

Post-Cataract Surgery Optic Neuropathy: Prevalence, Incidence, Temporal Relationship, and Fellow Eye Involvement

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- **PURPOSE:** To reassess the prevalence and incidence of post-cataract surgery optic neuropathy (PCSON) in the modern era.
- **DESIGN:** Retrospective cohort study.
- **METHODS:** SETTING: Single-center tertiary care practice. STUDY POPULATION: All patients with a diagnosis of nonarteritic anterior ischemic optic neuropathy (NAION) seen in the Wilmer Eye Network system between January 1, 2010 and December 31, 2014 were included. Inclusion was based on the following: (1) a history of an acute unilateral decrease in vision, (2) a visual field defect consistent with NAION, (3) a relative afferent pupillary defect, (4) observed optic disc swelling, and (5) no other etiology being found. MAIN OUTCOME MEASURES: The prevalence and incidence of PCSON and the temporal association between surgery and onset of PCSON. The secondary outcome was the risk of PCSON in the fellow eye of patients with prior unilateral spontaneous NAION.
- **RESULTS:** One hundred eighty-eight patients had developed NAION during the study period. Of these, 18 (9.6%) had undergone cataract surgery (CS) during the year prior to developing NAION. There was no significant temporal pattern associated with the distribution of NAION cases ($P = .28$). The incidence of PCSON in patients who had noncomplex CS was 10.9 cases per 100 000 (95% CI, 1.3, 39.4).
- **CONCLUSIONS:** Our data indicate that both the prevalence and incidence of NAION after modern CS are comparable to those of the general population and that there is no significant temporal relationship between modern CS and the subsequent development of NAION in the operated eye. Thus, although this study has inherent biases owing to its retrospective nature, concern regarding an increased risk of PCSON in the fellow eye in patients who have experienced it or spontaneous NAION in 1

eye may be unwarranted. (Am J Ophthalmol 2016;■:■–■. © 2016 Elsevier Inc. All rights reserved.)

CATARACT SURGERY IS ONE OF THE MOST COMMON and safe procedures performed throughout the world. Nevertheless, rare complications occur, including hemorrhage, infection, and retinal detachment, all of which can cause severe and permanent visual loss.¹ In addition to these potential causes of visual loss, an anterior optic neuropathy resembling nonarteritic anterior ischemic optic neuropathy (NAION) has been documented to occur after apparently noncomplex cataract surgery,^{2–7} resulting in devastating visual morbidity. In some cases, visual loss is present immediately after surgery (the immediate form),^{2,8} whereas in others, symptoms develop several days, weeks, or months postoperatively (the delayed form).^{2,3,9–14} Some authors have suggested that increased intraocular pressure (IOP), raised intraorbital pressure from a retrobulbar or peribulbar anesthetic, systemic perioperative hypotension, or a combination of these factors may be responsible for the immediate form,^{3,12–15} whereas the causative factors for the delayed form are unknown, although intraocular surgery-related posterior pole edema, which involves the nerve, resulting in vascular compression, has been proposed.^{16,17} Because there have been substantial changes in both anesthetic and surgical techniques, we wondered if these changes had affected the incidence and prevalence of so-called post-cataract surgery optic neuropathy (PCSON).

METHODS

THIS IS A SINGLE-CENTER RETROSPECTIVE COHORT STUDY. Approval was obtained from the Johns Hopkins University School of Medicine Institutional Review Board for all aspects of this study. All work was compliant with the Health Insurance Portability and Accountability Act, and confidentiality was maintained in accordance with the principles of the Declaration of Helsinki.

- **STUDY POPULATION:** This study was based on a cohort of patients with a diagnosis of NAION (International

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Classification of Diseases, Ninth Revision [ICD-99] code 377.41) seen at the Wilmer Eye Institute and its satellites between January 1, 2010 and December 31, 2014. We included only patients who were diagnosed with NAION, with the diagnosis confirmed by an ophthalmologist or a neuro-ophthalmologist based on the following history and findings: (1) an acute decrease in vision in 1 eye, (2) an ipsilateral visual field defect, (3) an ipsilateral relative afferent pupillary defect (RAPD), (4) unilateral optic disc swelling (directly observed by a Wilmer ophthalmologist at presentation or documented by an outside ophthalmologist), and (5) no other etiology being found (eg, structural lesion compressing the orbital optic nerve, infiltrative process). We did not require that the patient have a disc at risk (defined as cup-to-disc ratio <0.35) in the contralateral eye.^{18,19}

