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RESEARCH ARTICLE

Ocular Morbidity in Chronic Kidney Disease at the Departmental Teaching Hospital of Borgou and Alibori (Benin)

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Abstract

Background: Ocular diseases in chronic kidney disease patients are frequent. The aim was to study ocular morbidity during chronic kidney disease at the departmental teaching hospital of Borgou and Alibori (CHUD-B/A) of Benin in 2019

Methods: This was a cross-sectional study carried out in the Ophthalmology and Nephrology departments of CHUD-B/A from 08 May to 08 September 2019 and concerned all chronic kidney patients followed up in the Nephrology department who had consented. Non-probability sampling with exhaustive enumeration of patients was carried out. A multiple logistic regression model with a threshold of 5% was used to identify factors associated with occular diseases.

Results: A total of 50 patients (100 eyes) were included. The sex ratio was 1.38 and 66% were aged 40 or over. 88% of the eyes examined had at least one ocular condition. Among the eyes examined, 23% had cataracts, 9% had ocular hypertonia, 4% had corneal damage, 47% had hypertensive retinopathy, 4.26% of which was Kirkendall stage 3, 10% had diabetic retinopathy, 30% of which was complicated proliferative retinopathy, 8% had glaucomatous optic neuropathy and 8% had non-glaucomatous optic neuropathy. Dialysis, hyperuraemia, and the stage and age of chronic kidney disease were associated with the occurrence of hypertensive retinopathy.

Conclusion: Ocular diseases are dominated by the ocular complications of arterial hypertension and diabetes. They can be prevented by early detection.

Keywords: Eye Diseases, Chronic Kidney Disease, Retinopathy, Benin.

1. Introduction

Chronic kidney disease (CKD) is a serious condition affecting many people worldwide. The eye shares structural, embryological and genetic elements with the kidney, suggesting that CKD and ocular disease (OD) may be closely linked. A growing number of studies have found an association between CKD and eye diseases such as age-related macular degeneration (AMD), glaucoma, cataracts, especially diabetic retinopathies and the reduced visual acuity they cause [1,2]. Similarly, some research has shown that certain parameters of retinal microcirculation are predictive of chronic kidney disease [1]. In addition, CKD shares common risk factors (diabetes, hypertension, smoking, obesity) and common pathophysiological mechanisms (inflammation, oxidative stress, endothelial and microvascular dysfunction) with ocular conditions [1]. Socio-demographic factors (age, sex, place of origin), socioeconomic factors (monthly income, level of education), health factors (dialysis status or not) , certain lifestyles (smoking, alcoholism, consumption of or contact with toxic substances)

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and certain biological variables (creatinine, uremia, cholesterol) are also involved in this interrelationship between the eye and the kidney. [2].

Thus, the eye in general and the retinal microcirculation in particular, accessible by direct and non-invasive means of visualization, offer the opportunity to explore in greater depth the association of microvascular and systemic abnormalities with renal dysfunction [3]. The state of one would reflect the state of the other. Studies along these lines have been carried out in the West and in certain African countries. All show a close association between ocular and renal disease [1]. More specifically, one study by Wong et al. in the USA found an association between retinopathy and renal dysfunction that was independent of age, diabetes, hypertension and other risk factors [4]. Another study by Grunwald et al. in the USA showed that the presence of retinopathy was associated with increased creatinine values and worsening renal dysfunction [5].

The interrelation between the eye and the kidney is real. However, we lack information on this subject for the African population in general and the Beninese population in particular. Work on this subject could form the basis of prevention strategies aimed at improving the care and follow-up of chronic kidney disease sufferers. This would enable early detection of ocular complications, thereby increasing the effectiveness and efficiency of the various treatments.

This justifies the choice of the present work, whose objective was tostudy ocular morbidity during chronic kidney disease at CHUD-B/A in 2019.

2. Methods

This was a cross-sectional study conducted over a four-month period from May 1st, 2019, to August 31, 2019, in the Ophthalmology and Nephrology departments of Borgou and Alibori Departmental Teaching Hospital (CHUD-B/A).

