

Clinical profile of secondary glaucoma subtypes in patients attending ophthalmology department at Erbil Teaching Hospital, Erbil, Iraq

Received: 14/09/2022

Accepted: 12/04/2023

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Abstract

Background and objective: As Glaucoma is the second leading cause of blindness worldwide, this study aims to determine the most common factors that leads to the development of secondary glaucoma in patients attending the Outpatient Ophthalmology Department.

Methods: A hospital based prospective cross-sectional study which involved 100 patients. The study was conducted in ophthalmology department of Erbil Teaching Hospital in Erbil city from June 2021 till April 2022. The participants were diagnosed with secondary glaucoma.

Results: Hundred patients were included in the study, their mean age (SD) was 52.3 (15.1) years, the median was 55.5 years, and the age range was 16 to 82 years. The largest proportion of the sample (32%) were aged 60-69 years, and more than half (61%) were males. The most common subtypes of secondary glaucoma were post ocular surgery (26%), the types of the operations that led to secondary glaucoma were pars plana vitrectomy (38.5%), cataract surgery (46.2%), and corneal surgery (15.4%). Post traumatic glaucoma represents (23%), the types of ocular pathologies that occurred after trauma were as follows: angle recession (43.5%), cataract (21.7%), lens subluxation (8.7%), retinal detachment (8.7%), hyphema (8.7%), and sphincter tear (8.7%). Drug induced glaucoma was present in (15%) of study population, The majority (86.7%) of patients were taking corticosteroids, 6.7% were taking tranquilizers, and 6.7% were taking other drugs. Pseudoexfoliative (PEX) glaucoma was found in 14% of all Study population. This study has found that Neovascular glaucoma was 12% (and had the highest baseline IOP among the other types of secondary glaucoma) while Inflammatory glaucoma was the least type of secondary glaucoma in this study (10%).

Conclusion: Secondary glaucoma is mostly monocular in nature. Post ocular surgery glaucoma was the leading cause of secondary glaucoma followed by post Traumatic glaucoma, and drug induced glaucoma is the third leading cause for secondary glaucoma in our society. The knowledge of secondary cause of glaucoma helps early detection and prompt treatment of these types of glaucoma.

Keywords: Secondary Glaucoma; Pseudoexfoliation syndrome; Intraocular pressure; Trauma; Steroid drugs; Erbil city.

Introduction

Glaucoma is the second leading cause of blindness worldwide. Glaucoma refers to a group of diseases characterized by optic neuropathy, visual loss, in addition to increase in the intraocular pressure "IOP".⁽¹⁾

The level of intraocular pressure and the resistance of the optic nerve axons to pressure changes will determine the degree of the optic nerve damage and visual field loss.⁽²⁾ According to the World Health Organization (WHO) the number of

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people around the world with high intraocular pressure ((IOP)) of (>21 mm Hg) = 104.5 million. Glaucoma is responsible for 12.3% of blindness cases over the globe; and it is considered the second leading cause of blindness worldwide, after cataract.^(3,4)

We have two types of glaucoma, a primary and secondary type. In primary glaucoma usually there is no apparent association with known ocular or systemic disorders that cause increased resistance to aqueous outflow or angle closure, and it usually affect both eyes. While in secondary glaucoma there is an associated ocular or systemic disease that is responsible for increase in intraocular pressure (IOP) and it may be asymmetric or unilateral.⁽⁵⁾

Non-penetrating trauma (i.e. blunt trauma) to the eye can causes many insults to the anterior segment structures that can giving rise to the development of secondary glaucoma.⁽⁶⁾

Neovascular glaucoma (NVG) is usually a common complication of many ocular vascular diseases, most commonly, ischemic central retinal vein occlusions and proliferative diabetic retinopathy.⁽⁷⁾