- **DATA COLLECTION:** The records of all patients diagnosed with NAION during the study period were reviewed to identify those who had undergone ipsilateral cataract surgery during the 1-year period prior to developing the optic neuropathy. We then completed a data collection sheet for each patient that included the following information: age at presentation, sex, stated race, tobacco use, diabetes mellitus, systemic hypertension, systemic hypotension, hyperlipidemia, obstructive sleep apnea, coronary artery disease, arthritis, anemia, migraine, coagulopathy, hyperhomocysteinemia, erectile dysfunction drug use, amiodarone use, interferon- α use, date of NAION, visual acuity at presentation and at all follow-up visits, IOP at presentation and at all follow-up visits, treatment(s) attempted, and history of any other recent ocular surgery. In addition, various factors related to the surgery itself were recorded, including preoperative anesthetic technique, surgical technique, type of implant, duration of surgery, and time interval between surgery and NAION onset. Contralateral eye involvements were recorded as new events. When the data from a patient's medical record were either incomplete or missing, the patient, the patient's ophthalmologist, or both, were contacted to complete the required data. When the date of occurrence of NAION was unclear, including absence of documented optic disc swelling, the patient was excluded from the study. We included patients in whom cataract surgery was part of a more complex procedure, such as Descemet stripping endothelial keratoplasty (DSEK).

- **MAIN OUTCOME MEASURES:** The main outcome measures were the prevalence and incidence of PCSON. Secondary outcomes were the temporal association between surgery and onset of the neuropathy as well as the risk of PCSON in the fellow eye of patients with prior unilateral spontaneous NAION.

- **STATISTICAL ANALYSIS:** Statistical analysis was performed using Stata statistical software (version 10.0, 2007; Stata Corporation, College Station, Texas, USA). Frequencies and medians of demographic variables were

tabulated for patients/eyes and compared using the χ^2 test or the Student t test for categorical and continuous data, respectively. P values were 2-sided with a defined significance level of .05 such that P values $<.05$ were considered as statistically significant.

- **TEMPORAL RELATIONSHIP ANALYSIS:** The time interval between cataract surgery and the development of NAION initially was divided into 17 3-week groups. We then combined the 3-week groups into 3-month groups: within 3 months, 3–6 months, 6–9 months, and 9–12 months. The temporal relationship between NAION onset and previous surgery was evaluated by using a χ^2 goodness-of-fit test to compare the observed cases with an expected uniform distribution across the 4 consecutive 3-month time intervals.

- **CALCULATION OF INCIDENCE OF NONARTERITIC ANTERIOR ISCHEMIC OPTIC NEUROPATHY IN THE FELLOW EYE AFTER NONARTERITIC ANTERIOR ISCHEMIC OPTIC NEUROPATHY IN 1 EYE:** Incidence rates for development of NAION in the fellow eye after NAION in 1 eye were calculated as the number of events divided by the sum of person-years (PY) at risk. At-risk eyes included all eyes that were free of NAION at presentation with at least 1 follow-up visit in our clinic. Assuming a Poisson distribution, we calculated a 95% confidence interval (CI) for the incidence rate of NAION in the fellow eye during the follow-up period.

- **INCIDENCE OF POST-CATARACT SURGERY OPTIC NEUROPATHY:** To estimate the overall incidence of PCSON, we identified during the 5-year study period a subgroup of patients in whom NAION developed within 1 year after cataract surgery at the Wilmer Eye Institute or one of its satellites (the numerator). The number of cataract surgeries between January 1, 2009 and December 31, 2013 was extracted via a computer database according to the surgical Current Procedural Terminology code of 66984 (the denominator). We made the assumption that any patient who had surgery at Wilmer or one of its satellites and who subsequently developed visual loss in the operated eye would either return to Wilmer of his or her own accord or be referred back to Wilmer by the patient's ophthalmologist, optometrist, or primary care physician. A 95% CI was calculated for the incidence rate during the follow-up period. The estimated annual incidence of NAION within 1 year of undergoing cataract surgery in our cohort was compared with the previously reported incidence of NAION in the general population aged 50 years and older by Hattenhauer and associates²⁰ and the previously reported incidence of PCSON.¹³

RESULTS

- **PATIENT DEMOGRAPHICS:** Our retrospective search of the Wilmer Eye Institute database of patients during this

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