



Unveiling Current Profile of Secondary Glaucoma from A Tertiary Eye Care Centre In Southern India

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ABSTRACT

Introduction: Secondary glaucoma is a significant cause of visual morbidity and present a major challenge to ophthalmologists. Given their varied aetiological profile across regions, understanding the current spectrum is essential for early detection, timely diagnosis, and prompt management to prevent irreversible vision loss.

Objective: To determine the clinical profile and aetiological pattern of secondary glaucoma in a tertiary eye care centre in Southern India.

Methodology: This hospital-based cross-sectional study was conducted at a tertiary eye care centre in Southern India from 2023 December to 2024 May. Consecutive sampling technique was utilised and ethical approval was taken. Patients diagnosed with secondary glaucoma, based on defined inclusion criteria, were enrolled after obtaining ethical approval. All patients underwent a comprehensive ophthalmic evaluation including visual acuity assessment, slit-lamp examination, tonometry, gonioscopy, and fundus examination. Data were analysed using the SPSS version 21.0

Result: Among 8034 glaucoma patients, 524 (6.5%) had secondary glaucoma. The mean age was 50 ± 18 years, with a male predominance (336, 64.1%). The most common causes were pseudoexfoliative glaucoma (121, 23.1%), neovascular glaucoma (105, 20.0%), and steroid-induced glaucoma (102, 19.5%). Nearly half of the patients (258, 49.2%) presented with visual acuity $<3/60$, and 65 (12.4%) had no light perception. Advanced optic nerve damage was noted in a significant proportion (50, 9.54%)

Conclusion: Secondary glaucomas constitute a diverse and significant clinical entity with considerable visual morbidity. Late presentation and advanced optic nerve damage highlight the need for improved screening, early diagnosis, and timely intervention. Region-specific data such as this can guide better clinical decision-making and resource allocation in managing secondary glaucoma.

Key words: Glaucoma; neovascular glaucoma; pseudoexfoliation syndrome; secondary glaucoma; visual impairment.

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INTRODUCTION

Glaucoma is the second leading cause of blindness, affecting nearly 12 million people worldwide (George et al., 2010). Among its subtypes, secondary glaucoma contributes significantly to visual morbidity and is not limited to the elderly population. According to the WHO Blindness Data Bank, blindness due to secondary glaucoma is estimated at 2.7 million globally (Quigley HA, 1996). The reported prevalence varies widely, ranging from 6% to 22% across studies, reflecting heterogeneity in aetiologies and populations studied (Das et al., 2001; Krishnadas et al., 2001; Yamamoto et al., 2005).

At a regional level, particularly in developing countries, the burden of secondary glaucoma is influenced by diverse demographic, educational, economic, and cultural factors. Variations in patient awareness, accessibility to eye care services, and differences in health care infrastructure further contribute to the observed disparities in prevalence and clinical presentation (Dubey et al., 2019; Gurung et al., 2021). These factors result in delayed presentation and advanced disease at diagnosis, thereby increasing the risk of irreversible visual loss.

Locally, in the Indian context, rapid advancements in surgical practices, increased utilisation of ophthalmic services, and rising life expectancy are altering the aetiological spectrum and clinical profile of secondary glaucoma. This evolving scenario highlights a gap in updated epidemiological data, necessitating region-specific studies to better understand current trends and guide effective management strategies.

Given this background, there is a need to comprehensively evaluate the changing patterns of secondary glaucoma. The objective of this study was to assess the prevalence, aetiological spectrum, clinical characteristics, and management patterns of secondary glaucoma in patients presenting to a tertiary eye care centre in Southern India.

METHODOLOGY

This cross-sectional study was conducted at a tertiary eye care hospital after obtaining Institutional Ethics Committee approval (Reference number: BMCRI/EC/25/2024; Dated: 2024 June 28) and adhering to the Declaration of Helsinki. Written informed consent was obtained from all participants. All patients presenting to the glaucoma clinic between 2023 December 1 and 2024 May 31, diagnosed with secondary glaucoma, were included using a consecutive sampling technique. The sample size was calculated using OpenEpi software (version 3.01), based on a study by Dubey et al., which reported a 7.32% prevalence of secondary glaucoma among 5725 screened glaucoma patients. Assuming a similar prevalence, with 0.8% absolute precision and 95% confidence interval, and applying finite population correction, the required sample size was 4000. Accounting for a 3% loss to follow-up, the final sample size was rounded to 4200 patients, with an expected 300-360 cases of secondary glaucoma were expected within the study cohort. All patients underwent detailed history taking and comprehensive ophthalmic evaluation, including visual acuity assessment using a Snellen chart, slit-lamp biomicroscopy, and fundus examination with a 90D lens by a glaucoma specialist. Intraocular