Different types of ocular surgeries may be followed by an increase in intraocular pressure (IOP) due to anatomical changes in ocular tissue. Also, agents used during intra ocular surgery may cause secondary IOP elevation, such as the viscoelastic substances that is routinely used in cataract surgery.⁽⁸⁾

Drug -induced glaucomais an open-angle glaucoma caused by prolonged use of certain types of drugs. For example, in patients those are using corticosteroid drugs, which is the most important drug that affects the intraocular pressure, Glaucoma may develop at any time during long-term corticosteroid administration. Therefore, IOP needs to be monitored regularly in patients receiving corticosteroid treatment.⁽⁹⁾

By Identifying the risk factors for the development of secondary glaucoma, this can lead us to develop a different new

strategy for disease screening and prevention that will be useful in identifying persons for whom close medical supervision is indicated. This study aimed to investigate the clinical profile and distribution of various subtypes of secondary glaucoma in patients attending the ophthalmology department. The objectives of this study are to know the most common factors that giving rise to secondary glaucoma and to evaluate which type is the most common cause of secondary glaucoma's visual disability.

Methods

Study design and setting

The study was a hospital based prospective cross-sectional study which involved 100 patients. The study was conducted in ophthalmology department of Erbil Teaching Hospital in Erbil city from June 2021 till April 2022. The participants were diagnosed with secondary glaucoma.

Inclusion criteria

Participant should have all the following criteria in order to be involved in the study:

- High intraocular pressure of more than 21 mmHg
- Glaucomatous optic disc changes
- No neurological cause for optic disc neuropathy
- Visual field defect that follows glaucomatous damage on perimetry.
- The presence of secondary cause for glaucoma such as intraocular inflammation, neovascularization, trauma, drug, pigment dispersion and others.

Exclusion criteria

Any participant with any of the following settings has been excluded from the study:

- Primary open angle glaucoma.
- Primary angle closure glaucoma
- Congenital glaucoma

Full ophthalmological evaluations based on clinical history putting emphasis on history of ocular trauma, ocular surgery, history of medications, diabetes and other related medical history. Examination included best corrected visual acuity (BCVA) using Snellen charts, slit-lamp biomicroscopy,

intraocular pressure measurement using both airpuff and Goldmann applanation tonometer, gonioscopy and dilated fundus examination using condensing lenses were performed. Goldmann applanation tonometer was used to measure IOP after permitting participants to rest for 10 minutes. Proparacaine eye drop was used to numb participants' eyes and sterile fluorescence were used to stain the tear. Subjects have been made aware never to squeeze their eyes or hold their breath.

All subjects underwent meticulous examination of the anterior chamber angle using three mirror gonioscopes. The examination was to identify the status of the angle whether it is open or closed, the presence of abnormal pigmentation, neovascularization, peripheral anterior synechiae (PAS), pseudoexfoliative material and intraocular tumor or mass.

Examination of the disc clinically using condensing lens (+ 90D) were performed to all subjects. Clinical disc appearance was compared to the optical coherence tomography (OCT) images of the optic disc and retinal nerve fiber layer using Optovue OCT. On the other hand; Humphrey visual field examination (24-2, SITA standard III) were performed to subjects capable of doing this test.

Statistical analysis

Data were analyzed using the Statistical

Package for Social Sciences (SPSS, version 26). Chi square test of association was used to compare proportions of two or more groups. Fisher's exact test was used when the expected frequency (value) was less than 5 or more than 20% of the cells of the table. One way analysis of variance (ANOVA) was used to compare means of the study groups, and a post-hoc test (LSD) was used to compare each two means. A *P* value of ≤ 0.05 was considered as statistically significant.

Ethical consideration

All data will be anonymous and no personal, or identifiable information are required as a part of this study. Data from information will be stored with me and be kept until I publish my research results then I will discard them and I will ensure that no one will use them again.

An informed consent and information sheet will be given to patients according to his language, either English, Kurdish or Arabic before involving them into the research.

