Original Paper · Travail original · Originalarbeit

Ophthalmologica

Ophthalmologica 2000;214:403–405

Received: May 17, 1999
Accepted after revision: December 1, 1999

Visual Acuity Disturbances in Chronic Renal Failure

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Key Words
Refraction · Visual acuity · Hemodialysis · Chronic renal failure

Abstract
Patients affected by chronic renal failure often complain of blurred vision when submitted to hemodialysis. Refraction, visual acuity and lens transparency have been evaluated in 36 eyes of 18 patients who underwent hemodialysis, before and after the treatment. Student's t test did not prove any statistically significant difference between the considered parameters. However, a change in refraction was noted in 64% of the eyes, always in hyperopic mean. Corrective glasses had to be changed to ensure the same visual acuity as before the hemodialytic treatment. Particular care must be taken in lens prescription in those patients who could undergo dialysis for chronic renal failure.

Introduction

Lens transparency and its changes have long been investigated in healthy subjects as well as in pathological conditions by using different methods. The age-related opacification process of the lens in healthy subjects has been studied with the help of the Opacity Lens Meter 701 [1]. The influence of diabetes mellitus on the lens transparency has been investigated by using linear densitometry of the Scheimpflug camera [2] and with the Opacity Lens Meter 701 [3].

The Scheimpflug camera has been shown to be one of the most reliable devices for objective lens transparency assessment. However it does not allow a simple quantification index for lens opacification staging because it requires a microdensitometric analysis to translate the photographic findings into numerical data [4].

The Lens Opacity Meter 701 is based on the quantification of the backscattered light from the lens when this is explored with a light whose wavelength is close to the infrared. The backscattered light gives a numerical index of lens transparency. Normal values, determined in previous papers, for lens transparency in a healthy population have been established with the Opacity Lens Meter. This device is therefore more easily used for comparison between healthy subjects and patients affected by different pathologies.

In our experience a large proportion of patients under hemodialytic treatment complain of blurred vision after dialysis. This might be due to hemodialysis which provokes remarkable changes in osmolality in any extracellular liquid [5].

In our study we intend to investigate whether patients with chronic renal failure, submitted to hemodialysis, show a change in refractive conditions and in lens transparency before and after the treatment.

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Materials and Methods

Thirty-six eyes of 18 patients affected by chronic renal failure were enrolled in the study. The patients' mean age was 47.2 ± 22 years, and they were all submitted to hemodialytic treatment for 2 ± 1 years.

Hemodialytic treatment had the following characteristics: sodium bicarbonate dialysis for every patient, 3 times a week, session lasting 3.5–4 h. The composition of the dialytic solution was: 141 mEq/l, K 2 mEq/l, sodium bicarbonate 32 mmol/l, glucose 1 g/l. The mean reduction in body weight after dialysis was 3.3 ± 0.7 kg. All patients were under therapy with antihypertensive drugs, such as ACE inhibitors or calcium channel blockers and calcium carbonate. Fourteen of 18 patients were under treatment with erythropoietin and 13/18 were under treatment with vitamin D.

Main hematochemical parameters before dialysis were: Ht(%) 32.3 ± 3.4, calcium 9.9 ± 0.7 mg/dl, PO_4 4.5 ± 1.2 mg/dl, K 5.3 ± 0.5 mEq/l, Na 137 ± 3 mEq/l. Mean values of urea and serum creatinine before dialysis were 80 ± 9 and 9 ± 2 mg/dl; after dialysis 30 ± 8 and 4 ± 2 mg/dl, respectively.

Every patient was submitted, before being included in the study, to a complete ophthalmic check. Slit lamp examination, visual acuity measurement with and without correction, tonometry by applanation, autorefractometry and ophthalmoscopy were carried out. Three basic parameters have been taken into account in our study: lens transparency, visual acuity and refractometry.

The Lens Opacity Meter 701 was used to measure the density of the lens; this instrument emits a modulated dark red beam, 700 nm of wavelength, and 1.5 mm in diameter. The subject looks at a green fixation target in the instrument, enabling the examiner to position the red beam in the center of the lens in order to make a measurement of any opacity which is located along the optic axis only [6, 7].

Depending on the density of the opacity of the lens, a smaller or larger proportion of the light is scattered back toward the Lens Meter. The scattered light is received by a sensor, which converts the light signal into an electrical impulse. The examination takes a few minutes; five consecutive measurements are taken for each eye and the results are displayed digitally. There is also a printout facility. A printed paper strip gives the value of each measurement, the mean value and the standard deviation. The mean of five consecutive measurements was considered as lens transparency value.

