a significant decline in overall outpatient visits during the lockdown by 78.9%, glaucoma outpatient visits by 80.9%, and the mean number of

Table 2: Comparison of clinical evaluation findings of patients presenting with glaucoma emergencies between March 23 and June 23, 2019 and March 23 and June 23, 2020

Parameters	2019 n (%)	2020 n (%)	Mean difference (95% CI)	Percentage change (%) and P
Presenting UCVA, Number of eyes	5026	1522		
Mean (SD) in Log Mar	1.36 (1.03)	1.55 (1.06)	-0.19 (-0.24 to -0.13)	<0.001^M
Presenting BCVA, Number of eyes	1829	453		
Mean (SD) in Log Mar	1.05 (1.07)	1.15 (1.12)	-0.093 (-0.2 to 0.017)	0.183^M
Presenting IOP, Number of eyes	4565	1315		
Mean (SD)	23.01 (13.32)	26.91 (15.86)	-3.9 (-4.75 to -3.04)	<0.001^M
Lens, Number of eyes	5139 (100%)	1555 (100%)		
Pseudophakia	1978 (38.5)	599 (38.5)	-0.0003 (-0.27 to 0.02)	>0.99^P
Clear lens	1356 (26.4)	407 (26.2)	0.002 (-0.022 to 0.027)	0.75 (D) and 0.875^P
Cataract	1135 (22.1)	448 (28.8)	-0.067 (-0.09 to -0.04)	30.31 (I) and <0.001^P
Aphakia	657 (12.8)	101 (6.5)	0.062 (0.047 to 0.078)	49.21 (D) and <0.001^P
Subluxated	13 (0.3)	0	0.002 (0.001 to 0.0039)	0.0471^P
Gonioscopy, Number of eyes	5592 (100%)	1654 (100%)		
Closed	433 (7.7)	169 (10.2)	-0.024 (-0.04 to -0.008)	32.46 (I) and 0.0014^P
Open	5159 (92.3)	1485 (89.8)	0.024 (0.008 to 0.041)	2.7 (D) and 0.0014^P
Fundus, Number of eyes	4860	1432		
<0.85	1498 (30.8)	430 (30.02)	0.01 (-0.017 to 0.04)	2.53 (D) and 0.4712 ^P
>0.85	1313 (27)	291 (20.32)	0.07 (0.045 to 0.09)	24.74 (D) and <0.001^P
GOA	160 (3.3)	25 (1.8)	0.015 (0.006 to 0.023)	45.45 (D) and 0.0032^P
No fundus view	1889 (38.86)	686 (47.9)	-0.091 (-0.112 to -0.06)	23.26 (I) and <0.001^P

^MMann-Whitney U-test; ^PProportion test; GOA - glaucomatous optic atrophy; UCVA - Uncorrected visual acuity; BCVA - Best-corrected visual acuity; IOP - Intraocular pressure; D - Percentage decrease; I - Percentage increase; Bolded P are significant (P<0.05)

Table 3: Comparison of emergency diagnosis, laser PI, and incisional surgeries between March 23 and June 23, 2019 and March 23 and June 23, 2020

Parameters	2019 n (%)	2020 n (%)	Mean difference (95% CI)	Percentage change (%) and P*
Emergency diagnosis, n	4542	1408		
Secondary open-angle glaucoma	2113 (46.5)	513 (36.4)	0.101 (0.71 to 0.13)	21.72 (D) and <0.001
Neovascular glaucoma	1023 (22.5)	335 (23.8)	-0.013 (0.04 to 0.01)	5.77 (I) and 0.3211
Phacomorphic glaucoma	131 (2.9)	114 (8.1)	-0.052 (-0.07 to -0.04)	179.3 (I) and <0.001
Secondary angle-closure glaucoma	116 (2.6)	78 (5.5)	-0.029 (-0.04 to -0.02)	111.5 (I) and <0.001
Phacolytic glaucoma	129 (2.8)	74 (5.3)	-0.025 (-0.04 to -0.01)	89.28 (I) and <0.001
Others [†]	1030 (22.67)	294 (20.88)	0.018 (-0.01 to 0.04)	7.89 (D) and 0.1568
Procedures (Laser and surgeries), n	2715	475		82.5 (D)
Laser peripheral iridotomy, n	1606/2715 (59.2%)	231/475 (48.63%)	0.104 (0.06 to 0.15)	17.78 (D) and <0.0001
Primary angle closure glaucoma	808/1606 (50.3)	42/231 (18.2)	0.321 (0.27 to 0.38)	63.81 (D) and <0.0001
Primary angle closure and primary angle closure suspects	750/1606 (46.7)	152/231 (65.8)	-0.191 (-0.26 to -0.13)	40.89 (I) and <0.0001
Acute-angle closure glaucoma	25/1606 (1.6)	21/231 (9.1)	-0.74 (-0.11 to -0.04)	468.75 (I) and <0.0001
Secondary glaucoma	19/1606 (1.2)	14/231 (6.1)	-0.049 (-0.08 to -0.02)	408.33 (I) and <0.0001
Nanophthalmos	4/1606 (0.3)	2/231 (0.9)	-0.06 (-0.1 to -0.2)	200 (I) and 0.1245
Small-incision cataract surgery	170/2715 (6.26%)	129/475 (27.15%)	-0.208 (-0.25 to -0.17)	333.71 (I) and <0.0001
Total glaucoma surgeries (Diode and incisional surgeries), n	939/2715 (34.58%)	115/475 (24.2%)	0.1 (0.06 to 0.14)	30.02 (D) and <0.0001
Transscleral cyclophotocoagulation	133/939 (14.16)	45/115 (39.13)	-0.25 (-0.34 to -0.16)	176.34 (I) and <0.0001
Incisional surgeries	806/939 (85.83)	70/115 (60.86)	0.24 (0.15 to 0.33)	29.09 (D) and <0.0001^P
Nonpenetrating deep sclerectomy	15/939 (1.59)	4/115 (3.47)	-0.19 (-0.05 to 0.12)	118.2 (I) and 0.1525
Combined trabeculectomy with cataract surgery	505/939 (53.78)	29/115 (25.21)	0.28 (0.19 to 0.37)	53.12 (D) and <0.0001
Trabeculectomy	158/939 (16.82)	20/115 (17.39)	-0.01 (-0.08 to 0.06)	3.38 (D) and 0.8787
Glaucoma tube shunt surgery	128/939 (13.63)	17/115 (14.78)	-0.01 (-0.08 to 0.06)	8.43 (D) and 0.7352

