Use of Nitrous Oxide in Midwifery Practice–Complementary, Synergistic, and Needed in the United States

Judith P. Rooks, CNM, MPH, MS

INTRODUCTION

A 50/50 mixture of nitrous oxide (N_2O) and oxygen is a safe, inexpensive, and reasonably effective labor analgesic that is available and widely used and appreciated by women in Canada, the United Kingdom (UK), Scandinavia, Australia, and many other parts of the modern Western world, but is not even known to most women in the United States, where it is offered in only a few hospitals.[1]

I became interested in N_2O while directing a symposium on The Nature and Management of Labor Pain.[2] Systematic reviews of evidence regarding both the effectiveness and harms of virtually every method of labor analgesia being used in the United States were presented at the symposium and published as a supplement to the May 2002 issue of the *American Journal of Obstetrics and Gynecology*. Dr. Mark Rosen's paper on N_2O was based on findings from his systematic review and two decades of personal experience providing N_2O to women during labor at Moffitt Hospital at the University of California at San Francisco (UCSF).[3] UCSF has recently adopted new guidelines that authorize midwives, as well as anesthesiologists, to teach and assist women to use N_2O in labor[4] (see page 308).

USE OF NITROUS OXIDE IN OTHER COUNTRIES

N_2O is used by nearly half of women giving birth in many Western countries, and by more than 60% in the UK.[1] While 62% of women in a nationwide study conducted in the UK in 2000 used N_2O, 31% of those who used it also used transcutaneous electrical nerve stimulation (TENS; usually during the first stage of labor; most women switch to N_2O for the second stage); 42% also received one or more injections of meperidine or an equivalent opioid, and almost a third had epidural analgesia. Twenty-five percent of the women who used N_2O used at least two other kinds of analgesia; 27% used N_2O and nothing else (J. Green, personal communication, October 8 and December 1, 2006; unpublished data from the 2000 Greater Expectations study, Mother & Infant Research Unit, University of Leeds, UK). This concurs with information from Dr. Michael Klein, Emeritus Professor of Family Practice and Pediatrics at the University of British Columbia, who said that, "While nitrous oxide is used widely in Canada, it is not a substitute for epidurals. It is adjunctive. The substitute for epidurals cannot be one 'magic bullet,' but involves the entire approach to labor and birth. In such a revamped and reconfigured approach to birth (actually it is what Canadian midwives normally do), nitrous oxide will be used with variable frequency, depending on local conditions, maternal desires and what else is in the 'tool box' of the caregiver" (personal communication, October 11, 2006).

EFFECTIVENESS OF NITROUS OXIDE

The pharmacologic pathway by which N_2O achieves analgesia is not well understood. The most widely held hypothesis is that N_2O induces the release of endogenous endorphins, and perhaps dopamine, in the brain, creating both euphoric effects and modulation of pain stimuli within the brain.[3] N_2O provides less complete pain relief than an epidural, and a few women report little or no benefit; yet most women who have used it say it was effective and are satisfied. A consumer-oriented book coauthored by Dr. William Camann, Immediate-Past President of the Society for Obstetric Anesthesia and Perinatology, describes what women experience as "diminished pain, or a continued awareness of pain, without feeling bothered by it . . . a kind of strange sensation of feeling the pain while at the same time feeling a sense of bliss. So, the pain may still exist for some women, but the gas may create a feeling of: 'Painful contraction? Who cares?!'"[5] In studies, N_2O is more effective for parous women than for primagravids.[3]

A critical aspect of the use of N_2O during labor is that the woman administers the gas to herself and therefore controls when and how much she uses. Part of its effectiveness may rest in the woman's sense of being able to control not only the nitrous oxide, but also the pain and herself. Pain experienced by individuals who are "confident that they can cope masterfully with the challenge" can result in exhilaration, rather than suffering.[6] According to Lowe,[6] "In contrast, helplessness and suffering are experienced when individuals have insufficient resources and are unable to cope." Locus of control is important, and there is a strong positive association between "coping" and "controlling."[7] Conducting a systematic review of evidence regarding the association between pain and women's satisfaction with their childbirth, Hodnett[8] concluded that personal expectations, the

Address correspondence to Judith P. Rooks, CNM, MPH, MS, FACNM, 2706 SW English Court, Portland, OR 97201. E-mail: jprooks1@comcast.net

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amount of support provided by caregivers, the quality of the woman's relationship with her caregivers, and the degree of her involvement in making decisions about her own care can override pain, as well as many other factors that influence satisfaction.

