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Pre-Senile Cataract in Diabetic Patients: Prevalence and Early Diagnosis

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Abstract

Hypothesis: Since cataract is more prevalent in the diabetic population, the authors compared the findings of the gold standard Lens Opacity Classification System III (LOCSIII) with the Scheimpflug objective measures in a presenile population.

Methods: This was a cross-sectional study of diabetic patients between 50 and 60 years old. Patients answered a questionnaire about clinical conditions, complications, medications in use and demographics, and were submitted to a complete non-dilated and dilated ophthalmological evaluation, including a Scheimpflug lens densitometry (Pentacam Nucleus Staging) and the Lens Opacity Classification System III (LOCSIII) based evaluation. All patients signed an informed consent term.

Results: Eighty-six eyes from 43 patients were enrolled; 96.5% had some degree of cataract, as classified by LOCS III and 46.5% by Pentacam. Most of the patients had corrected visual acuity of 20/20 (74.4%) and 25.6% had corrected visual acuity of 20/40 or worse.

Conclusions: Corrected visual acuity in the majority of patients was normal and they mostly had non-proliferative diabetic retinopathy. LOCS III remains an earlier and less expensive method of cataract diagnosis. Different cataract morphology seems to relate to different systemic complication, although this finding must be confirmed by further studies.

Keywords: Cataract; Diabetes; Cross-sectional study

Introduction

Cataract is the lens opacity of the eye that may cause significant loss of visual acuity and is the leading cause of avoidable blindness (48% of cases) worldwide. The most common form of cataract is senile cataract, which typically affects people over the age of 60 years with strongly increasing incidence in each successive decade of life. This may be related to the fact that despite progress made in surgical techniques, cataract cannot be prevented or treated pharmacologically [1].

The diabetic patient is 29 times more likely to develop blindness compared to non-diabetic patients. It is estimated that 80% of diabetic patients will have some degree of diabetic retinopathy within 25 years after diagnosis [2]. Cataract is often co-diagnosed in the presence of diabetic retinopathy. It is believed that cataract is more prevalent and appears earlier in the diabetic population; however, there are no studies in pre-senile patients (under 60 years old) to support these assertions [3].

In Brazil, 33% of people 50 years old and older that present with vision impairment from 20/63 to 20/200 have cataract, and the prevalence of cataract blindness in the overall presenile population is 0.6%. Nonetheless, there are no estimates of the prevalence of cataract among presenile diabetics in the literature [4]. Previous clinical trials have indicated that duration of disease, severity of retinopathy, use of diuretics, high levels of glycated hemoglobin and tobacco use were significantly associated with the increased prevalence of cataract in the diabetic population [3,5-8].

The gold standard test for the diagnosis of cataract classification is the Lens Opacity Classification System III (LOCSIII). LOCSIII was validated in 1993 and is based on slit-lamp pictures and retro illumination (Figure 1). It is an important method in clinical practice, especially considering healthcare policy, where low-cost methods are necessary. However, this method is susceptible to the interpretation of the examiner, which can compromise its reproducibility [9-12].

In turn, the Scheimpflug system uses modern technology in the early diagnosis of cataract [8,13]. Studies suggest that Scheimpflug measurements can provide early diagnosis of cataract in addition to automatic staging. It is a non-invasive method that allows the study of the anatomy and biometry of the anterior segment of the eye. The Scheimpflug camera captures the eye's anterior segment, creating a three-dimensional precise image, which determines the depth and angle of the anterior chamber, and the thickness, density and positioning of the lens, in a fast and reproducible manner [14,15].

The software generates a nuclear cataract grade in five stages (PNS cataract grading score) (Figure 2). Nevertheless, this nuclear cataract classification is not only based on the densitometry values but also on formulas not provided by the manufacturer [9].

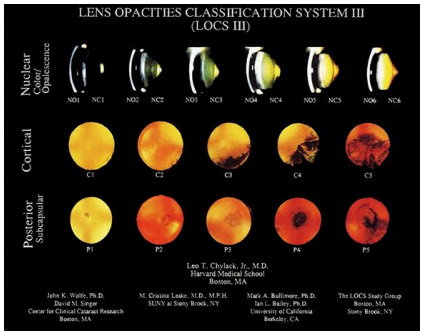

Figure 1: Original LOCS III pictures and cataract classification according to color and opalescence of each different layer of the lens: nuclear, cortical and posterior subcapsular.

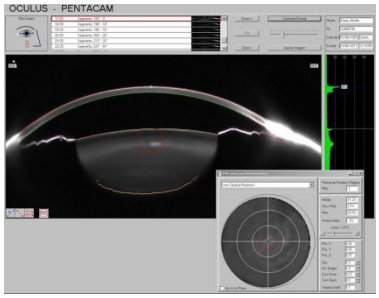

Figure 2: Example of Scheimpflug image and nucleus staging of the lens.

