Modification of Dialysis for Management of Elevated Intraocular Pressure: A Case Report

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Abstract

In this report, we discuss the case of a chronically ill 74-year-old male who developed severe intraocular pressure (IOP) elevations following dialysis treatments after intraocular lens (IOL) exchange. He presented with elevated IOP at 1-week post-op, which was treated topically and orally with success. However, he soon experienced recurrent episodes of severe IOP spikes in the 30–50 mmHg range accompanied by severe pain, nausea, and vomiting. After multiple such episodes, the patient was admitted to the hospital for close observation, where it was found that his IOP severely increased soon after dialysis. After discussion with nephrology, increasing the duration and weekly number of dialysis sessions led to significantly improved IOPs. The patient has done well since that time and was able to return to normal dialysis length and schedule without issue. This case sheds light on possible IOP elevations post dialysis, especially if aqueous outflow is acutely impeded.

Introduction

Ocular dialysis disequilibrium describes a proposed phenomenon whereby intraocular pressure increases during hemodialysis due to disproportionate changes in the osmolality of aqueous humor as opposed to the blood. This imbalance in osmolality is thought to disrupt the equilibrium between production and outflow of aqueous humor in the eye, which determines the intraocular pressure (IOP) (1). Elevations in intraocular pressure can lead to vision-threatening complications such as acute angle closure glaucoma, both in patients with existing glaucoma and those without. Furthermore, other risk factors or acute conditions can contribute to IOP elevations and may also need to be controlled. In the case presented below, a pars plana vitrectomy (PPV) and intraocular lens (IOL) exchange complicated by hyphema and vitreous hemorrhage likely exacerbated the issue, as both can lead to increased ocular inflammation with blockage of the trabecular meshwork. This case presents an interesting etiology and potential solution for intraocular pressure elevation in an end-stage renal disease (ESRD) patient undergoing hemodialysis.

Case Presentation

A 74-year-old male presented for partially dislocated posterior chamber intraocular lens (PCIOL) in his left eye, which was his only functional eye. He suffered from multiple chronic illnesses, including Merkel cell carcinoma of the right eyelid and right parotid gland (currently in remission), blindness of the right eye due to complications from radiation treatments, chronic obstructive pulmonary disease, atrial fibrillation, gastroesophageal reflux disease, obstructive sleep apnea, coronary artery disease, and ESRD treated with dialysis for several years. Of note, the patient had not had any previous glaucoma or ocular hypertension issues. He subsequently underwent uncomplicated pars plana vitrectomy with IOL exchange with a scleral sutured IOL in the left eye. One day postoperatively the patient had a visual acuity of 20/40, but by day 3 post-operation, his vision had declined. One week post-operation, the patient's vision was restricted to perception of hand motion only (HMO) with severe pain, and significant vitreous hemorrhage, hyphema, and small nasal choroidal effusion noted on examination. His measured intraocular pressure was 39 mmHg, far exceeding the generally accepted "normal" range of 10 to 21 mmHg. We were able to regain control of the IOP with administration of topical brimonidine, dorzolamide, timolol, Xalatan®, and oral Diamox®. With the patient's IOP acutely managed, the plan at that time was to observe in the outpatient setting for spontaneous resolution of the previously noted hyphema and vitreous hemorrhage. However, during this observational period, he returned several times for urgent appointments due to severe pain,

in addition to nausea and vomiting. At this time, he was noted to have severe IOP elevations, with maximum recorded IOP reaching 53 mmHg. Given the unclear etiology of the patient's symptoms, he was admitted to the hospital for pain control and very close observation. Over the course of his inpatient stay, his IOP was checked frequently and noted to only severely spike in the evenings after dialysis. He was evaluated multiple times while on dialysis and never had significant elevation of IOP during treatment itself. At that time, we surmised that fluid shifts were a possible etiology of his symptoms, especially with vitreous humor now absent post PPV. Lengthy discussions with nephrology led to a plan to prolong dialysis treatment times, running the dialysis machine as slowly as possible to hopefully slow electrolyte and fluid shifts into the eye, with the goal of stopping the IOP spikes following dialysis sessions. The patient responded very well to this modified, prolonged dialysis protocol. His IOP never exceeded 24 mmHg and was typically in the middle to upper teens. Furthermore, with the addition of a fourth dialysis day per week, his IOP has been in the middle teens, even with discontinuation of Diamox. We have observed consistent IOP maintenance for months on this regimen. The patient additionally underwent anterior and posterior chamber wash out to treat his persistent vitreous hemorrhage. He is currently doing very well and seeing well from the previously affected eye. He has not had any significant IOP elevations since the alteration of his dialysis protocol.

Discussion

This case provides further evidence for the effect of hemodialysis on IOP, as well as a potential solution for managing IOP increases associated with said treatment. As mentioned above, one of the primary factors thought to contribute to changes in IOP is the changes in fluid osmolarity inherent to dialysis itself. Specifically, as molecules such as urea are removed from the blood, the osmolality of fluids in the body decreases. However, the decrease in aqueous humor osmolality is thought to be disproportional to the decrease in plasma osmolality, thus leading to hypertonicity of the aqueous humor. This hypertonicity leads water to move into the aqueous space (1). Additionally, a population-based study conducted in Malaysia found that the presence of chronic kidney disease may itself be another risk factor for elevated IOP due to impaired aqueous outflow (2).

Regarding management of IOP elevations during dialysis, the available body of literature is somewhat limited. While several possible solutions have been reported in prior studies, there does not appear to be a widely used protocol at this time. Prior suggested solutions have included administration of intravenous glucose, pan-retinal photocoagulation for neovascular glaucoma, and surgical interventions such as Ahmed valve implantation (1, 3–5). A case report by Maja et al. did note an attempt at decreasing dialysis rate as an intervention but ultimately resorted to placement of an Ahmed valve when dialysis modification was ineffective (3).

Of note, current literature related to this topic yields conflicting answers regarding the effects that dialysis may have on IOP. A 2015 study found that IOP decreased significantly after hemodialysis treatment (6). Conversely, literature reviews conducted by Levy et al. and Liakopoulos et al., respectively, were unable to demonstrate a clear correlation between hemodialysis and changes in IOP (7, 8). More recent studies conducted by Jung et al. and Wang et al. suggest that different patient responses in IOP may be due to individual differences in ocular structures such as anterior chamber angle and corneal thickness (9, 10).

While the current literature is divided regarding changes in IOP following dialysis, we believe that this case sheds some light on patient factors that may contribute to elevated IOP. We also hope that the case can provide a framework for effective treatment of elevated IOP in patients who may present similarly. A modification of dialysis protocol as described in this case — increasing treatment frequency and duration with a decreased dialysis rate — could prove invaluable for maintaining eye health in patients with various comorbidities who are also receiving concurrent ophthalmologic care.

Conclusion

In conclusion, we acknowledge that more definitive research is needed regarding the effects of dialysis on IOP, given the lack of consensus in the current literature. Additionally, there is much to explore in terms of the broader utility of dialysis modification in managing possible IOP increases, especially considering the scarcity of recent studies regarding this topic. It is our hope that cases such as this can contribute to further development of a flexible dialysis protocol that can accommodate patients with various

comorbidities, while minimizing risk for exacerbation or development of glaucoma.

Disclosures

Nothing to disclose.

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