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Ocular Findings in Pediatric Patients with Chronic Kidney Disease Stage 5 on Regular Hemodialysis

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Abstract

Background: Patients undergoing hemodialysis (HD) are subjected to the effects of both uremia and the dialysis procedure on multiple organ systems.

Aim of Study: To evaluate ocular changes and complications associated with chronic kidney diseases stage 5 on regular hemodialysis (CKD5d).

Patients and Methods: This cross-sectional study included 63 Egyptian children with CKD5d, who were recruited from Pediatric Dialysis and Nephrology Unit, and 50 age and gender matched controls, from outpatient's clinic, Children's Hospital, Ain Shams University Cairo, Egypt. Detailed history, physical examinations, and some laboratory investigations were done for all. Ocular examinations were done by measuring the best corrected visual acuity (BCVA), anterior segment, intra-ocular pressure (IOP), pre & pots-HD session, and fundus examinations.

Results: Ocular examination revealed abnormalities in 20.6% of CKD5d patients, and 10% of controls; where the best corrected visual acuity (BCVA) was impaired in 19% of patients and 10% of controls, the difference was not statistically significant as regards the BCVA (p=0.086), while eye movement disorders, anterior segment abnormalities and fundus changes were found in 6.3%, 6.3%, 4.7% of patients respectively, no similar findings were reported in controls. Intraocular pressures (IOP) were normal in all patients and controls; however, the mean pre-HD IOP was significantly higher compared with both post-HD measures and the control group (p<0.001, <0.001 receptively). Patients with ocular changes were significantly younger, with longer duration of hemodialysis, lower hematocrit, and serum iron levels, compared with those without significant ocular changes (p=0.03, 0.007, 0.021, 0.041, respectively).

Conclusion: The CKD patients undergoing HD may be at increased risk of developing visual complications, thus frequent ophthalmological examination & IOP monitoring are important.

Key Words: *BCVA – CKD5d – HD – IOP.*

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Introduction

PATIENTS with end stage renal disease experienced a wide range of clinical manifestations that necessitates the start of renal replacement therapy, as hemodialysis (HD), for fluid, electrolyte & acid base homeostasis **[1]**. The effect of HD on the eyes are complex and diverse, with wide range of complications, though it can improve certain ocular manifestations, nevertheless its negative impact outweighs the positive ones **[2,3]**. Ocular abnormalities associated with HD include intraocular pressure (IOP) changes, corneal and conjunctival abnormalities, dystrophic calcification, inflammation, cataracts, and retinal diseases **[1]**. A potential pathophysiological mechanism is the correlation with increased plasma colloid osmotic pressure (COP), alterations in calcium and phosphor levels during the phase of uremic state, and chronic inflammation **[1,3]**. Uremia and hemodialysis can cause increased plasma osmotic pressure, abnormalities in minerals levels and long-standing inflammation **[4]**.

Aims of the study:

To evaluate the ocular abnormalities in pediatric CKD5d patients and detect their correlations to some clinical measures as hemodialysis duration, anthropometric & blood pressure measurements, and laboratory data as complete blood count, iron profile, calcium, and phosphorus.

Patients and Methods

This cross-sectional study was conducted on 63 pediatric CKD5d patients (126 eyes) and 50 age & gender matched controls (100 eyes), during the period from June 2019 – March 2020. Sample size was calculated using G power program, setting the type-1 error (α) at 0.05 and the margin of error at 5%, results from previous study by Jung et al., 2013, who included 30 CKD5d patients, that found significant eye changes on examination including

the intraocular pressure (IOP), corneal thickness, ocular surface, and macular thickness **[2]**, based on these, a sample size of 20 cases will be needed, however we had included all pediatric CKD5d patients at our pediatric dialysis & nephrology unit, who fulfilled the inclusion criteria.

Patients involved in the study were on regular hemodialysis (HD) for at least 3 months and treated with hybrid of conventional HD, and online hemodiafiltration (OL-HDF) using both Gambro (Baxter Gambro AK 98 dialysis machine, USA) and Fresenius 5008 S classic machine (Fresenius Medical Care AG, Bad Homburg, Germany), with polysulfone high flux membrane dialyzer, three times per week for about 3 hours at a time. Patients were recruited from Pediatric Dialysis and Nephrology Unit, Children's Hospital, Ain Shams University, where all compliant subjects between 5-18 years were included, while those with history of diabetes mellitus, ocular trauma, at least 3 months before enrollment were excluded. The control group were healthy children accompanying their brothers or sisters during the consultation in the outpatient's clinic, in the same period. Informed and written consents were obtained before the start of the study, from patients and their caregivers according to Children's Hospital and Faculty of Medicine, Research Ethics Committee.

