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Original Article

Profile of Secondary Glaucoma in a Resource-Limited Setup: Institution-Based Cross-Sectional Study

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Abstract

Background: *Prevalence and types of secondary glaucoma varies between countries. This study aims to determine the current clinical profile, proportion, and causes of various types of secondary glaucoma in newly diagnosed glaucoma patients at Menelik II Specialized Hospital.*

Methods: *This hospital-based cross-sectional descriptive study was conducted at a glaucoma clinic between May 1 and July 31, 2022. All newly diagnosed secondary glaucoma patients aged 18 years and above were included. A structured questionnaire comprising socio-demographic data, history, visual acuity, intraocular pressure, slit-lamp, gonioscopy, fundus examination findings, and finally, the diagnosis was used. Data management and analysis were done using SPSS version 26.*

Results: *Four hundred forty-nine newly diagnosed glaucoma patients visited the clinic during the study period. One hundred seventy-three (38.53%) patients were diagnosed to have secondary glaucoma. The leading causes of secondary glaucoma were found to be Pseudoexfoliative glaucoma (75.5%), followed by neovascular glaucoma (7%), uveitic glaucoma (6.7%), lens-induced glaucoma (5%), and miscellaneous causes (5.7%). Secondary glaucoma was a significant cause of visual morbidity, with 57.04% of eyes presenting with best corrected visual acuity of < 6/60, intraocular pressure > 30 mmHg in 45.3% of eyes, and 61.74% with a cup-to-disc ratio of ≥0.7.*

Conclusion: *The leading causes of secondary glaucoma were found to be Pseudoexfoliative glaucoma (75.5%), followed by neovascular glaucoma (7%), uveitic glaucoma (6.7%), lens-induced glaucoma (5%), and miscellaneous causes (5.7%). Secondary glaucoma is a significant cause of visual morbidity. Timely diagnosis and early and appropriate management are essential to prevent irreversible visual loss.*

Keywords: Blindness, Clinical profile, Glaucoma, Neovascular glaucoma, Pseudoexfoliative glaucoma
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Introduction

Glaucoma is a group of disorders with a common denominator of characteristic optic neuropathy, characteristic visual field loss, and often, but not invariably, increased intraocular pressure. It poses a significant public health concern as it is the second leading cause of blindness and a leading cause of irreversible blindness worldwide (1). In the last decades, the prevalence of glaucoma has been increasing rapidly worldwide in line with population growth and ageing. In 2013, the number of people (aged 40–80 years) with glaucoma worldwide was estimated to be 64.3 million, increasing to 76.0 million in 2020. The number of people with glaucoma worldwide will rise to 111.8 million in 2040, disproportionally affecting people residing in Asia and Africa (2). Secondary glaucoma forms a heterogeneous glaucoma group characterized by identifiable underlying secondary ocular or systemic causes, leading to elevated IOP and, subsequently, to glaucomatous optic neuropathy. Etiologies of secondary glaucoma include lens pathology, trauma, neovascularization, steroid use, uveitis, ocular surgery, pseudoexfoliative material (PXF), and any other abnormal ocular and systemic pathologies. The prevalence of secondary glaucoma

varies from 6 to 22% among various studies with varied etiologies(3–7). Despite its public health significance, limited data on secondary glaucoma prevalence, clinical profile, and possible risk factors are available. With improved surgical practices, increased awareness of more people availing to seek ophthalmic services, and increased life expectancy, there is a change in the profile of secondary glaucoma (8). Currently, there is a lack of data on the profile of secondary glaucoma in Ethiopia. This study evaluated the proportion, etiologies, and characteristics of newly diagnosed patients with secondary glaucoma presenting to a tertiary eye care hospital in Addis Ababa.

Methods and Patients

Study design and study population

This hospital-based, cross-sectional descriptive study was conducted among newly diagnosed secondary glaucoma patients at a glaucoma clinic in Menelik II Specialized Hospital, Addis Ababa, Ethiopia, between May 1- July 31, 2022. All consecutive new patients who were 18 years old and above, with a diagnosis of secondary glaucoma, were included. The ophthalmology residents did an ophthalmic examination of patients, and glaucoma consultants confirmed the final diagnosis of all included in the study. Enrolled patients who fulfilled the inclusion criteria were selected and assessed with a structured questionnaire. A detailed clinical history and ocular examination were made. The principal investigator completed the sections on socio-demographic data, presenting complaints, associated symptoms, risk factors, ophthalmic examination, and relevant investigations.

