Case Report

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Diffusion MR Imaging of Postoperative Bilateral Acute Ischemic Optic Neuropathy

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A 57-year-old woman experienced bilateral acute ischemic optic neuropathy after spine surgery. Routine MR imaging sequence, T2-weighted image, showed subtle high signal intensity on bilateral optic nerves. A contrast-enhanced T1 weighted image showed enhancement along the bilateral optic nerve sheath. Moreover, diffusion-weighted image (DWI) and an apparent diffusion coefficient map showed markedly restricted diffusion on bilateral optic nerves. Although MR findings of T2-weighted and contrast enhanced T1-weighted images may be nonspecific, the DWI finding of cytotoxic edema of bilateral optic nerves will be helpful for the diagnosis of acute ischemic optic neuropathy after spine surgery.

Index terms: *Optic neuropathy, ischemic; Diffusion magnetic resonance imaging*

INTRODUCTION

Postoperative visual loss after general anesthesia for non-ocular surgery is not common, but this devastating complication occurs in about 0.2% to 4.5% of cases depending on the type of surgery (1). To our knowledge, there were a few reports using diffusion weighted image (DWI) for postoperative ischemic optic neuropathy (2).

CASE REPORT

A 57-year-old woman underwent a multilevel laminectomy with posterior lumbar interbody fusion for herniation of nucleus pulposus and spinal stenosis. She did not have a history of diabetes, hypertension, or any cardiac problem. For more than 11 hours of surgery in the prone position, a large blood transfusion (more than 16 units of packed red cells) was performed due to massive bleeding. After surgery, she complained of bilateral blindness and underwent an ophthalmologic examination. No significant abnormality was observed except for peripapillary hemorrhage on the right eyeball. The woman also underwent orbital MR imaging including DWI at five days after surgery. A T2 weighted image (repetition time [TR] = 3000, echo time [TE] = 100) showed subtle high signal intensity on bilateral optic nerves. After contrast injection, an axial T1 weighted image (TR = 500, TE = 12) shows enhancement along the bilateral optic nerve sheath. Moreover, the axial DWI (TR = 4338.2, TE = 46.7, b = 1000, section thickness = 3 mm, matrix = 128 x 126, field of view = 24 cm) showed high signal intensity on bilateral optic nerves and restricted diffusion on an apparent diffusion coefficient (ADC) map (Fig. 1). The ADC values were 0.425 x 10^{-3} mm^2/s in the right optic nerve, 0.420 x 10^{-3} mm^2/s in the left optic nerve, 0.656 x 10^{-3} mm^2/s in the right temporal lobe, and 0.785 x

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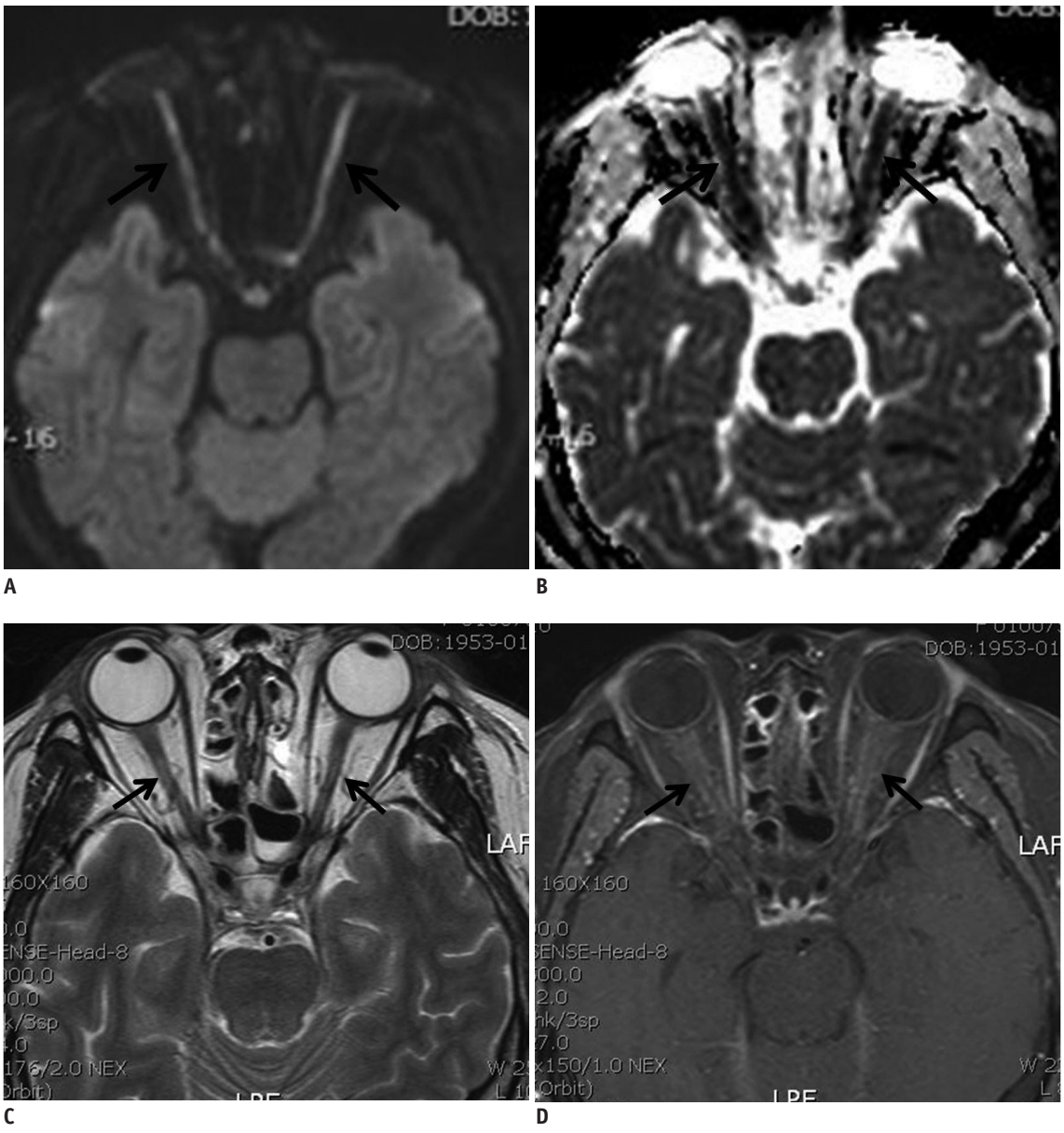

