Original Article

A Study to Assess the Knowledge and Practices on Nitrous Oxide as Labour Analgesia among Nurses in Labour and Delivery Units

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ABSTRACT

Aim: The aim of present study is to assess the knowledge and practice related to the administration of nitrous oxide as labour analgesia among staff nurses and midwives and to identify the gaps in knowledge and practice.

Materials and Methods: The overall aim of this study is to achieve safe administration of Nitrous oxide to the women in labour and to reduce the associated risks for the employees with administration. The research design was quasi experimental one group pre - test post – test by observation method using purposive sampling technique. A total of 34 nurses working in labour and delivery units in King Khalid University Hospital were selected. To test the statistical significance paired sample t - test was used and to test the relation between the demographic variables and the test scores, independent t- test and ANOVA were used.

Results: The results were compared with the latest scientific evidences to identify gaps in the nursing practice on safe administration of Nitrous oxide to the women in labour. A nursing protocol on safe administration of nitrous oxide in labour and delivery was prepared in line with the most recent and updated research findings for the desired outcome. There is significant difference in the pre and post test scores on knowledge of nurses with a mean difference 8.64 in scores, and is highly significant with a much higher 't' value 14.450 and the 'p' value of <0.001.

Conclusion: The data over last 6 months shows 5-10% of women in labour are opting for epidural analgesia, while there is no record of information on usage of other modes of analgesia more specifically- Nitrous oxide in labour and delivery. The nurses in labour units have not been trained and educated specifically to the administration of entonox, hence it is been considered as an interesting area to be dealt with because of the wide application in the area.

Keywords: Nitrous oxide, entonox, labour analgesia, active labour

INTRODUCTION

Nitrous oxide (N2O) is simply a gas which you can breathe in. It has no color, smell and doesn't irritate. It was discovered in 1772. It's safe to use for longer periods of time if you mix it with oxygen (O2). Hence, the "laughing gas" or "happy gas' used now is called N2O-O2 and contains at least 30% oxygen . Usually, the mix is about 70% oxygen to 30% nitrous oxide. In medicine, sometimes a mix of 50% oxygen to 50% nitrous oxide is used. This is known as entonox or more commonly, "gas and air".

The first important use of nitrous oxide was made possible by Thomas Beddoes and James watt. Humphrey Davy encouraged to experiment with new gases for patients to inhale. Despite Davy's discovery that inhalation of nitrous oxide could relieve a conscious person from pain, another 44 years elapsed before doctors attempted to use it for anaesthesis.[1]

In India, for general anesthesia purposes, nitrous oxide is available as Nitrous oxide IP. Nitrous oxide can be used as an oxidizer in a rocket motor. In vehicle racing, Nitrous oxide allows the engine to burn more fuel by providing

more oxygen than air alone, resulting in a more powerful combustion. It is approved for use as a food additive specially as an aerosol spray propellant.[2] Nitrous oxide was been used for anesthesia in dentistry since December 1844. Inhalation of Nitrous oxide is frequently used to relieve pain associated with childbirth, trauma, oral surgery and acute coronary syndrome.

Nitrous oxide has been shown to be effective in treating a number of addictions including alcohol withdrawal. Nitrous oxide is also gaining interest as a substitute gas for CO_2 in laparoscope surgery; it can cause analgesia, depersonalization, derealisation, dizziness, euphoria and some sound distortion. Research has also found that it increases suggestibility and imagination. In August 2015, the London Borough of Lambeth Council banned the use of drug for recreational purposes, making offenders liable to an on-the-spot fine upto £ 1,000.[3,4]

The experience of labour pain differs among women, and the response to pain is highly individual. Women should have access to a variety of approaches to promote comfort and reduce pain throughout labor. Pain is a subjective and varied phenomenon, the birth wishes of pregnant women are as diverse as the women themselves.[5] In the labour, factors such as patient ability and choice to receive pharmacological pain management, labour support, risk level of clinical situation and provider influence can impact a woman's pain experience.[6-11]

There are typically three pharmacological choices for labour analgesia in King Khalid University Hospital obstetrical services. These include: epidural, intravenous or intramuscular opioids and inhaled nitrous oxide. The availability of all three options is dependent on site-specific resources.