pressure was measured using Goldmann applanation tonometry, and gonioscopy was performed using a Sussman four-mirror lens. Additional investigations such as ultrasound biomicroscopy, B-scan ultrasonography, and optical coherence tomography (ZEISS) for retinal nerve fibre analysis were performed when indicated and possible. Visual field testing using Humphrey Field Analyser (ZEISS) was performed in reliable patients but was not used as a diagnostic criterion. Secondary glaucoma was diagnosed based on a known inciting event or pathology, characteristic anterior segment findings, and raised intraocular pressure and/or glaucomatous optic nerve damage. The fellow eye was evaluated to exclude primary glaucoma. Patients unwilling to consent, those with primary glaucomas, congenital, juvenile, or normal-tension glaucoma, ocular hypertension,

glaucoma suspects, and those with prior trabeculectomy or triple surgery were excluded. Categorical variables were defined in numerals and percentages. The data were entered in MS Excel spreadsheet and analysis was done using BM SPSS Statistics version 21 (IBM Corp., Armonk, N.Y., USA).

RESULT

A total of 8034 patients diagnosed with glaucoma or glaucoma suspects were evaluated at the glaucoma clinic during the study period, of whom 524 (6.5%) were diagnosed with secondary glaucoma. The mean age at presentation was 50 ± 18 years, with a range from 3 to 85 years (Table 1). A male predominance was observed, with 336 (64.1%) males and 188 (35.9%) females, resulting in a male-to-female ratio of 1.8:1.

Table 1: Age group distribution among secondary patients.

Age	Frequency (Percent)
1-10	22(4.2)
11-20	35(6.7)
21-30	31(5.9)
31-40	44(8.4)
41-50	88(16.8)
51-60	133(25.4)
61-70	121(23.1)
71-80	47(9.0)
81-90	3(0.6)

Table 2: Visual acuity of patients diagnosed as secondary glaucoma.

	Frequency (Percent)
No Light Perception	65(12.04)
Less than or equal to 3/60	258(49.23)
Greater than 3/60	201(38.35)

At presentation, the mean intraocular pressure was 35 ± 11 mmHg. Defective vision was the most common presenting complaint. No light perception was noted in 65 (12.4%) patients in the affected eye, while 258 (49.2%) patients presented with visual acuity ranging from less than 3/60 to perception of light (Table 2).

Open angle type of glaucoma (n=323,61%) was most common in patients who had gonioscopically visualisable angles. Glaucomatous optic atrophy

was found in 50 (9.54%) cases, and advanced cupping of CDR >0.8 in 67 patients (Table 3).

The most common cause was pseudoexfoliative glaucoma (PXFG) 121 (23.09%) followed by neovascular glaucoma (NVG) 105 (20.03%), steroid induced glaucoma (SIG) 102 (19.46%), inflammatory and uveitic glaucoma's 55 (10.49%), silicon oil induced 37 (7.06%), lens induced 33 (6.29%), post traumatic 31 (5.91%) (Figure 1).

Table 3: Disc evaluation among patients,

	Frequency (Percent)
Advanced cupping (CDR >0.8, including glaucomatous cupping)	117(31)
CDR 0.7-CDR 0.5	152(40)
<CDR 0.5	108(29)

