Proportion of angle closure glaucoma in Tamale, Ghana

Catherine K. Liu BS[1]

Omair Ali MD[1]

Ian Murdoch MD[2]

Judith Simon MD[3]

From [1]Wills Eye Hospital, Thomas Jefferson University, Philadelphia, PA; [2]Moorfields Eye Hospital, London, United Kingdom; [3]Northern Community Eye Hospital, Tamale, Ghana.

The authors have no financial supports or conflicts of interest to disclose. Corresponding author & reprint requests to: Judith Simon, MD, Northern Community Eye Hospital, BA 108 Chinkara St., Rice City, Gumani, Tamale, Ghana. Tel: (233) 54-685-7881, Email: fdaza77@gmail.com

Publication history

This manuscript was previously submitted to *Eye* for its Global Health Issue (reference number: EYE-23-871) and is currently posted to Research Square: doi: https://doi.org/10.21203/rs.3.rs-2964262/v1.

Précis

In the largest clinic-based study to date, our review of 588 patients presenting with glaucoma in Northern Ghana revealed 36% of these had primary angle closure glaucoma.

Abstract

Purpose: Glaucoma is the second leading cause of blindness worldwide. In Africa, glaucoma is an established public health problem, and primary angle-closure glaucoma (PACG) is not commonly discussed. Recognizing it is important because of its negative impact on visual morbidity, and also because its treatment is different from primary open angle glaucoma (POAG). In response to the observation of many PACG cases at the Northern Community Eye Hospital in Tamale, Ghana, we investigated the proportion of those attending with a first diagnosis of glaucoma who had PACG.

Patients and Methods: Using the electronic records, we identified 976 patients who attended with a first diagnosis of glaucoma between January 2021 and October 2022. Of these, 588 met the inclusion criterion of a clear glaucoma subtype diagnosis.

Results: Of these 316 (53.7%) had POAG, 210 (35.7%) PACG, and 62 (10.5%) secondary glaucoma. Thus, over a third of presenting glaucomas had PACG.

Conclusion: This study highlights that PACG is present in about a third of patients presenting to our clinic inNorth Ghana . Our study demonstrates the importance of a clear diagnostic pathway including gonioscopy in the assessment of glaucoma patients and the consideration of wider training on angle closure glaucoma diagnosis and management.

Key words: Angle closure glaucoma; Ghana; gonioscopy

Introduction

Glaucoma is the leading cause of irreversible blindness worldwide.[1,2] Primary open angle glaucoma (POAG) is the most prevalent form,[2–18] followed by primary angle closure glaucoma (PACG),[5–16] which is commonly misdiagnosed.[19] If promptly diagnosed PACG, unlike POAG, is a preventable disease.[20] For this reason, diagnosis and prompt treatment of PACG is imperative.[1,21–23] Quigley and Broman (2006) estimate that PACG carries a three-fold increased risk for severe, bilateral visual impairment and is responsible for nearly half of all glaucoma-related blindness cases in the world. Despite literature from the past 20 years consistently showing PACG to be up to 18.5% of presenting glaucomas in ophthalmology departments in the African continent,[5–16,24] it has been a commonly held perception that PACG, especially acute angle closure glaucoma (AACG), is rare in African populations.[25,26]

In the routine work at the Northern Community Eye Hospital (NCEH) in Tamale, Ghana, a high number of patients presenting with PACG was observed. To investigate this, we undertook a retrospective study of presenting cases with a diagnosis of glaucoma.

Materials and Methods

Ethics

Institutional Review Board (IRB) approval was not required for this retrospective audit. The study was performed in adherence to the tenets of the Declaration of Helsinki and complied with the Health Insurance Portability and Accountability Act.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

Study design

This study is an audit of all individuals diagnosed with glaucoma presenting to the NCEH for an initial visit between January 2021 and October 2022.

The details of every individual attending the hospital, including visit diagnoses, are kept in a secure electronic medical record (EMR) system. For our study, we extracted the records of every individual who presented to our clinic and had "glaucoma" in either their initial visit description or visit diagnosis in the EMR. Inclusion criteria included those with a diagnosis of "primary open angle," "acute angle closure," "chronic angle closure," and "secondary" glaucoma. Exclusion criteria included all with no mention of glaucoma and those diagnosed with end-stage glaucoma of unspecified type, suspected glaucoma, mixed-mechanism glaucoma, or glaucoma with primary vision loss from another cause.