Data collection

The vision was taken using the Snellen chart at 6 meters in both eyes, occluding one at a time. In those who didn't see with the Snellen chart, it was taken by counting the finger (CF) based on the distance the patient could see in a meter. Hand motion was recorded when vision was less than counting the fingers in front. Light perception (LP) with or without projection was recorded when it was less than hand motion. Intraocular pressure (IOP) was measured with I–care in both eyes before dilation and a gonioscopy. Anterior segment findings like corneal oedema, opacity, surgical marks, keratic precipitates, anterior chamber reaction, anterior and posterior synechiae, iris neovascularization, presence and site of PXF, lens pathology, and other relevant findings were noted. A gonioscopic examination was done to determine the status of the angle of each eye using a Sussman gonioscopy lens. A dilated fundus examination was done thirty minutes after applying 1% Tropicamide in both eyes. Both eyes were examined with a slit lamp and a +90-diopter lens. The extent of glaucomatous disc damage on fundoscopy was assessed by evaluating the vertical cup/disc from 11 to 1 o'clock superiorly and from 5 to 7 o'clock inferiorly. Retinal and other optic disc changes were recorded whenever possible.

Operational Definition

Secondary glaucoma was diagnosed when the following criteria were met. Documented history and findings include trauma, neovascularization, steroid use, uveitis, PXF (pseudoexfoliation syndrome), and previous intraocular surgeries. Those surgeries include complicated cataract surgery, vitreoretinal surgery, keratoplasty, or any other abnormal ocular or systemic findings that could have caused IOP elevation with associated glaucomatous optic neuropathy.

Visual field (VF) abnormality was not considered a criterion for diagnosing glaucoma. The other eye was thoroughly evaluated to rule out primary glaucoma. If the optic disc could not be examined because of media opacity (hence, VF test was not possible), then a visual acuity ≤3/60 and IOP exceeding the 99.5th percentile (> 26 mmHg) was taken as sufficient for a diagnosis of glaucoma (9). Secondary open-angle glaucoma is a diverse group of diseases diagnosed when the anterior chamber angle is open on gonioscopy based on the Shaffer gonioscopic grading system and if there is an identifiable cause. An identifiable pathologic cause closes the angle directly or by angle factors such as peripheral anterior synechiae or irido-trabecular apposition. The severity of glaucoma was grouped as mild, moderate, and severe using the Canadian glaucoma staging system (10).

Data quality control and analysis

After the evaluation of each patient, a diagnosis for each eye was identified and documented. The principal investigator revised each data for completeness and entered. Data management and analysis were done using the SPSS version 26.

Ethical considerations

Ethical clearance for this study has been obtained from the Research and Publication Committee of the Department of Ophthalmology, School of Medicine, College of Health Sciences, Addis Ababa Universit, Ref Number MF/OPH/146/20 date 06/04/2020. Informed consent was obtained from each participant. Confidentiality and privacy were maintained. All individual identifiers were omitted from the collected data.

Result

A total of 449 new patients were diagnosed as glaucoma or glaucoma suspects in Menelik Hospital during the study period. One hundred seventy-three (38.53%) had secondary glaucoma. Ninety-five (54.9%) were males, and seventy-eight (45.1%) were females with an M: F ratio of 1.2:1. The mean age at presentation was 57.47 ±14 years, ranging between 19 to 85 years (Table 1). The leading causes of secondary glaucoma were found to be pseudoexfoliative glaucoma (PXG) 75.5%, neovascular glaucoma (NVG) 7%, uveitic glaucoma (6.7%), lens-induced glaucoma (5%), and miscellane-