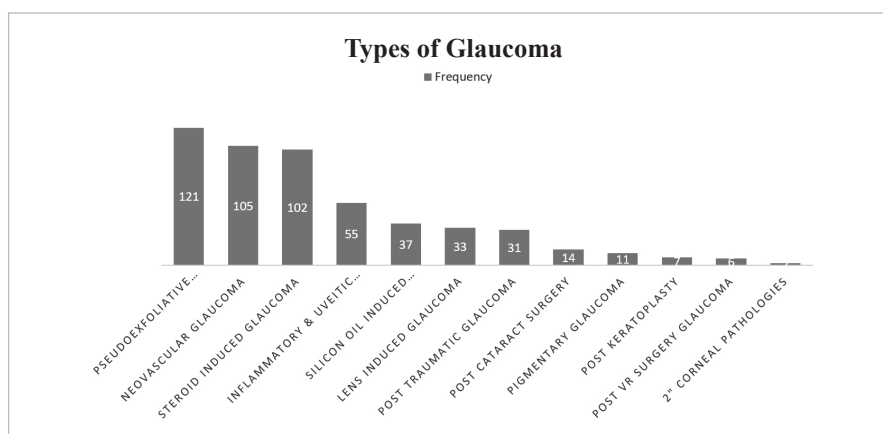


Figure 1: Distribution of aetiologies of secondary glaucoma.



Pseudoexfoliative glaucoma (PXFG) constituted 23.1% cases of all secondary glaucoma, and the mean age group was 68 years, with a male preponderance (2.3:1). Unilateral PXFG was present in 87 patients (72.72%), whereas bilateral PXFG was seen in 17 patients. (28.09%). Sixty-nine (57.02%) were presented with visual acuity $<3/60$. Sixty eight eyes (56.19%) presented with an IOP >30 mm of Hg and the mean IOP was 32.5 mmHg (Table 4). Optic nerve head on evaluation showed a cup-to-disc ratio of $\geq 0.8:1$ in 55 eyes (45.5%). Pseudoexfoliative glaucoma was managed surgically and medically in 10.7% and 90.3% eyes, respectively. Pseudo exfoliative glaucoma 77 (57.59%) was the most common glaucoma in patients above 60 years of age.

Neovascular glaucoma (NVG) accounted for 20.06% cases of all secondary glaucoma. One hundred and five eyes of 93 patients were affected by NVG. Unilateral NVG was present in 81 patients (77.1%), whereas bilateral NVG was seen in 12 patients. Common causes of NVG were proliferative diabetic retinopathy (49.2%) and central retinal vein occlusion (41.3%). The mean age of presentation was 54 years and mean IOP was 40.6 mmHg. Ninety two (87.6%) presented with a visual acuity less than $3/60$, and seventy one presented with IOP >30 mmHg. Out of 76 eyes where gonioscopic visualisation of angles was possible, 21 (27.6%) eyes were closed. Disc evaluation was difficult in most cases and where appreciable, only 11 eyes had advanced cupping. And surgical intervention was advised only in four eyes, more than 24 eyes needed cyclodestructive procedures for IOP control.

Steroid induced glaucoma (SIG) was noted in

19.5% ,which was 102 eyes of 62 patients. The mean age of presentation was 31 years, with most patients (76%) presenting after usage of topical potent steroids or intraocular injection. This was the most prevalent glaucoma in patients less than 40 years of age (32.5%). The mean IOP was 32 mmHg, with 61.7% presenting with an IOP >30 mmHg. Only 33 patients (32.3%) presented with advanced cupping and except for two eyes, rest all were gonioscopically open angle glaucomas. Surgical intervention was required only in two (1.96%) patients.

Inflammatory and Uveitic glaucoma identified in 10.5% of eyes, with mean IOP at presentation 32.12 mmHg. 50% (27) eyes presented with a visual acuity less than $3/60$, and 34(72.3%) of the 47 eyes visualised gonioscopically had closed angles. All the patients were medically managed ,with five eyes having advanced cupping.

Silicon induced glaucoma was found in 7.5%, with the mean age of presentation being 50 years. Thirty-five eyes (99. %) of patients presented with visual acuity less than $3/60$, with 32 eyes having pressures more than 30mmHg. Nine eyes had advanced cupping, sixteen of them having silicon oil in situ for a period greater than three months and fourteen of these patients were advised silicon oil removal.

Lens induced glaucoma (LIG) was detected in 6.3% of patients, the mean presenting age being 53 years with the mean IOP of 39.75mmHg. As expected 32 out of the 33 eyes had a visual acuity of less than $3/60$, with almost 87.8% (29 eyes) having an IOP of greater than 30 mmHg. Only ten eyes were accessible for gonioscopy, and all were open angles with initiation of

prior medical treatment elsewhere. None of the fundus were visible except for one, and hence cupping was only appreciable in B scan in five patients. All the patients underwent cataract surgery.