To obtain a minimum pupil size of 5 mm all the examinations were performed in a darkened room and background light was dimmed if necessary; none of the patients was dilated pharmacologically.

Visual acuity was measured in tenths of Snellen fractions at a distance of 3 m. Refractometry was obtained by using an autorefractometer (model Nikon 5500). Lens transparency measurement, visual acuity and autorefractometry were performed before and after dialysis.

An age-matched control group of 30 eyes of 15 nephropathic patients was considered. None of these patients underwent dialysis. Student's t test was used to investigate any statistical significance.

Results

The lens transparency in the 36 eyes studied ranged from 10 to 41.6 with a mean value of 23.8 ± 11.2 before dialysis. Lens transparency in the control group ranged from 11 to 39.8 with a mean of 24.1 ± 10.7. Student's t test did not yield any statistical difference ($p = 0.7126$) of lens transparency in both groups.

After dialysis, lens transparency in the eyes studied ranged from 9.4 to 41.4 with a mean of 23.4 ± 10.9. There was no statistical difference ($p = 0.8232$) as compared with the values before dialysis by Student's t test. No statistical significance was noted between lens transparency values in the eyes studied after dialysis and controls ($p = 0.7943$).

Visual acuity before dialysis ranged from 0.2 to 1.0 with a mean of 0.72. In the control group, visual acuity ranged from 0.3 to 1.0 with a mean of 0.78. No statistical significance was present in both groups with regard to visual acuity. After dialysis, visual acuity in the eyes studied ranged from 0.3 to 1.0 with a mean of 0.74 and Student's t test did not show any statistically significant difference before and after the treatment ($p = 0.8434$). No statistical significance was noted either in visual acuity after dialysis and control values ($p = 0.7985$).

Due to the difficulty of analyzing a parameter composed of two variables, spherical and cylindric, we considered the spherical equivalent to analyze refractive changes. Student's t test was not statistically significant after dialysis ($p = 0.4932$). However, we could observe that, to obtain best visual acuity after dialysis, refraction was changed in 23 of the 36 eyes examined. A hyperopic refractive change, ranging from +0.25 to +0.75, was always noted.

From our results we can state that no statistically significant difference was found in lens transparency, as well as in visual acuity and in refraction before and after hemodialysis. We can also remark that refraction changed in 64% of our patients after dialysis, even if no statistical significance was found. It seems therefore that hemodialysis does not alter lens transparency but in some way it might modify the refractive condition of the eye.

Discussion

Lens transparency and its age-related opacification process have long been investigated. Many caractogenic risk factors have been identified and different methods have been used to study them [8]. The availability of a simple and reproducible method to quantify lens opacity is very important in any study concerning lens opacification progress. The Opacity Lens Meter seems to us a useful and suitable device to document, with a numerical quantification, a change in lens transparency.

Chronic renal failure has already been recognized as a risk factor in cataractogenesis [9]. Previous papers reported ocular findings which were strictly related to the hypocalcemia subsequent to dialysis [10, 11]; our patients, thanks to a therapy with calcium carbonate and vitamin D, never showed calcium serum values below the normal range.

However, we are not focusing on the cataractogenic potential of chronic renal failure but on the blurred vision that many of the patients complain of after dialysis, trying to identify the reason of visual acuity disturbances. The Opacity Lens Meter did not show any statistically significant difference in lens transparency before and after hemodialysis. This treatment does not seem to induce any objective change in lens transparency and visual acuity was the same before and after the treatment. Statistically speaking, we did not find differences in refraction, however the blurred vision of our patients prompted us to change, in 64% of them, refractive correction to ensure the best visual acuity possible. In all cases of refractive change, an increase in hyperopic degree was measured, ranging from +0.25 to +0.75.

Hemodialysis induces a remarkable plasmatic osmolarity variation due to the quick decrease in urea, creatinine and other osmotically active substances. Osmolarity variation is often not so quick in some tissues as in the rest of the body, in the brain, for instance [12, 13]. This is due to the different passage of certain osmotically active substances through the barriers of some tissues, which are freely permeable to water but slowly permeable to urea and creatinine. This different osmotic gradient is responsible for a quick shift of water in certain tissues.

For this reason we believe that the difference in refraction might be due to a change in lens hydration, with no changes in transparency. Care must be taken in lens prescription in those patients affected by chronic renal failure who could undergo dialytic treatment.

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