The aims of the present study are to determine the prevalence of cataract in a presenile diabetic population, to compare the findings of the LOCSIII clinical evaluation with the Scheimpflug objective measures and to register other possible diabetic complications that may relate to different cataract types.

Materials and Methods

This is a cross-sectional study of 43 diabetic patients referred to the Ophthalmology Service after clinical evaluation at the Endocrinology Service of Hospital Nossa Senhora da Conceição, Grupo Hospitalar Conceição, Ministry of Health (HNSC-GHC-MH), in Porto Alegre, Brazil from 2011 to 2014. Eligibility criteria were as follows: age between 50 and 60 years old, the ability to provide information about eyesight and agreement to answer a questionnaire about demographics, diabetic complications and other medical diagnosis and treatments used. After freely signing the informed consent and answering the questionnaire all subjects underwent a comprehensive eye examination, including uncorrected and corrected visual acuity, refraction, applanation tonometry, dilated slit-lamp and fundoscopic examination.

Patients were then submitted to the Scheimpflug lens densitometry using the PNS program (Pentacam Nucleus Staging) to classify nucleus opacity between 0 and 5 and were also classified according to the Lens Opacity Classification System III (LOCSIII), considering density 0-6 for nuclear, cortical and subcapsular cataracts [16]. In all patients, LOCS III was assessed by the same ophthalmologist, who was blinded for the Pentacam results.

The following variables were assessed: duration of diabetes, corrected and uncorrected visual acuity, the presence or absence of diabetic retinopathy and its classification according to the ETDRS [17], last glycosylated hemoglobin value, smoking history, medications in use, gender, and race. The presence of other diabetic complications (heart, kidney and neurological), classified according to the DCCT (Diabetes Control and Complications Trial) /EDIC (Epidemiology of Diabetes Interventions and Complications) research groups were also assessed [18].

Pearson's chi-square test was used for categorical variables and Student's T-test was used for continuous variables. Multiple logistic regression was used to control for confounding variables. Descriptive data were evaluated by the nonparametric Mann-Whitney test for independent variables. The p-value was considered significant if alpha <0.05. The computer and statistical analysis support was provided by consultants in Education Management and Research of HNSC.

The project was approved by the Ethics in Research committee of HNSC-GHC-MH. The patients involved were not subjected to any additional risks in the routine care and treatment of cataract, which were routinely applied.

Results

Eighty-six eyes from 43 patients were enrolled (Table 1); 96.5% had some degree of cataract, as classified by LOCS III and 46.5% by Pentacam. The agreement between the 2 methods to detect cataract was very poor (Kappa=0.061). The percentages of cataract classified by LOCS III and Pentacam, respectively, are shown in Tables 2 and 3.

Most of the patients in this study had corrected visual acuity of 20/20 (74.4%) and 25.6% had corrected visual acuity of 20/40 or worse. There was no significant difference between corrected visual acuity in patients with or without cataract, as diagnosed by Pentacam (0.77 *vs.* 0.828; p=0.739) or LOCS III (0.4 *vs.* 0.816; p=0.072).

Patient Characteristics	Percentage of Patients (n=43)
Gender	
Male	51.2%
Diabetes Type	
Type I	4.7%
Type II	95.3%
Years of disease	10.30
Mean HbA1C	7.87
Smoking	16.27%
Comorbidities	
Hypertension	80%
Hypothyroidism	25%
Dyslipidemia	28.2%
Insulin use	54.8%

Antidiabetic oral use	71.4%
Diabetes Complications	
Retinopathy	51.2%
Peripheral nephropathy	14%
Nephropathy	20.9%
Cardiopathy	20.9%
Encephalopathy	9.3%
Corrected VA	
Less or equal to 20/40	25.6%
20/30 to 20/20	74.4%

Table 1: Patient characteristics.

Type of cataract (N=86 eyes)	Density 0	Density 1	Density 2	Density 3	Density 4	Density 5	Density 6
Nuclear	7%	3.5%	41.8%	41.8%	3.5%	1.2%	1.2%
Cortical	52.3%	3.5%	29.1%	14%	0%	1.2%	0%
Subcapsular	88.4%	2.3%	1.2%	2.3%	1.2%	4.7%	0%

Table 2: Percentage distribution of cataract density by LOCS III classification and cataract type.

Nuclear cataract (N=86 eyes)	Density 0	Density 1	Density 2	Density 3	Density 4	Density 5	Density 6
Percentage of patients	53.5%	44.2%	2.3%	0%	0%	0%	0%

Table 3: Percentage distribution of cataract density by Pentacam for nuclear cataract.