Fig. 1. Fiftyseven-year-old woman with postoperative bilateral acute ischemic optic neuropathy.
A, B. Diffusion weighted image **(A)** and apparent diffusion coefficient map **(B)** shows restricted diffusion (arrows) on bilateral optic nerves. **C.** Axial T2 weighted image shows subtle high signal intensity (arrows) on bilateral optic nerves. **D.** Contrast enhanced axial T1 weighted image shows enhancement (arrows) along bilateral optic nerve sheath.

10^{-3} mm^2/s in the left temporal lobe. These findings are consistent with postoperative bilateral acute ischemic optic neuropathy after spine surgery. One month later, the woman still experienced bilateral visual loss, except for a response to light on one eye.

DISCUSSION

Postoperative ischemic optic neuropathy is one of the severe complications that can develop after various surgeries such as cardiac surgery, spine surgery, head and neck surgery, prostatectomy, liver transplantation, major vascular surgery, liposuction, and so on (3). According to a previous report, the American Society of Anesthesiologists, postoperative visual loss registry, ischemic optic neuropathy was most frequently developed after spine surgery (4). Several reports described the important etiologies of postoperative ischemic optic neuropathy (3-8). Although there is still controversy for the most important etiology of postoperative ischemic optic neuropathy, a large amount of blood loss producing hypotension and anemia with prolonged operative time in the prone position may

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play an important role in postoperative visual loss (4-6), as in our case. Considering the fact that many other surgeries can cause large amounts of blood loss producing hypotension and anemia, the increased orbital pressure secondary to the prone position or Trendelenburg position or jugular vein ligation with prolonged operative time may be the most important etiology (1, 4, 5). Therefore several recommendations have been suggested to help avoid or minimize this severe complication as followings: information about visual impairment prior to surgery, avoidance of direct pressure to the eyeball, avoidance of perioperative hypotension or anemia, and so on (1, 3, 5, 8). In addition, because ischemic optic neuropathy may be reversible in its early stages, regardless of etiologies or type of surgery, it is important to diagnose postoperative ischemic neuropathy in a timely and precise manner, as well as to provide early treatment (8). However, there exists no specific treatment strategies for perioperative ischemic optic neuropathy (3).

Conventional T1- and T2-weighted images as well as contrast-enhanced images were insufficient for the diagnosis of ischemic optic neuropathy. Optic nerve enhancement, including optic nerve itself as well as optic nerve sheath, is possible (9). Optic nerve enhancement may be caused by blood-brain barrier disruption secondary to various causes including ischemia, tumor, infection, trauma and so on, as other cranial nerves (10). This enhancement may be nonspecific. However, this enhancement may be one of the findings showing ischemic optic neuropathy under restricted diffusion and specific clinical features. And, as observed in recent infarctions in the brain, restricted diffusion due to cytotoxic edema can be a specific finding for ischemic optic neuropathy on DWI. To date, there were several reports using DWI for diagnosing an acute optic nerve infarction or acute ischemic optic neuropathy after infection, surgery or noninflammatory disease (2, 11, 12). Our case also shows that DWI can play an important role in the precise diagnosis of postoperative acute ischemic optic neuropathy. Besides acute ischemia, lymphomatous optic neuropathy, traumatic optic neuropathy, or atypical optic neuritis can cause restricted diffusion in the optic nerves (13-15).

In conclusion, restricted diffusion on DWI and an ADC map may be a specific finding associated with postoperative acute ischemic optic neuropathy regardless of type of surgery. In addition, T2 high signal intensity and optic nerve sheath enhancement may be an additional and useful findings for the detection of postoperative acute ischemic optic neuropathy.

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