

Recurrent Intraocular Pressure Elevation During Hemodialysis in a Patient with Neovascular Glaucoma

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Purpose: To report a patient with symptomatic intraocular pressure (IOP) elevation in an eye with neovascular glaucoma (NVG) during hemodialysis.

Methods: Case report.

Results: Recurrent episodes of severe ocular pain and elevated IOP in the NVG eye were noted during hemodialysis in a 29-year-old man. The patient was recently diagnosed at our ophthalmology clinic with NVG due to central retinal vein occlusion. IOP was temporarily controlled after the Ahmed valve implantation. However, after the fibrous membrane developed and occluded the tip of the Ahmed valve, IOP elevation during hemodialysis recurred. Further treatments with intravenous mannitol, oral carbonic anhydrase inhibitor, topical antiglaucomatous agents and subconjunctival 5-fluorouracil (5-FU) injections all failed to control relapsing pain and IOP elevation. Eventually, enucleation and hydroxyapatite implantation were performed.

Conclusions: Physicians must be alert to the possibility of IOP elevation in glaucomatous eyes during hemodialysis. *Korean Journal of Ophthalmology* 20(2):109-112, 2006

Key Words: Ahmed valve, Hemodialysis, Intraocular pressure (IOP), Neovascular glaucoma (NVG)

Hemodialysis is performed to maintain patients with end stage renal disease, but there are still various complications which are associated with the procedure. Headache, nausea and fatigue sometimes develop in combination with the rise in intraocular pressure (IOP). An intradialytic increase in IOP was already reported in patients without glaucoma,¹⁻⁶ and marked IOP increases had been shown in patients suffering from glaucoma.⁷⁻⁸ The mechanism that has been most widely proposed for this IOP increase is the movement of water from the plasma into the aqueous humour due to an osmotic disequilibrium between the two compartments caused by a rapid decrease in plasma osmolarity.¹⁻⁴

There have been studies on Korean nonglaucomatous patients with IOP elevations during hemodialysis and also on the medial control of intradialytic IOP elevation in Korean nonglaucomatous patients; but reports on glaucoma patients have been limited. We would like to report a neovascular glaucoma (NVG) patient with marked IOP elevation during

hemodialysis who had been refractory to treatment.

Materials and Methods

On August 2, 2004, a 29-year-old Korean male visited our ophthalmology department due to decreased visual acuity of his right eye for one week before the visit. His visual acuities were decreased to Right: 20/60, Left: 20/1000, and his IOPs were within the normal range. His vision at his previous visit on February 11, 2004 was Right: 20/25 and Left: 20/200. On fundus examination and fluorescein angiogram, a new diagnosis of central retinal vein occlusion was made in his right eye. There was no definite neovascularization on fluorescein angiogram and no relative afferent papillary defect (RAPD) at present. His left eye had showed old branch retinal vein occlusion with laser scars, which had been treated at our clinic two years before. He had end-stage renal failure due to Immunoglobulin A nephropathy, and he had begun regular hemodialysis at our hospital nephrology department in 1993. He also had secondary hypertension and was on medication for this condition.

We prescribed oral fibrinolytics. Since the patient was young and the fellow eye had branch retinal vein occlusion, we planned a trans pars plana vitrectomy and a radial optic neurotomy of his right eye. While waiting for the operation on August 30, he visited our clinic complaining of severe

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ocular pain. Unfortunately his visual acuity had dropped to light perception, the IOP of his right eye was 48 mmHg, and 360 degrees of neovascularization of the iris was observed. On gonioscopic examination, crowded new vessels were seen at 360 degrees of the open angle. The patient was diagnosed as NVG due to ischemic type central retinal vein occlusion. The patient was prospectively examined.

Results

On August 30, when first diagnosed as NVG, the patient's IOP was lowered to 4 mmHg by anterior chamber paracentesis. Anterior chamber paracentesis was chosen as an initial treatment in order to minimize metabolic complications that might have been accompanied by aggressive mannitolization or high-dose oral acetazolamide medication. Topical β -blocker, a carbonic anhydrase inhibitor combination (Cosopt[®]), α -agonist (Alphagan[®]), prostaglandin analogue (Travatan[®]) and oral acetazolamide (Diamox[®]) 125 mg four times a day were prescribed. However, a few hours later he visited our emergency department suffering throbbing ocular pain during hemodialysis and his IOP was 38 mmHg. Severe ocular pain during hemodialysis also developed on September 1, and the IOP of his right eye was 46 mmHg. The IOP was lowered to 16 mmHg by anterior chamber paracentesis, but a 1.5-mm high hyphema developed. Ahmed valve implantation was done on September 2. The IOP was managed at a normal range until 19 days postoperatively.

