

Original Research Article

Open-angle glaucoma in diabetic patients' prevalence and risk factors: a cross-sectional study in Sudan

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ABSTRACT

Background: Diabetic patients are at increased risk of glaucoma compared to the general population. Risk factors for glaucoma that is specific to diabetic patients include increased IOP, retinopathy and neovascular changes and years since diagnosis of diabetes. This cross-sectional study aims to report on the prevalence of glaucoma in diabetic patients in community diabetes centre in Sudan and examine associations with previously reported risk factors.

Methods: A cross-sectional study was carried out in Omdurman specialised diabetic healthcare centre in Sudan. A total of 300 patients consented to participation. All patients filled in a survey for both demographics and diabetic disease history then had an assessment for glaucoma by an ophthalmologist. The assessment included examination of the anterior segment, optic nerve assessment and fundus examination using a stereoscopic slit lamp, intraocular pressure (IOP) measurement using tonometry, peripheral anterior chamber configuration and depth assessments using gonioscopy and central visual field assessment using perimetry.

Results: Prevalence of open-angle glaucoma diagnosis was 2.8% among diabetic patients who were included in this study. Family history for glaucoma was significantly associated with increased risk of open-angle glaucoma (OR 5.67, 95% CI 1.74-18.45). Retinopathy was also associated with an increased risk of developing the condition (OR 3.1, 95% CI 1.11-8.51). Gender, years since diabetes diagnosis and medications did not have significant associations.

Conclusions: Patients with diabetes are at increased risk of developing open-angle glaucoma, but the prevalence among the diabetic population attending community diabetes centre in Sudan remains low. Among different clinical determinants, diabetic retinopathy and genetic determinants may explain the increased risk in the diabetic population.

Keywords: Diabetes, Diabetic retinopathy, Glaucoma, Risk factors

INTRODUCTION

Glaucoma

Glaucoma is a group of progressive diseases where optic nerve damage leads to vision loss. It is considered the leading cause of irreversible blindness worldwide. Open-angle glaucoma and closed-angle glaucoma are the most common forms. Both could be further divided into primary and secondary according to cause and acute, subacute and chronic according to progression. The group of conditions impacts the patient's quality of life,

physical ability and emotional wellbeing.^{1,2}

Primary open-angle glaucoma is a bilateral chronic progressive disease that is often asymmetrical. The conditions are characterised by optic disc or retinal nerve fibre layer structural abnormality and open anterior chamber in the absence of known causes. The disease affects the adult population and could present with or without corresponding visual loss. Risk factors associated with the condition include higher intraocular pressure, older age, family history and African descent, among others. While traditionally raised IOP thought to be the

leading cause for the optic neuropathy. Up to 40% of cases with open-angle glaucoma has normal to low intraocular pressure.³

Early detection is essential and has a direct impact on the outcomes. Treatment modalities both in early and late disease stages help to prevent progression; the visual impairment caused is considered irreversible.⁴ Secondary open-angle glaucoma is predominantly iatrogenic. Causes include corticosteroids eye drops, ocular surgery and laser.

On the other hand, an Angle-closure glaucoma is a group of diseases where there is acute or chronic progressive closure of the anterior chamber angle. Risk factors associated with ACG include female gender, hypermetropia, ethnicity, age and second eye having angle closure. Short axial length, shallow anterior chamber and small corneal diameter are other hereditary anatomical risk factors. Eye conditions that can cause ACG include the thick cataractous lens, ectopic lens, neovascularisation and tumours. Iatrogenic Secondary ACG causes include eye surgery-induced or drug-induced. Common topical and systemic drugs include phenylephrine, atropine, tricyclic antidepressants, topiramate and sulphonamides. In Angle-closure glaucoma, the narrowing or closure of the anterior chamber angle causes elevated IOP. The presentation is more acute and requires emergency interventions.

Glaucoma and diabetes

Association between glaucoma and diabetes were significant in two meta-analyses studies. Patients with diabetes are more likely to develop glaucoma compared to those without diabetes diagnosis with (RR=1.48 (95% confidence interval (CI), 1.29-1.71) (OR=1.50, 95% confidence interval (CI) 1.16, 1.93). The risk was more for patients with more years since diagnosis. Increased IOP was noted diabetic patients compared to non-diabetics, and that effect was associated with an increase in the fasting blood sugar.^{5,6}

This study aims to report on the prevalence of glaucoma among patients with diabetes attending primary healthcare centre in Sudan. The study will also report on clinical patient characteristics, including family history, years of diabetes, the current mode of treatment and presence of retinopathy and possible associations with the diagnosis of glaucoma. The study will provide baseline epidemiological data for planning and further studies in this field that specific to Sudan.