All subjects were subjected to detailed history taking focusing on age, gender, primary diagnosis, duration of CKD and HD, history of previous eye trauma. Anthropometric measures including weight and height assessment and BMI. Weight was assessed in the morning for controls, and 30 minutes after termination of HD session in CKD5d patients. Body mass index (BMI) was calculated as dry body weight (kg) divided by height in meters squared (m^2). Blood pressure was measured with auscultatory methods using a mercury sphygmomanometer using suitable cuff size according to size of the subjects. It was measured in a sitting position after a 10min complete physical rest, and for HD patients, it was measured 1 hour before HD session. Systolic & diastolic blood pressure Z scores were determined according to age, sex, and height measurements using blood pressure calculator **[5]**.

Ophthalmological examinations were done for all the subjects in the form of the BCVA assessment, using a Snellen chart for distant vision, with auto - refractometer for best corrected visual acuity assessment, anterior segment examination by slit lamp Biomicroscopy, fundus examination using slit lamp Biomicroscopy with +90 Diopter lens, and IOP measurements using non-contact Goldmann applanation tonometer 1 hour before and 1 hour after the hemodialysis session. Some laboratory investigations as complete blood count (CBC), serum calcium, phosphorus, and iron profile were done.

Data management and analysis:

The collected data was revised, coded, tabulated and introduced to a PC using Statistical package for Social Science (SPSS 25). Data was presented and suitable analysis was done according to the type of data obtained for each parameter. Descriptive statistics including mean, standard deviation (± SD) and range for parametric numerical data, while median and interquartile range (IQR) for non-parametric numerical data, frequency, and percentage of non-numerical data. Analytical statistics including student *t*-test was used to assess the statistical significance of the difference between two study group means. Mann Whitney Test (U test) was used to assess the statistical significance of the difference of a non-parametric variable between two study groups, Chi-Square test was used to examine the relationship between two qualitative variables, paired *t*-test was used to assess the statistical significance of the difference between two means measured twice for the same study group. *p*-value, the level of significance was nonsignificant if >0.05, Significant if <0.05.

Results

We had examined 63 CKD5d patients and 50 age and gender matched controls, with mean ages of 13.17±2.38 & 12.54±1.48 years respectively, all our patients were underweighting and short in comparison to controls (p=<0.001, <0.001 respectively). Though normal blood pressure measurements at time of examination, (as it was controlled by antihypertensive medications), our patients had significantly higher systolic and diastolic blood pressure z-scores than controls (p=0.036, 0.009 respectively); (Table 1). The most prevalent etiology among our CKD5d patients was congenital anomalies of kidney and urinary tract (CAKUT); (24 patients, 38.1%), including bilateral hypoplastic & dysplastic kidneys, posterior urethral valve, ureteropelvic junction obstruction, ectopic insertion of the ureter and vesicoureteral reflux. Other causes were ciliopathies (14 patients, 22.2%), as Joubert syndrome, Bardet-Biedl syndrome, Senior Løken syndrome, cerebro-oculo-renal syndrome and nephronophthisis. We also had 10 patients (15.9%) with podocytopathy, especially focal segmental glomerulosclerosis (FSGS), 9 patients (14.3%) with unknown etiologies, 4 patients (6.3%) with chronic tubulointerstitial nephritis (TIN) and 2

patients (3.2%) with thrombotic microangiopathy (TMA). The mean durations of the CKD and hemodialysis were 4.55 years ±2.81, 1.97 years ±1.18 years respectively. On reviewing all patients' medical history, we had one patient (1.6%) with a history of retinal hemorrhage in both eyes due to uncontrolled blood pressure during the first year of HD, who was diagnosed as Bardet-Biedl syndrome (Table 1).