On the 20th day postoperatively, the IOP of his right eye was 35 mmHg following hemodialysis, and was normalized

by anterior chamber paracentesis and subconjunctival 5-fluorouracil (5-FU) injection. Gross hyphema developed after the injection which prevented examination of the status of the anterior chamber. On September 24, his IOP was 28 mmHg before hemodialysis, but on the same day he suffered severe ocular pain and his IOP was elevated to 48 mmHg after hemodialysis. Since the IOP elevation and pain usually happened in the afternoon following hemodialysis, we decided to check his IOP both before and after the hemodialysis.

From September 24 through October 6, the mean IOP difference of the patient's NVG eye before and after hemodialysis was 26 mmHg, and the difference showed statistical significance (SPSS version 11.5, Nonparametric Wilcoxon signed ranks test; $p=0.028$) (Fig. 1). The IOP of the fellow eye remained in the normal range without a statistical shift regarding the hemodialysis ($p=0.066$) (Fig. 1). To stop the vicious cycle, we checked and controlled his IOP before starting hemodialysis and also mixed 300-400 cc of 25% mannitol during the hemodialysis. His IOP was successfully controlled by this method for ten days thereafter. By October 18, the hyphema was much improved but a fibrous membrane occluding the Ahmed valve tip developed and the IOP began to rise again. A Neodymium: YAG laser at the fibrous membrane and a subconjunctival 5-FU injection were performed but failed to control the IOP. On behalf of many trials the patient had recurrent ocular pain attacks and nonclearing hyphema, and his IOP was around 50 mmHg with no response to treatment. On November 18, evisceration and hydroxyapatite implantation were performed.

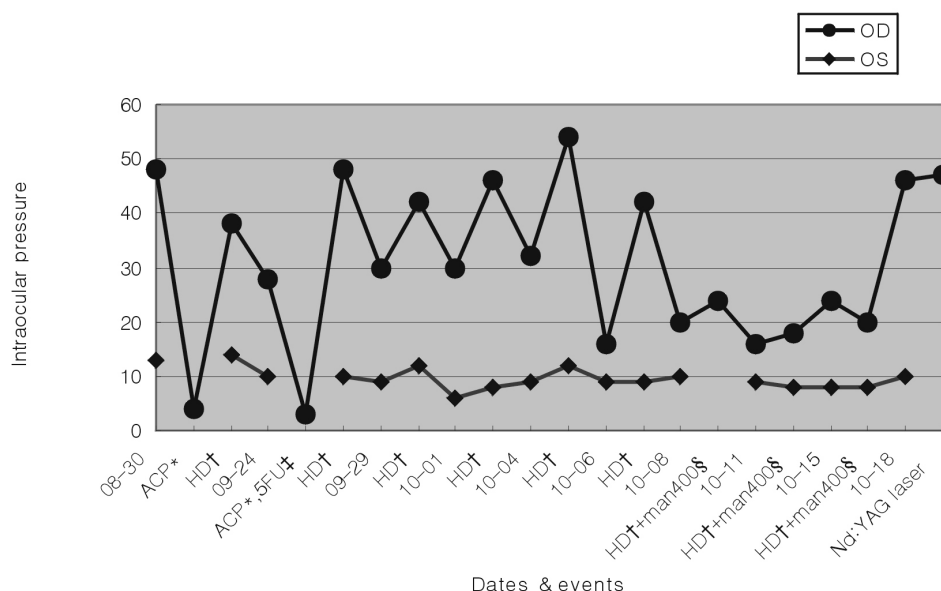


Fig. 1. Intraocular pressure shifts according to dates and events.

Intraocular pressures were checked by Goldmann applanation tonometry (mmHg). *ACP=anterior chamber paracentesis; † HD =hemodialysis; ‡ 5-FU=subconjunctival 5-fluorouracil injection; §man 400=intravenous mannitolization 400 cc; OD=right eye; OS =left eye.

