Changes in Intraocular Pressure after Hemodialysis at Hemodialysis Center Al Gamhoria Teaching Hospital, Aden

Sawsan Fuad Mohamed* Abeer Ahmed Ba Abbad**
Seena. Abdulla Yousuf**

Abstract

The relationship between intraocular pressure (IOP) changes and haemodialysis (HD) has been evaluated for more than 50 years, the reported findings are variable.The aim of the study is to evaluate the changes in IOP after HD.Ninety patients (180 eyes) undergoing HD with chronic renal failure were enrolled. Measurement of IOP was taken before and approximately 5 minutes after ending HD . Demographic data, causes of the chronic renal failure, duration of HD, and medical history of eye state were recorded. The mean age of the patients was 40.8 ± 14.1 years. The mean pre-dialysis IOP was 14.538 ± 3.66 mm Hg and mean post-dialysis IOP was 15.876 ± 4.13 mm Hg and the mean IOP change was 1.33 (P =< 0.001) .The mean IOP change was significant in non hypertensive/ non diabetics, non operated eye and without history of eye diseases -1.40 ± 3.53mmHg , -1.17 ± 3.74 mmHg, -1.59±4.35 mm Hg, respectively (P=< 0.001).Our result supported the view that the effect of HD on IOP is variable. We recommend ocular examination for all patients undergoing HD to prevent visual complications.

Key words: Intraocular pressure, hemodialysis, changes.

Introduction:

Hemodialysis (HD) is the mainstay therapy, which is offered for end stage renal disease patients who cannot undergo renal transplantation[23].

During HD, numerous metabolic parameters can change, including blood urea, sodium, potassium, and glucose levels; these fluctuations result in osmotic changes in blood, aqueous and vitreous humor, and other extracellular fluids[5].

The ocular effects of chronic renal failure (CRF) in the patients treated with HD has had a wide range of findings, including; refractive changes, dry eye, increased tear osmolarity, conjunctival calcium deposits, band keratopathy, corneal endothelium changes, lenticular opacity,disturbances in the retrobulbar circulation[6,18,19,27]. Moreover, a change in retinal vessels diameter also observed by digital fundus processing[4], but there was no significant effect on retinal thickness observed by Optical Coherence Tomography[20]. Changes in intraocular pressure (IOP) during or after HD have also been widely reported in the literature[5]. Increased, decreased, as well as unchanged IOP has been reported during HD in various studies. [14, 24, 28].

Materials and method:

Study design and setting:

A hospital-based, cross-sectional study targeting all patients underwent HD at Hemodialysis Center/ Al Gamhoria Teaching Hospital, during the period 16-24 April 2016.

Study population:

The target population in this study was all patients underwent HD at Hemodialysis Center/ Al Gamhoria Teaching Hospital in Aden,Yemen. Patients were divided into groups according to the time and days on which they underwent HD. A total of 90 patients (180 eyes) who were on HD for 9 days in the month of April 2016 were analyzed.

Exclusion criteria: Patients with positive serological tests for hepatitis B or C virus and HIV, patient with corneal disease, eye infection, allergy to anesthesia drops, and patients who refused to participate in the study.

Instrument and procedure of data collection:

The variables studied were age, gender, base etiology for chronic kidney diseases, and duration of HD. Ocular medical history taken from the patients was; history of ocular diseases, using eye drops, eye surgery/ laser, and if the patient felt any visual changes and/or pain during or after HD.

IOP was measured with Schiotz tonometer in both eyes before HD and approximately 5 minutes after HD by the authors. Patients were divided in to two groups on the basis of different tonometric readings; group 1; no significant change in IOP , group 2; significant change in IOP (decreases or increases by 3mmHg or more).

Statistical analysis:

The data were analyzed using computer facilities: Statistical Package for Social Sciences

* Ophthalmology Department, Faculty of Medicine and Health Sciences, Aden University.

** Public health and social medicine department. Faculty of medicine and Health Sciences, Aden University.Received on 18/12/2017 and Accepted for Publication on 11/7/2018

(SPSS) program version 15.
Descriptive statistics were calculated from data of the patients (mean, standard deviations, frequencies, and percentages).
Statistical analysis using statistics cross-tabulation, non-parametric chi-square test with a significant level of p-**value ≤ 0.05** was performed to identify any significant relationship between the qualitative studied variables of the patients.
A paired sample t-test was carried out to examine the deference of IOP before and after HD at a ($p \leq 0.05$) level of significance.

