# Table of Contents

## Obstetric Anesthesia / Pharmacology
- Nitrous oxide for labor analgesia: Utilization and predictors of conversion to neuraxial analgesia........................................3

## Pharmacology
- Does nitrous oxide labor analgesia influence the pattern of neuraxial analgesia usage? An impact study at an academic medical center ....5
- Role of sugammadex in accelerating postoperative discharge: A meta-analysis .................................................................7
1 Pharmacology CE credit.*

None of the editors or contributors have any real or potential conflicts of interest to disclose.

Indicates Continuing Education Credit is available for this abstract and comment during the CE approval period. Continuing Education Credit is available to individual subscribers on the Anesthesia Abstracts website at [www.AnesthesiaAbstracts.com](http://www.AnesthesiaAbstracts.com).

New health information becomes available constantly. While we strive to provide accurate information, factual and typographical errors may occur. The authors, editors, publisher, and Lifelong Learning, LLC is/are not responsible for any errors or omissions in the information presented. We endeavor to provide accurate information helpful in your clinical practice. Remember, though, that there is a lot of information out there and we are only presenting some of it here. Also, the comments of contributors represent their personal views, colored by their knowledge, understanding, experience, and judgment which may differ from yours. Their comments are written without knowing details of the clinical situation in which you may apply the information. In the end, your clinical decisions should be based upon your best judgment for each specific patient situation. We do not accept responsibility for clinical decisions or outcomes.

* This program has been prior approved by the American Association of Nurse Anesthetists for 20 Class A CE credits; Code Number 1035464; [Expiration Date 10/31/2020](http://www.AnesthesiaAbstracts.com).
Nitrous oxide for labor analgesia: Utilization and predictors of conversion to neuraxial analgesia

Sutton CD, Buttwick AJ, Riley ET, Carvalho B

Abstract

Purpose  The purpose of this study was to describe nitrous oxide use for labor analgesia and identify predictors of conversion to neuraxial anesthesia in laboring women.

Background  Nitrous oxide (N₂O) is an NMDA receptor antagonist with mild analgesic properties. It has been used in many countries around the world for labor analgesia; however, until recently most centers in the USA did not offer N₂O. Since 2012 the number of centers offering N₂O for labor analgesia has increased from five to well over 100. The rate of N₂O use, conversion to neuraxial anesthesia, and predictors of conversion are unknown.

Methodology  This was a single center retrospective study at a tertiary care hospital obstetric center with approximately 4,500 deliveries per year and an epidural rate > 80%. Anesthesia department staff evaluated all patients and provided education to patients on analgesic options. If a women desired N₂O they educated and set-up the delivery system (50:50 N₂O:O₂). Intravenous access was not required, but recommended, and all patients were monitored with pulse oximetry and continuous fetal heart monitoring. No additional opioids were administered without permission from the anesthesia provider.

Result  There were 146 women who received N₂O of 4,698 deliveries (N₂O rate = 3%), and 133 of those met study inclusion criteria. A majority of the women who used N₂O were first-time moms. Just over half indicated a preference for a “nonmedical birth.” Four patients used N₂O as an adjunct to inadequate epidural analgesia and two for laceration repairs after delivery. The median change in pain after initiation of nitrous oxide was 0 (no change). The median duration of nitrous use was 80 minutes. Most (95%) received N₂O only during stage 1 of labor and the median cervical dilation was 5 cm. Less than 4% of women who used nitrous used it during stage 2 of labor. Among nitrous users 81.5% had a vaginal delivery, 3% had an operative vaginal delivery, and 15% had a cesarean delivery.

Women with twins and those undergoing trial of labor after cesarean delivery were excluded from the analysis. Data was obtained from medical records dated September 2014 to September 2015. Statistical analysis was appropriate.

Almost 2/3rds of patients converted from N₂O to epidural analgesia. Women who did not convert to neuraxial analgesia were more likely to have spontaneous labor (61% vs. 15%, P < 0.0005), to have a “nonmedical” birth plan (55% vs. 40%, P = 0.03),
have better pain control after initiation of N₂O (P = 0.04), and have a higher cervical dilation at the time of request for N₂O (7 vs. 4, P < 0.00005). Predictors of conversion from N₂O to epidural analgesia were induced labor and augmented labor.

**Conclusion**  Nitrous oxide use was limited in this teaching hospital, and a majority of women who used nitrous later requested epidural analgesia. Women undergoing induction or augmented labor should be counseled about the higher likelihood they may convert to epidural analgesia.

**Comment**  
I suspect in this study another reason that only 3% of women requested N₂O initially was that it was a teaching hospital and anesthesia providers may have influenced their decision. Also the service was only recently offered at the facility, which may explain why only 10% of women included N₂O in their birth plan. I would be curious to see what their rate of use is now.