Intraocular pressure of the NVG eye (right eye) of the patient showed a marked increase after hemodialysis ($p=0.028$). The intraocular pressure of the left eye remained within the normal range without statistical change regarding hemodialysis ($p=0.066$).

Discussion

Intradialytic IOP elevation can occur, and there have already been several reports on this issue. It has been reported in patients without glaucoma¹⁻⁶ and also in patients suffering from glaucoma.⁷⁻⁸ Jung et al.⁵ found IOP elevation after hemodialysis in Korean nonglaucomatous patients. IOP fluctuation is more harmful in glaucoma patients, and since reports on IOP fluctuations in glaucoma patients during hemodialysis have been limited, we decided to present this case.

There have been many mechanisms reported to explain this phenomenon. The most common is that the rise in IOP may be the result of a rapid fall in plasma osmolarity with a consequent increase in aqueous formation: a mechanism analogous to the cerebral edema that occurs in the disequilibrium syndrome. This relation between plasma osmolarity and IOP during hemodialysis has been studied since the report of Sitprija and coworkers.⁹⁻¹¹ They first discovered that a rapid decrease in plasma osmolarity caused markedly increased IOP levels during hemodialysis. However there is conflicting evidence about the rate of an osmolarity decrease that can induce an increase in IOP during hemodialysis. In addition, Hojs and Pahor¹² could not find statistically significant differences in IOP either before or after hemodialysis even though osmolarity changes were present. They insisted that with modern techniques of hemodialysis, a rise in IOP might be unlikely. Tokuyama et al.¹³ even reported a decrease in IOP after hemodialysis, and also that IOP change had inverse correlation with the increase in plasma colloid osmotic pressure caused by the removal of fluid during the hemodialysis.

Some have suggested that decreased aqueous outflow might be the mechanism of an intradialytic IOP increase since most of the patients who showed an IOP elevation during hemodialysis also had a shallow anterior chamber angle.^{2,14-16} Low pCO₂ was also reported as a cause.¹¹ However, Tawara et al.¹⁷ and Seo et al.¹⁸ showed that a pCO₂ elevation was not significant during hemodialysis and that neither had correlations with IOP.

The NVG patient initially had an open angle of Grade 4 using the Shaffer grading system with no peripheral anterior synechiae. Although gonioscopy could not be performed after the hyphema developed, the patient probably had a crowded occluded angle with neovascularization and obstruction of the trabecular meshwork with red blood cells. Thus the rapid fall in plasma osmolarity and disequilibrium due to hemodialysis and decreased aqueous outflow both seem to be the mechanism of IOP elevation in this case. We may have been given more information if the plasma osmolarity and plasma colloid osmotic pressure of the patient had been checked in this patient. However, this case is a good example to remind physicians of complications associated with hemodialysis.

As a treatment modality, carbonic anhydrase inhibitor has long been accepted as the drug of choice in hemodialysis-

associated IOP elevation. Nevertheless, oral carbonic anhydrase inhibitor causes metabolic acidosis which might be fatal to patients with end-stage renal disease. Seo et al.¹⁸ administered an oral hypertonic solution (glycerol) instead and showed effective IOP control with less complications in NVG and glaucoma patients. The topical carbonic anhydrase inhibitor was less effective than the oral administration used in their study. Masuda et al.⁷ reported that Argon laser trabeculoplasty successfully controlled the IOP elevation in exfoliative glaucoma patients showing intradialytic IOP elevation, while Choong et al.⁶ reported that bilateral IOP elevation after hemodialysis stabilized with topical β -blocker in nonglaucomatous patients.

In this case, elevated IOP levels during hemodialysis were refractory to the treatments. The cause seems to be the occlusion of the aqueous outflow due to the neovascularization of the angle, fibrosis of the Ahmed valve tip, and fibrosis of bleb. This was because intradialytic IOP elevations were controlled before the formation of the fibrous membrane. The patient's young age and NVG are both well-known risk factors of bleb fibrosis and failure.

According to this case, physicians should be aware of the possibilities of IOP elevation during hemodialysis in glaucomatous patients. There have been several studies with nonglaucomatous patients, but reports on IOP fluctuations in glaucomatous patients under hemodialysis are still limited. So far, the influence of hemodialysis on IOP is not clear, and even in recent studies opposite findings have been found.¹⁹ Further evaluations of glaucoma patients under regular hemodialysis with information including their osmolarity, plasma colloid pressure and gonioscopic findings might be meaningful in future studies.

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