Ocular examination revealed abnormalities in 26 eyes of 13 patients (20.6%), and 10 eyes of 5 controls (10%), where impaired vision by BCVA was reported in 12 CKD5d patients (19%), and 5 controls, while five CKD5d patients (7.9%) couldn't be assessed for BCVA because of their uncooperativeness. Eye movement disorders, anterior segment abnormalities and fundus changes were found in 4 (6.3%), 4 (6.3%), and 3 (4.7%) CKD5d patients respectively, including the five CKD5d patients, whom BCVA couldn't be assessed. No similar abnormalities were found in controls (Table 2). Anterior segment examination had revealed abnormalities in the form of faint, dense cortical and posterior subcapsular cataract (6 eyes of 3 patients, 4.7%), while one patient had keratoglobus megalocornea. Eye movements abnormalities in the form of bilateral congenital nystagmus since birth, before HD owing to bilateral dense cortical cataract was found in one patient (1.58%), while 3 patients (4.7%) had strabismus (squint) in the form of esotropia owing to hypermetropia, which was before the HD in one patient & developed after HD in the other 2 patients. Papilledema (grade 1 and 3) was reported in 2 patients (3.1%), while tessellated fundus with tilted disc was found in one patient (1.58%), which is a non-pathological normal variant of choroidal vessels that are seen clearly on retinal examination due to hypopigmented or hypoplastic retinal epithelium (Table 2).

Table (1): Clinico-demographic data of our studied groups.

Clinico-demographics	Patients (No.=63) Mean ± SD	Controls (No.=50) Mean ± SD	*p*-value
Age (years)	13.17 (2.38)	12.54 (1.48)	0.24
Gender (Number, %):			
Male	34 (54%)	28 (56.0%)	0.83
Female	29 (46%)	22 (44.0%)	
Diagnosis (Number, %):			
CAKUT	24 (38%)	–	–
Ciliopathy	14 (22.2%)	–	–
Podocytopathy	10 (6.3%)	–	–
Unknown	9 (14.2%)	–	–
Chronic TIN	4 (6.3%)	–	–
TMA	2 (3.17%)	–	–
Weight Z score	–2.66 (2.91)	0.340 (1.12)	<0.001
Height Z score	–2.06 (2.96)	0.0 (1.2)	<0.001
BMI Z score	–1.64 (3.1)	0.680 (1.81)	<0.001
Systolic BP Z-score	0.83 (1.56)	0.50 (0.86)	0.036
Diastolic BP Z-score	0.71 (1.40)	0.44 (0.77)	0.009
Duration of disease (years)	4.55 (2.81)		
Duration of HD (years)	1.97 (1.18)	–	–

BMI : Body mass index.
BP : Blood pressure.
CAKUT : Congenital anomalies of kidney and urinary tract.
CKD : Chronic kidney disease.
HD : Hemodialysis.
TIN : Tubulointerstitial nephritis.
TMA : Thrombotic microangiopathic hemolytic anemia.

Table (2): Ocular abnormalities of studied groups.

Ocular abnormalities	Patients		Controls		*p*-value
	(n=63)	Eyes (n=126)	(n=50)	Eyes (n=100)	
BCVA:					
Good vision (≥6/18)	46	92 (73.1%)	45	90 (90%)	0.086
Impaired vision (6/24-60)	10	20 (15.8%)	5	10 (10%)	
Blind (≤3/60)	2	4 (3.2 %)	0	0 (0.0%)	
Couldn't be assessed	5	10 (7.9%)	0	0 (0.0%)	
Movement disorders:					
Nystagmus	1	2 (1.58%)	0	0 (0.0%)	0.015
Squint	3	6 (4.6%)	0	0 (0.0%)	
Anterior segment changes:					
Cataract:					
- Dense cortical	1	2 (1.58%)	0	0 (0.0%)	0.015
- Faint cortical	1	2 (1.58%)	0	0 (0.0%)	
- Posterior subscapular	1	2 (1.58%)	0	0 (0.0%)	
Keratoglobus megalocornea	1	2 (1.58%)	0	0 (0.0%)	
Fundus changes:					
Papilledema	2	4 (3.1%)	0	0 (0.0%)	0.119
Tessellated fundus, tilted disc	1	2 (1.58%)	0	0 (0.0%)	
IOP:					
Mean ± SD	16.13 (1.8)**		14.2 (1.9)**		<0.001

BCVA: Best corrected visual acuity. IOP: Intra-ocular pressure. **: IOP before HD session.

All our controls and CKD5d patients had normal IOP, before & after HD session, and no one had glaucoma, however the average mean IOP pre-HD bilaterally was significantly higher compared to post HD measurements & to controls (p<0.001, <0.001 respectively) & (Tables 2,3). Patients with ocular changes were significantly younger, with longer duration of hemodialysis, lower hematocrit, and serum iron levels, compared with those without significant ocular changes (p=0.03, 0.007, 0.021, 0.041, respectively); (Table 4).

Table (3): Bilateral average IOP before & after HD session for CKD5d patients.