Glaucoma was diagnosed by characteristic disc changes (Disc Damage Likelihood Score [DDLS] score of >4) since field testing was not always available.[27] Gonioscopy differentiated POAG and PACG. PACG was diagnosed as the presence of a closed angle through >180 degrees on direct view. Patients who had the accompanying symptom of pain were diagnosed with AACG, as has been previously used in clinic-based studies.[9,15,24] Asymptomatic patients[9,15,24] found to have the accompanying presence of signs of past closure, such as peripheral anterior synechiae and pigment patches in the absence of past inflammation or other causes were diagnosed with chronic angle closure glaucoma (CACG). Secondary glaucoma was recorded if a clear underlying cause of glaucoma was identified, eg: uveitis, trauma, etc. Other variables were recorded, specifically, age, gender, kind and duration of symptoms, family history, past ocular and medical history, and intraocular pressure.

Statistics

Descriptive statistics are used for the proportion of glaucoma subtypes presenting. The confidence intervals were calculated using the exact binomial distribution.

Results

From January 2021 to October 2022, 976 individuals were diagnosed with POAG, AACG, CACG, or secondary glaucoma at their presenting visit to the NCEH. Of the 976 individuals, 388 individuals were excluded because they were diagnosed with end-stage glaucoma of unspecified type, suspected glaucoma, mixed-mechanism glaucoma, or vision loss from a secondary cause (Figure 1).

588 patients were included in the study. Included in the CACG group were two individuals initially misdiagnosed with AACG, four individuals misdiagnosed with mixed-mechanism glaucoma, two individuals misdiagnosed with ocular hypertension, one individual misdiagnosed with optic atrophy, and 11 individuals misdiagnosed with POAG (Figure 1). Demographic features are listed in Table 1. Just over two thirds of the population (n=397, 68%) were male. Of the 849 eyes, 427 (50%) were right eyes. The median age was 60.5 years (mean 58.2 years ± 16.1). A majority (n=525, 89%) were aged 40 years and over.

Upon individual chart review, it was found the patients had gonioscopically documented findings sufficient for the above definition of CACG. Of the 588 patients included in the study, 849 eyes were included in the study because some patients were unilaterally affected by glaucoma (table 1).

Three hundred and sixteen patients (53.7%) were diagnosed with POAG, 211 (35.7%) with PACG, and 62 (10.5%) with secondary glaucoma (Table 2). 19 (3.23%) were diagnosed with AACG and 191 (32.5%) were diagnosed with CACG (Table 2). The proportion of PACG presenting in our Tamale clinic was therefore 35.7% (CI: 31.8-39.7; Figure 2). The severity of glaucoma was not graded but we did look for a mention of end-stage/advanced glaucoma in the comments and the proportions are shown in table 2. It can been seen that at least one third of individuals have advanced disease.

Discussion

In agreement with previously reports of glaucoma subtypes presenting in African clinics,[5–17] our study demonstrates that PACG represents a sizable proportion (Table 2).

Table 3 and Figure 2 show the findings of prior studies from the African continent with ours. As early as 1973, Luntz reported 15.2% of 196 black patients attending the glaucoma clinic at the University of the Witwatersrand, South Africa had PACG. Olawoye and Sarimaye (2013) found 9.2% of 336 patients presenting in Ibadan in Nigeria had PACG, and Tenkir et al. (2013) found PACG in 18.5% of their patients in Jimma University Hospital, Ethiopia. The proportion in our study is the highest yet reported (36% vs 6.6-15%; Table 3 & Figure 2).[9,15,24] Use of gonioscopy is not unique to our study and, thus, not a contributing factor to the difference in PACG proportion. Our definition of PACG may be more inclusive but our definition has been widely used in prior studies. [9,15,24] Finally, there may be a genetic component to the high proportion with PACG. The largest ethnic group in our area is Dagomba, a population not previously reported. Those with PACG might be likely to self-refer to a clinic for two principal reasons. Firstly, AACG is accompanied by sudden visual deterioration together with severe pain, and secondly, both AACG and CACG are more often associated with severe visual loss.[1,20]

Living in rural communities, like those in Northern Ghana, reduces access to care,[30] increasing risk for undiagnosed glaucoma.[31] The inconvenience of travel and financial burden associated with seeking care makes it even more difficult to receive the necessary medical evaluation and management that is promptly required,[32] especially for an aging population who depend on others for support.[32] Some hypotheses why patients with CACG (Table 2) did not present to our clinic in a timely fashion include poverty, lack of health education, distrust of eye

care services, distance, and high pain tolerance. The proportion with PACG (Table 4 & Figure 3) may be an underestimate of the true proportion. We were unable to distinguish sufficiently from the histories if this was the case. Improving outreach to medically underserved areas can reveal a more accurate picture of the proportion and prevalence of PACG as well as allow for earlier diagnosis of glaucoma in these populations and, ultimately, reduce preventable vision loss.

