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Prevalence and severity of diabetic retinopathy in patients attending the endocrinology diabetes clinic at Mulago Hospital in Uganda

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ABSTRACT

Aims: The epidemiology for diabetic retinopathy (DR) has been well described in the western population. Countries in Sub-Saharan Africa have attempted to identify the prevalence of diabetic eye disease, however, there still remains a degree of paucity across the continent due to inadequacy in health system organisations and resource poor settings. We aimed to identify the severity and prevalence of DR and maculopathy of patients attending the diabetes clinic at Mulago Hospital, Kampala, Uganda.

Methods: A cross-sectional observational study of 44 patients who attended a diabetes clinic at Mulago Hospital in April 2016. Parameters measured included visual acuity (VA) using a Snellen chart, blood glucose (mmol/l) and blood pressure (mmHg). Screening for DR grading was carried out with indirect fundoscopy and retinal photograph. Only the highest graded eye of retinopathy of each patient was included.

Results: A total of 41 eyes from 41 patients were included. Of these patients 15 were male. The average age of patients was 50.4 years. Six eyes (14.6%) had a VA < 6/18. Prevalence of DR was 19.5% (8 eyes) and 14.6% (6 eyes) had maculopathy. Of all eyes 14.6% had sight-threatening retinopathy, which was 85.7% of total cases of retinopathy in our study.

Conclusions: We observed a high prevalence of DR and maculopathy, particularly sight threatening retinopathy, considering the proportion of patients screened. There is a need for a co-ordinated diabetes screening service through integration of the diabetes clinic and eye clinic at Mulago Hospital to better identify and treat this sight-threatening condition.

1. Introduction

The prevalence of diabetes mellitus (DM) in Africa is estimated to be 23.9 million by 2030, more than double the prevalence of that in 2010 [1]. More specifically in Uganda, the population estimated to have diabetes was around 98,000 in 2000, having increased more than fifteen fold in a decade [2]. Along with it the number of patients with compli-

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cations such as visual impairment with diabetic retinopathy (DR) is likely to rise. Often due to its asymptomatic nature in the initial stages, many patients present late when disease may be advanced.

The World Health Organisation (WHO) recommends that regular dilated eye examinations are carried out for all patients with diabetes to identify any eye pathology at an early stage to enable early intervention and reduce the risk of progression to sight loss [3]. This has been reflected in the form of DR screening programmes, particularly in developed countries such as the United Kingdom where epidemiological data for diabetic eye disease has been reported [4,5]. DR prevalence has also been documented in other western countries in the form of individual studies or meta analyses [6–9]. Furthermore more detailed information such as prevalence differences according to ethnicity both in the UK as well as globally have been published [9–12]. DR prevalence has also been studied in some Sub-Saharan African countries although there still remains a degree of paucity in real world prevalences across the continent due to inadequacy in health system organisations and resource insufficiency in some settings [13–16].

At present there is no existing screening programme for DR and no recent published literature on the prevalence of DR in the Ugandan population that reflects the growing incidence of diabetes mellitus. Otim et al. in 1975 found that 8.6% of eyes had evidence of diabetic retinal changes in 105 patients with diabetes in comparison to controls at Mulago Hospital in Uganda [17]. We therefore aimed to identify the current severity and prevalence of DR and maculopathy reflecting the growing incidence of DM in patients attending the diabetes clinic at Mulago Hospital in Kampala, Uganda.

2. Methods

An observational cross-sectional study was carried out involving 44 patients who attended the DM clinic at Mulago Hospital in April 2016. Mulago Hospital is the major tertiary referral centre in Kampala, Uganda. All patients had a confirmed diagnosis of DM for which they were on treatment. For all patients attending this clinic informed consent was taken prior to data collection and screening. The study participants were interviewed and the information was recorded using a pre-designed standard questionnaire. Parameters measured by the clinic healthcare staff included random blood glucose (mmmol/l) and blood pressure (mmHg). Visual acuity was assessed best corrected where appropriate using a Snellen vision chart at a distance of 6 m. Intraocular pressure (mmHg) was measured in each patient using an Icare TA01i tonometer machine (Icare, Finland). Both eyes were then dilated using Guttae tropicamide 1% and Guttae phenylephrine 2.5%.