Although its efficacy varies, it is recommended as a pharmacological pain management option, when used with proper waste anesthetic gas scavenging. Nitrous oxide (N_2O) is a weak anesthetic at high doses and an analgesic and anxiolytic at low doses. Everything about the effectiveness, safety, and risks of nitrous oxide is related to dose, which is a product of the concentration and duration of its use or other exposure.[12]

During childbirth, entonox analgesia can help to relieve the pain experienced by women as they undergo labour. It does not completely eliminate the sensation associated with contractions, but reduces the level of pain and anxiety to make them more manageable. Patient safety is a key component of nitrous oxide self-administration, nurses must have thorough education and demonstrate competency before providing care for women using nitrous oxide.[13,14]

Most Nurse Practice Acts do not provide for a registered nurse to administer anesthetic gases. However, in the case of nitrous oxide use as labor analgesia, the registered nurse is not administering the nitrous oxide, it is the woman who administers it to herself. The nurse's role is to reinforce education provided per the anesthesia team; perform and document appropriate nursing assessments, patient relief and side effects response and, lastly, to guard patient physical safety.[15]

While nitrous oxide is commonly known as laughing gas, the potential risk it poses is no laughing matter.[16] Workers in many healthcare settings are exposed to it during their daily routines, especially when dealing with anaesthetized patients. Studies have suggested that exposures in some settings are 12 - 40 times higher than recommended limits, even with scavenging systems in place. During medical procedures, great emphasis is placed on patient care and safety. Unfortunately, worker safety is often overlooked. Environmental control measures and/or changes in work practices will be necessary to reduce the high environmental levels observed in using nitrous oxide, environmental monitoring may be undertaken to check the efficacy of such measures in reducing the environmental levels. [17-22]

Nitrous oxide is used for almost all the women in labour, each labour suite is equipped with Nitrous oxide flow meter, but there is no uniformity in the procedure of administration as well as documentation, most importantly the engineering controls for safety are not in practice.[23,24]

The objective of our study is to analyze the existing practices in the labour and delivery unit regarding the nitrous oxide administration, identify the best evidences through literature review, compare the Hospital practices with international guidelines and disseminate the best practiced to apply in clinical situation and overall to achieve safe administration of Nitrous oxide both for the patient and the care provider.

MATERIALS AND METHODS

The study design was a pre experimental pretest posttest design and observation method. All the staff nurses and midwives working in the labour and delivery unit of the hospital, a total of 34 sample (n=34) answered the validated pre developed questionnaire with 25 questions as a pretest on 11th January 2015. Structured teaching of 1 hour 10 minutes with the reading material were provided to the participants on 14th January 2015, post test was given to the same group from 26th to 29th January 2015. Same data was collected for both pre and post test. Data was also collected by using an observation checklist

on six key elements such as, pretreatment evaluation, set up, patient preparation, post procedure and documentation, a total of 10 observations were made in 10 days starting from 1st to 10th February 2015. Frequencies and percentages of their responses were tabulated and represented graphically.

The data were analyzed using descriptive and inferential statistics, to test the statistical significance paired sample t-test was used, and to test the relation between the demographic variables and the test scores, independent t- test and ANOVA were used.

RESULTS

Table 1: Pre Test Scores on Knowledge assessment

Pre test scores descriptives	Statistic	Std. Error
Mean	11.32	.360
95% Confidence Interval for Mean (Lower Bound)		
95% Confidence Interval for Mean (Upper Bound)	12.06	
Median	11.00	
Variance	4.407	
Std. Deviation	2.099	
Minimum	8	
Maximum	17	
Range	9	
Interquartile Range	3	
Skewness	.441	.403
Kurtosis	.212	.788

The pre test scores on knowledge assessment shows the mean pretest score is 11.32, and the standard deviation is 2.09, while the 95% confidence interval for the mean, lower and upper scores are 10.59 and 12.06 respectively.

