Uremic Optic Neuropathy: A Potentially Reversible Complication of Chronic Kidney Disease

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Keywords
Uremic optic neuropathy · Hemodialysis · Steroids

Abstract
Uremic optic neuropathy (UON) is one of the rare causes of vision loss in chronic kidney disease patients. It is infrequently seen nowadays as most of the patients are dialyzed early owing to better availability of medical services. It is a clinical diagnosis, correlating loss of vision with optic disc edema in a patient with kidney failure which improves noticeably with hemodialysis and steroids. We describe a patient with UON with excellent improvement on timely institution of hemodialysis and steroid therapy.
Case Report

A 27-year-old male patient presented to the hospital with headache and decreased vision for 3 days with rapid deterioration in a day. There was no history of fever. He had a history of easy fatigability for the past 6 months, pedal edema, and reduced urine output for the past 2 weeks. He had no comorbidities and was neither a smoker nor an alcoholic. Blood pressure and pulse rate on admission were 190/96 mm Hg and 90 beats/min. Physical examination showed pallor, bilateral pedal edema, and raised jugular venous pulses. He was conscious and oriented. He had no sensory or motor deficit and no neck rigidity.

Pupils showed isocoria and sluggish response to light bilaterally, and extraocular movements were normal. Ophthalmic examination revealed a visual acuity of 2/60 and 5/60 in the right eye and left eye, respectively, with a normal field of vision, and color vision was poor in both eyes. Fundoscopy revealed hard exudates over the macula with disc edema in both eyes (shown in Fig. 1).

Laboratory investigations revealed a hemoglobin level of 4.7 g/dL, serum creatinine 15.3 mg/dL, and urea 160 mg/dL (Table 1). Urinalysis detected 2+ proteinuria (Table 2). Ultrasonography of the kidneys showed bilateral small-sized kidneys with loss of corticomedullary differentiation. Computed tomography of the brain was a normal study. Anti-nuclear antibody by the immunofluorescence method was negative with normal complement levels. Anti-neutrophil cytoplasmic antibodies serology was also negative. Hepatitis B surface antigen was negative. As the patient was young and did not have a history of hypertension, native kidney disease was attributed to undiagnosed chronic glomerulonephritis, though hypertensive nephrosclerosis could not be ruled out definitely. His blood pressure was controlled gradually with antihypertensives, and hemodialysis was initiated along with steroid therapy and blood transfusion. Three units of packed red blood cells (∼350 mL each) were transfused during dialysis for the first 3 days (1 unit per day). Hemoglobin improved to 8.1 g/dL. Dialysis was conducted daily for the first 3 days and on alternative days for the next 2 weeks and then continued on a thrice-weekly schedule (Table 3). Corticosteroids given were methylprednisolone 500 mg intravenously once daily for 3 days followed by oral prednisolone 1 mg/kg once daily for 1 month followed by tapering for 1 month.

On day 2 of dialysis, the patient had a subjective improvement in vision. And, on day 4 after initiation of treatment, visual acuity was 4/60 and 6/60 in the right and left eye, respectively. Fundus showed circumpapillary “high water” line due to improving edema. One month later, the

Fig. 1. Fundus picture. Mild pale edema of the optic disc with hard exudates and narrow retinal vessels in the right and left eye of the patient.
Patient's vision improved noticeably, 6/36 and 6/24 in the right eye and left eye, respectively, with brisk pupillary light reflexes.