Patients of either sex aged 15 years, followed in the Nephrology Department of the CHUDB/A during the study period for chronic kidney disease of any stage, able to answer the questions and having given their consent were included. The sample was non-probabilistic with exhaustive enumeration. The dependent variable was the presence of at least one ocular morbidity. These included damage to the ocular appendages, damage to the cornea, damage to the pupil, damage to the lens, damage to the vitreous humor and/or damage to the retina. The variables studied were sociodemographic, socioeconomic, clinical and paraclinical, including ophthalmological and biological examination data.

a) Visual acuity (VA) at distance and near was performed for participants.

Distance visual acuity was >7/10 if the patient could count fingers at 2m; 3/10 <VA≤7/10^{e} for a patient could count fingers at 1m; 1/20 <VA≤3/10 when observing hand movements; 1/50^{e}<VA≤1/20for light perception only and VA≤1/50 in the absence of light perception. And according to the World Health Organization (WHO) classification it was blindness if VA≤1/20, profound visual decline if 1/20 <VA≤3/10, moderate visual decline if 3/10<VA≤7/10^{e} and normal visual function if VA>7/10^{e} . An VA ≤ 7/10 was considered a decrease in visual acuity and normal visual acuity was greater than 7/10^{e} .

Near visual acuity. Normal near vision corresponds to P2. Any near visual acuity greater than this is considered abnormal. [6].

b) An ophthalmologist performed a fundus examination after dilating both eyes with tropicamide eye drops every 15 minutes until dilation was complete. Dilatation was cautious in cases of ocular hypertonia.

c) Intraocular pressure (IOP): measured by an ophthalmologist using either the Goldman applanation tonometer and slit lamp, or a forced-air tonometer.

d) Glomerular filtration ratewas calculated using the MDRD (Modification of Diet in Renal Disease) formula.

Data collection took place in two phases: the individual interview and the ophthalmological examination. The individual interview was conducted using an interview guide. The results of the ophthalmological and biological examinations were recorded in the files.

The data collected were recorded using a data entry mask designed with Epi Data 3.1 software, then processed and analyzed with STATA MP 14 and Epi info 7.2.0.1 software respectively. Microsoft Word 2013 was used for thesis data entry, and Microsoft Excel 2013 for data organization in the form of tables or graphs. The data collected and entered were first cleared, then checked, examined, estimated and corrected for any errors and inconsistencies.

This work was carried out in accordance with the ethical standards in force in Benin. All data collected during our work were used solely for the purposes of our study and were kept confidential.

3. Results

3.1 Descriptive Study

During the period of our study, 65 patients with chronic kidney disease were cared for in the nephrology department of CHUD-B/A, including 42 outpatients, 21 dialysis patients and 2 non-dialysis patients hospitalized in internal medicine. Based on our inclusion criteria, we enrolled 50 patients with chronic kidney disease, i.e. 100 eyes, with a participation rate of 76.92%.

3.2 Frequency of Eye Disorders

Hypertensive retinopathy and diabetic retinopathy were diagnosed in 47% and 10%, respectively. Cataracts and retinal detachment were found in 23% and 2% of eyes, respectively. Table I shows the distribution of the number of eyes according to ocular disease.

Table I. *Distribution of the number of eyes according to ocular conditions found. (CHUD-B/A 2019, N=100)*

		Right eye		Left eye			Total
		n	%	n	%	n	%
Damage to the ocular adnexa							
	Pterygium	6	12,00	5	10,00	11	11,0
	Pterygoid	3	6,00	3	6,00	6	6,00
	Pinguecula	1	2,00	1	2,00	2	2,00
Corneal damage							
	Superficial Punctate Keratitis (SPK)	1	2,00	1	2,00	2	2,00
	Corneal erosion	1	2,00	1	2,00	2	2,00
	Contact sheet	1	2,00	1	2,00	2	2,00
	Corneal dystrophy with neovascularization	1	2,00	-	-	1	1,00
Pupil damage							
	Pupillary seclusion	-	-	1	2,00	1	1,00
Lens damage							
	Cataracts	10	20,00	13	26,00	23	23,00
	Pseudophakia	6	12,00	4	8,00	10	10,00
Vitreous humor damage							
	Vitreous degeneration			1	2,00	1	1,00
Retinal damage							
	Hypertensive retinopathy	24	48,00	23	46,00	47	47,00
	Diabetic retinopathy	5	10,00	5	10,00	10	10,00
	Traction retinal detachment	1	2,00	1	2,00	2	2,00
	Glaucomatous optic neuropathy	4	8,00	4	8,00	8	8,00
	Non-glaucomatous optic neuropathy	4	8,00	4	8,00	8	8,00
	Macular hole	1	2,00	1	2,00	2	2,00