Accurate diagnosis of glaucomatous sub-types is extremely important as it guides differing vision-preserving management. For this purpose, use of gonioscopy in the work-up of patients with glaucoma is beneficial. Although alternate techniques for examining angle narrowing, such as limbal chamber depth estimation by slit-lamp examination, have been used, gonioscopy remains the preferred method for accurate assessment of the angle.[33–37] If angle-closure is seen on exam, laser iridectomy and cataract or clear-lens extraction are effective treatments for lowering eye pressure.[38] Specifically cataract surgery is effective at reducing visual field loss[39] and IOP for at least ten years.[40] It is also easier,[41,42] faster,[41,42] cheaper,[41,42] and safer[41,42] than glaucoma surgery. Furthermore, in our experience, physicians generally receive more training in cataract surgery over glaucoma surgery and thus, more willing to perform it in Ghana. Given the benefits of gonioscopy and effective surgical options, including cataract surgery and laser iridectomy, available for patients diagnosed with PACG, there is a case to be made for providing resources to teach ophthalmologists in Africa about these diagnostic and therapeutic tools. With a projected increase in life expectancy among African populations[43] and thus, glaucoma proportion and prevalence[7,12,23,44] we can expect a continued rise in its proportion requiring intervention.

Among the African public, there is poor awareness of glaucoma.[2,45,46] The most impactful modes of information delivery in Africa are TV and radio followed by religious institutions (church, mosque, etc.) and word-of-mouth.[46] Using these tools to increase knowledge about the

disease are key to early diagnosis and prevention of blindness worldwide[20,38,47] given the association between PACG and vision loss,[1,20,22,48] blindness,[1,20,22,48] and reduced quality of life.[49] Public health campaigns have also been successful at increasing awareness of glaucoma in Africa.[50] Continued public health campaigns can improve education about this disease and increase prevention and treatment in African communities. We would love to see the proportion with a mention of end-stage glaucoma at presentation be reduced from the current level of one third oof all our patients.

In conclusion we have found that PACG is not as rare in our North Ghana population as commonly believed. Given the benefits of gonioscopy and surgical treatments available for diagnosing and managing PACG we suggest provision of learning opportunities for African clinicians to use these tools to reduce preventable vision loss from this condition.

References

1. Quigley H, Broman A. The number of people with glaucoma worldwide in 2010 and 2020. *Br J Ophthalmol*. 2006;90(3):262-67.

2. Kyari F, Abdull MM, Bastawrous A, et al. Epidemiology of glaucoma in sub-saharan Africa: Prevalence, incidence and risk factors. *Middle East Afr J Ophthalmol*. 2013;20(2):111-25.

3. Tham YC, Li X, Wong TY, et al. Global prevalence of glaucoma and projections of glaucoma burden through 2040: A systematic review and meta-analysis. *Ophthalmology*. 2014;121(11):2081-90.

4. Tielsch JM, Sommer A, Katz J, et al. Racial variations in the prevalence of primary open-angle glaucoma. The Baltimore Eye Survey. *JAMA*. 1991;266(3):369-74.

5. Herndon LW, Challa P, Ababio-Danso B, et al. Survey of glaucoma in an eye clinic in Ghana, West Africa. *J Glaucoma*. 2002;11(5):421-25.

6. Budenz DL, Barton K, Whiteside-de Vos J, et al. Prevalence of glaucoma in an urban West African population: The Tema Eye Survey. *JAMA Ophthalmol*. 2013;131(5):651-58.

7. Ellong A, Mvogo CE, Bella-Hiag AL, et al. Prevalence of glaucomas in a Black Cameroonian population. *Sante*. 2006;16(2):83-88.

8. Ashaye A, Ashaolu O, Komolafe O, et al. Prevalence and types of glaucoma among an indigenous African population in southwestern Nigeria. *Invest Ophthalmol Vis Sci*. 2013;54(12):7410-16.

9. Tenkir A, Solomon B, Deribew A. Glaucoma subtypes in Ethiopian clinic patients. *J Glaucoma*. 2013;22(2):110-16.

10. Kyari F, Entekume G, Rabiu M, et al. A population-based survey of the prevalence and types of glaucoma in Nigeria: Results from the Nigeria National Blindness and Visual Impairment Survey. *BMC Ophthalmol*. 2015;15:176.

