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CORRELATION OF OCULAR PERFUSION PRESSURE AND INTRAOCULAR PRESSURE CHANGES DURING HEMODIALYSIS IN END-STAGE RENAL DISEASE: AN OBSERVATIONAL STUDY

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ABSTRACT

BACKGROUND: Patients with chronic kidney disease who get hemodialysis experience a brief increase in intraocular pressure and a drop in ocular perfusion pressure. This helps in the early diagnosis of optic nerve damage from glaucoma and that results in irreversible loss of vision.

OBJECTIVE: This observational study aims to investigate the correlation between OPP and IOP changes during hemodialysis in patients with ESRD

MATERIALS AND METHODS: The observational study enrolled 60 adult patients diagnosed with ESRD undergoing regular hemodialysis at Saveetha Medical College & Hospital, Chennai. Patients with a history of ocular diseases (e.g., glaucoma, uveitis) or ocular surgeries were excluded from the study. Before the initiation of hemodialysis, baseline measurements of BP, MAP, IOP & OPP were obtained using standard techniques. BP was recorded as the average of three consecutive measurements taken using an automated sphygmomanometer. IOP was measured using a Schiotz tonometer. During hemodialysis, BP was monitored continuously and additional BP measurements were obtained at 2-hour intervals. IOP measurements were repeated at the same time points.

RESULTS: Mean IOP from the initiation to the end of hemodialysis was found to be increased and the mean arterial pressure and ocular perfusion pressure were found to be decreased from the initiation to the end of hemodialysis. At the end of study period, mean arterial pressure (MAP) from the initiation to the end of hemodialysis was found to be decreased by 89 mm Hg. It was found to be statistically significant (p- value: 0.001). Ocular perfusion pressure from the initiation to the end of hemodialysis was found to be decreased by 67.2 mm Hg in both eyes. It was found to be statistically significant (p-value 0.001). Intraocular pressure ocular perfusion pressure from the initiation to the end of hemodialysis was found to be decreased by 21.8 mm Hg in both eyes. It was found to be statistically

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significant (p-value 0.001).

CONCLUSION: Our study reveals the importance of screening and monitoring of intraocular pressure and characteristic early optic nerve head changes and early visual field changes of glaucoma in end-stage renal disease patients who are on hemodialysis. Variations in ocular perfusion pressure due to IOP and BP fluctuations may play a role in glaucoma development or progression. Hence monitoring of intraocular pressure and screening for early optic nerve head changes and early visual field defects is mandatory in end-stage renal disease patients on hemodialysis.

KEYWORDS: Intra Ocular Pressure, Ocular Perfusion Pressure, Hemodialysis, Glaucoma.

INTRODUCTION:

Chronic kidney disease is a slow and irreversible decrease of kidney function over months or years. The prevalence of CKD is estimated to be 10% worldwide. The aging population, diabetes, hypertension and glomerulonephropathy are the main causes of the rise in CKD patients. Age-related macular degeneration, ischemic optic neuropathy, high intraocular pressure (IOP), glaucoma, macular edema and CKD can all be made worse by hemodialysis (HD), the therapy for the disease. Glaucoma is a chronic optic nerve condition that progresses over time, resulting in visual field defects (1). Raised intraocular pressure is the most prevalent risk factor for glaucoma and the only aspect of the disease that can be treated. Ocular perfusion pressure and IOP can be impacted by changes in hemodynamics, plasma colloid-osmotic pressure and plasma osmolarity during HD. During their sessions, patients with CKD receiving HD may notice temporary increases in intraocular pressure (IOP) and decreases in ocular perfusion pressure. For this reason, it's critical to routinely check IOP and ocular perfusion pressure throughout HD sessions and for CKD patients undergoing HD (2). This monitoring can help identify glaucomatous optic nerve damage and probable permanent vision impairment early on, as well as changes in ocular perfusion pressure and IOP.