ous causes (5.7%). Miscellaneous causes include traumatic, steroid-induced, pseudophakic, post-keratoplasty, and aphakic glaucoma (Figure 1). The most common cause of secondary glaucoma in the age group between 18 and 40 years was uveitic glaucoma (UG) accounts for 48% of the cases. All post-traumatic and steroid-induced glaucoma cases were in this age group. Between the age group of 41 to 60 years and in the age group >60, the most common cause of secondary glaucoma was pseudoexfoliative glaucoma, accounting for 70.83% and 84.2% cases, respectively, followed by neovascular glaucoma and lens-induced glaucoma. Neovascular glaucoma was a significant cause of secondary glaucoma that affects all age groups, with 47% of the patients being in the age group 41 to 60 years. The most common secondary cause in males and females was PXG, accounting for 74.73% and 56.41% of cases, respectively. Intraocular pressure of examined 173 patients (298 secondary glaucoma eyes) ranged between 10 to 72 mmHg, averaging 30±15mmHg. It was identified that 60 glaucomatous eyes were on IOP-lowering medications, whereas the other ten eyes underwent trabeculectomy. The vision of 40 eyes was no light perception (NLP), and 111(37.3%) presented with visual acuity of <3/60 to LP (Table 2). The optic nerve was evaluated in 230(77.1%) glaucomatous eyes, of which vertical cup-to-disc ratio(VCDR) was >0.85 in 124(41.6%) eyes, 0.7-0.85 in 61(20.46%) eyes, <0.65 in 45(15.1%) eyes. In the rest of 68 (22.8%) eyes, fundus could not be visualized due to corneal oedema and scar, lens opacity, posterior synechiae, and vitreous opacity. Gonioscopy was possible to perform in 275 glaucomatous eyes (92.3%), and the angle was open in 238 (79.9%) eyes, while a closed angle was identified in 37 (12.4%) eyes. Due to different unconducive ocular conditions, doing a gonioscopy in 23 (7.7%) eyes was complex.

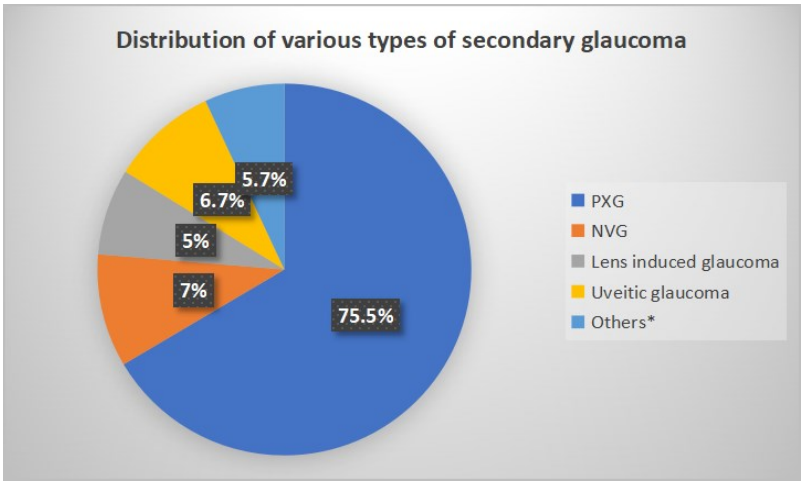
The majority of patients with secondary glaucoma were bilateral (69.4%), unilateral in 28.3%, and 2.3% (5 patients) had different types of secondary glaucoma in each eye, of whom four patients had PXG in one eye and NVG in the fellow eye. In contrast, one patient had uveitic glaucoma in one eye and NVG in the other eye. All cases of steroid-induced glaucoma were bilateral, whereas all post-traumatic were unilateral. The majority of NVG cases (64.7%), post-uveitic (84.6%), and lens-induced glaucoma (75%) were unilateral, whereas 89.1% of PXG patients were bilateral.