Post traumatic glaucomas was noted in 5.9% of our patients, and was commonly seen in the younger population with a mean age of 32 years. Typically, more than half patients presented within a week of trauma, with a closed globe mode of injury. Eleven of the eyes had a poor vision of less than three metres, with 27 eyes having an intraocular pressure greater than 30mmHg. None of the eyes visualised by fundoscopy showed advanced cupping, and only one patient needed surgical intervention.

The rest of our patients (7.14%) developed glaucoma attributable to corneal pathologies, post keratoplasty, pigmentary glaucoma and glaucoma following cataract surgery, (Table 4) which contributed to about 40 patients, who were diagnosed on the basis of their presentation and managed accordingly.

Surgical intervention in the form of either cataract with trabeculectomy or cataract surgery with surgical PI was required in 68 patients on their first visit (Table 5). Thirty-nine patients (7.44%) had to be started on three or more topical anti glaucoma medications (AGM), while 23 (4.38%) of them needed hyperosmotic agents along with topical AGM's on their initial presentation to the hospital for acute IOP control.

Table 4: Characteristics of various glaucoma's presented in this study.

Type of Glaucoma	Percentage	Mean age	Vision less than 3/60	Mean IOP	>30 mmHg IOP	Advanced cupping	Bilaterality	Surgical intervention
PXFG	23.1	66	69	32.5	68	55	17	13
NVG	20.06	54	92	40.6	71	11	24	4
SIG	19.5	31	24	32	63	33	40	2
Inflammatory	10.5	48	27	32.12	35	5	0	0
Silicon oil induced	7.5	50	35	30	32	9	0	14
LIG	6.3	53	32	39.75	29	-	0	33
Secondary to trauma	5.9	32	11	35.87	27	0	0	1
Others (post keratoplasty, pigmentary, post cataract surgery, etc.)	7.14	28	18	39.6	23	16	4	3



Table 5: Types of surgical intervention among patients.

	Frequency (Percent)
Combined Cataract+Trabeculectomy	20(29.5)
Lens Extraction	23(33.8)
Cataract surgery with Surgical Iridectomy	19(27.9)
Others-Silicon oil removal, Paracentesis	6(8.8)

DISCUSSION

In the present study conducted in a South Indian population, secondary glaucomas accounted for 6.5% of all glaucoma cases, which is consistent with recent Indian studies (Dubey et al., 2019; Seth et al., 2023). This reflects a notable increase compared to earlier reports (Krishnadas et al., 2001; Yamamoto et al., 2005), suggesting a rising trend in the incidence of secondary glaucomas over time. However, as this study was conducted in a tertiary eye care centre, the findings may not fully represent the general population due to referral bias.

A clear male preponderance was documented, with males affected nearly twice as frequently as females. This trend aligns with multiple studies (Das et al., 2001; Dubey et al., 2019; Gadia et al., 2008; Seth et al., 2023), although it contrasts with findings by Ezinne et al. (2021). This disparity may be attributed to higher exposure among males to risk factors such as trauma, surgery, and systemic diseases, as well as a greater likelihood of males seeking care at tertiary centres.

A significant proportion of patients presented with advanced disease, with nearly two-thirds exhibiting poor visual acuity, a mean intraocular pressure of 35 mmHg, and one-third showing

advanced disc cupping and glaucomatous optic atrophy. These findings are in concordance with previous studies (Dubey et al., 2019; Gadia et al., 2008; Seth et al., 2023) and highlight the aggressive nature and late presentation of secondary glaucomas, emphasising the need for earlier detection and intervention.

In this study conducted in the South Indian population, secondary glaucomas accounted for 6.5% of all glaucoma cases during the study period, which was in line with recent studies conducted in the Indian population (Dubey et al 2019) (Seth et al ,2023), showing a dramatic increase in incidence over time from earlier studies. (Krishnadas et al., 2001) (Yamamoto et al., 2005). This study was done in the population that presented or was referred to a tertiary eye centre and hence may not be the exact representative sample population.