Intraocular Pressure During Hemodialysis:

A condition known as ocular dialysis disequilibrium can occur from hemodialysis, which causes a brief elevation in intraocular pressure. In patients with a reduced aqueous outflow capacity because of an impaired or closed iridocorneal angle, the likely mechanism is a dyssynchronous reduction in osmolality between the blood and the eye during hemodialysis, which causes the aqueous humor to become hypertonic relative to the blood (3). This results in an increase in intraocular pressure. Increased intraocular pressure during hemodialysis can harm eyesight; symptoms include headache, ocular discomfort, photophobia, changes in vision and visual loss. In patients receiving hemodialysis, it is crucial to pay attention to intraocular pressure and glaucoma risk factors in order to diagnose and prevent subsequent ocular illness and vision loss. Patients receiving hemodialysis who are at risk, especially those over 40, with diabetes or with a history of eye illness, should be encouraged by their clinicians to have routine ophthalmologic evaluations (4). Healthcare professionals should be especially cautious when dealing with disorders that might restrict aqueous outflow, such as central retinal vein occlusion and diabetic proliferative retinopathy (5). It is important to promptly refer patients for

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ophthalmic inquiry if they complain of headaches, ocular discomfort, or vision abnormalities while receiving dialysis, as intraocular pressure readings taken during non-dialysis periods may be normal. The portable tonometer, in our experience, takes very little training and is easy to use in the outpatient dialysis scenario. It's possible that this gadget may come in handy in the future for managing these complicated patients and doing research. (6). We aimed to correlation between variations in intraocular pressure and hemodialysis, to evaluate the relationship between variations in ocular perfusion pressure and hemodialysis and also aimed to determine the appropriate and justified to test end-stage renal disease patients receiving hemodialysis for intraocular pressure, unique alterations in the optic nerve head and changes in the visual field of glaucoma.

MATERIAL AND METHODS:

The observational study enrolled 60 adult patients diagnosed with ESRD undergoing regular hemodialysis in Saveetha Medical College & Hospital, Chennai. Patients with a history of ocular diseases (e.g., glaucoma, uveitis) or ocular surgeries were excluded from the study. Before the initiation of hemodialysis, baseline measurements of BP, MAP, IOP & OPP were obtained using standard techniques. BP was recorded as the average of three consecutive measurements taken using an automated sphygmomanometer. IOP was measured using a Schiotz tonometer. During hemodialysis, BP was monitored continuously and additional BP measurements were obtained at 2-hour intervals. IOP measurements were repeated at the same time points using the Schiotz tonometer. The mean arterial pressure (MAP) was calculated using the formula: MAP = Diastolic BP + 1/3 (Systolic BP -Diastolic BP). Calculation of Ocular Perfusion Pressure: OPP was calculated at each time point using the formula: OPP = MAP-IOP.

STATISTICAL ANALYSIS:

Data analysis was performed using Microsoft excel. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. Paired t-tests was used to compare MAP, IOP and OPP measurements at different time points. Pearson correlation analysis was conducted to assess the relationship between changes in OPP and IOP during hemodialysis. A p-value < 0.05 was considered statistically significant.

RESULT:

In the present observational study conducted with sample size of 60 adult patients diagnosed with ESRD undergoing regular hemodialysis at Saveetha Medical College & Hospital, Chennai. The results as follows,

Age, Gender, Duration and Comorbidities

The age group of the patients includes under the study ranges from 45 to75 years with a mean age of 60.5 ±8.2. The distribution of patients according to their age, gender, duration and comorbidities is shown in Table 1

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Table 1: Baseline Characteristics

Variables	Mean ±SD (Range)
Age (Years)	60.5 ±8.2 (45-75)
Gender (M/F)	34/26
Duration Of ESRD (Months)	48.7 ±12.4 (24-72)
Comorbidities	
• Hypertension	45(75%)
• Diabetes mellitus	20(33.3%)
• Cardiovascular disease	15(25%)

Of the 60 patients in the study showed patient with hypertension is more than the patient with diabetes and cardiovascular disease. The mean of patient with hypertension is 45, patient with diabetes mellitus is 20 and patient with cardiovascular disease is 15.

Changes in Blood Pressure and Intraocular Pressure During Hemodialysis

Of the 60 patients in the study showed the changes in blood pressure and intraocular pressure during hemodialysis showed in below table 2

Table 2: Changes in Blood Pressure and Intraocular Pressure During Hemodialysis Changes in Ocular Perfusion Pressure (OPP) During Hemodialysis

Time point	Systolic BP (mmHg)	Diastolic BP (mmHg)	IOP (mmHg)
Baseline	154	86	17.5
2 hours into HD	138	78	19.4
After HD	124	72	21.8

Mean IOP from the initiation to the end of hemodialysis was found to be increased by 21.8mm Hg in both eyes after HD.