3.2.1 Socio-demographic and Socio-economic Characteristics

The mean age of patients was 46.64±15.91 years, with a median of 45 years [extremes 17 and 88 years]. The most represented age group was [60-70 years[or (24%). The study population comprised 29 (58%) men and 21 (42%) women. The sex ratio was 1.38. Within the study population, 22% (11/50) of patients had no formal education, while 78% (39/50) had at least primary education. Wage earners, housewives and pensioners accounted for 28% (14/50), 22% (11/50) and 20% (10/50) of our series respectively.

3.2.2 Clinical Features

As for medical history, hypertension and diabetes were found in 94% and 22.26% respectively. According to body mass index, 6% (3/50) of patients were lean, 56% (28/50) were of normal build, 30% (15/50) were overweight, and 8% were obese. Chronic kidney disease was diagnosed in less than a year, between 1 and 6 years and more than 6 years respectively for 64.0; 24.0 and 12.0%. Twelve (24%) patients smoked and 14 (28%) regularly consumed alcohol, with an average daily intake of 3.36±4.09 Madeira glasses. Similarly, 38 (76%) of patients consumed herbal tea and 35 (70%) self-medicated.

3.2.3 Functional Signs

The most recurrent functional signs were near visual impairment (30%), far visual impairment (24%), blurred vision (20%) and ocular pruritus (4%).

3.3 Ophthalmological Examination

Decreased distance visual acuity (BAV) (AV ≤ 7/10^{e}) was observed in 39% (39/100) of cases. In 72% (36/50) of patients, uncorrected near visual acuity was normal, while in 28% (14/50) it was abnormal. Palpebral oedema was observed in 10% (10/100) of eyes. Five

patients were bilaterally affected. Abnormalities were dominated by pterygium in 11 (11%) eyes, pterygoid in 6 (6%) eyes, and pinguecula in 2 (2%) eyes. It was observed in 2% (2/100) of corneal erosions, 2% (2/100) of corneal spotting, 1% (1/100) of corneal dystrophy, 1% (1/100) of epithelial bullae and 1% (1/100) of retrodescemetic precipitates.

Two cases of are flexic semi-mydriasis (2%) and two other cases of areflexic mydriasis (2%) were observed on pupil examination. 96% of eyes had a normal pupil. The directphotomotor reflex (PMR)was normal in 96 eyes (96%) and abolished in 4 eyes (4%). One eye (1.0%) showed (1/100) iridal atrophy and one (1.0%) pupillary seclusion. The lens was transparent in 67 (67%) eyes. Cataracts were present in 23% of eyes, and 10% had pseudophakia. Intraocular pressure was elevated in 9% of eyes. Of all the eyes examined, 22% (22/100) showed papillary pallor. Of all the eyes examined, 34 (34%) had one or more macular abnormalities, including 27 with macular remodeling, 6% with macular edema and 2% with macular hole.

3.4 Biological Data Related to Chronic Kidney Disease

Hyperuremia was observed in 41 (82%) patients. Mean uremia was 1.09 g/L ± 0.69 g/L, with extremes of 0.22 g/L and 2.89 g/L. Hypercreatininemia (creatinine > 14 mg/L) was found in 48 (96%) patients. Mean creatinine was 86.24 mg/L ± 86.34 mg/L, with extremes of 15.94 mg/L and 409.5 mg/L.

Mean glomerular filtration rate (GFR) was 20.08 ml/min.1.73 m² ± 19.52 ml/min.1.73 m² with extremes of 1.09 ml/min.1.73 m² and 91.01 ml/min.1.73 m².

Hemoglobin levels below 10 g/dL were observed in 96% (48/50) of patients, i.e. 46% (28/50) of women and 40% (28/50) of men. The hemoglobin level was 8.83 g/dL ± 2.55 g/dL, with extremes of 3.9 g/dL and 13.9 g/dL.