Results

Hundred patients were included in the study, their mean age (SD) was 52.3 (15.1) years, the median was 55.5 years, and the age range was 16 to 82 years. The largest proportion of the sample (32%) were aged 60-69 years, and more than half (61%) were males (Table 1).

Table 1 Age and gender distribution

	No.	(%)
Age		
< 30	11	(11.0)
30-39	11	(11.0)
40-49	9	(9.0)
50-59	28	(28.0)
60-69	32	(32.0)
≥ 70	9	(9.0)
Mean (SD)	52.3	(15.1)
Gender		
Male	61	(61.0)
Female	39	(39.0)
Total	100	(100.0)

The most common subtypes of secondary glaucoma were post ocular surgery (26%), and traumatic (23%), in addition to the other types mentioned in Figure 1.

Significant differences were detected between males and females regarding the subtypes of glaucoma ($P = 0.013$), where it

is evident in Table 2 that 16.4% of males had neovascular glaucoma compared with 5.1% of females; 8.2% of males had drug induced glaucoma, compared with 25.6% of females; and 11.5% of males had Pseudoexfoliation glaucoma compared with 17.9% of females (Table 2).

Table 2 Secondary glaucoma subtypes by gender

Secondary glaucoma subtypes	N	Males	Females	<i>P-value*</i>
		No. (%)	No. (%)	
Uveitic glaucoma	10	4 (6.6)	6 (15.4)	0.013
Neovascular glaucoma	12	10 (16.4)	2 (5.1)	
Traumatic glaucoma	23	19 (31.1)	4 (10.3)	
Drug induced glaucoma	15	5 (8.2)	10 (25.6)	
Post ocular surgery glaucoma	26	16 (26.2)	10 (25.6)	
Pseudoexfoliation glaucoma	14	7 (11.5)	7 (17.9)	
Total	100	61 (100.0)	39 (100.0)	

*By Chi square test.