Ethical considerations:
Permission was taken from the director of the Hemodialysis Center/ Al Gamhoria Teaching Hospital, and the Research and Ethics Committee of the Faculty of Medicine and Health Sciences of Aden University have approved this study. The principles outlined in the Declaration of Helsinki were followed.
The purpose of the study was explained and short notes about IOP were introduced to the patients in the day of their HD at the center, then verbal consent was obtained from the patients.

Results:
A total number of patients 90 patients (180 eyes) who attended the Hemodialysis Center / Al Gamhoria Teaching Hospital during the study period, were included in this study; Fifty eight (64.4%) were males and 32 (35.6%) were females. The mean age was 40.8 ± 14.1 years (range 15 - 72 years). The predominant etiologies of CRF were hypertension 33.3% glomerulonephritis 24.4%, and diabetes mellitus with hypertension 14.4%. The mean duration of HD was 23.9 months.
The differences between male and female patients regarding age group, causes of CRF and duration of HD / months was statistically not significant. (Table 1).

Table 1. Demographic parameters and etiology of chronic renal failure

Age group in years	Male (n=58)	Female(n=32)	Total (n=90)	Chi square test
	No. (%)	No. (%)	No. (%)	
15 – 31	15 (25.9) 23	11 (34.4) 14	26 (28.9)	2= 2.328 with 3 df ; p= 0.518
32 – 48	(39.7) 18	(43.8) 7	37 (41.1)	
49 – 65	(31.0) 2	(21.9) 0	25 (27.8)	
66 – 72	(3.4)	(0.0)	2 (2.2)	
Mean age (**±SD**)	42.2(±SD=14.5)	38.3(±SD=13.2)	40.8(±SD=14.1)	
Causes of RF				
Hypertension	20 (34.5) 14	10 (31.3) 8	30 (33.3)	2= 6.893 with 11 df ; p= 0.808
GN	(24.1)	(25.0)	22 (24.4)	
HT + DM	8 (13.8) 5	5 (15.6) 3	13(14.4)	
Polycystic K	(8.6) 4	(9.4) 2	8(8.9)	
Kidney stone	(6.9) 2	(6.3) 2	6(6.7)	
Toxic/drugs	(3.4) 2	(6.3) 0	4(4.4)	
Obstruction	(3.4) 0	(0.0) 1	2(2.2)	
Cancer	(0.0) 0	(3.1) 1	1(1.1)	
DM	(0.0) 1	(3.1) 0	1(1.1)	
Malaria	(1.7) 1	(0.0) 0	1(1.1)	
Trauma	(1.7) 1	(0.0) 0	1(1.1)	
U. stone	(1.7)	(0.0)	1(1.1)	
Duration of hemodialysis / months				
0.25 – 22	35 (60.3) 12	17 (53.1) 9	52 (57.8)	2= 2.071 with 4 df ; p= 0.546
23 – 46	(20.7) 8	(28.1) 4	21 (23.3)	
47 – 69	(13.8) 2	(12.5)	12 (13.3)	
70 – 93	(3.4) 1	0 (0.0) 2	2 (2.2)	
94 – 116	(1.7)	(6.3)	3 (3.3)	
Mean(±SD)	23.9(±SD= 25.55)			

HT= hypertension, GN= glomerulonephritis, DM= diabetes mellitus, K = kidney, U= urethra

IOP of both eyes before and after HD was examined, the change in IOP either (increase or decrease) was 38.3 % of the eyes. IOP increased in 28.9% and decreased in 9.4% of the eyes. The mean of the changes of IOP before and after HD was - 133± 4.30 and the comparison of the difference between means of IOP changes was tested using paired t-test and it was found that it was statistically significant (P =< 0.001) with 95% confidence interval (Table 2).

Table 2. IOP changes before and after HD

IOP before and after HD					**Mean ± *SD***	**T**	**df**	***P* – value**	***95% confidence interval of the interval***	
Eye	No changed	Increased	Decreased	Total					Lower	Upper
	No. (%)	No. (%).	No. (%).	No. (%)						
	111 (61.7)	52 (28.9)	17 (9.4)	180 (100)	-133 ± 4.30	- 4.17	179	0.000	-1.970	-.7053

The IOP changes after HD was examined among patients have hypertension ± diabetes, those with history of eye disease and with history of eye surgery**.**

The results showed that from 86 patients, who have history of hypertension ± diabetes**,** 55.8% had no changes, 27.9% got increase in IOP, and 16.3% got decrease in IOP.