Nuclear cataract was associated with nephropathy (p=0.0005), heart disease (p=0.01), neuropathy (p=0.01) and hypothyroidism (p=0.04). Cortical cataract was only associated with nephropathy (p=0.005). Subcapsular cataract was associated with encephalopathy (p=0.02), hypertension (p=0.04), hypothyroidism (p=0.04) and dyslipidemia (p=0.04; Table 4).

Systemic diseases	Nuclear severity	Sig.	Cortical severity	Sig.	Subcapsular severity	Sig.
Nephropathy	Yes 3.11 No 2.21	p=0.005	Yes 1.83 No 0.9	p=0.005	Yes 0.83 No 0.28	p=0.337
Heart disease	Yes 3.06 No 2.22	p=0.01	Yes 1.39 No 1.01	p=0.353	Yes 0.83 No 0.28	p=0.337
Neuropathy	Yes 2.83 No 2.32	p=0.015	Yes 1.50 No 1.03	p=0.347	Yes 0.58 No 0.36	p=0.698
Encephalopathy	Yes 2.13 No 2.42	p=0.092	Yes 1.25 No 1.08	p=0.789	Yes >0.001 No 0.44	p=0.021
Hypertension	Yes 2.31 No 2.63	p=0.185	Yes 0.91 No 1.38	p=0.191	Yes >0.001 No 0.41	p=0.04
Hypothyroidism	Yes 2.53 No 1.9	p=0.04	Yes 0.85 No 1.05	p=0.565	Yes >0.001 No 0.43	p=0.04
Dyslipidemia	Yes 2.41 No 2.34	p=0.815	Yes 1.32 No 0.91	p=0.309	Yes >0.001 No 0.46	p=0.039
Insulin	Yes 2.39 No 2.37	p=0.929	Yes 1.35 No 0.76	p=0.072	Yes 0.30 No 0.32	p=0.971
Oral hypoglycemic	Yes 2.35 No 2.46	p=0.709	Yes 0.90 No 1.54	p=0.395	Yes 0.35 No 0.21	p=0.615

Table 4: Analysis of average cataract severity determined by LOCS III, by systemic disease group.

The presence of diabetic retinopathy was associated with nephropathy (p=0.001) and with the likelihood of being on insulin treatment (p=0.000) (Table 5).

Variable	Percentage with Diabetic Retinopathy	Sig.
Nephropathy Yes No	58.8% 88.9%	p=0.001
Heart disease Yes No	50% 55%	p=0.877
Neuropathy Yes No	51.4% 66.7%	p=0,397
Encephalopathy Yes No	53.8% 25%	p=0.237
Hypertension Yes No	62.5% 43.8%	p=0.288
Hypothyroidism Yes No	53.3% 30%	p=0.121
Dyslipidemia Yes No	39.3% 63.6%	p=0.091
Insulin Yes No	26.3% 69.6%	p=0.000
Hypoglycemic	66.7%	p=0.091

Yes No	43.3%	

Table 5: Univariate retinopathy analysis.

Discussion

The increase in lens thickness and opacity that accompany aging are widely known, and diabetic patients are predisposed to present earlier with cataract. An objective and standardized classification system that can accurately reflect lens changes is thought to help in the cataract surgery decision making process [19]. The present study compares Scheimpflug automatic staging pictures with the gold standard, cataract slit lamp LOCS III, in presenile diabetics. Similar studies have not been performed before.

Recently, Pei et al. showed a significant correlation between cataract detection using LOCS III and Pentacam; however, their study was limited by the use of a single "peak value" of lens density and not the PNS. According to previous studies, Pentacam was able to make an early diagnosis of cataract [9,19]. The present study does not confirm this idea because the same patient had a more opalescent lens at the slit-lamp evaluation than in Scheimpflug pictures, which means that Pentacam takes a longer time to identify nuclear cataracts and consider them denseless. Another disadvantage is that PNS is only for nuclear cataract grading, while LOCS III also classifies cortical and/or subcapsular cataracts.

This work is original, as the authors were able to establish different relationships between cataract formation and diabetic complications; similar findings could not be identified in literature. Different systemic conditions relate to different cataract ratings and densities ranging from nuclear to cortical and posterior subcapsular layers. The use of insulin and the presence of kidney disease are highly-related to cataracts and diabetic retinopathy. Patients with renal failure are apparently more likely to present with earlier blindness than patients with ischemic heart disease or peripheral neuropathy, constituting a risk group for ophthalmologic complications. Corrected visual acuity in the majority of patients was normal and they mostly had non-proliferative diabetic retinopathy: a wonderful and unexpected finding for diabetic patients over 50 years of age and approximately 10 years of disease, treated in public health from a third world country. We could not find any similarly designed studies with which to compare our results.

According to the current research, Scheimpflug cameras are an objective and expensive technique that are more helpful in following cataract evolution than in early or population-based diagnosis. LOCS III remains an earlier and less expensive method of cataract diagnosis.

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Conflict of Interests

The authors declare no conflict of interests.

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