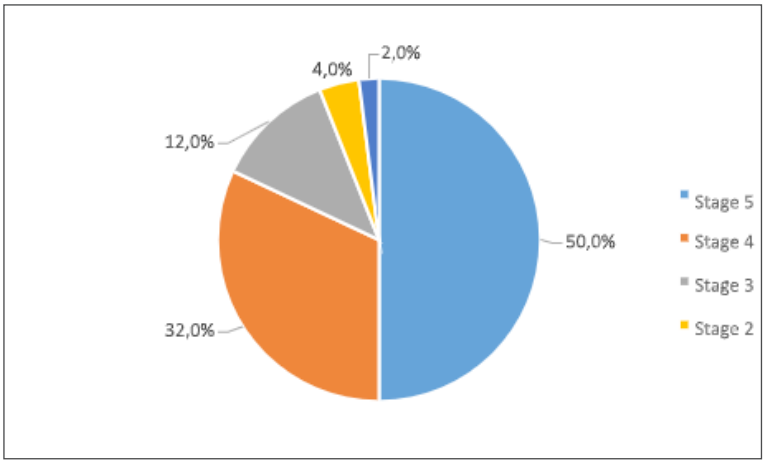

Figure 1. *Distribution of patients according to CKD stage. (CHUD-B/A 2019, N=50)*

3.5 Chronic Kidney Disease (CKD)

e) Chronic kidney disease grade

Of the 50 patients, 2% were CKD 1 and 50% CKD 5. Figure 1 shows the distribution of patients by stage.

3.5.1 Kidney Damage

Anatomo-clinically, 21 (42%) had hypertensive nephropathy, 15 (30%) chronic glomerular nephropathy and 14 (28%) chronic tubulointerstitial nephropathy.

3.5.2 Use of Dialysis

Of the 25 patients in MRC stage 5, 17 (68%) were actually on hemodialysis.

3.6 Identifying Factors Associated with Cardiovascular Complications

The ocular morbidity in general, was statistically associated with hyperuremia (p=0.023, OR=1.683 $CI_{95\%}$ =[0.125-3.242]) and hypertensive nephropathy (p=0.009, OR=2.035 $CI_{95\%}$ =[0.504-3.566]). (Table I)

In particular, cataract occurrence was associated with CKD age (OR=28.50 $CI_{95\%}$ =[3.981-204.02] p=0.001), treatment with sodium bicarbonate (OR=2,937 $CI_{95\%}$ =[0.8939.659]), calcium-channel blockers (OR=1.723 $CI_{95\%}$ =[0.524-5.672] p=0.030) and converting enzyme inhibitors (OR =1.776 $CI_{95\%}$ =[0.409-7.714] p=0.027). (Table II)

In addition, the occurrence of hypertensive retinopathy was associated with advanced stagesof CKD (stage 3 OR=0.122 $CI_{95\%}$ =[0.024-0.626] p=0.012 ; stage 4 OR=0.367 $CI_{95\%}$ =[0.1460.923] p=0.033 ; stage 5 OR=1.00 $CI_{95\%}$ =[0.077-3.496] p=0.067), to age of CKD (OR=10.968 $CI_{95\%}$ =[2.110-57.019] p=0,004), hemodialysis (OR=3.953 $CI_{95\%}$ =[1.504-10.393] p=0.004), hyperuremia (OR=8.25 $CI_{95\%}$ =[1.691-40.250]) p=0.009 . (Table II)

Table II. *Factors associated with ocular morbidity in general and cataract in patients with chronic kidney disease at CHUD-B/A in 2019*

	Total eyes (N)	n	(%)	OR	$IC_{95\%}$	p
Presence of morbidity in general						
Hyper uremia						**0,023**
Normal	18	13	72,22	1		
Yes	82	75	91,46	1,683	[0,125-3,242]	0,034
Nephropathies						
Hypertensive	42	40	95,24	2,035	[0,504-3,566]	0,009
Chronic Tubulointerstitial	28	21	75,00	1		
Glomerular	30	27	90,00	1,484	[0,321-3,289]	0,107
Cataracts						
Duration of CKD (years)						**0,000**
< 1	55	11	20,00	1,583	[0,393-6,378]	0,518
1-5	22	3	13,64	1		
6-10	11	9	81,82	28,50	[3,981-204,02]	0,001
Sodium bicarbonate						**0,005**
Yes	39	16	41,03	2,937	[0,893-9,659]	0,076
No	49	7	14,29	1		
Calcium channel blockers						**0,030**
Yes	40	6	15,00	1		
No	48	17	35,42	1,723	[0,524-5,672]	0,371
Converting enzyme inhibitors						**0,027**
Yes	14	7	50,00	1,776	[0,409-7,714]	0,443
No	74	16	21,62	1		