Male to female preponderance was noted in the present study with almost males being affected twice as frequently as females which was reiterated by almost all studies (Das et al., 2001; Dubey et al., 2019; Gadia et al., 2008; Seth et al., 2023) .This gender disparity was not noted by Ezinne et al., (2021), and may also be due to the instigating factors such as trauma, surgery and systemic conditions being more common in the male population and that male patients tend

to be more likely to seek treatment at higher centres than females.

Two third of the patients presented with a poor visual acuity, and the mean IOP was 35 mmHg, and one third of patients also presented with advanced disc cupping and glaucomatous optic atrophy which correlated with almost all of the studies (Dubey et al., 2019; Gadia et al., 2008; Seth et al., 2023) that indicated that secondary glaucomas consistently was more detrimental at presentation, warranting a closer look at measures taken to curb its morbidity.

The mean age of the study population was 50 years, with 74.8 % being more than 40 years, which might also explain why pseudoexfoliative glaucoma (23.1%) was the most common cause of secondary glaucoma in this study. This was in line with the most recent study conducted in the South Indian population by Seth et al., (2023), where PXFG had an incidence of 2.1% of all glaucomas, and 22.1% among secondary glaucomas. But most studies previously indicated that the incidence of pseudoexfoliation was only 6% in southern India by Krishnadas et al., (2003) and specifically in the rural population was only 3.8% by Aravind et al., (2003), of which 7.5% and 13% had glaucoma incidence respectively. This indicates an evolving incidence of PXFG in this population attributable to increased life expectancy, greater awareness among patients and easier access to health care, as it is considered to be triggered by environmental factors to which the rural population is more exposed.

The second most common glaucoma was NVG (20.06%) which was the most commonest cause of glaucoma in most studies conducted

in the second decade of the 20th century in the Indian population as well as in other countries reiterated by Dubey et al., (2019) and Liu et al., (2023). It shows almost three fold increase in its incidence from studies conducted in 2000's (Krishnadas et al., 2001; Gadia et al., 2008) implying the profound escalation of lifestyle diseases in the current population. Currently metabolic diseases like diabetes are most rampant in the Indian population, hence routine fundus evaluation screening for diabetic retinopathy and timely intervention when found may hamper the amplification of NVG in the future.

Similarly, SIG (19.5%) was the third most prevalent glaucoma, also the highest in the population less than 40 years, due to over the counter availability of steroids which are often self-administered by persons who are not aware of their potentially catastrophic adverse effects (Jones et al., 2006). Steroid induced glaucoma has an important social impact because it is often diagnosed after significant damage has already occurred in both adults and children.

In contrast, lens-induced glaucoma (LIG) accounted for only 6.3%, representing a marked decline from earlier studies (Krishnadas et al., 2001) and reports from other developing countries such as Nepal (Gurung et al., 2021). This reduction may be attributed to improved awareness, outreach programs, and better access to cataract surgical services.

The distribution of secondary glaucoma aetiologies continues to evolve over time and varies across regions. Recent studies have identified post-cataract surgery glaucoma, LIG, and NVG as leading causes in different

populations (Seth et al., 2023; Gurung et al., 2021; Liu et al., 2023).

Post-traumatic glaucoma constituted 5.9% of cases, which is lower than previously reported (Dubey et al., 2019). Similarly, glaucoma following vitreoretinal surgery accounted for 8.2% in this study, compared to higher rates reported earlier (Gadia et al., 2008). These differences may be related to variations in surgical practices, particularly the duration of silicone oil tamponade.

Overall, the findings underscore that a substantial proportion of secondary glaucomas arise from potentially preventable causes. This highlights the need for heightened clinical vigilance, rational use of medications, early screening for systemic diseases, and timely surgical intervention to reduce the burden of visual morbidity associated with secondary glaucoma

CONCLUSION

Overall, the findings of this study emphasise the dynamic and evolving nature of secondary glaucomas and their underlying aetiologies within the local population. Given that a substantial proportion of these conditions are potentially preventable, there is a critical need for continuous surveillance of their patterns over time. Early recognition of emerging trends can facilitate targeted screening, rational clinical practices, and timely intervention. Such an approach is essential to mitigate disease progression and reduce the overall burden of visual morbidity associated with secondary glaucoma. As a cross-sectional study, causal relationships and disease progression could not be assessed. Longitudinal follow-up would be required to better understand the natural history and outcomes of secondary glaucoma.



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