Twenty four Patients with history of eye diseases 41.7% had no changes, 41.7% got increase in IOP and 16.6% got decrease in IOP; and from 18 Patients with history of eye surgery 44.4% got no changes, 44.4% got increase in IOP and 11.2% got decrease in IOP **(** Table 3 **).**

Table 3. IOP changes after HD in hypertensive group, operated eye, and eye diseases group

IOP after HD				
	No changed	Increased	Decreased	Total
Diseases	**No. (%)**	**No. (%)**	**No. (%)**	**No. (%)**
HT/ ± DM	48 (55.8)	24 (27.9)	14 (16.3)	86 (100)
Eye diseases	10 (41.7)	10 (41.7)	4 (16.6)	24 (100)
Eye surgery	8 (44.4)	8 (44.4)	2 (11.2)	18 (100)

The difference between means of IOP changes before and after HD was examined. Patients with or without hypertension (± diabetes), those with or without history of eye diseases and those with or without history of eye surgery, the results showed that it was significant in non hypertensive/ non diabetics, non operated eye and without history of eye diseases -1.40 ± 3.53mmHg , -1.17 ± 3.74 mmHg, -1.59±4.35 mm Hg, respectively (P=<0.001). As well as in patients with hypertension (± diabetes), P = 0.021. (Table 4).

Table 4: Statistical comparisons of IOP changes after HD in hypertensive group, eye surgery, and eye diseases group

Diseases		**Mean±*SD***	***P* – value**	***95% confidence interval***	
				Lower	**Upper**
HT/ ± DM					
Yes	IOP change (mmHg)	-1.26 ± 5.02	.021	- 2.34	- .1927
No	IOP change (mmHg)	-1.40 ± 3.53	<0.001	- 2.12	- .67
Eye diseases					
Yes	IOP change (mmHg)	.30 ± 3.54	.674	- 1.19	1.80
No	IOP change (mmHg)	-1.59±4.35	<0.001	- 2.28	- .90
Eye surgery ± laser					
Yes	IOP change (mmHg)	-2.82± 7.69	.138	- 6.64	1.00
No	IOP change (mmHg)	-1.17 ± 3.74	<0.001	- 1.75	- 1.55

Subjectively, around three (3.3%) were satisfied and expressed improving of vision (3.4% among male and 3.1% among female) while 22.2% were unsatisfied and expressed worsen after HD +/- eye pain (17.2% among male and 31.3% among female) and 74.5% of patients had no complain or change in vision (79.3% among male and 65.6% among female).

The difference between male and female patients regarding eye symptoms was statistically not significant (Table 5).

Table 5: Eye symptoms among patients after HD.

Eye symptoms after HD	Male	Female	Total
	No. (%)	No. (%)	No. (%)
No changed	46 (79.3)	21 (65.6)	67 (74.5)
Satisfied VA	2 (3.4)	1 (3.1)	3 (3.3)
Unsatisfied VA /+-Pain	10 (17.2)	10 (31.3)	20 (22.2)
Total	58 (100)	32 (100)	90 (100)

2= 2.346 with 2 df ; p= 0.310

Discussion:

Various studies have reported about changes in intraocular pressure during and /or after HD. Many conflicting results have been published on the effects of HD on IOP[5].

In the current study, the analysis of IOP changes after HD identified three groups of (eyes) patients. First group consisted of 111 eyes (61.7%) in which IOP did not change significantly; second group consisted of 52 eyes (28.9%), in which there was significant increase of IOP, the third group consisted of 17 eyes (9.4%), in which there was significant decrease of IOP after HD.

Some studies have described an IOP elevation during HD [17,26] , which has been attributed to the osmotic disequilibrium between serum and aqueous humor induced by the HD procedure, especially when the facility of the outflow system is already compromised[16].

Moreover, study reported that intraocular hypertension is common which may contribute to the development of glaucoma and cataract[30].

On the other hand, IOP decrease significantly was also reported [18,24 , 30]; these studies supported the notion that the increase in plasma colloid pressure induced by fluid removal during the HD session is the underlying cause of decreased IOP[27], while other studies did not establish a significant change in IOP [3,10 , 24].

Moreover, studies have reported underestimation of IOP values after HD may happen due to decreased central corneal thickness induced by fluid loss[8], and the effects of fluid loss on corneal thickness may be a good explanation for IOP variations after HD[1].