Pseudoexfoliative glaucoma constituted 75.5% of all cases of secondary glaucoma. Two hundred twenty-five eyes of 119 patients were affected by PXG, and the affected patients' age ranged from 46-85 years. It was bilateral in 106(89.1%) patients and unilateral in 13(10.9%) patients. One hundred five (46.7%) eyes presented with a best corrected visual acuity (BCVA) of <6/ 60. Eighty-two (36.4%) eyes presented with an IOP >30 mm Hg. Optic nerve head evaluation showed a cup-to-disc ratio of ≥0.7 in 156 (69.3%) eyes. On gonioscopy, 214 (95.1%) eyes had open angles, whereas closed angles were present in 4(1.8%) eyes, and evaluation was difficult in 7(3.1%) eyes due to corneal oedema related to high IOP. Among the examined patients, 225 eyes were found to have pseudoexfoliation material. PXF was identified at the pupillary margin in 61 eyes, the anterior lens capsule in 8 eyes, and the pupillary margin and anterior lens capsule in 156 eyes. Among PXG patients, five (4.2%) patients had the subluxated cataractous lens, which was bilateral in three, whereas the other four (1.8%) patients had associated retinal vein occlusion. Pseudoexfoliative glaucoma was more common in males (61.3%) than females (38.7%). Fifty-two (43.7%) patients reported known chronic medical illnesses, of whom 39 were hypertensive, six were diabetic, five were both diabetic and hypertensive, and the other two were asthmatic. Neovascular glaucoma constituted 7% of cases of all secondary glaucoma. Twenty-one eyes of 18 patients were affected by NVG. Unilateral NVG was present in 15 (83.3%) patients, whereas bilateral in three (16.7%) patients. All eyes presented with either NLP (61.9%) or LP (38.1%). Nineteen eyes (90.5%) presented with an IOP >30 mmHg. Optic nerve head evaluation showed a VCDR of ≥0.9 in six (28.6%) eyes, whereas it was not evaluated in the rest due to poor visualization of the posterior segment. On gonioscopy, eleven (52.4%) eyes had closed angles. In contrast, open-angle was present in one (4.8%) eye, and gonioscopy was not done in eight (38.1%) eyes due to corneal oedema related to high IOP. Among the NVG patients, four were diabetic patients with proliferative diabetic retinopathy, four were known hypertensive patients, of whom one had ischemic central vein occlusion, and the rest had no known ocular or systemic disease. Secondary glaucoma due to uveitis constituted 6.7% of all the cases. Most patients were between 18 to 40 years of age. Twenty eyes of 16 patients have been affected, of which 61.9% were unilateral cases. Females were affected more (1:2.2). Most patients had recurrent anterior uveitis (81.3%), and the rest had recurrent panuveitis. At presentation, 19 eyes (95%) had visual acuity of <6/60, thirteen eyes (65%) had an IOP>30 mmHg, and 45% had a cup-to-disc ratio of ≥0.7. It was impossible to evaluate the rest due to poor posterior segment visualization. Gonioscopy showed closed angles in sixteen eyes (80%), and the rest two had open angles, whereas the remaining two were not evaluated due to corneal oedema related to high IOP. Associated posterior synechia was present in most of the eyes.

Lens-induced glaucoma constituted 5% of all the cases of secondary glaucoma, affecting patients mainly in the age group of >40 years (84.6%). Fifteen eyes of 13 patients were affected, of which 84.6% were unilateral. All the patients presented with visual acuity of <6/60, and fourteen eyes (93.3%) had IOP>30 mmHg. 12(80%) eyes presented with phacomorphic glaucoma, whereas the other three were related to the subluxated cataractous lenses. The hazy view made the posterior segment impossible to see in all cases. Miscellaneous causes

Table 1: Socio-demographic characteristics of newly diagnosed secondary glaucoma patients. Menelik Hospital, Addis Ababa, Ethiopia, 2022.

Patient Characteristics	Categories	n (%)
Gender		
	Male	95 (54.9)
	Female	78 (45.1)
Age		
	18-40	25(14.5)
	40-60	72(41.6)
	>60	76(43.9)
Marital status		
	Single	11(6.4)
	Married	130(75.1)
	Divorced	17(9.8)
	Widowed	15(8.7)
Residence area		
	Urban	92 (53.2)
	Rural	81 (46.8)
level of education		
	Illiterate/no formal education	90 (52)
	Elementary School (1-8)	51 (29.5)
	High School (9-12)	20 (11.6)
	Diploma and /or above	12 (6.9)
Current occupation		
	Government employee	10 (5.8)
	Private/self-employee	33 (19.1)
	Daily labor	5 (2.9)
	Housewife	25 (14.5)
	Student	7 (4.0)
	Farmer	64 (37.0)
	Retired	29 (16.8)



Pseudoexfoliative Glaucoma (PXG), Neovascular Glaucoma (NVG)

Fig 1: Distribution of various types of glaucoma. Menelik Hospital, Addis Ababa, Ethiopia.2022.

constituted approximately 5.7% of all the cases of secondary glaucoma. These include traumatic (4 eyes), steroid-induced (6), pseudophakic glaucoma (3), post keratoplasty (3), and aphakic glaucoma (1).

Table 2: Presenting best corrected visual acuity of secondary glaucoma. Menelik Hospital, Addis Aba-ba, Ethiopia. 2022.