The biggest take away from this study is that if a women is going to have induced or augmented labor with oxytocin they are more likely to request an epidural. When labor is induced or augmented it is no longer “natural” labor, and all of us who have taken care of these patients know they will have stronger contractions that require an epidural to manage the pain effectively. It would be interesting to see what the patients satisfaction scores were because other studies have suggested despite poor pain control with N₂O, women were still highly satisfied with their anesthetic care.¹ The problem with measurement of patient satisfaction is that it is a difficult concept to measure. For some women, if we are simply nice and have a good bedside manner the patient may report being more highly satisfied. It may be that the patients still hurt, but they do not care about the pain when they are receiving N₂O.

**Dennis Spence, PhD, CRNA**


The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
Abstract

Purpose The purpose of this study was to compare the frequency of epidural use before and after implementation of a nitrous oxide labor analgesia protocol.

Background The use of nitrous oxide (N\textsubscript{2}O) for labor analgesia is not uncommon in other countries. In recent years there has been an increase in the number of USA medical center labor and delivery units offering N\textsubscript{2}O. It is unclear if incorporation of N\textsubscript{2}O for labor analgesia decreases use of epidural analgesia.

Methodology This was an impact study to examine how the rapid introduction of a N\textsubscript{2}O labor analgesia protocol at Brigham’s & Women’s Hospital affected the rate of labor epidural use. Nitrous oxide use was supervised by labor and delivery nursing staff per institutional policy. Nitrous was self-administered by patients via Pro-Nox delivery system (50:50 N\textsubscript{2}O:O\textsubscript{2}) (Carestream Medical, Langley, British Columbia, Canada).

Result There were 4,315 total births in the time period before implementation of the N\textsubscript{2}O labor analgesia protocol and 4,224 births after implementation. Labor epidural use was not significantly different after implementation of a N\textsubscript{2}O labor analgesia protocol (77% vs. 74%). The rate of N\textsubscript{2}O utilization during the 8-month period of time was 18%. Over time the use of N\textsubscript{2}O for labor analgesia increased from about 100 times per month in August 2015 to 150 times in November 2015. The rate of cesarean delivery was stable and between 25% to 30% during both 8-month periods. The rate of epidural use month-to-month was stable throughout both 8-month study periods.

Conclusion The availability of a N\textsubscript{2}O labor analgesia protocol did not influence neuraxial analgesia rates. Further research is needed to determine why some women may choose N\textsubscript{2}O over neuraxial analgesia and its impact on maternal satisfaction and neonatal outcomes.

Comment There are a number of facilities in the United States that offer N\textsubscript{2}O as an option for labor analgesia. It is my understanding that the N\textsubscript{2}O program is managed by nursing services with oversight by the institutional conscious sedation committee and anesthesia.
department. However, at Vanderbilt University Medical Center, administration of N\textsubscript{2}O is under the direction of the Obstetrical Anesthesia Division. Patient assessment and consent, set-up of equipment, and initial teaching is performed by an anesthesia provider.\textsuperscript{1} Most nursing policies should state a licensed independent provider must first be assessed prior to N\textsubscript{2}O administration.\textsuperscript{2} Epidural analgesia should be encouraged if there is potential or actual fetal distress or a high risk for cesarean delivery. N\textsubscript{2}O cannot be administered within 2 hours of opioid administration and the patient cannot receive an epidural at the same time. Continuous pulse oximetry should be on at all times.

I reviewed the Arizona State Board of Nursing Advisory Opinion and it states the responsible RN may not leave the patient unattended or engage in other tasks that might compromise the patient.\textsuperscript{2} The Pro-Nox manufacturer resources state the N\textsubscript{2}O delivery system has an internal on-demand valve to limit secondary exposure, scavenging capabilities, audible and visual low gas pressure alarms, and safety shut off when the gas pressure is too low to deliver 50/50 mix.\textsuperscript{3}

I must admit I do not have any experience with N\textsubscript{2}O for labor analgesia; however, a number of my anesthesia colleagues who work at facilities likewise have not seen a significant decrease in epidural or cesarean delivery rates. One study reported only 52\% of women who received N\textsubscript{2}O rated N\textsubscript{2}O as being highly effective for labor analgesia compared to 92\% for neuraxial analgesia.\textsuperscript{4} However, these same patients reported being highly satisfied with nitrous oxide and neuraxial analgesia (93\% vs. 96\%). Approximately 40\% of women who start out with N\textsubscript{2}O later request neuraxial analgesia. The most common side effects are dizziness and nausea and vomiting.\textsuperscript{5}

I suspect we will continue to see facilities establishing an N\textsubscript{2}O labor analgesia protocol; however, it will most likely be considered another labor analgesia option for a woman who does not or cannot receive an epidural. Nitrous oxide might be easier and safer to use than remifentanil IVPCA, which is many times administered to women who cannot get an epidural; however, research is needed to confirm this.