METHODS

A cross-sectional study was carried out in Omdurman specialised diabetic healthcare centre in Sudan. Inclusion criteria included inviting all diabetic patients who attended the community centre between January 2016 and June 2016 to participate in the study. Exclusion

criteria included patients with an established diagnosis of closed-angle glaucoma and patients where the parameters of diagnosis of POAG were not possible to be assessed. A total of 300 patients consented to the participation of the study. All patients filled in a questionnaire for demographic data and past medical history of relevance. They had a fasting blood glucose sample as an indicator for their blood sugar control, then an ophthalmologist examined both eyes for all patients. The examination included an examination of the anterior segment, optic nerve assessment and fundus examination using a stereoscopic slit lamp, intraocular pressure (IOP) measurement using tonometry, peripheral anterior chamber configuration and depth assessments using gonioscopy and central visual field assessment using perimetry. Glaucoma was defined as IOP>21mmHg and cup disc ratio >0.03 with a pale neuroretinal rim.

RESULTS

The descriptive analysis includes participants characteristics and proportions of glaucoma. The inferential analysis used the Chi-square test of independence was based on a significance level of 5%, and Cramer's V Coefficient (V) were reported where chi-square test results were significant. Fisher Exact Probability Test was used to analyse contingency tables where expected values were less than 5. Odd's ratio with 95% confidence intervals is reported for significant relationships.

Descriptive analysis of results

Over six months of the study, 300 participants enrolled with the study. Authors received a total of 300 filled surveys and 600 eye examination results. This patients were predominantly females (412; 68.7%), and the sample was predominantly younger than 60 years of age (214; 71%). Nearly half of the patients reported diabetes history for less than five years (149; 50%), and the same proportion reported a positive family history of diabetes (148; 50%). About three-quarters of the patients were on oral hypoglycaemic (432; 72%); While nearly one fifth were on insulin (110; 18%).

The results of 600, both eyes, Examination findings were more typical of diabetic eye disease. Retinopathy was more common (94; 15%) than glaucoma (17; 2.8%). Most of the patients had an acceptable vision of more than 6/24(415; 69.2%). The afferent pupillary defect was very uncommon (4; 0.7%) (Table 1). The total 17 cases of eye diagnosis of glaucoma were found in a total of 12 patients, with five patients suffered from bilateral disease (5; 1.2%) (Table 2).

Relationships between glaucoma and independent variables

A chi-square test of independence was performed to examine the relation between the presence of glaucoma

and the independent variables. Independent variables list included gender, age groups, family history, years since diabetes diagnosis, mode of treatment and neuropathy. Fisher Exact Probability Test was used instead of the Chi-square test as expected values were less than 5 for both family history and retinopathy. The proportion of subjects who had glaucoma did not differ by gender, years since diabetes diagnosis or mode of treatment, $p > 0.05$ (Table 3).

Table 1: Descriptive analysis of patient characteristics and eye disease.

| Patient characteristics (n=300) | | Frequency | % |
|--|-------------------|-----------|-------|
| Gender | Male | 94 | 31.3% |
| | Female | 206 | 68.7% |
| Age group in years | <41 | 46 | 15.3% |
| | 41 - 50 | 75 | 25.0% |
| | 51 - 60 | 93 | 31.0% |
| | 61 - 70 | 73 | 24.3% |
| | >71 | 13 | 4.3% |
| Duration of diabetics | ≤5 years | 149 | 49.7% |
| | 6-10 years | 65 | 21.7% |
| | 11-15 years | 31 | 10.3% |
| | 16-20 years | 35 | 11.7% |
| | 21-25 years | 17 | 5.7% |
| | 26-30 years | 3 | 1.0% |
| Family History of Diabetes | Yes | 169 | 56.3 |
| | No | 131 | 43.7 |
| Medication in use | insulin | 55 | 18.3% |
| | Oral hypoglycemic | 216 | 72.0% |
| | Diet control | 29 | 9.7% |
| Eye examination characteristics (n= 600) | | Frequency | % |
| Visual Acuity | >6/24 | 415 | 69.2% |
| | 6/24-3/60 | 157 | 26.2% |
| | <3/60 | 28 | 4.7% |
| Afferent pupillary defect | Yes | 4 | 0.7% |
| | No | 596 | 99.3% |
| Retinopathy | Yes | 94 | 15.7% |
| | No | 506 | 84.3% |
| Presence of Glaucoma | Yes | 17.0 | 2.8% |
| | No | 583.0 | 97.2% |

Table 2: Descriptive analysis of glaucoma cases according to laterality.

| Breakdown of glaucoma cases according to laterality | | |
|---|-------------|-----------------|
| Laterality | No. of eyes | No. of patients |
| Unilateral Glaucoma | 7 | 7 |
| Bilateral glaucoma | 10 | 5 |
| Total | 17 | 12 |

In this study 11.8% of patients with a positive family history of glaucoma were found to have glaucoma and only 2.3% from the group of patients with no family

history, statistically significant difference ($p < 0.01$, Fisher's exact test). (OR 5.67, 95% CI 1.74-18.45). 6.3% of patients with retinopathy on examination were found to have glaucoma and only 2.2% from the group of patients with no retinopathy, a statistically significant difference ($p < 0.01$, Fisher's exact test). (OR 3.1, 95% CI 1.11-8.51) (Table 4).