*Proportion test; D - Percentage decrease; I - Percentage increase; Bolded P are significant (P<0.05); [†]Juvenile glaucoma, traumatic glaucoma, uveitic glaucoma, steroid-induced glaucoma, acute angle-closure glaucoma, and developmental glaucoma

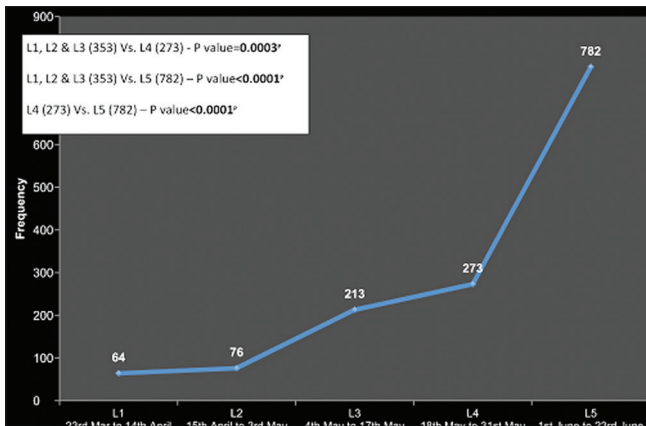


Figure 1: Frequency of patient visits in glaucoma clinic during the various phases of lockdown in 2020

glaucoma patients seen per day also decreased by 80.7%, which corroborated with reports from other specialties.^[26-28] However, despite an overall decline in number of emergency patient visits during the lockdown, we found an increase in the proportion of glaucoma emergencies by 62% as compared with the previous year. Additionally, we observed that the proportion of emergency cataract surgeries increased by 4.3 times and the proportion of transscleral cyclophotocoagulation increased by 2.8 times during the pandemic. We attribute these observations to the termination of all the routine outpatient visits and elective procedures, which led to overall lower total numbers during the lockdown and relatively high proportions of emergency visits and procedures.

Despite the lower frequency of surgery during the lockdown months, adherence to postoperative visits decreased by half. Additionally, out-of-state patients presented less frequently, likely related to travel restrictions. Our findings demonstrate a significant increase in emergent visits and a dramatic decline in maintenance visits, highlighting a potential increase in vision loss during these months. Our study, like others, suggest that the substantial impact of lockdown guidelines was evident by the health-seeking behavior of patients during the pandemic.^[29-31]

We observed gender inequalities in seeking healthcare, similar to prior analyses.^[29-33] Our cohort was predominantly male (64.8%) during the pandemic and the year prior (69.1%), with a significant increase in the disparity of men vs. women in all except the third lockdown phase ($P = 0.003$). Similarly, Das *et al.*^[29] demonstrated less frequent presentation of vulnerable groups such as females (37.8%), those of low socioeconomic status (27.3%), pediatric age (22.1%), and those living more than >100 km (9.7%). These findings highlight the disparity in healthcare access, even for emergency care, during the pandemic.