Retinal examination was carried out with indirect fundoscopy with a 20D Volk lens by one of two ophthalmologists, who graded for DR and maculopathy using the DR grading system as per the UK National Health Service (NHS) screening programme (Table 1) [18]. In our study sight-threatening retinopathy was defined as R2 or worse or the presence of maculopathy (M1). Each of these patients also had retinal photography done with Pictor Plus non-mydritic fundus camera (Volk, USA). Each retinal photography image where available was then analysed by two independent assessors (both ophthalmologists) and graded once again according to the NHS screening programme for DR and maculopathy.

All data collected was entered onto a Microsoft Excel for Mac 2011 database. For inclusion in the analysis of this study, only one eye of each patient was included, this was the eye which had the highest grade of retinopathy if present. Exclusion criteria included patients where both eyes were ungradable, an insufficient fundal view due to cataract or other ocular media opacities to allow grading on examination. The prevalence of DR and maculopathy was then calculated for included eye. Where patients were identified to have ocular or medical complications during our study, they were referred for onward treatment.

Table 1 – Diabetic retinopathy (DR) grading protocol [18]

Retinopathy		Grading features
R0	No visible retinopathy	No retinopathy features
R1	Background	Any microaneursym(s) (MA) Any haemorrhage(s) Any exudates
R2	Pre-proliferative	Venous beading Venous loop or reduplication Intraretinal microvascular abnormality (IRMA) Multiple deep, round or blot haemorrhages
R3	Proliferative	New vessels on disc (NVD) New vessels elsewhere (NVE) Pre-retinal or vitreous haemorrhage
Retinopathy ungradable (U)		Clarity of vessels insufficient to perform useful analysis Macula or disc not centred in field of view
Maculopathy		
M0	No visible maculopathy	No maculopathy features
M1	Maculopathy	Exudate within 1 disc diameter (DD) of the fovea centre Circinate or group of exudates within the macula Any MA or haemorrhage within 1 DD of fovea associated with BCVA $\leq$ 6/12
Maculopathy ungradable		Small vessels of macula not clearly visible

Statistical analysis was performed using Statistical Package for the Social Sciences, version 19 (SPSS Inc, Chicago, IL). Continuous data was presented as the mean and standard deviation, categorical data was presented as number and percentage. Binary logistic regression analysis was used to determine factors associated with the presence of sight threatening DR. P-values ≤ 0.05 were considered statistically significant.

3. Results

A total of 87 eyes from 44 patients with a confirmed diagnosis of DM were screened. Of these 41 eyes from 41 patients were included in the study. Three patients were excluded overall due to significant cataract obscuring the fundal view. One patient was able to have only one eye screened, due to a prior evisceration, and therefore it was this eye that was included. Demographics of included patients are shown in Table 2. Snellen visual acuities were categorised as per WHO definitions (Table 3). Of the eyes where vision was worse than 6/18, 60% of these eyes reduced vision was explained by another ocular co-morbidity other than DR, such as cataract.

Overall the prevalence of diabetic retinopathy in patients attending the DM clinic at Mulago Hospital was 8 eyes (19.5%) and 6 eyes (14.6%) had diabetic maculopathy. Table 4 categorises the retinopathy and maculopathy grading according to the NHS diabetic retinopathy screening programme. Patients with type 1 DM accounted for 12.5% of total eyes with retinopathy and 16.7% of eyes with maculopathy. Of all included eyes 14.6% (85.7% of total cases of retinopathy) had sight-threatening retinopathy which was defined as a minimum of R2 in retinopathy grading or the presence of maculopathy (M1) (Table 5).