However, recently, a 24 -hour IOP monitoring was performed on HD day 1 and then on a day without HD[22] showed a significantly higher mean 24-hour IOP on the day of HD, which bringing to level that increase the risk of glaucoma development and progression[11].

Both diabetes and hypertension are very closely related to chronic kidney disease[9]. Two studies in Yemen[2,21] showed the main causes of CRF were hypertension glomerolonephritis / infection and diabetes mellitus. In the current study 33.3% of the total 90 patients undergoing HD the causes of CRF were hypertension (14.4 % with hypertension and diabetes mellitus) followed by 24.4% Glomerulonephritis.

Many studies suggested ocular examination for all patients with diabetes and/or hypertension undergoing HD[7,12].

The mean IOP change was significant in the total 180 eyes p=<0.0001; interestingly, the hypertention and diabetes were not risk factors to change the IOP after HD. The mean IOP change in the hypertensive with/ out diabetes was significant p=0.021 as well as in the non-hypertensive non-diabetes p=< 0.001.

It was reported that eyes, which previously underwent vitrectomies, were at risk of IOP elevation due to postoperative aqueous outflow compromise[29].

In the current study, the non-operated eye and no history of eye diseases showed significant changes p=< 0.001. These results support the study reported the influence of HD on IOP is not clear and opposite findings have been found[14].

Unsuspected finding was reported; where IOP decreased significantly in the eyes with occludable angles, but was not in nonoccludable angles[25]. However, other study showed no any significant changes in IOP in the operated or not operated eye after HD[25].

Many studies have reported sudden decrease in visual acuity during HD [15], ocular pain and headaches have been also reported[13,19]. In contrast, study reported best-corrected visual acuity was not significantly changed after HD[17].

However, in the current study, 22.2% were unsatisfied and have history of frequent blurry vision w/out pain after each HD, which almost improved next day. In contrast, 3 patients (3.3%) were satisfied and felt better after each HD.

Finally, there are some limitations in this study; including limited ocular parameters that affect the IOP reading, such the central corneal thickness measured by Pachymetry, which is not available in Algamhoria Teaching Hospital.

Conclusion: Our result supported the view that the effect of hemodialysis on intraocular pressure is variable. In addition, a significant rise of IOP after HD is relatively frequent. There is a lack of awareness among nephrologists and medical staff about the possibility of IOP may rise during hemodialysis. We recommend ocular examination for all patients undergoing hemodialysis to prevent visual complications.

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التغيرات في ضغط العين بعد غسيل الكلى في مركز غسيل الكلى مستشفى الجمهورية التعليمي، عدن

سوسن فؤاد محمد عبير أحمد باعباد

سيناء عبدالله يوسف

الملخص

هناك دراسات عديدة لمعرفة التغير في ضغط العين و غسيل الكلى لأكثر من 50 عاما ، ونتائج الأبحاث كانت مختلفة.

هدف الدراسة هو معرفة التغيرات في ضغط العين بعد غسيل الكلى . تم فحص تسعين مريضاً (180 عيناً) في مركز غسيل الكلى في مستشفى الجمهورية التعليمي يخضعون لغسيل الكلى يعانون الفشل الكلوي المزمن.تم قياس ضغط العين قبل غسيل الكلى وكذلك بعد إنهاء غسيل الكلى بخمس دقائق . تم تسجيل البيانات الديموغرافية، وأسباب الفشل الكلوي المزمن ومدة غسيل الكلى والتاريخ الطبي لحالة العين .

كان متوسط عمر المرضى 40.8 ± 14.1 سنة. متوسط ضغط العين قبل غسيل الكلى 14.538 ± 3.66 ملم زئبق ، و بعد غسيل الكلى كان 15.876 ± 4.13 ملم زئبق وكان متوسط التغير بينهم 1.33 . (P = <0.001) كان متوسط تغير ضغط العين في المرضى غير المصابين بمرض ارتفاع ضغط الدم / غير المصابين بداء السكري وبدون تاريخ مرضي للعين −1.40 ± 3.53 ملم زئبق، −17. ± 3.74ملم زئبق، −1.59 ± 4.35 ملم زئبق، على التوالي .(P = <0.001) . أيدت نتيجة هذه الدراسة نتائج الدراسات السابقة ، بأن تأثير غسيل الكلى في ضغط العين هو متغير . كما نوصي بفحص العين لجميع المرضى الذين يخضعون لغسيل الكلى لمنع المضاعفات ارتفاع ضغط العين.

الكلمات المفتاحية: ضغط العين ، غسيل الكلى ، تغيرات