Similar to our study, Das *et al.*^[29] recently reported on the demographic and clinical profiles of 1192 patients seen during the COVID-19 pandemic. That study triaged 775 patients (65.0%) as ocular emergencies, with 97 patients (8.1%) requiring general urgent eye care, and 32 patients (4.1%) requiring medical or surgical treatment for a glaucoma emergency. Although Das *et al.*'s^[29] rate of glaucoma emergencies was lower than ours, they demonstrated a significant increase in overall emergencies

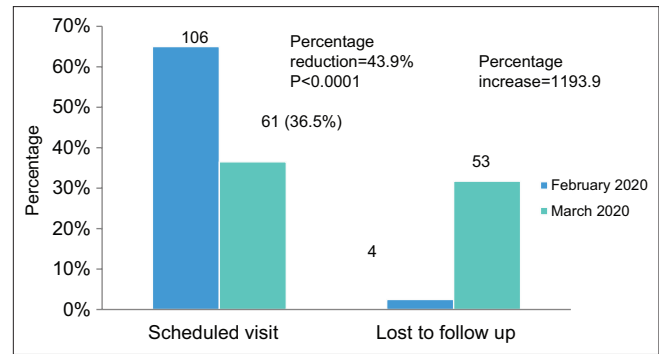


Figure 2: Comparison of postoperative scheduled visit and lost to follow-up between the first lock down (L1) and the previous month (February 2020)

during the lockdown as compared to 1 month prior (40.3% vs. 24.7%).

Similarly, Posarelli *et al.*,^[30] recently reported a significant increase in nondeferrable urgency visits and decrease in overall emergencies in the lockdown period when compared with the 1-month prelockdown and the same time period in 2019. In addition to the increase in glaucoma emergencies, we observed a 48.9% increase in high-risk patients (E1) and a 48.4% increase in new cases presenting as emergencies during the lockdown compared to 2019. Of patients who presented with glaucoma emergencies during the lockdown, the reasons for hospital visits varied significantly and the nature of emergencies appeared to be more severe than the year prior, as our cohort presented with greater vision loss, higher IOP, advanced cataracts, and severe optic disc damage.

Among glaucoma emergencies, lens-induced etiologies were the most common during the lockdown, with 129 patients undergoing emergency cataract surgery. Interestingly, the proportions of acute angle-closure were 5.68 times higher, phacomorphic glaucomas was 2.8 times higher, and phacolytic glaucoma was 2 times higher in 2020 as compared to 2019, though the total number of emergencies were fewer during the lockdown. Small-incision cataract surgery performed for lens-induced emergencies in both the studied periods showed significant improvement in postoperative visual acuity and IOP reduction from baseline, but IOP reduction was greater in 2019. This may have been related to the delayed presentation during the lockdown; greater lens-induced inflammation may have led to major trabecular outflow system obstruction with poor IOP response postsurgery.

Although the proportion of emergency cataract surgeries was 4.3 times higher during the lockdown, we witnessed a significant decline in the total number of glaucoma surgeries by 30% compared to the same time period the year prior (115/475 (24.2%) vs. 939/2,715 (34.58%); $P < 0.001$). This finding may reflect a preference for more conservative approaches requiring fewer postoperative visits during the pandemic. Accordingly, the proportions of cyclophotocoagulation procedures and nonpenetrating deep sclerectomy were increased and the proportions of office procedures and diagnostic testing were reduced. Additionally, there was a decrease in the proportions of trabeculectomies, tube shunts, and phacotrabeculectomy by 3.38, 8.43, and 53.12%, respectively, during the pandemic vs. the same time period the year prior. Similarly, a study in Italy reported

fewer invasive surgeries and greater proportions of laser and nonpenetrating surgeries during the pandemic compared to the same months in 2019.^[34] This reflects the conscious effort of the eye care providers to avoid recommending elective procedures and referrals and the hesitance of the patients to enter the hospital for care. The complexity of disinfecting instruments and potential restrictions may have also posed as impediments to care.

Additionally, we found a 43.9% reduction in scheduled postoperative visits with a 1193.9% increase in lost-to-follow-up rates compared to 1 month before lockdown. A substantial proportion of these postoperative patients were in critical or advanced stages of disease; possible progression during the lockdown may have greatly impacted visual status, as evidenced by prior studies.^[35]

Significant challenges remain in identifying these patients and rescheduling them for follow-up visits in the future months. An option of teleconsultation was offered to our patients to address this issue; however, there was a poor response during the initial phases of lockdown.

Eye care providers will thus need to develop strategies to address the immense backlog in the postlockdown period by encouraging stable, low-risk patients and elderly patients to seek eye care locally or via telemedicine. Additionally, we could trace high-risk patients from existing databases and prioritize them for follow-up visits in an effort to offer the most vulnerable individuals optimal care. Furthermore, reinforcement of healthy practices using patient education sessions with special emphasis on both mental and eye health is warranted. Several challenges still remain, as the risk of virus transmission may persist even after the vaccination.

Conclusion

To the best of our knowledge, this is the first study reporting the demographic and clinical profile of glaucoma emergencies during the acute phase of COVID-19. Our findings suggest that patients with glaucoma emergencies sought care despite the risk of disease contraction and government-imposed restrictions. Lens-induced glaucomas were the most common glaucoma surgical emergency during the pandemic among our clinical population. Fewer glaucoma diagnostic studies and more nonincisional procedures such as transscleral cyclophotocoagulation were performed to minimize postoperative visits. Further understanding of the profile of emergencies may help in developing novel strategies to anticipate future challenges in managing glaucoma care during subsequent waves of the pandemic. A paradigm shift in eye care delivery with greater teleconsultation may help accommodate previously deferred visits and prevent unnecessary exposure for patients who can be adequately monitored from home.

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Conflicts of interest

There are no conflicts of interest.

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