Most research about the efficacy of various approaches to pain control are based on the use of either visual images or oral questions that require a person to assign a score to the degree of pain s/he is experiencing at a given point in time. What score should a woman assign to pain she is effectively coping with, as compared to pain that overwhelms her and makes her feel out of control? Although N_2O is less effective than an epidural, it appears to be more potent than opioids,[3] which may have long-recognized negative effects on the newborn[9] and were used by about 22% of women who gave birth in the United States in 2000.[10]

SAFETY, RISKS, SIDE EFFECTS, AND LIMITATIONS

A 50% mixture of N_2O with oxygen is safe for both the mother and her baby.[3,5] N_2O is eliminated through the lungs, not the liver, so the effects are transient and noncumulative. Potential adverse effects include nausea and vomiting and, "very rarely," the loss of consciousness if too much gas is inhaled, for example, because someone is holding the mask against the woman's face, thus overriding the protection built into self-administration.[3,5] *Self-administration is essential.* If a woman were to lose consciousness, however, a couple of breaths of room air or oxygen resolves the problem rapidly. There are no known adverse side effects for the newborn.[3,5] Referring to its long use at UCSF, Dr. Rosen said that "We've never seen a groggy baby from inhalation of 50% N_2O. It just doesn't happen."

Factors that limit acceptability include inadequate analgesia; sensations of being light-headed or "spacey," dizzy, or drowsy; not liking to use a mask; fatigue if N_2O is used over a long period of time; and the abrupt cessation of pain relief once the woman stops inhaling the gas.[5] No method of analgesia is without some negative effect, however, and these effects are mild compared to those associated with other forms of analgesia more commonly used in the United States today.

BENEFITS OF THE USE OF NITROUS OXIDE

N_2O is not an opioid and thus does not depress either the mother's or the newborn's respirations. Unlike an epidural, N_2O is not associated with maternal fever, prolonged second stage, or an increased incidence of occipitoposterior position of the fetal head at birth, increasing the need for either a cesarean section[11,12] or vacuum or forceps and thus increasing the incidence of third and fourth degree lacerations.[11-14] Maternal fever can lead to the drawing of blood, administration of antibiotics, and longer hospitalization of the newborn.[15] N_2O does not require intravenous fluids or continuous electronic fetal heart rate monitoring, lead to the increased use of oxytocin augmentation and urinary bladder catheterization,[16] preclude taking a shower or bath, or make it difficult or impossible to walk to use a bathroom.[16–18] It can be started and stopped at any time, unlike the effects of an epidural that, once started, are on board for the duration.

THE COMPLEMENTARITY AND SYNERGY OF NITROUS OXIDE WITH MIDWIFERY

A bill that would have given every woman the right to pain relief during labor was first discussed in the British parliament in 1950.[19] During the ensuing debate, the Chairman of the Central Midwives Board wrote a letter urging the Chief Medical Officer of the Ministry of Health to support the bill. Midwives would be essential to the success of the British National Health Service, and, he wrote, "The future of the midwife depends on her power to relieve pain."[19] Although the bill was overwhelmingly popular, it eventually floundered on the rocks of fiscal reality. Most women gave birth at home, and N_2O was, at that time, only available in large, heavy canisters that would require expensive transportation to homebirths. Nevertheless, British midwives were authorized to administer meperidine in both hospitals and homes in 1950 and N_2O in the 1960s. The context for these changes was an understanding that the cost-effective use of midwives could not be achieved in the long run in the national health service of a democracy such as Britain unless the midwives could provide effective pain relief to women during labor.

N_2O is a unique method of analgesia that complements and is synergistic with the midwifery model of care. The ability to provide a safe and reasonably effective, noninvasive form of labor analgesia is essential for midwifery to become mainstream in any Western society in which consumer choice is an important factor in health care.

OCCUPATIONAL AND ENVIRONMENTAL RISKS

A Russian study published in 1967 first raised the specter of occupational health risks for anesthesiologists and other operating room personnel from exposure to air contaminated by volatile anesthetics.[20] N_2O is weaker than other volatile anesthetics and unique in its action and effects, but is still a volatile anesthetic (analgesic except at very high concentrations) and is included among the anesthetics that caused concern. The trend

Judith P. Rooks, CNM, MPH, MS, FACNM, is an epidemiologist with a long career as a researcher, writer, teacher, and consultant in midwifery, maternal health, and family planning in the United States and developing countries.

toward greater use of regional and intravenous anesthesia and analgesia in the last 40 years may be, in part, a response to these concerns, which, in the case of N_2O, extend to dentistry personnel and those who take care of women during childbirth.