Changes in Ocular Perfusion Pressure (OPP) During Hemodialysis

Of the 60 patients in the study showed Changes in Ocular Perfusion Pressure (OPP) During Hemodialysis during hemodialysis showed in below table 3

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Table 3: Changes in Ocular Perfusion Pressure (OPP) During Hemodialysis

Time point	MAP (mmHg)	IOP (mmHg)	OPP (mmHg)
Baseline	109	17.5	91.5
2 hours into HD	98	19.4	78.6
After HD	89	21.8	67.2
p-value for paired T-test	0.001	0.001	0.001

Mean arterial pressure (MAP) from the initiation to the end of hemodialysis was found to be decreased by 89 mm Hg. It was found to be statistically significant (p- value: 0.001). Ocular perfusion pressure from the initiation to the end of hemodialysis was found to be decreased by 67.2 mm Hg in both eyes. It was found to be statistically significant (p-value 0.001).
Intraocular pressure ocular perfusion pressure from the initiation to the end of hemodialysis was found to be increased by 21.8 mm Hg in both eyes. It was found to be statistically significant (p- value 0.001).

DISCUSSION:

In this study, we observed significant changes in both blood pressure (BP) and intraocular pressure (IOP) during hemodialysis in end-stage renal disease (ESRD) patients. Specifically, there was a notable decrease in systolic and diastolic BP after 2 hours of hemodialysis compared to baseline measurements. The following are the causes of variations in ocular perfusion pressure during a hemodialysis session. In order to maintain a relatively constant blood flow, autoregulation—the vascular bed's capacity to change the vascular resistance in response to changes in perfusion pressure—plays a critical role in impairment. Variations in blood pressure caused by changes in fluid during the active phase of hemodialysis treatment (7,8).
Calculation of ocular perfusion pressure (OPP) revealed a corresponding decrease in OPP during hemodialysis, reflecting the alterations in mean arterial pressure (MAP) and intraocular pressure (IOP). The negative correlation between changes in OPP and IOP suggests that reductions in OPP may contribute to the observed increase in IOP during hemodialysis. It is found that there is statistically significant fluctuation in ocular perfusion pressure during a hemodialysis session.
Accordingly, hemodialysis patients might have frequent IOP and OPP fluctuations during long-term, frequent sessions of hemodialysis, each lasting several hours may subsequently increase patient's risk for glaucoma development and progression. If diagnosed and treated at an early stage, glaucoma is one of the avoidable causes of irreversible vision impairment. It has been demonstrated that ocular perfusion pressure and intraocular pressure are recognized risk factors for open angle glaucoma. Few research has examined the transient changes in intraocular pressure and ocular perfusion pressure during hemodialysis (5,6,9).
Changes in Blood Pressure and Intraocular Pressure During Hemodialysis, the mean IOP from the initiation to the end of hemodialysis was found to be increased by 21.9mm Hg in both eyes after HD were similar to study conducted by Anuradha et al. Mean arterial pressure (MAP) from the initiation to

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the end of hemodialysis was found to be decreased by 89 mm Hg. It was found to be statistically significant (p- value: 0.001). Ocular perfusion pressure from the initiation to the end of hemodialysis was found to be decreased by 67.2 mm Hg in both eyes. It was found to be statistically significant (p-value 0.001).
Intraocular pressure ocular perfusion pressure from the initiation to the end of hemodialysis was found to be decreased by 21.8 mm Hg in both eyes. It was found to be statistically significant (p- value 0.001) were similar to study conducted by Anuradha TR, Radhakrishnan B, Nithya G, et al (2). Thus, the study results showed the correlation between changes in ocular perfusion pressure (OPP) and intraocular pressure (IOP) during hemodialysis.

CONCLUSION:

Our study concluded that there is transient increase in intraocular pressure to around 21.8mmHg during hemodialysis and Ocular perfusion pressure from the initiation to the end of hemodialysis was found to be decreased by 67.2 mm Hg in both eyes. Likewise, there was a notable rise in intraocular pressure observed during the dialysis procedure. Variations in ocular perfusion pressure due to IOP and BP fluctuations may play a role in glaucoma development or progression.
Hence monitoring of intraocular pressure and screening for early optic nerve head changes and early visual field defects is mandatory in end-stage renal disease patients on hemodialysis. So, doing a routine screening of IOP and glaucoma changes before initiation of hemodialysis therapy is reasonable and justifiable.

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