CKD5d patients	Mean ± (SD)	Paired *t*-test	*p*-value
Average bilateral IOP before HD	16.13±1.87	11.18	<0.001
Average bilateral IOP after HD	14.56±1.84		

HD : Hemodialysis.
IOP: intra-ocular pressure.

Table (4): Comparison between CKD5d patients with and without ocular abnormalities.

Ocular abnormalities	YES (n=13) Mean ± SD Median (IQR)	NO (n=50) Mean ± SD Median (IQR)	Test of significance	
			Value	*p*-value
Age (years)	11.85±3	13.56±2.27	*t*=2.22	0.03
Gender:				
Male no.	5 (38.46%)	25 (55.56%)	X^2=1.18	0.277
Female no.	8 (61.54%)	20 (44.44%)		
CKD duration (years)	5 (3-6)	3 (3-5)	z=–1.070	0.285
HD duration (years)	3 (1.5-4)	1.5 (1-2)	z=–2.713	0.007
Weight Z-score	-2.61 (-4.29 - -1.39)	-1.82 (-3.3 - -0.52)	z=–1.119	0.263
Height Z-score	-2.34 (-3.53 - -0.82)	-1.07 (-2.95 - 0.07)	z=–1.520	0.129
BMI Z-score	-1.64 (-3.18 - -0.34)	-1.58 (-2.86 - -0.07)	z=–0.503	0.615
Systolic BP Z-score	0.8 (0.09 - 1.3)	1.66 (0.08 - 2.56)	z=–1.156	0.248
Diastolic BP Z-score	0.64 (0.14 - 1.37)	1.75 (0.49 - 2.45)	z=–1.781	0.075
Hb (g/dL)	10.06±1.34	10.73±1.58	*t*=–1.535	0.130
HCT %	30.88±4.12	34.02±4.4	*t*=–2.385	0.021
Serum Iron (mg/dL)	90.4±38	115.15±36.14	*t*=–2.090	0.041
Serum Ferritin (mg/dL)	290 (177-542)	370 (299-479)	z=–0.755	0.450
Calcium (mg/dL)	8.87±1.3	9.22±0.92	*t*=–0.901	0.371
Phosphorus (mg/dL)	5.91±2.35	4.95±1.95	*t*=1.344	0.184

BMI : Body mass index.
BP : Blood pressure.
CKD : Chronic kidney disease.
Hb : Hemoglobin.
HCT : Hematocrit.
HD : Hemodialysis.
*Student *t*-test of significance (*t*).
*Chi-Square test of significance (X^2).
*Mann-Whitney test of significance (z).

Discussion

A wide range of clinical & pathological ocular changes are seen in patients with CKD, whether because of the disease itself or because of renal replacement therapy including the HD, causing variable degree of ocular abnormalities affecting the anterior & posterior segments **[2]**, so, we aimed at full ophthalmological examination of our pediatric CKD patients on regular hemodialysis to detect ocular abnormalities and study their correlations to some clinical and laboratory measures.

We examined 63 CKD5d pediatric patients and 50 age and gender matched controls. Among our CKD5d patients, the most prevalent diagnosis was CAKUT, this agrees with ERA-EDTA Registry **[7],** and with previous studies about CKD epidemiology in pediatric age group, which reported the high prevalence of CAKUT among their pediatric CKD children **[8,9]**. We had noticed that all our patients were underweight and short compared to controls. This is a known complication of CKD, and it is multifactorial owing to malnutrition, vitamins, minerals deficiencies & inflammation, which play a golden role in all organ functions including the eye **[10]**.

We had reported impaired visual acuity, measured by BCVA, in 20 eyes of 10 CKD5d patients (15.8%), while 4 eyes of 2 patients (3.2%) were blind, 7.9% of our patients couldn't be assessed for BVCA owing to their uncooperativeness. Meanwhile 10% of our apparently healthy controls had impaired vision by BCVA, which was not less than 6/60, the visual acuity was not statistically significant between our studied patients and controls.

