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Intraocular pressure during haemodialysis

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There are now many patients with severe renal disease who are maintained for long periods on repeated haemodialysis. A case showing a gross rise in intraocular pressure recently drew attention to some of the ocular problems of management which may occur during this treatment.

Summary of observations

A 45-year-old woman, having borne five children and suffered from toxamia of pregnancy, developed hypertension, chronic pyelonephritis, and uraemia. In April, 1970, she underwent bilateral nephrectomy and was afterwards maintained on twice-weekly haemodialysis and anticoagulant therapy while awaiting a renal transplant.

In November, 1970, she developed spontaneous hyphaemata in both eyes, visible macroscopically in the right and as a dense flare with the slit lamp in the left. There were numerous dilated vessels on both irides, especially in the chamber angles, and on both optic discs. The anterior chambers were deep due to a recession of the lens-iris diaphragm. The intraocular pressures were low—right 7 mm. Hg, left 8 mm. Hg applanation. After treatment with steroid drops the blood absorbed, the flare subsided, and the dilated vessels disappeared. Gonioscopy at this stage revealed a wide angle in the right eye, open below but with extensive peripheral anterior synechiae to trabecular level elsewhere, estimated at 70 per cent. of the circumference. The left eye was described as showing a 'false angle' with peripheral anterior synechiae to trabecular level all round. The pressure in the right eye returned to normal but that in the left remained very low between dialyses. The corrected visual acuity at this stage was right 6/9 left 6/24.

After these events the patient complained repeatedly of pain in the left eye during dialysis. Measurements of intraocular pressure before, during, and after dialysis showed a striking and consistent pattern. The pressure in the right eye was within the normal range and either remained unaltered or showed only a slight rise during dialysis. That in the left, however, although starting well below the normal level, began to rise after an hour from the start of dialysis. The following figures were recorded:

Intraocular pressure (mm. Hg Schiötz)

Time of measurement	*Right*	*Left*
Between dialyses:	17·3	7·1
6 hours after start:	21·9	81·6

Tonography

This was carried out between dialyses using a Schiötz tonometer. The low initial pressure in the left eye made recording difficult. The coefficient of outflow was 0·15 in the right eye and 0·06 in the left, suggesting that a gross obstruction to outflow was contributing to the large rise in pressure in the left eye.

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Histology

This suggestion was confirmed by the report on the eyes removed for pathological examination after death, which included the following statements:

RIGHT EYE: Extensive peripheral anterior synechiae are present on one side of the anterior chamber: on the opposite side the angle is widely patent and Schlemm's canal open.

LEFT EYE: Extensive peripheral anterior synechiae are present on both sides of the anterior chamber, completely occluding the canal and trabecular meshwork.

Management

In an attempt to relieve the severe pain accompanying these pressure changes, and in the hope of reducing the adverse effects on the optic nerve, 500 mg. of Diamox and Pilocarpine drops 2 per cent. were given at the beginning of dialysis. There was some subjective improvement and the rise in pressure in the left eye was less severe, but the general pattern remained the same and as time went on the rise in tension in the right eye during dialysis increased.

The left optic disc gradually became atrophic, the vision being reduced to perception of light. The visual acuity of the right eye also began to deteriorate and was giving great cause for anxiety when the patient died in November, 1971.

Observations on other dialysis cases

Intraocular pressure readings were taken before and during dialysis in thirteen cases without ocular symptoms or known ocular disease other than hypertensive retinopathy. A rise in intraocular pressure occurred in six cases and tonography readings between dialyses were obtained in three of these. The Table shows the pressure changes and outflow characteristics in these eyes.

Table *Pressure changes in twelve normal eyes showing a rise during dialysis with outflow readings*

Pressure before dialysis		*Pressure rise during dialysis*		*Outflow facility (8 eyes)*	
Mean	*S.D.*	*Mean*	*S.D.*	*Mean*	*S.D.*
18·1	± 0·99	+5·5	± 1·6	0·35	+ 0·85

Discussion

It is clear from the thirteen cases examined that a rise in intraocular pressures occurs in at least one-third of cases undergoing dialysis, although this rise is not gross provided the outflow facility is normal. Nevertheless, the average diurnal variation in intraocular pressure is only about 3 mm. Hg (Duke-Elder, 1952), so that even when the outflow is good (normal value 0·28 ± 0·05; Becker and Shaffer, 1961) dialysis can still, on average, almost double any rise in pressure which might be due to chance.

The rise in pressure may possibly be due to the rapid fall of serum osmolarity during dialysis with a consequent increase in aqueous formation—a mechanism analogous to the cerebral oedema which occurs in the disequilibrium syndrome (Hampers and Schupak, 1967). Several authors have recorded a rise in intraocular pressure during dialysis in human subjects (Sitprija, Holmes, and Ellis, 1964a; Appelmans, Dernouchamps, de Wolf,

and Dralands, 1967; Ramsell, Ellis, and Paterson, 1971) while Sitprija and others (1964b) have shown that a rise in intraocular pressure of nearly 50 per cent. can occur during dialysis of uraemic dogs if the serum osmolarity falls rapidly but that no significant increase takes place if dialysis proceeds more slowly or if acetazolamide is administered.

It seems, therefore, that the state of the intraocular pressure should be considered when planning long-term haemodialysis and that the possibility of outflow obstruction should be kept in mind. Patients with chronic simple glaucoma in particular may have to be protected by the administration of Diamox and pilocarpine before dialysis.

Summary

A case is described in which a severe rise of intraocular pressure occurred repeatedly in one eye during haemodialysis, in association with a gross obstruction to outflow as demonstrated by tonography and *post mortem* histology. Pressure readings during dialysis in twelve other cases, with tonography in six between dialyses are also presented.

Certain practical implications in the planning of long-term haemodialysis are suggested.

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