Binary logistic regression was conducted to determine factors associated with severity of diabetic eye disease in our cohort. No statistically significant association was found for

Table 2 – Patient demographics

Age in years, mean (SD)	50.4 (12.5)
Gender, n (%), males	15 (36.6%)
Ethnicity, n (%)	Black African, 41 (100%)
DM type	
Type 1, n (%)	5 (12.2%)
Type 2, n (%)	36 (87.8%)
DM treatment	
Diet controlled, n (%)	2 (4.9%)
Oral medications, n (%)	18 (43.9%)
Insulin, n (%)	21 (51.2%)
Duration of DM in years, mean (SD)	8.1 (6.4)
Random blood glucose in mmol/L, mean (SD)	13.5 (8.5)
Missing data, n (%)	20 (48.8%)
Hypertension status in mmHg, n (%), mean, (SD)	
Normal (<120 and <80)	6, 111.3 (9.8)/72.3 (7.1)
Pre-hypertension (120–139 or 80–89)	8, 124.8 (8)/80.6 (5.5)
Hypertension 1 (140-159 or 90–99)	7, 136 (18.5)/92.8 (3.1)
Hypertension 2 (≥160 or ≥100)	4, 168.5 (7.6)/105.5 (8.2)
Missing data, n (%)	16 (39%)

Table 3 – Snellen visual acuity of each study eye (n = 41), WHO grading.

Snellen visual acuity in metres	n (%)	95% confidence interval
Normal vision (6/4–6/18)	35(85.4%)	72.3–93.7%
Visual impairment (≤6/18–6/60)	1 (2.4%)	0.3–10.8%
Severe visual impairment (≤6/60-NPL)	5 (12.2%)	4.8–24.7%

Table 4 – DR and maculopathy grading (n = 41).

Retinopathy grading	n (%)	95% confidence interval
R0	33 (80.5%)	66.5–90.3%
R1 (background)	4 (9.8%)	3.4–21.5%
R2 (pre-proliferative)	1 (2.4%)	0.3–10.8%
R3 (proliferative)	3 (7.3%)	2.1–18.3%
Maculopathy grading		
M0	35 (85.4%)	72.3–93.7%
M1	6 (14.6%)	6.3–27.7%

Table 5 – Identification of sight threatening disease: retinopathy (≥R2) or presence of maculopathy (M1) (n = 41).

Severity of diabetic eye disease	n (%)	95% confidence interval
None	34(82.9%)	69.4–92.0%
Mild	1 (2.4%)	0.3–10.8%
Sight threatening	6 (14.6%)	6.3–27.7%

age, gender, estimated duration of diagnosis of DM, average blood glucose level and presence and severity of hypertension.

4. Discussion

Our study at Mulago Hospital diabetes clinic indicated that the prevalence of DR was 19.5% and diabetic maculopathy was 14.6%. To the best of our knowledge to date there is only one published study which showed the prevalence of DR in Uganda to be 8.6% in 1975 [17]. Since, population numbers with a diagnosis of DM has substantially increased and our study proportionately represents the increased prevalence of DR [2]. Furthermore we were able to categorise severity of retinopathy, identifying that 85.7% of patients who were identified to have DR could be categorised as having sight threatening DR. Our findings are also comparable to previously published epidemiological studies on DR from Sub-Saharan Africa [19]. Specifically our rates of DR were similar to that of the population in Ghana, Nigeria and Kenya, even though some of these countries included only type 2 diabetic patients, our study still remains comparable as the majority of our patients with DR were type 2 diabetic (87.5% of total eyes with retinopathy and 83.3% of total eyes with maculopathy) [20,21]. On the other hand the prevalence of DR has been reported to be much higher in other areas of Africa, such as South Africa for both type 1 and 2 groups as well as in Northern Africa [22–24]. However, it is crucial to note, that there is still a large variation in the estimated DR rate in Sub-Saharan Africa, which has shown the overall prevalence to be ranging from 7 to 64.5% [19].