11. Sanou J, Zouré AA, Bakyono BS, et al. Epidemiology of glaucoma in Burkina Faso: Determination of the prevalence and circulating glaucomatous phenotypes in Ouagadougou. *J Fr Ophtalmol*. 2022;45(9):1063-68.

12. Ezinne NE, Ojukwu CS, Ekemiri KK, et al. Prevalence and clinical profile of glaucoma patients in rural Nigeria—A hospital based study. *PLOS ONE*. 2021;16(12):e0260965.

13. Daba KT, Gessesse GW, Sori SB. Proportion of glaucoma among voluntary people coming for glaucoma screening program at Jimma University Department of Ophthalmology, Jimma, Ethiopia. *Ethiop J Health Sci*. 2020;30(1):13-22.

14. Ntim-Amponsah CT, Amoaku WMK, Ofosu-Amaah S, et al. Prevalence of glaucoma in an African population. *Eye (Lond)*. 2004;18(5):491-97.

15. Olawoye O, Sarimiye T. Is angle closure glaucoma a problem in Nigeria? *Niger J Clin Pract*. 2014;17(2):159-62.

16. Olawoye O, Kizor-Akaraiwe N, Pons J, et al. Clinical characteristics and stage at presentation of glaucoma patients in Sub-Saharan Africa. *J Glaucoma*. 2022;31(9):717-23.

17. Rotchford AP, Johnson GJ. Glaucoma in Zulus: A population-based cross-sectional survey in a rural district in South Africa. *Arch Ophthalmol*. 2002;120(4):471-78.

18. Leske MC, Connell AM, Schachat AP, et al. The Barbados Eye Study. Prevalence of open angle glaucoma. *Arch Ophthalmol*. 1994;112(6):821-29.

19. Gordon-Bennett P, Ung T, Stephenson C, et al. Misdiagnosis of angle closure glaucoma. *BMJ*. 2006;333(7579):1157-58.

20. Sun X, Dai Y, Chen Y, et al. Primary angle closure glaucoma: What we know and what we don't know. *Prog Retin Eye Res*. 2017;57:26-45.

21. Alper MG, Laubach JL. Primary angle-closure glaucoma in the American Negro. *Arch Ophthalmol*. 1968;79(6):663-68.

22. George R, Panda S, Vijaya L. Blindness in glaucoma: Primary open-angle glaucoma versus primary angle-closure glaucoma-A meta-analysis. *Eye (Lond)*. 2022;36(11):2099-2105.

23. Foster PJ, Buhrmann R, Quigley HA, et al. The definition and classification of glaucoma in prevalence surveys. *Br J Ophthalmol*. 2002;86(2):238-42.

24. Luntz MH. Primary angle-closure glaucoma in urbanized South African caucasoid and negroid communities. *Br J Ophthalmol*. 1973;57(7):445-56.

25. Sarkies JW. Primary glaucoma amongst Gold Coast Africans. *Br J Ophthalmol*. 1953;37(10):615-20.

26. Rodger FC. Eye diseases in the African continent. *American Journal of Ophthalmology*. 1958;45:343-58.

27. Bayer A, Harasymowycz P, Henderer JD, et al. Validity of a new disk grading scale for estimating glaucomatous damage: correlation with visual field damage. *Am J Ophthalmol*. 2002;133(6):758-63.

28. Bonomi L, Marchini G, Marraffa M, et al. Epidemiology of angle-closure glaucoma: Prevalence, clinical types, and association with peripheral anterior chamber depth in the Egna-Neumarket Glaucoma Study. *Ophthalmology*. 2000;107(5):998-1003.

29. Ashaye AO. Clinical features of primary glaucoma in Ibadan. *Nigerian Journal of Ophthalmology*. 2003;11(2):70-75.

30. Verrey JD, Foster A, Wormald R, et al. Chronic glaucoma in northern Ghana--A retrospective study of 397 patients. *Eye (Lond)*. 1990;4 (Pt 1):115-20.

31. Weih LM, Nanjan M, McCarty CA, et al. Prevalence and predictors of open-angle glaucoma: results from the visual impairment project. *Ophthalmology*. 2001;108(11):1966-72.

32. Murdoch I, Smith AF, Baker H, et al. The cost and quality of life impact of glaucoma in Tanzania: An observational study. *PLoS One*. 2020;15(6):e0232796.

33. Wu AM, Stein JD, Shah M. Potentially missed opportunities in prevention of acute angle-closure crisis. *JAMA Ophthalmol*. 2022;140(6):598-603.