Our findings could be partly explained by acute and chronic ocular changes that occur with hemodialysis, the visual acuity depends mainly on the integrity of the cornea, lens, and retina, where all are vulnerable to deleterious changes during HD **[2],** where rapid fluid shifts during HD, with sudden glycemic changes and hence changes in macular osmolarity and edema all can cause acute ocular changes **[6]**. Moreover, the primary CKD diagnoses may be the cause of chronic & persistent ocular changes, the two blind CKD5d patients in the present study were diagnosed with ciliopathies, one had Bardet-Biedl syndrome, that's known to cause retinitis pigmentosa, cone-system dysfunction and ends up by blindness, the other case had Senior Løken syndrome, which cause nephronophthisis and ocular abnormalities **[11,12]**. In addition to the wide range of CAKUT cases in our patients, that are also associated with eye abnormalities, which could be due to common genetic mutations as PAX2 gene, that is expressed in multiple embryonic tissues including the optical disk, where its dysfunction is associated with renal morphological abnormalities & **[13]**. Interestingly, patients with PAX2 mutation could be presented with podocytopathy, focal segmental glomerulosclerosis (FSGS); **[14]**.

A previous Egyptian study conducted by El-Ghany S. M. et al., on pediatric CKD5d patients found, a higher prevalence of impaired vision, where bilateral impaired visual acuity was more than 60%, compared to 13.3% among controls **[10]**. Their results were attributed to high prevalence of corneal and conjunctival calcifications, that impair the visual pathway, however we had no reported similar findings of corneal or conjunctival calcifications, also the serum calcium and phosphorus levels were not significantly different between those with and without ocular changes. Another Egyptian pediatric study by Mansour, D.E et al., reported impaired vision in 27.3% patients, while 15.8% were legally blind, which was explained by the primary disease diagnosis & the effect of HD on visual pathway **[15]**.

Our study had reported anterior segment abnormalities among 3 patients in the form of cataract & keratoglobus megalocornea (4.7%, 1.58% respectively), while corneal & conjunctival calcifications were not reported in our CKD5d patients, with no anterior segment abnormalities detected in our controls. The prevalence of cataract in our CKD5d patients might be attributed to the primary disease, or to the complications of the CKD and/or dialysis. As we had a wide range of CAKUT, ciliopathies and podocytopathy patients who had a higher incidence of cataract. The use of steroid during the treatment of podocytopathy cases may had a role, in addition to the urea trapping in the lens in CKD patients, causing long-standing water accumulation, eventually an osmotic cataract, in addition to persistent dynamic fluid flux through the lens during HD, aiding to cataract formation, in addition to atherosclerosis, endothelial dysfunction, renin-angiotensin system dysfunction, and Calcium-Phosphorus dysregulation and chronic oxidative stress, causing lens proteins carbamylation, and hence, cataract formation **[10,16-20]**. In contrast to our study, a recent study found high frequency of conjunctival calcification (60.6%), which was explained by the disturbed bone mineral metabolism in their CKD5d patients **[21]**.

Though the blood pressures were within normal at the time of ophthalmological examination, we had two patients with papilledema (3.1 %), which could be explained by the effect of uremia on retina inducing osmotic pressure changes, in addition to hemodialysis, which cause changes in retinal circulation. The associated changes in hematocrit level, and amount of ultrafiltration and uremic toxin removals, all these induce vasodilation of retinal vessels, sluggish retinal blood flow and in turn decreased retinal thickness around the macula **[22-24]**. Previous ocular studies in CKD patients had reported frequent abnormalities in posterior segment in these patients, in the form of retinopathy, and intra-retinal hemorrhage, which were explained by chronic hypertension, atherosclerosis induced retinal arteriolar narrowing, causing progressive retinal damage, vision threatening problems **[10,19,25,31]**.

Though we had normal IOP in all our studied CKD patients and healthy children, a significantly higher mean IOP were found in pre- HD measures, compared to both, post-HD, and controls. The increased pre-HD IOP compared to post HD could be explained by the reductions of total body water after HD session, due to ultrafiltration effect of hemodialysis, hence declining the aqueous humor volume & IOP **[29]**. Similarly, Jung et al., had found a decline of IOP post-HD **[2]**, while other studies had found controversial results, where Evans RD and Rosner M. found a higher IOP in post HD in comparing to the pre-HD measures, due to the reduced serum osmolality during HD causes imbalance between blood and ocular surface, and fluid influx via ciliary body into the posterior chamber, aiding to increased post-HD IOP **[17]**.

The increased pre-HD IOP compared to controls could be explained by the impaired ocular trabec-

ular meshwork in CKD patients, owing to the increased oxidative stress, which is a known complication in CKD patients, that in turn, affect IOP, also the thickened ocular basement membrane led to decreased proteosome activity and subsequent decreased aqueous outflow **[28]**. In addition to the increased central corneal thickness in HD patients, which affect the tonometry reading of IOP, that depend on it, where thicker corneas causing an overestimated IOP **[27]**. All these may explain the higher susceptibility of CKD5d patients to the increased IOP.