Although our findings highlight there is a benefit of having a DR screening programme at Mulago Hospital, there are clearly barriers to this. The world health organisation (WHO) have already identified the common problems for healthcare delivery in developing countries [25]. Furthermore, Whiting el al identified more specific barriers to care of DR in Africa [26]. In our study we found that the majority of patients were not aware of the debilitating consequences of DM on the eye. Nathaniel et al. looked at the awareness and attitude of patients with diabetes attending the endocrinology clinic in a university teaching hospital in Nigeria [27]. They found that of their studied population, only 56.9% were aware that diabetes could affect the eye, with age and educational status significantly impacting the level of awareness [27]. Furthermore, the referral pathways between primary and secondary care, as well as those between diabetes and ophthalmic clinics were noted to be poorly co-ordinated. The majority of the population will also not have a family doctor or have difficult access to primary care who can direct them in the first place. For instance in our study random blood sugar was >11 mmol/L in 9 out of 21 patients (42.9%) indicating suboptimal glycaemic control too, highlighting the lack of diabetes care at a primary level.

Introducing a mandatory eye screening for all persons attending the diabetes clinic can identify sight threatening conditions such as DR, however, along with identification there needs to be both appropriate diagnosis and treatment facilities also available. Various diagnostic tools have been employed in retinal assessment. This includes use of the earliest optical coherence tomography (OCT) machine [28]. As well as combination techniques such as OCT with scanning laser ophthalmoscopy and more recently the use of OCT angiography [29–31]. At Mulago Hospital, there was a Spectral Domain OCT machine on site, however, this was not working at the time of this study. We were made aware by local staff that there were issues in equipment maintenance and arrangements were already made for the OCT machine to undergo repair. It has already been well established that OCT is a useful tool in detecting macula oedema and superior to clinical assessment with indirect ophthalmoscopy [32–34]. Thus, should the OCT machine have be in working order, it is possible that our current reported rate of maculopathy may have been underestimation. In future, we would look to utilise OCT during our DR grading assessment.

We identified patients who required treatment from our study, particularly those with proliferative retinopathy and maculopathy. However, at Mulago Hospital, we found a further barrier to treatment in that the argon laser was also not in working order and awaiting repair similar to the OCT machine. Furthermore, lack of training by local eye healthcare staff in using the argon laser itself was a barrier. We ensured that training in equipment maintenance was provided to local staff by our team.

The main limitations of our study include that it was a cross-sectional hospital based study done at one point in time at a tertiary hospital in Kampala. However, a systematic review of DR epidemiology in Africa has shown that the majority of studies have also been conducted in single hospital settings [14]. Our results may not be a representative sample for the whole country, particularly due to barriers to access to healthcare in more rural areas of Uganda. In our study all patients included were from urban areas of Uganda only, therefore, not accounting for the rural population, our results may not be representative of the whole Ugandan population. The prevalence of diabetes in Sub-Saharan Africa seems to vary with population areas, with it generally being reported to be higher in urban areas [35–37]. However, Chiwanga *et al.* compared diabetes mellitus prevalence in both rural and urban Uganda and found a much higher rate of dia-

betes in rural residents (16.1%) compared to *peri*-urban residents (7.6%) [38]. Thus, it is possible that the true number of patients with diabetes and DR is likely to be underrepresented in our study when accounting for the whole Ugandan population. Our study highlights the need for further research with a larger sample size and more diverse population.

5. Conclusion

Our study adds more recent data reflecting the rise in prevalence of DR and maculopathy at a tertiary centre in Uganda. It identifies that there is a need for a co-ordinated diabetes screening service through integration of primary care services, referral systems and the diabetes clinic and the eye clinic at Mulago Hospital to better identify and treat this sight-threatening condition despite the challenges.

Conflict of interest

No conflicting relationship exists for any author.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.diabres.2019.04.024.

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