THE EFFECT OF HEMODIALYSIS ON COLLOID OSMOTIC PRESSURE AND INTRAOCULAR PRESSURE

Ibrahim Smadi, MD, JB*, Sami Dassan, MD, JB**, Nabil Akash, MD, JB*

ABSTRACT

Objective: To investigate the relationship between changes in the intraocular pressure and plasma osmolarity, plasma colloid osmotic pressure, and body weight before and after hemodialysis.

Methods: Intraocular pressure, plasma osmolarity, plasma colloid osmotic pressure, and body weight were evaluated before and after hemodialysis in 32 patients with chronic renal failure.

Results: Significant decrease in intraocular pressure and plasma osmolarity was found post dialysis ($p<0.001$). Plasma colloid osmotic pressure increased significantly after dialysis ($p<0.001$). Because of fluid removal during dialysis body weight decreased significantly after dialysis ($p< 0.001$). There was no significant correlation between the changes in intraocular pressure and that in plasma osmolarity ($r=-0.2$, $p>0.2$). Change in the intraocular pressure correlated with change in plasma colloid osmotic pressure ($r=-0.5$, $p<0.001$) and the change in body weight ($r=0.5$, $p<0.001$). The change in plasma colloid osmotic pressure and that in body weight was statistically significant ($r=-0.7$, $p<0.001$).

Conclusion: The decrease in intraocular pressure correlated inversely with the increase in colloid osmotic pressure because of fluid removal during hemodialysis.

Key words: Colloid osmotic pressure, Intraocular pressure, Hemodialysis

JRMS Dec 2002; 9(2): 27-29

Introduction

Many authors [1,2] have described elevation in intraocular pressure (IOP) during hemodialysis because of chronic renal failure. It has been suggested that osmotic disequilibrium between serum and eyes is the underlying cause for these changes [1,2]. This occurs particularly in those with abnormal ocular outflow [2]. Recently, the relationship between IOP and plasma colloid osmotic pressure has been investigated [3]. In this study, the relationship between IOP, plasma osmotic pressure, plasma colloid osmotic pressure, and body weight before and after hemodialysis was investigated.

Methods

Thirty-two patients treated with hemodialysis at Prince Rashed Ben Al-Hassan Hospital for chronic renal failure between June to December 2000 were evaluated. No patient had ocular disease. Mean age was 42±12 ranging from 15 to 75 years. All patients were dialysed for a mean of 3.85 hours/session (range 3.5-4.5). An ophthalmic examination including Goldmann applantation tonometry was performed before and after hemodialysis. Plasma osmolarity was measured by freezing point depression. Plasma colloid osmotic pressure was calculated from the formula: Plasma colloid osmotic pressure = 5.5 X concentration of plasma albumin + 1.4 X the concentration of plasma globulin [4]. The amount of fluid removed during hemodialysis was considered as the change in body weight.

Statistical analysis

Data are presented as mean ± standard deviation. T-test was used in the statistical analysis. The p-value was set as significant if below 0.05. Correlation using coeffient of correlation =r was also applied.

Results

The IOP, plasma osmolarity, plasma colloid osmotic

From the Departments of:
*Internal Medicine, Prince Rashed Ben Al-Hassan Hospital, (PRBHH), Irbid-Jordan
**Ophthalmology, (PRBH)
Correspondence should be addressed to Dr. I. Smadi, (PRBHH).
Manuscript received February 2, 2001. Accepted February 6, 2002

pressure, and body weight before and after hemodialysis are shown in Table I. It was found that IOP decreased significantly post dialysis in both eyes (IOP right eye 14.2±2.7 mm Hg pre dialysis and 11.1±1.7 mm Hg post dialysis, p<0.001: IOP left eye 13.4±1.8 pre dialysis went to 11.2±2 mm Hg post dialysis, p<0.001). The change in IOP post dialysis was –3.1±2.3 mm Hg in the right eye and –2.2±1.4 mm Hg in the left eye. The plasma colloid osmotic pressure increased significantly from 25±1.7 pre dialysis to 27.1±2 mm Hg post dialysis p<0.001. Plasma osmolarity decreased from 307±4.5 pre dialysis to 287±13 mOsm/l after dialysis (p<0.001). Body weight decreased from 62±12.2 pre dialysis to 58±12.5 Kg after dialysis (p<0.001) due to fluid removal. There was a correlation between the change in IOP and that in plasma colloid osmotic pressure after hemodialysis (*r*=-0.5, p<0.001) (Fig. 1) and the change in body weight (*r*=0.5, p<0.001). A significant correlation between the change in plasma colloid osmotic pressure and that in body weight was also found (*r*=-0.7, p<0.001). However, there is no significant correlation between changes in IOP and that in plasma osmolarity (r= -0.2, P>0.2).

Discussion

The aim of hemodialysis is to correct the composition of the body fluid. Correction of body fluid composition results in change in plasma osmolarity. Removing of excessive accumulation of fluid causes change in plasma colloid osmotic pressure. Hemodialysis, although vital for patients with severe renal failure, has also unfavorable side effects. In the ophthalmic area, increase in IOP during hemodialysis accompanied by ocular pain has been reported [(1)]. Many studies evaluated the change in IOP and its relation to plasma osmolarity [(2,5)]. Few reports have been published about the relationship between the hydrodynamic change during hemodialysis and that of plasma colloid osmotic pressure [(4,6)]. It has been found that plasma colloid osmotic pressure is important in the hydrodynamic changes that occur during hemodialysis [(6)]. Increased concentration of plasma proteins such as albumin and globulin caused by water removal leads to an increase in plasma colloid osmotic pressure. As a result, water is pushed from the aqueous humor into the plasma causing reduction in IOP. Our study showed significant increase in colloid osmotic pressure after dialysis, which correlated significantly with the decrease in the IOP. This is in agreement with other reports [(3,4,6)]. Our data showed a change in plasma osmolarity of -3 mOsm/l/h, which was associated with significant change in IOP. The rate of osmolarity decrease that can induce an increase in IOP during hemodialysis is conflicting. Tokuyama and coworkers reported that IOP increased significantly when the change in plasma osmolarity during hemodialysis was –4.1 mOsm/l/h [(4)]. Gafter and coworkers showed no significant increase in IOP during hemodialysis when the change in plasma osmolarity was -6 mOsm/l/h.