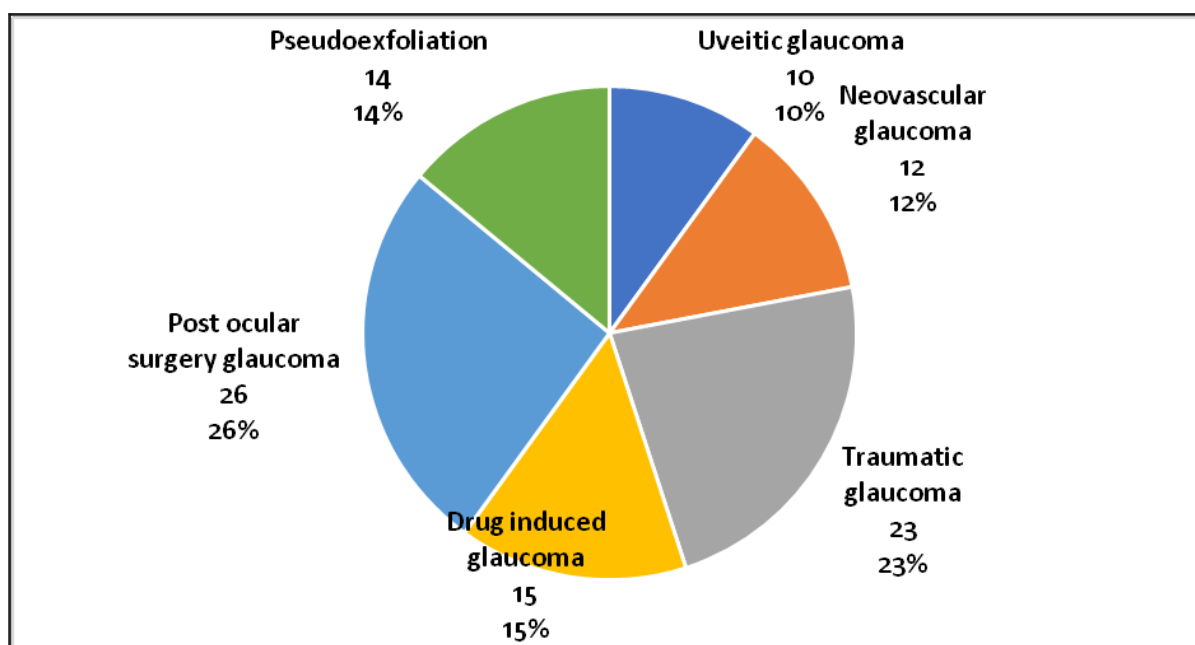


Figure 1 Secondary glaucoma subtypes

It is evident in Table 3 that there were significant differences in the mean age of patients between the types of glaucoma ($P < 0.001$), where it is clear that patients of post ocular surgery and pseudoexfoliation groups were in general older than the other patients (means are 60 and 62.8 years respectively) (Table 3).

The mean intraocular pressure (IOP) of the whole sample was 20 mmHg.

Table 4 shows that the highest means of IOP were of patients with neovascular glaucoma (22.5 mmHg) and patients with traumatic glaucoma (22 mmHg). And the least mean was of the patients with pseudoexfoliation glaucoma (18.2 mmHg). The differences in the means of IOP between the groups were significant ($P = 0.010$) as presented in Table 4.

Table 3 Mean age by types of glaucoma

Type of glaucoma	Mean age (years)	SD	P^*	Groups	P^{**}	Groups	P^{**}
A) Uveitis	44.0	14.8	< 0.001	A X B	0.009	B X E	0.758
B) Neovascular	58.7	10.4		A X C	0.979	B X F	0.413
C) Traumatic	44.1	17.3		A X D	0.730	C X D	0.649
D) Drug induced	42.2	13.1		A X E	0.001	C X E	< 0.001
E) Post ocular surgery	60.0	10.7		A X F	0.001	C X F	< 0.001
F) Pseudoexfoliation	62.8	5.0		B X C	0.002	D X E	< 0.001
				B X D	0.001	D X F	< 0.001
Total	52.3	15.1				E X F	0.517

*By: ANOVA. **By LSD (post-hoc test).

Table 4 Mean intraocular pressure by types of glaucoma

Type of glaucoma	Mean IOP	SD	P	Groups	P^{**}	Groups	P^{**}
A) Uveitis	21.4	4.0	0.010	A X B	0.577	B X E	0.010
B) Neovascular	22.5	4.2		A X C	0.731	B X F	0.020
C) Traumatic	22.0	6.1		A X D	0.121	C X D	0.023
D) Drug induced	18.5	4.4		A X E	0.073	C X E	0.006
E) Post ocular surgery	18.3	4.2		A X F	0.097	C X F	0.017
F) Pseudoexfoliation	18.2	3.0		B X C	0.760	D X E	0.915
Total	20.0	4.8		B X D	0.026	D X F	0.883
						E X F	0.951

*By: ANOVA. **By LSD (post-hoc test).

The majority (86.7%) of patients with drug induced glaucoma were taking corticosteroids, 6.7% were taking tranquilizers, and 6.7% were taking other drugs. The differences between the age groups were not significant ($P = 1.000$) as presented in Table 5.

Twenty-six patients developed glaucoma after ocular surgery. The types of the

operations that led to secondary glaucoma were pars plana vitrectomy (38.5%), cataract surgery (46.2%), and corneal surgery (15.4%). No significant differences were detected between the age groups regarding the types of ocular surgery ($P = 0.824$) as presented in Table 6.

Table 5 Types of drugs that induced glaucoma by age

Age	N	Corticosteroid	Tranquilizers	Others	<i>P</i> *
		No. (%)	No. (%)	No. (%)	
< 30	3	3 (100.0)	0 (0.0)	0 (0.0)	1.000
30-39	3	3 (100.0)	0 (0.0)	0 (0.0)	
40-49	3	3 (100.0)	0 (0.0)	0 (0.0)	
50-59	5	3 (60.0)	1 (20.0)	1 (20.0)	
60-69	1	1 (100.0)	0 (0.0)	0 (0.0)	
Total	15	13 (86.7)	1 (6.7)	1 (6.7)	

*By Fisher's exact test.