Dennis Spence, PhD, CRNA


The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
Pharmacology

**ROLE OF SUGAMMADEX IN ACCELERATING POSTOPERATIVE DISCHARGE: A META-ANALYSIS**

J Clin Anesth 2017;39:38-44
DOI: 10.1016/j.jclinane.2017.03.004
Caron M, Zarantonello F, Lazzarotto N, Tellaroli P, Ori C

**Abstract**

**Purpose** The purpose of this study was to determine whether sugammadex resulted in a more rapid time to discharge from the operating room (OR) to the post anesthesia care unit (PACU) than traditional antagonism with neostigmine.

**Background** Sugammadex encapsulates and inactivates rocuronium and vecuronium, thus creating a concentration gradient favoring movement of these nondepolarizing neuromuscular blocking drugs away from the neuromuscular junction into the plasma, quickly reversing neuromuscular blockade.

Neostigmine is a reversible, competitive inhibitor of acetylcholinesterase, which leads to a prolonged presence of acetylcholine in the synaptic junction. Acetylcholine competitively antagonizes nondepolarizing neuromuscular block at the postsynaptic nicotinic receptor thus hastening recovery of neuromuscular function. Numerous studies have shown that sugammadex results in faster reversal of neuromuscular block than neostigmine. Additionally, sugammadex has fewer side effects than neostigmine. The difference in efficacy between sugammadex and neostigmine may results in faster time to discharge from the OR to the PACU. However, the magnitude of this difference has not been established. The investigators conducted a systematic review and meta-analysis to address this issue.

**Methodology** This was a systematic review and meta-analysis of clinical trials comparing sugammadex to neostigmine for reversal of rocuronium or vecuronium neuromuscular block. For the meta-analysis, only randomized controlled trials were included that used quantitative analysis to evaluate the train-of-four ratio to evaluate neuromuscular recovery. Investigators used key terms to search PubMed, Google Scholar, and Cochrane Library electronic databases to identify English-language articles published from January 1, 2005 to August 1, 2016. The primary outcome was the time to discharge from the OR to the PACU. The secondary outcome was the time to discharge from the PACU to the surgical ward. Other outcomes included discharge-readiness, which was defined as time following administration of sugammadex or neostigmine until the anesthesia provider determined the patient ready to leave the OR or PACU.

**Result** There were six studies with 518 patients included in the meta-analysis. Included studies demonstrated a low or unclear risk of bias. Sugammadex resulted in an average 22 minute faster time to discharge from OR to PACU (P < 0.00001).
For patients with deep neuromuscular block the difference was 30 minutes (P < 0.002). Discharge readiness for patients moving from OR to PACU was faster with sugammadex compared to neostigmine (mean difference = 5.6 min, P < 0.0001). Sugammadex also resulted in an average 17 minute faster discharge from the PACU to the surgical ward (P = 0.046). In morbidly obese patients, sugammadex was associated with an average 9 minute faster discharge from PACU to surgical ward (P < 0.0001).

Conclusion Sugammadex accelerated discharge from the OR to the PACU, and to a lesser extent from the PACU to the ward compared to neostigmine.

Comment Sugammadex is a medication that ensures a rapid reversal of rocuronium and vecuronium, while at the same time minimizing side effects such as postoperative nausea and vomiting. The downside is that it is still rather expensive. The average wholesale price I found searching the web was $37 for a 500 mg single dose vial. Compare this to $8 for a 10 mg vial of neostigmine. These prices may be different than what your pharmacy pays, but proportionally, sugammadex is almost five times the price of neostigmine. However, if you reverse a deep block with sugammadex the patient will, on average, be ready for transfer to the PACU 30 minutes faster. With increased emphasis on production pressure and rapid room turnover, anything we can do to SAFELY extubate the patient faster and transfer them to the PACU is good for OR efficiency.

At my former facility the pharmacy placed restrictions on the use of sugammadex because of its price, and did not stock it in the operating room anesthesia carts. This required us to have a nurse run to the pharmacy to get some when we really needed it. When you have an unanticipated difficult airway that received an intubating dose of rocuronium, the last thing you want to do is wait for someone to get you sugammadex from the pharmacy. If this is the case at your institution I would encourage you to present evidence such as this article to your leadership and make the argument that you need sugammadex in your operating room.

Dennis Spence, PhD, CRNA

The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.