The occurrence of diabetic retinopathy was associated with hypertensive nephropathy (OR=2.375 $CI_{95\%}$ =[0.449-12.539] p=0.003). (Table II)

The occurrence of optic neuropathies was associated with CKD age (OR=4.667 $CI_{95\%}$ =[1.040-20.938] p=0.049), hyperuremia (OR=13.25 $CI_{95\%}$ =[2.687-65.340] p=0.002), hypertensive nephropathy (OR=1.167 $CI_{95\%}$ =[0.364-3.738]; p=0.003). (Table II)

Table III. *Factors associated with retinal damage and optic neuropathies in patients with chronic kidney disease at CHUD-B/A 2019*

	Total eyes (N)	n	(%)	OR	$IC_{95\%}$	p
Hypertensive retinopathies						
CKD stages						**0,002**
Stage 1	2	2	100,00	1,631	[0,918-2,896]	0,095
Stage 2	3	0	0,00	1		
Stage 3	10	2	20,00	0,122	[0,024-0,626]	0,012
Stage 4	28	12	42,86	0,367	[0,146-0,923]	0,033
Stage 5	45	31	68,89	1,00	[0,077-3,496]	0,067
Duration of CKD (years)						**0,000**
< 1	55	39	70,91	10,968	[2,110-57,019]	0,004
1-5	22	6	27,27	1,687	[0,277-10,279]	0,570
6-10	11	2	18,18	1		
Dialysis						**0,007**
Yes	31	23	74,19	3,953	[1,504-10,393]	0,004
No	57	24	42,11	1		
Hyper uremia						**0,000**
No	13	2	15,38	1		

Yes	75	45	60,00	8,25	[1,691-40,250]	0,009
Diabetic retinopathy						
Nephropathies						**0,036**
Hypertensives	40	8	20,00	2,375	[0,449-12,539]	0,003*
Chronic Tubulointerstitial	21	2	9,52	1.02	[0,242-4,57]	0,308
Glomerular	27	0	0,00	1		
Optical neuropathies						
Duration of CKD (years)						0,049
< 1	55	6	10,91	1		
1-5	22	6	27,27	3,063	[0,859-10,924]	0,085
6-10	11	4	36,36	4,667	[1,040-20,938]	0,044
Hyperuremia						0,000
No	13	8	61,54	1		
Yes	75	8	10,67	13,25	[2,687-65,340]	0,002
Nephropathies			0,000			
Hypertensives	40	10	25,00	1,167	[0,364-3,738]	0,003
Chronic Tubulointerstitial	21	0	0,00	1		
Glomerular	27	6	22,22	0,857	[0,268-2,746]	0,795

4. Discussion

4.1 Ocular Morbidity

The frequency of eye disease increased as CKD worsened and persisted. This could be explained by the fact that, as CKD progresses, the risk of developing cardiovascular disease becomes greater, or worsens if it already exists. Existing or worsening cardiovascular disease would increase the risk of developing eye disease. This could also be explained by prolonged, increased oxidative stress, which favours the genesis of certain eye diseases. In addition, as CKD progresses, patients also age and become increasingly exposed to age-related ocular pathologies such as cataract, age-related macular degeneration, glaucoma, dry eye syndrome, diabetic retinopathy and visual impairment. [93] thus increasing the frequency of eye diseases.

Hyperuremia has been identified as a factor aggravating ocular morbidity. This may be explained by its important role in the various pathophysiologies of ocular conditions in CKD, such as cataract and glaucoma. [1].

The eyes of patients with anemia were more affected by ocular disease than those without, although the association of anemia with ocular disease was not significant in our study (p=0.288). Anemia would therefore be linked to a greater risk of ocular morbidity. In fact, several studies agree that anemia is linked to the severity of CKD, which in turn increases the frequency of morbidity, including ocular morbidity. [7-9]. Similarly, according to other authors, the correction of anemia would have a beneficial effect on the rarefaction of morbidities in chronic renal patients [8,10]. However, Drüeke *et al.* [11] early and complete correction of anemia would not reduce the risk of cardiovascular complications.

In our study, the eyes of patients with hypertensive nephropathy were at greater risk of developing ocular disease. This could be explained by the common microvascular architecture of both organs, making them susceptible to the same risk factors such as hypertension and diabetes.