Table 6 Types of ocular surgery by age of the patients

Age (years)	N	Pars plana vitrectomy	Cataract surgery	Corneal surgery	<i>P</i> *
		No. (%)	No. (%)	No. (%)	
30-39	2	1 (50.0)	0 (0.0)	1 (50.0)	0.824
40-49	1	1 (100.0)	0 (0.0)	0 (0.0)	
50-59	6	2 (33.3)	3 (50.0)	1 (16.7)	
60-69	13	4 (30.8)	7 (53.8)	2 (15.4)	
≥ 70	4	2 (50.0)	2 (50.0)	0 (0.0)	
Total	26	10 (38.5)	12 (46.2)	4 (15.4)	

*By Fisher's exact test.

The types of ocular pathologies that occurred after trauma were as follows: angle recession (43.5%), cataract (21.7%), lens subluxation (8.7%), retinal detachment (8.7%), hyphema (8.7%), and sphincter tear (8.7%). No significant differences were detected between the age groups regarding the types of ocular pathologies caused by trauma ($P = 0.426$) as presented in Table 7.

Discussion

Glaucoma is a leading cause of irreversible blindness worldwide. Al-Shakarchi *et al.*⁽¹⁰⁾ defined the main causes of blindness in Iraq at Ibn Alhaitham Teaching Eye Hospital and glaucoma was the third leading cause. To the extent of our knowledge, this study is the first study that defines the secondary glaucoma in Erbil city, Kurdistan region, Iraq.

The most common cause of secondary glaucoma in this study was post ocular surgery glaucoma (26%). A multifactorial etiology was responsible for this type of glaucoma. Pseudophakic glaucoma was the major mechanism followed by glaucoma after parsplana vitrectomy.

In comparison with Gurung J *et al.*,⁽¹¹⁾ glaucoma following ocular surgery

represented 23% of all secondary glaucoma subtypes with glaucoma following keratoplasty was the main cause while pseudophakic glaucoma represented only 1.9%. On the other hand, Nanwani *et al.*⁽¹²⁾ found that glaucoma post pars plana vitrectomy was seen in 21.9%, pseudophakic glaucoma in 10%, and 3.2% following keratoplasty. Intraocular pressure following cataract surgery is expected to decrease due to the change and increase in anterior chamber depth;^(13,14) but post-surgical inflammation, IOL and lens particle related mechanisms of elevated IOP had been described.⁽¹⁵⁾

Glaucoma following pars plana vitrectomy had been postulated to be a result of a mechanical effect of either silicone or gas, or chronic oxidative stress to the trabecular meshwork which is related to the oxygen diffusion from posterior to anterior chamber.^(16,17) On the other hand, pathology of glaucoma following keratoplasty is multifactorial and is related to the patients and ocular factor plus type of surgery and its technique.⁽¹⁸⁾

Traumatic glaucoma constitutes 23% of this study population with angle recession glaucoma and traumatic cataract glaucoma making up the largest proportion of trauma

Table 7 Types of ocular pathology due to trauma by age

		Angle recession	Cataract	Lens subluxation	Retinal detachment	Hyphema	Sphincter tear	
Age	N	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	P^*
< 30	5	4 (80.0)	0 (0.0)	0 (0.0)	1 (20.0)	0 (0.0)	0 (0.0)	
30-39	5	2 (40.0)	2 (40.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (20.0)	
40-49	3	0 (0.0)	0 (0.0)	1 (33.3)	0 (0.0)	1 (33.3)	1 (33.3)	
50-59	6	2 (33.3)	2 (33.3)	0 (0.0)	1 (16.7)	1 (16.7)	0 (0.0)	
60-69	2	1 (50.0)	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
≥ 70	2	1 (50.0)	0 (0.0)	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.426
Total	23	10 (43.5)	5 (21.7)	2 (8.7)	2 (8.7)	2 (8.7)	2 (8.7)	