We had reported that patients with ocular changes were significantly younger, with longer duration of hemodialysis, lower hematocrit, and serum iron levels, compared with those without significant ocular changes (p=0.03, 0.007, 0.021, 0.041, respectively). Iron deficiency affects the retinal circulation, and disrupts the choroid structures, causing sluggish retinal blood flow and ocular abnormalities **[24,30]**.

Similarly, previous Egyptian studies had reported longer dialysis duration increases the risk of ocular abnormalities by folds, by disturbing the tear secretion and tear film stability, leads to long-standing ocular inflammation **[15,32]**. Chougule N. et al., had reported that the ratio of ocular abnormalities increases by more than 4 folds with HD duration less than one year, while the incidence of complications increased six folds with duration more than one year **[33]**. In contrast to our results, it had been reported that ocular changes were significantly linked to serum calcium and phosphorous levels, where hyperphosphatemia induces ectopic calcification and ocular inflammation, owing to imbalanced calcium, phosphorus metabolism **[34]**.

Conclusion and recommendations: The CKD patients undergoing HD may be at increased risk of developing visual complications, we recommend frequent ophthalmological examination & IOP monitoring for CKD5d pediatric patients.

References

1- National Kidney Foundation. K/DOQI clinical practice guidelines for chronic kidney disease: Evaluation, classification, and stratification. Am. J. Kidney Dis., 39: S1-266, 2002.

2- GHASEMI H., AFSHAR R., ZERAFATJOU N., et al.: Impact of Hemodialysis on Visual Parameters in Patients with End-Stage Renal Disease. Iran J. Kidney Dis., 6: 457-63, 2012.

3- JUNG J.W., YOON M.H., LEE S.W. and CHIN H.S.: Effect of hemodialysis (HD) on intraocular pressure, ocular surface, and macular change in patients with chronic renal failure. Effect of hemodialysis on the ophthalmologic findings. Graefes Arch. Clin. Exp. Ophthalmol., 251: 153-62, 2013.

4- AKTAS Z., OZDEK S., DINC U.A., AKYUREK N., ATALAY V., GUZ G., et al.: Alterations in ocular surface and corneal thickness in relation to metabolic control in patients with chronic renal failure. Nephrology, 12: 380-5, 2007.

5- SHYPAILO R.J.: Age-based pediatric blood pressure reference charts. Baylor College of Medicine, Children's Nutrition Research Center, Body Composition Laboratory. http://www.bcm.edu/ bodycomplab/BPappZjs/BPvAge-APPz.htm, 2008.

6- STOFFELNS B.M. and RICHARD G.: Is buckle surgery still the state of the art for retinal detachments due to retinal dialysis? Journal of Pediatric Ophthalmology and Strabismus, 47: 281-287, 2010.

7- WUHL E., VAN STRALEN K.J., WANNER C., ARICETA G., HEAF J.G., BJERRE A.K., et al.: Renal replacement therapy for rare diseases affecting the kidney: An analysis of the ERA-EDTA Registry. Nephrol. Dial Transplant, 29: iv1-8, 2014.

8- HARAMBAT J., VAN STRALEN K.G., KIM J.J. and TIZARD E.J.: Epidemiology of chronic kidney disease in children. Pediatr. Nephrol., 27: 363-373, 2012.

9- ARDISSINO G., DACCÒ V., TESTA S., et al.: Epidemiology of chronic renal failure in children: Data from the Ital Kid project. Pediatrics, 111: e382, 2003.

10- EL-GHANY S.M, EL-SALAM M.A., FARAG M.M. and EL-ASHWAH O.A.: Ocular Changes in Egyptian Children on Regular Hemodialysis. International Journal of Clinical Medicine, 10 (6): 353-362, 2019.

11- MOORE S.J., GREEN J.S., FAN Y., BHOGAL A.K., DICKS E., FERNANDEZ B.A., et al.: Clinical, and genetic epidemiology of Bardet-Biedl syndrome in newfoundland: A 22-year prospective, population-based, cohort study. Am. J. Med. Genet. A, 132: 352-360, 2005.

12- SCHEIDECKER S., HULL S., PERDOMO Y., STUDER F., PELLETIER V., MULLER J., et al.: Predominantly cone-system dysfunction as rare form of retinal degeneration in patients with molecularly confirmed Bardet-Biedl syndrome, Am. J. Ophthalmol., 160: 364-372, 2015.