In addition, the eyes of non-dialyzed stage 5 CKD patients were more likely to develop eye disease (91.18%) than those of stage 5 CKD patients on dialysis (87.50%). This suggests that dialysis offers some protection against eye disease in patients at the same risk (stage 5).

4.2 Damage to Appendages

Damage to the ocular adnexa in our study was mainly palpebral oedema (10.00%), pterygium (11.00%), pterygoid (6.00%) and pinguecula (2.00%). Ophthalmological examination revealed no conjunctival calcifications, corneal calcifications or subconjunctival haemorrhages. The results of some studies concur with our own, with a low proportion of these conditions. NDiaye Sow *et al*. [12] and Koman *et al*. [13] found 2.70% and 3.40% respectively of pterygium in their studies. On the other hand, the pterygoid was observed in 18.80% of cases by NDiaye Sow *et al*. [12]. In the literature, palpebral edema ranged from 11.00% to 63.00%. [12,14-16] of cases. Palpebral edema is thought to be related to the

fluid retention inherent in CKD. The inconsistency of their frequency across studies could be related to individual patient variability, socio-demographic disparities, patient lifestyle and different sampling procedures.

4.3 Ocular Disorders of the Anterior Segment

4.3.1 Corneal Damages

Corneal involvement in our study was summarized as 2% (2/100) corneal erosions, 2% (2/100) corneal clefts, 1% (1/100) corneal dystrophy, 1% (1/100) epithelial bullae and 1% (1/100) retrodescemetic precipitates. This result was like that found by Koman*et al*. [13] who found two cases (1.70%) of superficial punctate keratitis (SPK) and NDiaye Sow *et al*. [12] who found one case (0.89%) of corneal dystrophy in their study. Kouassi *et al*. [14] also observed one case (0.5%) of corneal dystrophy, two cases (1%) of corneal clearing and, in contrast to this study, 22.00% of KPS.

The small proportion of dialysis patients in our study would explain our results. In fact, in the literature, dialysis leads to lacrimal hyposecretion, which is responsible for a greater number of corneo-conjunctival lesions, particularly KPS, due to tissue devitalization [12]. This would explain why we were unable to identify as many corneo-conjunctival anomalies in our minority dialysis study population. Kouassi *et al*. [14] also justified the presence of KPS by lacrimal hyposecretion. They eventually added, at the risk of misunderstanding, that all these lesions are not specific to lesions encountered during chronic hemodialysis [14].

4.3.2 Cataracts

Twenty-three percent (23.00%) of the eyes in our study had cataracts. This frequency of cataract in our study was like that found by NDiaye Sow *et al*. [12] (26,80%). On the other hand, this frequency was higher than that found by Koman *et al*. [13] (2.67%), Bajracharya *et al*. [16] (5.90%), Dahal *et al*. [15] (13,00%). This difference in results could be justified by the socio-demographic disparities between the different study populations, the type of study population, and the sampling.

Length of CKD was statistically associated with cataract (p=0.000). Similarly, a duration of more than 6 years was associated with a very high risk of developing cataracts OR=28.50 IC_{95} =[3.981-204.02] p=0.001. This could be explained by the oxidative stress increased by CKD due to Advanced Glycation End-products (AGEs) [17] and the accumulated effect of free radicals . Some authors also point to metabolic disorders occurring early in the natural history of CKD [1]. Hyperuraemia favours chronic sequestration of water inside the lens, which in turn favours the development of so-called osmotic cataracts [18].

Twenty-five percent (25%) of the eyes of patients with hypertensive nephropathy had cataracts. This suggests that hypertension plays a non-negligible role in the development of cataracts, as other studies agree [19,20].

In our study, ACE inhibitors were associated with a greater risk of developing cataracts OR=1.776 $IC_{95\%}$ =[0.409-7.714] p=0.443. This contrasts with several other studies showing the essential role of ACE inhibitors in reducing Advanced Glycation End-products (AGEs), which delay progression to cataract in experimental models [21-23] and human models [24]. The difference with our study could be explained by patients' non-compliance with treatment.

The eyes of patients not taking calcium channel blockers were at greater risk of developing cataracts OR=1.723 $CI_{95\%}$ =[0.524-5.672]. Indeed, studies have shown that increased cytosolic calcium levels can lead to cataract formation, particularly cortical cataracts [25]. Thus, calcium channel blockers, by reducing lenticular calcium levels, would help to reduce the incidence of cortical cataracts [26].