*By Fisher's exact test.

induced glaucoma (43.5% and 21.7% respectively). Glaucoma following lens subluxation represent only 8.7% of all traumatic glaucoma cases with blunt trauma being the main cause for this type of glaucoma. Traumatic glaucoma was the leading cause of monocular glaucoma. A study reported 2.9% of traumatic glaucoma as a secondary cause for glaucoma,⁽¹⁹⁾ while another study reported a percent of 4.2%.⁽²⁰⁾ Dubey *et al.*⁽²¹⁾ found 14.8% of cases had traumatic glaucoma.

As angle recession glaucoma was responsible for the majority of traumatic glaucoma in this study and as it presents itself very late following trauma, it is very important to inquire a very good history in monocular causes of glaucoma and to examine the angle very clearly in order not to miss such cases.⁽²²⁾

Drug induced glaucoma was the third leading cause of secondary glaucoma in this study with a value of 15% of study population. Steroids represent more than 86.7 % of all medication related. Komaratih *et al.*⁽²³⁾ found that steroid related glaucoma was the second most common cause of secondary glaucoma with a percent of 29.5% of all secondary glaucoma type. Similarly, Gurung J *et al.*⁽¹¹⁾ stated that steroid was responsible for 16.3% of secondary glaucoma while in Ajite *et al.*⁽²⁵⁾ it was 14.1%. Armaly and Becker⁽²⁶⁾ described two types of population depending on their response to steroids; steroid responders (one third of population) and non-steroid responders. The effect of steroid and timing differs with different type of steroids depending on their potency, duration and route of administration.⁽²⁷⁾

The increase in steroid prescription and the use of such medications without medical direction may be responsible for making drug induced glaucoma the third leading cause for secondary glaucoma in our society.

Pseudoexfoliative glaucoma was found in 14% of all secondary glaucoma cases in this study. Nanwani *et al.* described glaucoma in 2.7% of cases while Ajite *et al.*

described it in 10.1%. Pseudoexfoliative glaucoma can be easily misdiagnosed with primary open angle glaucoma if the PEX material has not been seen. It is essential to discriminate between the two conditions as the PEX glaucoma had more rapid progression and it is less responsive to treatment.⁽²⁸⁾

This study has found that neovascular glaucoma was 12% and had the highest baseline IOP among the other types of secondary glaucoma. The cause was proliferative diabetic retinopathy. NVG accounted for 17.4% and 15.4 as stated by Dubey *et al.* and Komaratih *et al* respectively.

Uveitis (Inflammatory) glaucoma was the least type of secondary glaucoma in this study (10%). All cases were due to chronic anterior uveitis apart from one case which was due to Behcet disease.

Secondary glaucoma can be easily misdiagnosed with primary type of glaucoma as many features of secondary glaucoma may be hidden and not obvious to the ophthalmologist. It is important to exclude every possible cause of secondary glaucoma before making the diagnosis of primary glaucoma as it changes the fate, way of treatment, progression and prognosis of the disease. This study cannot give us a prevalence of secondary glaucoma in Kurdistan region, but it will give us a clue about the possible common causes of secondary glaucoma. Limitations of this study were the small sample size.

Conclusion

Secondary glaucoma is mostly monocular in nature. Post ocular surgery glaucoma was the leading cause of secondary glaucoma. Traumatic glaucoma is the second most common cause of secondary glaucoma and Drug induced glaucoma the third leading cause for secondary glaucoma in our society. The knowledge of secondary cause of glaucoma helps early detection and prompt treatment of these types of glaucoma.

Competing interests

The authors declare that they have no competing interests.

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