

# Factors to Weigh in While Administering Nitrous Oxide Anesthesia [Response to Letter]

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## Dear editor

Thank you for giving us the opportunity to respond to the publication in Clinical Ophthalmology entitled “Factors to weigh in while administering nitrous oxide anesthesia” by Shuja et al. We read with interest the letter to the Editor regarding the publication. This is our response to the three points raised by Shuja et al.

The first point is the use of nitrous oxide (N<sub>2</sub>O) anesthesia in patients with heart failure, hepatic dysfunction, and renal dysfunction. We perform preoperative electrocardiogram, chest x-ray, and blood test, and consult an internist to manage any abnormalities. Echocardiography is also performed when necessary. Additionally, we carefully monitor the vital signs of all patients, not only before, but also during and after surgery. Mitchell et al reported that N<sub>2</sub>O did not induce myocardial ischemia in patients with ischemic heart disease and poor ventricular function.<sup>1</sup> The ENIGMA-II trial, a randomised, single-blind trial, showed no evidence that N<sub>2</sub>O increases the risk of cardiovascular complications after major non-cardiac surgery.<sup>2</sup> We believe that 30% low-concentration N<sub>2</sub>O anesthesia can be safely used in patients with heart failure. Similarly, we also evaluate hepatic and renal function in blood tests preoperatively. Rahimzadeh described that N<sub>2</sub>O has been used in patients with advanced hepatic disease for many years without any complications.<sup>3</sup> This suggests that N<sub>2</sub>O can be used safely in patients with hepatic disease. Although short operating time and low-concentration N<sub>2</sub>O anesthesia are thought to have little effect on the liver and kidney, chronic exposure to N<sub>2</sub>O anesthesia could cause hepatic and renal disease.<sup>4</sup> When N<sub>2</sub>O anesthesia is used in ophthalmic surgery in the future, we should evaluate heart, liver, and kidney functions before and after surgery.

The second point is the preoperative amount of anesthesia. In our study,<sup>5</sup> low-concentration N<sub>2</sub>O anesthesia was administered as a preoperative procedure, while topical anesthesia and sub-Tenon’s anesthesia were also performed as a preoperative procedure. We attempted to control intraoperative pain with preoperative topical, sub-Tenon’s, and N<sub>2</sub>O anesthesia. Currently, cataract surgery can usually be performed under local anesthesia with little pain. Srinivasan et al reported that pain score, which was evaluated by numerical ratings from 0 (no pain) to 10 (severe pain), immediately after cataract surgery was significantly lower (P=0.0043) in sub-Tenon’s anesthesia (2.42±2.2) than in topical anesthesia (3.44±2.3).<sup>6</sup> In our study,<sup>5</sup> all patients included received the same dosage of 4% xylocaine eye drop and 2% sub-Tenon’s anesthesia (2mL). Meanwhile, our study demonstrated that the preoperative anxiety level was higher in the N<sub>2</sub>O group (43.7±21.8) than in the Air group (34.2±28.2), although the difference was not significant (P=0.096).<sup>5</sup> If, as Shuja et al point out, patients with higher preoperative anxiety require a higher dosage of anesthesia to reduce intraoperative pain, the N<sub>2</sub>O group should have greater intraoperative pain than the Air group. However, in our study,<sup>5</sup> the intraoperative pain score was significantly lower (P=0.014) in the N<sub>2</sub>O group (12.4±14.9) than in the Air group (24.2±22.4). This also suggests that 30% low-concentration N<sub>2</sub>O anesthesia is effective at significantly reducing intraoperative patient pain.

The third point is the safety of N<sub>2</sub>O anesthesia. In our study,<sup>5</sup> all patients included were preoperatively informed about the possibility of use of low-concentration N<sub>2</sub>O anesthesia during cataract surgery and the adverse effects of the anesthesia. N<sub>2</sub>O anesthesia has little effect on the respiratory system.<sup>7,8</sup> In order to avoid adverse effects of N<sub>2</sub>O, the

American Academy of Pediatric Dentistry recommends that the percentage of N<sub>2</sub>O delivered should not exceed 50% concentration during procedures.<sup>8</sup> In general, diffusion hypoxia is not known to occur in cataract surgery with short operating time and 30% N<sub>2</sub>O;<sup>9</sup> however, caution should be exercised when using more than 50% N<sub>2</sub>O. The most frequent adverse effects of N<sub>2</sub>O anesthesia are nausea and vomiting. The frequency of nausea and vomiting are as low as 3.7% with 50% N<sub>2</sub>O.<sup>10</sup> Noguchi et al also reported that no patients experienced intraoperative nausea with 30% N<sub>2</sub>O during cataract surgery.<sup>11</sup> Although 30% low-concentration N<sub>2</sub>O anesthesia is considered to have fewer adverse effects than 50% or higher concentrations of N<sub>2</sub>O, further studies are warranted to evaluate whether randomized controlled trials of the efficacy and safety of 30% low-concentration N<sub>2</sub>O anesthesia during cataract surgery are consistent with our results.<sup>5</sup>

## Disclosure

The authors report no conflicts of interest in this communication.

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