13- CHANG Y-M., CHEN C-C., LEE N-C., SUNG J-M., CHOU Y-Y. and CHIOU Y-Y.: PAX2 Mutation-Related Renal Hypodysplasia: Review of the Literature and Three Case Reports. Front. Pediatr., 9: 765929, 2022.

14- VIVANTE A., CHACHAM O.S., SHRIL S., SCHREIBER R., MANE S.M., PODE-SHAKKED B., SOLIMAN N.A., et al.: Dominant PAX2 mutations may cause steroid-resistant nephrotic syndrome and FSGS in children. Pediatr. Nephrol., 34: 1607-1613, 2019.

15- MANSOUR D.E., EL-BAYOMI A.M. and EL-AZAB A.M.: Abnormal ocular findings in chronic renal failure patients on hemodialysis. The Egyptian Journal of Hospital Medicine, 72 (11): 5640-5646, 2018.

16- BEHBEHANI A., KRAFT S., BUNCIC J.R., et al.: Ophthalmic assessment of children before renal transplantation. Can. J. Ophthalmol., 38: 379-384, 2003.

17- EVANS R.D. and ROSNER M.: Ocular abnormalities associated with advanced kidney disease and hemodialysis. Semin Dial, 18 (3): 252-257, 2005.

18- KLEIN R., KNUDTSON M.D., LEE K.E. and KLEIN B.E.: Serum cystatin C level, kidney disease markers, and incidence of age-related macular degeneration: The Beaver Dam Eye Study. Arch. Ophthalmol., 127 (2): 193-199, 2009.

19- MALLESWARI B., RAHMATHUNNISA and IRSHAD: Eye findings in chronic renal failure patients undergoing hemodialysis. International Journal of Contemporary Medical Research, 3 (7): 1912-1914, 2016.

20- KIANERSI F., TAHERI S., FESHARAKI S., FESHARAKI H., MIRMOHAMMAD KHANI M., POURAZIZI M. and MOGHADAM R.S.: Ocular manifestations in hemodialysis patients: Importance of ophthalmic examination in prevention of ocular sequels. International Journal of Preventive Medicine, 10: 20, 2019.

21- ISMAYıLOV A.S., GUCLU O.A. and EROL H.A.: Ocular manifestations in hemodialysis patients and short-term changes in ophthalmologic findings, Ther. Apher. Dial, 25: 204-210, 2021.

22- NAGAOKA T., TAKEYAMA Y., KANAGAWA S., SAKAGAMI K. and YOSHIDA A.: Effect of haemodialysis on retinal circulation in patients with end stage renal disease. Br. J. Ophthalmol., 88: 1026-1029, 2004.

23- TARAKÇıOĞLU M., ERBAĞCI A.B., USALAN C., DEVECI R., KOCABAŞ R.: Acute effect of hemodialysis on serum levels of the proinflammatory cytokines. Mediators Inflamm, 12: 15-19, 2003.

24- KUO H.L., CHOU C.Y., LIU Y.L., YANG Y.F., HUANG C.C. and LIN H.H.: Reduction of pro-inflammatory cytokines through hemodiafiltration; Ren Fail, 30: 796-800, 2008.

25- OOI Q.L., TOW F.K., DEVA R., ALIAS, M.A., KAWASAKI R., WONG T.Y., et al.: The Systemic microvasculature in chronic kidney disease. Clinical Journal of the American Society of Nephrology, 6: 1872-1878, 2011.

26- HU J., BUI K.M., PATEL K.H., KIM H., ARRUDA J.A., WILENSKY J.T., et al.: Effect of hemodialysis on intraocular pressure and ocular perfusion pressure. JAMA Ophthalmol., 131: 1525-31, 2013.

27- DINC U.A., OZDEK S., AKTAS Z., GUZ G. and ONOL M.: Changes in intraocular pressure and corneal and retinal nerve fiber layer thickness during hemodialysis. Int. Ophthalmol., 30: 337-340, 2010.

28- NONGPIUR M.D., WONG T.Y., SABANAYAGAM C., LIM S.C., TAI E.S. and AUNG T.: Chronic kidney disease and intraocular pressure, The Singapore Malay Eye Study. Ophthalmology, 117 (3): 477-483, 2010.

29- CHEN H., XI ZHANG and XI SHEN: Ocular changes during hemodialysis in patients with end-stage renal disease, BMC Ophthalmology, 18: 208, 2018.