**Discussion**

Optic neuropathy in uremia can be categorized etiologically into five main groups [1]: UON, ischemic optic neuropathy, optic neuropathy associated with adverse drug events, optic neuropathy as a consequence of increased intracranial pressure, and optic neuropathy associated with cerebral infection. Ischemic optic neuropathy presents with sudden painless visual loss, optic disc edema, and an altitudinal visual field defect [1]. The visual field defect is nearly pathognomonic of the disease which was not seen in our patient, and it does not

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**Table 1. Investigations**

| Investigations | Values | Reference range |
|---------------|--------|-----------------|
| Hemoglobin, g/dL | 4.7    | 13.5–17.5       |
| Total count, cells/cumm | 9,200 | 4.5–13.2        |
| Differential count, % | | |
| Neutrophils | 60     | 34–71           |
| Lymphocytes | 29     | 19–53           |
| Monocytes | 7      | 5–13            |
| Eosinophils | 4      | 1–7             |
| Platelets, ×10^5/mm | 1.7   | 1.5–4           |
| Urea, mg/dL | 160    | 15–40           |
| Creatinine, mg/dL | 15.3  | 0.5–1.2         |
| Sodium, mEq/L  | 131    | 135–145         |
| Potassium, mEq/L | 4.1   | 3.5–5           |
| Calcium, mg/dL | 8.1    | 8.6–10.3        |
| Phosphate, mg/dL | 5.5    | 3.4              |
| Bicarbonate, mEq/L | 16 | 23–30           |
| Serum albumin, g/dL | 3.1 | 3.4–5.4         |
| Serum globulin, g/dL | 2.6 | 2–3.5            |
| Bilirubin, mg/dL | 1.3    | 0.2–0.8         |
| Direct, mg/dL | 0.8    | 0.1–0.4         |
| Indirect, mg/dL | 0.4   | 0.2–0.7         |
| Alanine aminotransferase, U/L | 38 | 0–40            |
| Aspartate aminotransferase, U/L | 45 | 0–40              |
| Antinuclear antibody (immunofluorescence) | Negative | Negative |
| Complement levels (immunoturbidometery) | | |
| C3, g/dL | 1.1    | 0.9–1.80        |
| C4, g/dL | 0.3    | 0.1–0.40        |
| HIV 1 and HIV 2 antibodies | Nonreactive | Nonreactive |
| Hepatitis B surface antigen | Negative | Negative |
| HCV antibody | Negative | Negative |
improve with dialysis. Affection of vision due to drugs was ruled out as our patient had no medical history. Idiopathic intracranial hypertension, rarely associated with chronic kidney disease patients [2] was ruled out due to a lack of clinical features and imaging findings. Similarly, the patient did not have features of meningitis. The possibility of posterior reversible encephalopathy syndrome (PRES) was considered. Systemic features such as seizures or encephalopathy were absent (though could be a component of uremic encephalopathy if present), and it is unusual for PRES to present with visual loss in the absence of other systemic symptoms [3, 4]. CT brain also did not show any areas with hypointensity.

UON is rare and likely an underdiagnosed condition that is potentially reversible. It is a clinical diagnosis, correlating loss of vision with optic disc edema in a patient with kidney failure which improves noticeably with hemodialysis and steroids.

Our patient had vision loss as a presenting feature of newly diagnosed renal failure which is quite common in patients of UON though an uncommon presentation of chronic kidney disease [5]. Most of the patients diagnosed with end-stage kidney disease are dialyzed early

Table 2. Urinalysis

| Test                      | Result | Reference range          |
|---------------------------|--------|--------------------------|
| **Dipstick analysis**     |        |                          |
| Color                     | Yellow | Yellow                   |
| Clarity                   | Clear  | Clear                    |
| pH                        | 7.1    | 4.6–8                    |
| Specific gravity          | 1.009  | 1.005–1.030              |
| Glucose                   | Negative | Negative               |
| Blood                     | Negative | Negative             |
| Ketone                    | Negative | Negative            |
| Protein                   | 2+     | Negative                 |
| Leukocyte esterase        | Negative | Negative          |
| Nitrate                   | Negative | Negative             |
| **Urine microscopy**      |        |                          |
| White blood cells         | 3–4    | 0–5 per high power field |
| Red blood cells           | 2      | 0–4 per high power field |
| Squamous epithelial cells | None   | 0–5 per high power field |
| Bacteria                  | None   | None                     |