Best-corrected visual acuity	**Right eye**		**Left eye**	
	N	%	N	%
NLP	25	(14.5%)	15	8.7%
LP	35	(20.2%)	27	15.6%
CFI	11	(6.4%)	13	7.5%
<3/60-CFI	10	(5.8%)	15	8.7%
<6/60-3/60	10	(5.8%)	11	6.4%
<6/18-6/60	24	(13.9%)	31	17.9%
<6/12-6/18	19	(11%)	20	11.6%
≥6/12	39	(22.5%)	41	23.7%
Total	173	100%	173	100%

Discussion

This study provides information on various causes of secondary glaucoma presented to a tertiary eye hospital in Ethiopia. The secondary glaucoma study accounted for 38.5% of all new glaucoma cases during the study period, and it is comparable to a study done at the same hospital 13 years back, which identified 26.6% of patients with PXG and 14.3% with other secondary glaucoma (11). The previous studies did not mention secondary glaucoma subtypes, and pediatric age groups were included. This study has shown that the leading causes of secondary glaucoma were found to be pseudoexfoliative glaucoma (75.5%), followed by NVG (7%), uveitic glaucoma (6.7%), and lens-induced glaucoma (5%). PXG was disproportionately common in this study, which aligns with the previous reports, ranging from 11.3% to 35.2% for all sub-types of glaucoma in different parts of Ethiopia (12). Clinic-based reports of pseudoexfoliative glaucoma in other parts of Africa vary from no known reports in Ghana to a prevalence of 19% in South Africa (13). The higher prevalence is also reported in Finland, Iceland, Sweden, and other Scandinavian countries (14). The reason for this variation is unclear; environmental, geographic, genetic, and dietary factors are incriminated to be responsible.

The leading cause of secondary glaucoma was PXG, followed by NVG and uveitic glaucoma in this study, similar to the study done in Saudi Arabia (15). In comparison, other authors (3,8,14,16) found different common subtypes of secondary glaucoma. The prevalence of secondary glaucoma varies globally from 0.2 to 26.7% among various studies with varied etiologies (3,7,15–17). These variations in different studies might be due to differences in socio-demographic characteristics, study design, patient awareness, and availability and quality of ophthalmic services. The profile of secondary glaucoma is also changing with improved surgical practices, increased awareness among people towards ophthalmic services, increased life expectancy, and application of various preventive measures (6)

In this study, males were affected more frequently with secondary glaucoma (55%) compared to 45% of females. Likewise, it was reported that more males were affected in a study conducted in India(8). On the other hand, more females were affected, as reported in other studies(15-17). This dominance in females could be partly due to variations in the common subtypes of secondary glaucoma or other unknown factors. In the present study, males (61.3%) were affected by PXG more than females (38.7%). There were varying reports on gender predilection for pseudoexfoliative glaucoma in Africa (3,10,11). We acknowledge that it is not easy to know whether PXG is more common in males, as reported in this study, or whether the difference is due to the variation in health-seeking behavior between males and females. In our study, most cases of secondary glaucoma were bilateral (64.5%), contrary to other studies that reported unilateral secondary glaucoma as the most common (7,14). This could be due to PXG being the most typical cause of secondary glaucoma in the index study, a primarily bilateral disease with asymmetric involvement of both eyes. There were lower frequencies of post-surgical glaucoma, which might be explained partially due to the absence/ limited availability of the surgeries, as is the case for posterior segment surgeries, or due to improved surgical services and follow-up of post-surgical patients.

Secondary glaucoma was a significant cause of visual morbidity, with 57.7% of eyes presenting with BCVA <6/60, IOP >30mmHg in 45.3% of eyes, and 61.74% with a VCDR of ≥0.7 on presentation. It could be higher than this as there were cases in which the posterior segment was not visible, mainly due to media opacities. Their poor clinical profile could have contributed to a higher percentage.

Conclusion

Secondary glaucoma was a significant cause of visual morbidity and results from various identifiable ocular or systemic disorders. The underlying cause usually overshadows the features of associated secondary glaucoma, so the diagnosis is often overlooked, and management is delayed. Pseudoexfoliation remains the most common identifiable cause of secondary glaucoma, and most patients presented at an advanced stage with irreversible vision loss. Therefore, we recommend creating awareness about this disease and sharing details about emerging information of its risk factors to be explored.

Limitations of the study

The study was conducted in a tertiary eye care centre where most advanced and complicated cases are seen. Thus, mild to moderate cases could be treated in primary and secondary eye care centres, or they might not seek health care. Additionally, this study was a single-centre study with small study participants and mainly reflected the magnitude of secondary glaucoma in tertiary ophthalmic centres of Ethiopia. The proper visual field test was not performed as the Humphrey Field Analyzer was not available in our setup during the study period.

Competing interests

There is no competing interest to declare.

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Authors' contributions

All authors have approved the final version of the manuscript. AMA participated in the research proposal preparation, analysis, and writing of the data manuscript. GTG wrote the proposal, collected data, analyzed it, and wrote the manuscript.

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