Table 2: Post test scores on Knowledge Assessment

Pre test scores descriptives	Statistic	Std. Error
Mean	19.97	.467
95% Confidence Interval for Mean (Lower Bound)	19.02	
95% Confidence Interval for Mean (Upper Bound)	20.92	
Median	21.00	
Variance	7.423	
Std. Deviation	2.725	
Minimum	14	
Maximum	23	
Range	9	
Interquartile Range	4	
Skewness	-.980	.403
Kurtosis	-.141	.788

The post test scores on knowledge assessment shows the posttest mean score is 19.97 with the administration of same tool after teaching and intervention. The confidences for mean at 95% both lower and upper scores are 19.02 and 20.92 respectively.

Table 3: Paired sample statistics

	Mean	N	Std. Deviation	Sta. Error Mean
Post Test Scores	19.97	34	2.725	.467
Pre Test Scores	11.32	34	2.099	.360

The pre and post test score means as 11.32 and 19.97 respectively for the total number of participants (n=34). The standard deviation of pretest score is 2.09, while the posttest score standard deviation is 2.72. The mean posttest score has significantly increased after teaching.

Table 4: Paired sample t-test

	Mean Difference	't' Value	'p' Value	95% Confidence interval of the Difference	
				Lower	Upper
Post Test-Pre Test	8.647	14.450	< 0.001	7.430	9.865

Table 4 has the values of paired sample t-test. There is significant difference in the pre and post test scores on knowledge of nurses with a mean difference 8.64 in scores, and is highly significant with a much higher 't' value 14.450 and the'p' value of <0.001. The null hypothesis is rejected in this case, that is there is difference in pre and post knowledge assessment scores on Nitrous oxide administration among nurses working in labour and delivery unit.

Table 5 shows the frequency and percentage distribution of different observation criteria of Nitrous oxide administration practice among nurses' in labour and delivery unit. The results reflect, none of the assessment areas are practiced as expected by the nurses in setting up the flow meter.

Above data also denotes, few practices like; consent, usage of additional opioids, post procedure Oxygen flush, infection control practices and use log maintenance are not being noted by the observer. Where as in patient preparation instructions on self-administration of gas was accurately done in all the observations, but there was not written consent taken prior to administration.

In the procedure of administration, fixing the flow rate and concentration was done for all the observations, it is also evident from the table that the opiods were given

Table 5: Nitrous oxide administration practice assessment

S. No.	Assessment Criteria	Frequency		Percentage	
		Done	Not Done	Done	Not Done
I	Pretreatment evaluation				
	Assessment of patient suitability/absence of contraindications	05	05	50%	50%
	Baseline vital signs monitored	09	01	90%	10%
II	Set up of nitrous oxide flow meter				
	Pipeline Pressure checking	0	10	0	100%
	Checking inspiratory /expiratory hoses and rubber bag for leaking	0	10	0	100%
	Appropriate size mask	0	10	0	100%
	Attaching filter to the expiratory hose	0	10	0	100%
	Scavenging system check	0	10	0	100%
III	Patient Preparation				
	Informed consent including side effects	06	04	60%	40%
	Counselling on moving with assistance	08	02	80%	20%
	Consent form in the chart	0	10	0	100%
	Instructions on self-administration	10	0	100%	0
IV	Procedure of administration				
	Fixing the flow rate & Concentration	10	0	100%	0
	Proper use of mask with seal	9	1	90%	10%
	Ongoing patient instructions	8	2	80%	20%
	Periodical monitoring of vital signs	9	1	90%	10%
	No additional opioids	0	10	0	100%
V	Post procedure care				
	Oxygen Flush	0	10	0	100%
	Oxygen/nitrous oxide shut off	10	0	100%	0
	Cleaning of mask, tubing, discarding filter	0	10	0	100%
VI	Documentation				
	Complete documentation	06	04	60%	40%
	Use log	0	10	0	100%

along the course of nitrous oxide administration. The post procedure care shows oxygen flush and cleaning of the mask were not practiced by the nurses.[6] observations among 10 had maintained complete documentation relating to nitrous oxide administration, though there was no use log in the area.

