

# A Case Report on the Anxiolytic Properties of Nitrous Oxide during Labor

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## ABSTRACT

Widely used in Europe as a labor analgesic, nitrous oxide (N2O) is making a dramatic return in the United States. Valued for its analgesic properties, N2O also has anxiolytic characteristics. Fear and anxiety in childbirth have been associated with various negative effects, and N2O may have the potential to lessen these effects for some women. Women in the United States should have the option of using N2O during labor.

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Nitrous oxide (N2O) has analgesic and anxiolytic properties (Poorsattar, 2010). In countries such as Norway, New Zealand, Sweden, Australia, and England, usage rates of inhalational N2O during parturition reach are as great as 70% (Likis et al., 2012; Starr & Baysinger, 2013). Though widely used in Europe for more than 100 years, N2O has only recently become an option in the United States. As the moderator of the N2ODuringLabor listerv, I polled members at the time of this publication and found that only 38 hospitals and approximately 28 birth centers in the United States are either currently offering or working on plans to implement N2O as an analgesic option. In 2010, the American College of Nurse-Midwives (ACNM) published a position statement that supported the widespread access of N2O for women in the United States and cited the fact that women in the United States have fewer choices for pain relief than women in other countries (American College of Nurse-Midwives, 2010). The key points of the ACNM statement include the following: a) women have the right to have access to all safe options for pain relief in labor and birth, b) research does support the safety and efficacy of N2O use in labor and birth, c) midwives should play a role in the administration of N2O, d) women should receive education about this viable

option for pain relief, and e) where N2O is being used, there should be accompanying research and ongoing evaluation to add to the existing body of knowledge. Neither the American College of Obstetricians and Gynecologists (The College) nor the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN) has issued opinion or policy statements on the use of N2O for labor analgesia.

Nitrous oxide was first produced by the English scholar, minister, and scientist Joseph Priestley in 1772 (Riegels & Richards, 2011). Stanislav Klikovich of Poland used it as a labor analgesic in 1881 (Richards, Parbrook, & Wilson, 1976). When used for analgesia during labor, N2O is blended by a specialty Food and Drug Administration (FDA) approved apparatus at a 50/50 blend of N2O and oxygen (Collins, Starr, Bishop, & Baysinger, 2012). The woman controls her intake of the gas with her respiratory efforts by inhaling through a mask containing a demand valve that releases the gas only when the individual inhales". N2O may be used throughout all stages of labor. Alternatively, it may be initiated for second stage pushing or laceration repair after an unmedicated birth; for bedside procedures such as insertion of an intracervical foley

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**In multiple countries outside of the United States, women are offered the use of nitrous oxide for pain relief in labor.**

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bulb, or intravenous (IV) line; during manual removal of the placenta; or during placement of an epidural catheter (Stewart & Collins, 2012).

The exact mechanism of how analgesia or anesthesia from N<sub>2</sub>O is obtained is not fully understood (Schallner & Goebel, 2013). The prevailing theory for the anesthetic action of N<sub>2</sub>O is inhibition of excitatory glutamatergic neurotransmission via noncompetitive inhibition of the N-Methyl-D-aspartic acid (NMDA) subtype of glutamate receptors (Sanders, Weimann, & Maze, 2008). Ohashi, Guo, Oriti, Maze, and Fujinaga (2003) suggested that the mechanism of N<sub>2</sub>O may be via stimulation of endogenous opioid release. They purported that nitrous exerts its analgesic effect by prompting opioid peptide release in the brain stem, which then stimulates the descending noradrenergic inhibitory neurons, moderating the processing of pain impulses in the spinal cord. The exact nerve pathways utilized in this process have not been clearly identified. Gillman and colleagues noted increased prolactin levels and decreased cortisol levels among male participants who were administered N<sub>2</sub>O (Gillman, Katzeff, Vermaak, Becker, & Susani, 1988). The anxiolytic effect may be of significant use to laboring women, particularly in the transition stage of labor when self doubt, trepidation over one's ability to complete the birth, and decreased ability to cope can occur.

### Literature Review

In a recent Cochrane review of 26 studies involving 2959 women, authors noted that inhaled analgesia appears to be effective as a labor analgesic without increasing women's risk for operative delivery or causing adverse neonatal effects (Klomp et al., 2012). No information regarding the women's sense of control in labor while using N<sub>2</sub>O or satisfaction with the childbirth experience was included; thus, further research on these two issues was suggested (Klomp et al., 2012).

In a 2012 Agency for Healthcare Research and Quality (AHRQ) review on N<sub>2</sub>O use for labor analgesia, the authors noted that in comparison to epidural analgesia, N<sub>2</sub>O is less costly and less invasive (Likis et al., 2012). Epidural analgesia has greater efficacy than N<sub>2</sub>O, and N<sub>2</sub>O appears to

have greater efficacy than systemically administered opioids (Rosen, 2002). N<sub>2</sub>O offers enough relief to satisfy most women who attempt its use (Rooks, 2007).

Other benefits of N<sub>2</sub>O include a swift onset of action (within 1–2 minutes) and offset of action (within 1–2 breaths) (Akerman & Dresner, 2009). Additionally, if women find that they do not like N<sub>2</sub>O once they begin using it, it is easy to cease use and choose an alternative method of pain relief. This is a clear advantage over other pain relief methods in labor that are not as easily changed without a waiting period. Further, with regional anesthesia in particular, a woman's labor and birth positions are limited due to decreased limb strength and concern for dislodgement of anesthesia catheters. Women using N<sub>2</sub>O maintain a greater degree of mobility and freedom of movement (Stewart & Collins, 2012). Lastly, one of the most important features separating N<sub>2</sub>O from other alternatives is that it is self-administered (Likis et al., 2012). The degree of empowerment associated with the self-administration is one factor that may be important in promoting and enhancing women's satisfaction.

Although there is a paucity of literature documenting the anxiolytic benefit of N<sub>2</sub>O in the labor setting, N<sub>2</sub>O has long been useful in dental care for its analgesic and anxiolytic benefits (Poorsattar, 2010). Numerous researchers have demonstrated the positive anxiolytic effect in adult and pediatric populations (Adams, Eberhard-Gran, & Eskild, 2012; Bar-Meir et al., 2006; Bessière, Laboureyras, Ben Boujema, Laulin, & Simonnet, 2012; Byrne, Hauck, Fisher, Bayes, & Schutze, 2013; Chan, Wan, Gin, Leslie, & Myles, 2011; Ekbohm, Jakobsson, & Marcus, 2005; Gillman et al., 1988; Lowe, 2007; Luhmann, Kennedy, Porter, Miller, & Jaffe, 2001; Nilsson, Bondas, & Lundgren, 2010; Rouhe, Salmela-Aro, Halmesmaki, & Saisto, 2009). In a prospective study, Ekbohm et al. (2005) compared topical anesthetic cream to N<sub>2</sub>O prior to IV cannulation among children aged 6–18 years who had a history of difficulty with IV cannulation, were extremely anxious, or were required to undergo repetitive procedures. They noted that among children with a history of difficult IV cannulation and those who were undergoing repetitive procedures, the use of N<sub>2</sub>O was significantly associated with an overall decrease in the time required to gain IV access and fewer cannulation attempts. Higher satisfaction scores were also noted among the children, parents, and the nurses attempting cannulation. Similar positive effects of

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