Table 3. Hemodialysis parameters

| Parameter                  | First session | Second session | Subsequent sessions |
|----------------------------|---------------|----------------|---------------------|
| Duration, h                | 1.5           | 2              | 4                   |
| Ultrafiltration, L         | 1             | 1.5            | 2                   |
| Blood flow rate, mL/min    | 100           | 150            | 200                 |
| Dialysate flow rate, mL/min| 300           | 500            | 500                 |
| Flow                       | Co-current    | Counter current | Counter current    |
| Sodium, mEq/L              | 145           | 135            | 135                 |
| Anticoagulation            | Heparin (2500 U) | Heparin (5000 U) | Heparin (5000 U) |
| Dialyzer                   | Fresenius F4  | Fresenius F6   | Fresenius F6        |
before the manifestation of severe uremic complications due to better availability of renal replacement therapies.

The pathogenesis of UON is not well understood. Nerve conduction studies demonstrate defects in a large number of uremic patients [6]. Evidence of visual system dysfunction is documented by delay in visually evoked potentials with improvement after dialysis [7]. This is believed to be related to uremic toxins like guanidino compounds, myo-inositol, and other middle molecules [8] which may inactivate vitamin-B-dependent enzyme transketolase causing optic nerve dysfunction [9].

Hemodialysis by removing uremic toxins plays a definite role in the treatment of these patients as described by many previous observations [1, 5, 10, 11]. Steroids also seem to be useful in most of these cases. The basis to use steroids is to reduce optic disc edema which is believed to be one of the pathological components of UON. Rapid reduction in edema of the optic disc is warranted as a delay may result in permanent nerve damage. Dialysis helps in reducing optic disc edema directly by reducing volume overload and indirectly by removing uremic toxins. On the other hand, steroids might have an added benefit by their relatively quick and sustained action with regular administration.

Knox et al. [12] described 6 patients with diverse causes of vision loss in kidney failure patients and concluded that if correctly diagnosed prompt treatment can reduce morbidity. Lee and Vaithilingam [13] reported a 17-year-old male patient presenting with blurring of vision and ESKD who improved remarkably with steroids and hemodialysis. Korzets et al. [11] reported a patient presenting with diminution of vision in 1 eye with kidney failure, but the patient refused hemodialysis initially; subsequently, he developed UON of the opposite eye in 6 months. Steroids with hemodialysis were instituted after both eyes were involved with dramatic improvement in vision in the second involved eye. Saini et al. [10] reported a patient with acute loss of vision and first-time diagnosed kidney failure who did not respond to steroids, but his vision improved serially with each hemodialysis session.

Timing of initiation of treatment may be crucial and may dictate outcomes [1, 11, 12]. It should be considered a medical emergency as the early institution of treatment reduces morbidity [13].

Conclusion

Kidney failure presenting as UON is quite rare. However, vision can be affected by a plethora of conditions in patients with kidney failure. Cognizance of this rare presentation among physicians and nephrologists is necessary as it is potentially reversible with timely hemodialysis and steroid therapy.

Statement of Ethics

The Institutional Ethics Committee (Madurai Medical College) Review Board in our hospital requires approval only for original research and case reports with trial/experimental interventions (procedure/drugs) administered to patients. This patient has not been treated with trial/experimental therapy and has been administered only the approved form of treatment for the condition. All treatment and examinations followed the guidance of the Declaration of Helsinki. Written informed consent for treatment was obtained from the patient. And, written informed consent was obtained from the patient for publication of this case report and accompanying images.
Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Dr. Niranjan Raja contributed to initial evaluation, complete follow-up of the patient, and preparation of the manuscript. Prof. Arul Rajagopalan contributed to initial evaluation and preparation of the manuscript. Dr. Jegan Arunachalam contributed to evaluation of the patient. Dr. Arun Prasath contributed to evaluation of the patient. Dr. Rakesh Durai contributed to correction of the manuscript. Prof. Manoranjan Rajendran contributed to correction of the manuscript. All authors approved the final manuscript.

Data Availability Statement

All data generated or analyzed during this study are included in this article.

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