4.3.3 Intraocular Pressure (IOP)

In the general population of our study, 9.00% (9/100) of eyes had ocular hypertonia. Similarly, NDiaye Sow *et al*. [12] found 2.67% of eyes with ocular hypertonia in their study; hemodialysis patients and non-hemodialysis patients combined.

More specifically, 5.88% (2/34) of eyes in dialysis patients had ocular hypertonia, whereas almost twice as many, i.e. 10.61% (7/66) of eyes in non-dialysis patients, had ocular hypertonia. However, dialysis was not associated with ocular hypertonia in our study (p=0.714). Thus, we were unable to assess a possible protective effect of dialysis on ocular tone. The results of the literature were similar to our own. Indeed, Kouassi *et al*. [14] in their study of one hundred chronic kidney patients on dialysis alone, found 6.00% of eyes with ocular hypertonia. On the other hand, Hachache *et al* [27], in a study of 81 dialysis patients in France, found one case (1.23%) of ocular hypertonia.

The variation in the frequency of ocular hypertonia across studies, in both dialysis and non-dialysis patients, could be explained by the fact that chronic kidney patients, beyond the predispositions of CKD

and dialysis, could also, like any human being, develop other ocular conditions likely to give hypertonia such as glaucoma; this would be reinforced by the individual and family variabilities of patients in the various studies.

4.4 Fundus Changes

4.4.1 Hypertensive Retinopathy (HR)

The eyes of patients with HR represented 47.00% of our series. This result is like that found by Koman *et al*. [13] (53.84%), Kouassi *et al*. [14] (45.00%) and Bajracharya *et al*. [16] (47,10%). However, NDiaye Sow *et al*. [12] obtained a higher prevalence than ours, i.e. 75.90%. This predominance of RH could be justified by the preponderance of hypertensive patients in our study.

In our study, dialysis was statistically associated with HR (p=0.007). Indeed, dialysis patients in our study had a higher risk of developing HR OR=3.953 $IC_{95\%}$ =[1.504-10.393] p=0.004. This contrasts with the observations of Hachache *et al*. [27]. For them, arterial hypertension would usually be regulated by dialysis, which would lead to a decrease in the frequency of HR [27]. The high risk of HR among hemodialysis patients in our study is due to the fact that patients were dialyzed no more than two (02) times per week, whereas the literature recommends at least three times per week. [28,29]. To a certain extent, this would limit the management of hypertension and, in turn, favor the onset of RH. In Benin, the insufficient number of haemodialysis sessions per week could be justified by the high number of patients to be dialysed, despite the shortage of haemodialysis centers, on the one hand, and by the occasional lack of dialysis equipment, on the other. Nevertheless, it should be noted that the precarious socio-economic situation of many patients is also an obstacle to compliance with antihypertensive treatment.

4.4.2 Diabetic Retinopathy (DR)

We observed 10.00% DR in our study population; dialysis and non-dialysis patients combined. Similarly, Bajracharya *et al*. [16] and Dahal *et al*. [15] found higher proportions than ours, at 31.93% and 29.60% respectively. This difference could be explained by the duration of our study and the size of our sample.

4.4.3 Optical Neuropathies

Papillary pallor, often observed in neuropathies, is thought to be one of the particular fundus entities of chronic renal failure patients [30]. It was observed in 22.00% of the eyes in our study. This result was higher than that found by NDiaye Sow *et al*. [12] (3 eyes) and Kouassi *et al*. [14] (4,00%). According to Flament *et al*. [30] anemia is the main cause. In our study, hyperuremia was statistically associated with a very high risk of developing optic neuropathy (OR= $CI_{95\%}$ =[2.687-65.340] p=0.002). This suggests a link between elevated uraemia and the development of neuropathy. The association between the two parameters is much discussed in the literature. Indeed, the description of uraemic optic neuropathies, although rare, would seem to confirm this interrelation, verified by 'several studies [31].

5. Conclusion

Many chronic kidney patients develop ocular diseases during their illness. Ocular diseases were dominated by hypertensive and diabetic retinopathies. There was a direct link between the duration of chronic kidney disease and the onset of hypertensive retinopathy, neuropathy, and cataracts. This makes it possible to prevent the onset of these disorders.

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