Any hazards from unintentional inhalation of these gases are related to the concentration of the active gas in the ambient air and the length of individual exposures. The main concern regarding N_2O is a possible increased risk of early spontaneous abortions among female health and dentistry workers. Results from research assessing this association have been inconsistent.[20] Recent studies suggest that there is a very low or nonexistent causal association between exposure to N_2O and mutagenic, teratogenic, or carcinogenic effects.[3,20–22]

In 1977, the National Institute of Occupational Safety and Health (NIOSH) established the maximum allowable occupational exposure to N_2O as 25 parts per million (ppm) in the ambient air measured on a time-weighted average.[20] Sweden and the UK set their N_2O contamination standards at 100 ppm. The standard set by NIOSH was arbitrary, and not based on evidence of actual effects.[20] The Occupational Safety and Health Administration (OSHA) developed guidelines to reduce contamination from anesthetic gases by use of scavenging equipment, regular testing for leaks in the system, and better ventilation of hospitals. Anesthesiologists are responsible for hospital compliance with OSHA standards, including the education of employees and medical surveillance of exposed personnel. Today, concerns about occupational risks of N_2O contamination do not appear to be valid in situations with good ventilation and use of equipment to scavenge unused gas.[3,20] In addition, new methods are being developed to absorb N_2O and similar gases from both air and equipment.[23]

The environmental risk of N_2O is its contribution to the overall climate-heating effects of "greenhouse gases." Based on information released by the US Department of Energy in 2000, N_2O is responsible for 0.084% of the total load of greenhouse gases, excluding water vapor, and less than 5% of N_2O in the atmosphere is manmade.[24] A UK source attributes 6% of greenhouse gases to N_2O and says that man-influenced sources—including fossil fuel combustion (mainly in power stations), the use of nitrogenous fertilizers, slash and burn agriculture (mainly in rain forests), and human and animal waste—represent about 45% of the total output of N_2O into the atmosphere.[25] Although these estimates are disparate, it is clear that medical uses of N_2O are a very small part of the problem. In summary, the global warming risks are valid but low relative to many less vital uses of N_2O, including NASCAR races, the followers of which, however, have a more effective political voice than pregnant women in the United States, who might want to use N_2O but who don't even know about it as an option.

A review of recent publications in both international and US anesthesiology journals suggests a struggle exists regarding the continued use of N_2O.[26–29] Even the suggestion of risk is enough to prompt some to call for a ban on use of this old, inexpensive, off-patent, unglamorous, safe, and reasonably effective but not highly potent analgesic in favor of newer, more sophisticated and expensive methods to manage pain during labor—methods that pregnant women cannot control, which, in fact, require the services of an anesthesiologist. American dentists have weighed in on behalf of the continued availability of N_2O,[28] but obstetricians and midwives have not.

CONCLUSION

N_2O is not right for every woman during labor, but it is wonderful for some women and, as stated above, more effective for parous women than for women having their first babies. It is particularly helpful for women experiencing rapid labor, transition, second-stage labor, and while suturing the perineum. It can be extremely helpful for women who want to avoid an epidural, useful for women who have to wait for an epidural, and a blessing for everyone when there is a sudden, unexpected need for analgesia for an invasive procedure required because of an obstetric emergency.

Unfortunately, even the vague suggestion of occupational risk has scared many hospital administrators. In addition, many obstetricians and labor and delivery nurses—perhaps even some midwives—may prefer to hand pain management over to anesthesiologists entirely.

A woman cannot access a pain management method that is not provided in the setting in which she chooses to give birth. Thus, those who set hospital policies, who are mainly invisible and whose decision making is not transparent, can limit analgesic choices arbitrarily, before women deciding where to give birth even realize that they should have a choice.

What would you think if every restaurant in your city offered only steak—more or less expensive and fancy steak, but only steak—and not a single vegetarian, Chinese, or Thai restaurant in your whole city? When nearly all American hospitals disdain a labor pain management method that is widely available in most of the rest of the Western industrialized world, what are well-informed women who want to avoid an epidural to think or do? What are midwives in the United States to do if the pain relief method that is used by mainstream midwifery in much of the developed world is excluded through private, nontransparent decisions made by physicians and administrators in hospitals throughout our country?

American cultural values of autonomy and informed choice are being cited as the ethical imperative driving the concept of elective cesarean births.[30] If the proponents of this viewpoint are honest, they should also

support wider use of N_2O, once they become better informed about it. Midwives should promulgate this information and fight for the right of women to have additional choices for pain management during labor. Many nonpharmacologic methods of pain relief are also relatively effective and greatly underused in this country. N_2O is a valid and important option for pain relief during labor and should be more available to women in the United States.

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