DISCUSSION

The mean pre test and post test scores as per table 1 and 2 are 11.32 and 19.97 respectively, in this data set the scores improved by 8.64 as in table 4. Since the 'p' value is <0.001 we can conclude that there is a statistically significant difference between the two conditions. The't' value is 14.45, hence there is strong evidence that the teaching intervention improved the scores, but in our study the 95% confidence interval is between 7.4 to 9.9, this confirms that although the difference in scores is statistically significant, it is actually relatively small, so we need to consider that this difference in scores is practically important not just statistically significant.

In conclusion the difference between the pre and post test score means are not likely due to chance and are probably due to the teaching and resources provided. Independent sample 't' test on demographic variables like qualification of nurses, past experience with nitrous oxide administration and personal experience with nitrous oxide are not statistically significant.

One way ANOVA on variables like total labour and delivery experience and King Khalid University Hospital labour and delivery experience were also statistically insignificant. In conclusion the selected independent variables have no statistically significant effect on pre and posttest performance of the subjects in the study.

The data in table 5 shows the gaps in the setup and safe practices of nitrous oxide, as there is no scavenging system attached to the flow meter, and Oxygen flushing at the end of the administration to avoid diffusion hypoxia is not in practice, according to Rosen (2002) the key is to use scavenging system, even if nitrous oxide is relatively safe.[25] Clark MS (2010) in 'Contemporary issues surrounding nitrous oxide' stated, once the nitrous oxide flow is terminated, 100% oxygen should be delivered for five minutes.

Furthermore, the facility does not have single use mask and bacterial filter for the breathing circuit in terms preventing cross contamination, single use mask or mouth piece is better used in administering nitrous oxide (British Columbia perinatal health program 2007; Woodward 2008), it is also recommended that appropriate filter to be placed between the breathing system and the patient, and the filter to be changed between the patients (Bajekal RR et al, 2000).

As the entonox is one of the pharmacological approaches to pain management, there must be informed choice prior to administration of treatment, verbal consent is obtained prior to administration of Nitrous oxide therapy (Stewart LS et.al, 2012). The study demonstrated gaps in knowledge and practices of nurses administering Nitrous oxide for the labouring women.[26]

CONCLUSION

The literature addressing nitrous oxide for the management of labor pain has few studies of good or fair quality. Analyzing the existing practice and knowledge study was challenging. Research assessing practice of nitrous oxide as labour by the midwifes across the world should be strengthened.[27] The Satisfaction of mothers related to labour pain relief should also be assessed. The control measures to be followed are as follows: the heating, ventilating, and air conditioning (HVAC) system should contribute to the dilution and removal of waste gas, including nitrous oxide, which is not collected by the scavenging system.

Local exhaust systems should be placed close to the working area to remove leaking gas. General work area, adequate ventilation must always be provided. Use an adjustable, well-fitting single use mask. Monitor nitrous oxide air levels at bed-side using the Nitrous oxide monitor badges. Monitor ambient nitrous oxide air levels. Periodic maintenance of all anesthetic gas-delivery equipment is essential to verify proper gas delivery and to remedy leaks. Personal protective equipment (PPE). Certain types of Personal protective equipment (PPE) are effective in controlling Nitrous oxide exposure.

RECOMMENDATIONS

As far as practice is concerned the following instructions are recommended:-

A specific consent form for nitrous oxide analgesia is signed and witnessed.

Assessment of vitamin B12 levels should be considered before nitrous oxide administration in people with risk factors for deficiency of this vitamin.

Caution is recommended in administering nitrous oxide after previous administration of opioids as it can cause additional sedation, possible unconsciousness and airway compromise. Continuous pulse oximetry should be used and continued until the patient has returned to their pre procedural baseline observations and sedation score.

Nitrous oxide levels and time intervals must be recorded in the patient's treatment record. Flow chart for the gas is to be maintained. A use log is kept in the equipment cabinet. Each record of use is logged by the anesthesia provider or midwife checking out the machine.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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