30- CARRARO M.C., ROSSETTI L. and GERLI G.C.: Prevalence of retinopathy in patients with anemia or thrombocytopenia. Eur. J. Haematol., 67 (4): 238-244, 2001.

31- AKINCI A., CAKAR N., KARA N. and UNCU N.: Ocular Findings in Children with Chronic Renal Failure. Cornea, 28, 5-6. Chronic Kidney Disease. Clinical Ophthalmology, 9: 109-114, 2009.

32- ANBAR M., AHMED A.R., EL-MAZARY A.A.M. and MAHMOUD R.A.: Ocular surface disorders in a group of Egyptian children with end stage renal failure on dialysis: a cross-sectional study. Journal of Ophthalmology, 4767819, 7, 2016.

33- CHOUGULE N., HARAKUNI U., BANSAL R. and SUNNY L.: Ocular manifestations in patients with diabetes with end-stage renal disease. Indian J. Health Sci. Biomed. Res., 13: 155-9, 2020.

34- SUN W., SUN M., ZHANG M., LIU Y., LIN X., ZHAO S. and MA L.: Correlation between Conjunctival and Corneal Calcification and Cardiovascular Calcification in Patients Undergoing Maintenance Hemodialysis. Hemodialysis International, 19: 270-8, 2015.

نتائج فحوصات العين فى الأطفال المرضى الذين يعانون من مرض القصور الكلوى المزمن المرحلة الخامسة على الغسيل الكلوى الدموى المنتظم

الخلفية : يخضع المرضى الذين يخضعون لغسيل الكلى الدموى لآثار كل من يوريمية وإجراء غسيل الكلى على أجهزة متعددة الأعضاء.

الهدف من الدراسة : تقييم التغيرات والمضاعفات العينية المرتبطة بأمراض القصور الكلوى المزمن المرحلة الخامسة على الغسيل الكلوى الدموى المنتظم.

الموضوعات والأساليب : شملت هذه الدراسة المقطعية ٦٣ طفلاً مصرياً مصاباً بـ d5CKD، تم اختيارهم من وحدة غسيل الكلى وأمراض الكلى للأطفال، و٥٠ من الضوابط المتطابقة بين العمر والجنس، من العيادات الخارجية، مستشفى الأطفال، جامعة عين شمس. تم إجراء التاريخ التفصيلى والفحوصات البدنية وبعض التحقيقات المختبرية للجميع. تم إجراء فحوصات العين عن طريق قياس أفضل حدة البصر المصححة، والجزء الأمامى، وضغط العين قبل وبعد جلسة الغسيل الدموى، وفحوص قا ع العين.

النتائج : كشفت دراسة فحص العين عن تشوهات فى ٢٠.٦٪ من مرضى بأمراض القصور الكلوى المزمن المرحلة الخامسة على الغسيل الكلوى الدموى المنتظم، و ١٠٪ من الضوابط، حيث تم إكتشاف ضعف حدة البصر المصححة فى ١٩٪ من المرضى و ١٠٪ من الضوابط، ولم يكن الفرق ذا دلالة إحصائية فيما يتعلق بحدة البصر المصححة (p=0.086)، فى حين تم العثور على اضطرابات حركة العين وتشوهات الجزء الأمامى وتغيرات قا ع العين فى ٦.٣٪، ٦.٣٪، ٤.٧٪ من المرضى على التوالى، لم يتم العثور على نتائج مماثلة فى الضوابط.

كانت ضغوط العين طبيعية فى جميع المرضى والضوابط. ومع ذلك، كان متوسط ضغط العين قبل جلسة الغسيل الدموى أعلى بكثير مقارنة بكل من مقاييس ما بعد جلسة الغسيل الدموى والمجموعة الضابطة (p<0.001، <0.001 بشكل مستقبلى). كان المرضى الذين يعانون من تغيرات فى العين أصغر سناً بكثير، مع مدة أطول من غسيل الكلى، وانخفاض مستويات الهيماتو كريت، والحديد فى الدم، مقارنة بأولئك الذين ليس لديهم تغيرات كبيرة فى العين (p=0.03، 0.007، 0.021، 0.041، على التوالى).

الخلاصة والتوصيات : قد يكون مرضى القصور الكلوى المزمن الذين يخضعون للغسيل الكلوى الدموى المنتظم أكثر عرضة لخطر الإصابة بمضاعفات بصرية، وبالتالى فإن الفحص المتكرر للعيون ومراقبة ضغط العين مهمان.