34. Thomas R, George T, Braganza A, et al. The flashlight test and van Herick's test are poor predictors for occludable angles. *Aust N Z J Ophthalmol*. 1996;24(3):251-56.

35. Kashiwagi K, Tokunaga T, Iwase A, et al. Usefulness of peripheral anterior chamber depth assessment in glaucoma screening. *Eye (Lond)*. 2005;19(9):990-94.

36. Johnson TV, Ramulu PY, Quigley HA, et al. Low sensitivity of the van Herick Method for detecting gonioscopic angle closure independent of observer expertise. *Am J Ophthalmol*. 2018;195:63-71.

37. Smith SD, Singh K, Lin SC, et al. Evaluation of the anterior chamber angle in glaucoma: A report by the American Academy of Ophthalmology. *Ophthalmology*. 2013;120(10):1985-97.

38. Kang JM, Tanna AP. Glaucoma. *Med Clin North Am*. 2021;105(3):493-510.

39. Cheng YC, Sun MH, Wu WC, et al. Cataract extraction slowed the visual field progression rate in patients with angle-closure glaucoma. *Taiwan J Ophthalmol*. 2021;11(4):386-88.

40. Sakai D, Yamamoto S, Yoshimizu S, et al. Ten-year outcomes of cataract surgery for glaucoma management in patients with primary angle-closure disease. *Jpn J Ophthalmol*. 2023;67(2):129-37.

41. Azuara-Blanco A, Burr J, Ramsay C, et al. Effectiveness of early lens extraction for the treatment of primary angle-closure glaucoma (EAGLE): A randomised controlled trial. *Lancet*. 2016;388(10052):1389-97.

42. Ong AY, Ng SM, Vedula SS, et al. Lens extraction for chronic angle-closure glaucoma. *Cochrane Database Syst Rev*. 2021;3(3):CD005555.

43. United Nations Economic Commission for Africa. The state of demographic transition in Africa. Accessed December 21, 2022. https://www.uneca.org/sites/default/files/keymessageanddocuments/ice23rd_issue_paperenglish12_novdef.pdf

44. Luntz MH, Sevel D, Lloyd JPF. Incidence of unsuspected chronic glaucoma in a population sample at Oxford. *Br Med J*. 1963;2(5367):1237-40.

45. Murdoch I, Smith AF, Baker H, et al. The cost and quality of life impact of glaucoma in Tanzania: An observational study. *PLoS One*. 2020;15(6):e0232796.

46. Murdoch C, Opoku K, Murdoch I. Awareness of glaucoma and eye health services among faith-based communities in Kumasi, Ghana. *J Glaucoma*. 2016;25(10):e850-54.

47. Burton MJ, Ramke J, Marques AP, et al. The Lancet Global Health Commission on Global Eye Health: Vision beyond 2020. *Lancet Glob Health*. 2021;9(4):e489-551.

48. Dodds GE. Blindness in Southern Nigeria. *Br Med J*. 1952;1(4758):584.

49. Green J, Siddall H, Murdoch I. Learning to live with glaucoma: A qualitative study of diagnosis and the impact of sight loss. *Soc Sci Med*. 2002;55(2):257-67.

50. Opoku K, Murdoch IE. Bridging the language barrier in health awareness. *JAMA Ophthalmology*. 2013;131(10):1367.

Figure/Table Legends

Figure 1. Flowchart of study population selection.

Figure 2. Percent proportion of primary angle closure glaucoma (PACG) diagnoses with 95% confidence intervals.

Figure 3. Percent proportion of chronic angle closure glaucoma (CACG) diagnoses with 95% confidence intervals.

Table 1. Demographics of those presenting to Northern Community Eye Hospital in Tamale, Ghana between January 2021 and October 2022 with a diagnosis of glaucoma and established subtype. One person (diagnosed with acute angle closure glaucoma [AACG]) did not have an age listed in our EMR. The second column denotes those in whom a note was made of end-stage or severe disease.

Table 2. Glaucoma subtype in those presenting to Northern Community Eye Hospital in Tamale, Ghana between January 2021 and October 2022.

Table 3. Comparative data of number of individuals diagnosed with primary open angle glaucoma (POAG), primary angle closure glaucoma (acute and chronic; PACG), and secondary glaucoma in our study and other clinic population-based studies on glaucoma prevalence in African continent.

Table 4. Comparative data of number of individuals diagnosed with chronic angle closure glaucoma (CACG) in our study and other clinic-based studies on glaucoma proportion in African continent.