Table 3: Chi-square test for glaucoma presence and gender, duration of disease and mode of treatment.

| χ^2 Tests | p | Cramer's V |
|--------------------------------|------|------------|
| Gender | 0.38 | 0.02 |
| Duration of disease | 0.27 | 0.02 |
| Mode of treatment (Medication) | 0.77 | 0.03 |

Table 4: Fisher's exact test for glaucoma presence and family history and retinopathy

| | Odds ratio (95% CI) | p-Value |
|----------------|---------------------|---------|
| Family History | 5.67 (1.74-18.45) | <0.01 |
| Retinopathy | 3.07 (1.11-8.51) | <0.05 |

DISCUSSION

During the six months of the study, 600 eyes of 300 subjects were examined. Some of the patients were excluded from the study, having got angle-closure glaucoma and normal-tension glaucoma. The overall result of the study showed that 2.8% of the subjects (17 eyes) had POAG.

The majority of the subjects were females (68.7%). The only justification for this result is that females are keener than males regarding their health. An accountable number of subjects 49.7% claimed that the duration of the diabetes was <5 years which was most of the time did not go with the retinal changes detected. Most of this patients were attending the centre just for blood glucose testing and medications as an acceptable level of care for their diabetes.

Many were not aware of ophthalmic complications of diabetes and their need for fundus examination at least annually. Some of the patients could not see from only simple cataract, and they were not aware of their condition, and simple operation for cataract extraction was needed.

Most of the patients were not familiar with the term glaucoma and the hazards of the disease, and others had confusing ideas about glaucoma and cataract considering them as identical terms, this unawareness reflects the shortage in health education in this community. It indicates that doctors play a minor role in this field.

Intensive metabolic control delays the onset of DR, it does not prevent it, it slows the progression of

background diabetic retinopathy (BDR), and also it decreases the incidence of macular oedema and decreases the need of laser photocoagulation.^{7,8}

Most of the subjects 56.3% had a family history of diabetes and they were not keen of testing of their blood sugar before symptoms appear which was due to the lack of knowledge about diabetes and the importance of family history as a risk factor for developing the disease. 72% of the subjects were on oral hypoglycemic drugs, although their blood sugar was markedly elevated even with the maximum tolerable medical treatment (MTMT).

They were insisting on continuing using tablets and refused insulin for fear of injections which will probably lead them to more severe complications earlier. Either late diagnosis or poor metabolic control could explain the findings due to lack of screening services in most of the subjects. The duration of diabetes and medications used for diabetes control appear not to influence the presence of POAG ($p=0.27$). No study was done comparing the association.

Family history and retinopathy findings

POAG was found to be more in patients with a family history of glaucoma which supports the family history as a risk factor Baltimore Eye Study which found that family history was a significant risk factor of POAG and the findings were noted in the literature since 1977.^{9,10}

In this sample, there is a nearly 2-18 times increase in the prevalence rate in those with a positive family history of glaucoma. Studies of family history and glaucoma are prone to bias, which probably explains the widely differing prevalence rates in different studies. Patients who know a member of their family has glaucoma are more likely to present to the clinic and are more likely to attend for the survey, and family history is provided by the patients and can, therefore, be subject to recall bias. Finally, a large number of glaucoma goes undiagnosed in the community.¹¹

Patients with retinopathy were also more likely to have glaucoma. The finding could explain why the disease seems to have a higher prevalence in diabetic patients. Similar results was noted in a large study conducted on Danish patients.¹² Researchers could explore the mechanism that retinopathy, a recognised microvascular complication of diabetes, could increase the risk of glaucoma in this cohort of patient.

CONCLUSION

Patients with diabetes are at increased risk of open-angle glaucoma, Glaucoma family history and retinopathy are the main risk factors for open-angle glaucoma in the early years of diabetes. Gender of patients, duration of diabetes and medication used for control of diabetes were found to be insignificantly related to glaucoma.

Recommendations

An Ophthalmologist is needed in every diabetic centre to provide the essential ophthalmic care required for the diabetic population.

Health education programs are necessary to be designed and implemented, targeting the general population as well as people with diabetes to increase awareness of glaucoma and its possible risk factor. Referral system is needed for people with diabetes who are discovered as being glaucomatous or suspected with glaucoma to an eye clinic or specialised glaucoma clinic for further management.

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