The IOP did not change significantly in 16 patients during or following a high-flux hemodialysis treatment in spite of change in plasma osmolarity of –7.7 mOsm/l/h [(7)]. It seems that using modern techniques of hemodialysis [(7)] and modification in the dialysis parameters [(1,8,9)] make significant increase in IOP unlikely.

In conclusion, our study showed a significant correlation between the change in IOP and the change in plasma colloid pressure during hemodialysis. Intraocular pressure tends to decrease during hemodialysis owing to increase in plasma colloid osmotic pressure resulting from water removal.

Table I. Intraocular pressure, plasma colloid osmotic pressure, plasma osmolarity, and body weight in 32 patients before and after hemodialysis.

	Before hemodialysis (mean ± SD°)	**After hemodialysis (mean ± SD)**	**Change in value (mean ± SD)**	**P value**
IOP* Rt. Eye	14.2±2.7	11.1±1.7	-3.1±2.3	<0.001
IOP Lt. eye	13.4±1.8	11.2±2	-2.2±1.4	<0.001
PCOP**	25±1.7	27.1±2	2.9±2.6	<0.001
PO^	307±6.7	287±6.6	-11.7±7.5	<0.001
Body weight	62±12.2	58±12.5	-3.4±0.5	<0.001

* IOP: Intraocular pressure.
** PCOP: Plasma colloid osmotic pressure.
^ PO: Plasma osmolarity.
° SD: Standard Deviation.

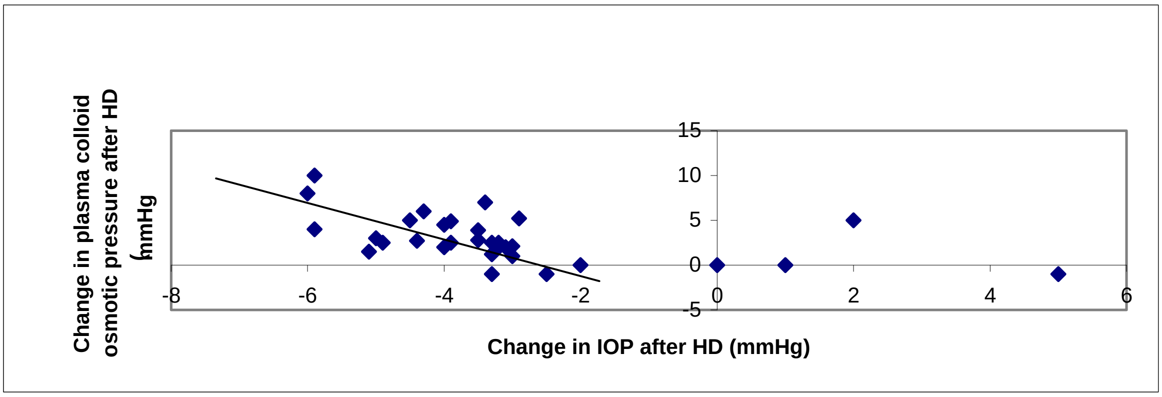

Fig. 1. Correlation between the change in IOP and that of plasma colloid osmotic pressure after hemodialysis (HD).

References

1. **Ignacio M, Jose A, Begona A, Ramon R.** Prevention of intraocular pressure elevations during hemodialysis. *American Journal of Kidney Diseases* 2000; 36: 197-198.
2. **Sitprija V, Holmes JH, Ellis PP.** Intraocular pressure changes during artificial kidney therapy. *Arch Ophthalmol* 1964; 72: 626-631.
3. **Tokuyama T, Ikeda T, Sato K, *et al*.** Marked decrease in intraocular pressure in a neovascular glaucoma patient during hemodialysis. *Jpn J Ophthalmol* 1997; 41:101-103.
4. **Tokuyama V, Ikeda T, Sato K.** Effect of plasma colloid osmotic pressure on intraocular pressure during hemodialysis. *Br J Ophthalmol* 1998; 82:751-753.
5. **Leiba H, Oliver M, Shimshoni M, *et al*.** Intraocular pressure fluctuations during regular hemodialysis and ultrafiltration, *Acta Ophthalmol* 1990; 68: 320-322.
6. **Fauchald P.** Transcapillary colloid osmotic gradient and body fluid volumes in renal failure. *Kidney Int.* 1986; 29: 895-900.
7. **Austin JN, Klein M, Mishell J, *et al*.** Intraocular pressures during high-flux hemodialysis. *Renal Fail* 1990; 12: 109-112.
8. **Jaeger PH, Morisol M, Wauters JP, *et al*.** Prevention of glaucoma during hemodialysis by mannitol and acedazolamide. *N Engl J Med* 1980; 303: 702.
9. **Rever B, Fox L, Christensen R, *et al*.** Adverse ocular effects of acetate-hemodialysis. *Am J Nephrol* 1983; 3: 199-204.