An observation into the accumulation of N_2O in the pneumoperitoneum during laparoscopic surgeries

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Received: 8th August, 2018 **Accepted:** 9th March, 2019

Abstract

Introduction and Aim: Nitrous oxide (N_2O) is one of the oldest inhalational anaesthetic agents used in modern anaesthesia practice, N_2O has been on and off the list of drugs in the anaesthesiologist's armamentarium.

It is believed that diffused N_2O will accumulate in the third spaces causing its expansion and pressures build up.

However, much is not known about how much it diffuses. The aim of present study is to analyze the extent of N_2O in peritoneal cavity following creation of pneumoperitoneum for laparoscopic surgeries as well as relationship to the duration of pneumoperitoneum.

Materials and Methods: Twenty two ASA I & II patients of both sexes aged between 18 to 65 years who underwent elective laparoscopic cholecystectomy were included with consent. N_2O and O_2 were administered at a fixed proportion of 60:40. Volatile anaesthetic agent Sevoflurance was administered and adjusted to achieve a MAC_{age} of 1.1 to 1.2.

Results: Entire 22 (50% female) patients with mean $\pm$ standard deviation (SD) age and weight of 40.18 $\pm$ 8.96 years and 63.05 $\pm$ 6.09 kilogram fulfilled inclusion criteria and data were analyzed. No N_2O or anaesthetic agent was detected in the aspirated sample at the end of surgery.

Conclusion: Amount of N_2O accumulated in CO_2 pneumoperitoneum used for laparoscopic surgeries are insignificant to nil for 3hour procedures.

Keywords: Nitrous oxide, Pneumoperitoneum.

Introduction

Nitrous oxide (N_2O) is one of the oldest inhalational anaesthetic agents used in modern anaesthesia practice. For various contradicting views the use of N_2O has been on and off the list of drugs in the anaesthesiologists armamentarium. One such conviction theory is that N_2O enter into gas filled space within the body because of different diffusion gradients for O_2/N_2O and N_2.[1] It is believed that diffused N_2O will accumulate in the third spaces causing its expansion and pressures build up. After the publication of ENIGMA-II trial, there has been a renewed interest on this time tested agent's safety.[2] During laparoscopic intrabdominal surgeries, artificial pneumoperitoneum is created in the peritoneal cavity (third space). During N_2O based general anaesthesia (GA), due to inherent property, N_2O is expected to diffuse in to the space. However, much is not known about how much it diffuses or whether this diffusion is clinically significant or not. We planned to test the belief that it diffuses out into third space (peritoneal cavity) and planned the present study with an aim to analyze the extent of N_2O in peritoneal cavity following creation of pneumoperitoneum for laparoscopic surgeries as well as relationship to the duration of pneumoperitoneum.

Our primary objective was to measure N_2O concentration (F N_2O) in the gases sampled from the peritoneal cavity during laproscopic surgeries. Secondarily to test whether the quantity of N_2O has any relation to the duration of pneumoperitonium.

Materials and Methods

After the approval from institutional ethical committee, the present prospective observational study was conducted in tertiary care teaching hospital of India. The hospital is situated nearly at sea level. Twenty two ASA I & II patients of both sexes aged between 18 to 65 years who underwent elective laparoscopic cholecystectomy were included with consent. Any of the cases which were converted to laprotomy or where the pneumoperitonium had to be released or interrupted for more than 10 minutes were excluded from the study. A case which was converted to open procedure from laparoscopic was excluded. Surgeries where pneumoperitoneum was interrupted for more than 5 minutes were also excluded from the study.

All the patients were induced for GA by following a standard regimen based on body weight. All the patients were intubated with cuffed ETT and were put on ventilation with age and weight adjusted parameters. N_2O and O_2 were administered at a fixed proportion of 60:40. Volatile anaesthetic agent Sevoflurance was administered and adjusted to achieve a MAC_{age} of 1.1 to 1.2. GA was conducted using Mindray WATO 65 workstation (Mindray Medical International Limited, Shenzhen, China). Surgical procedure was conducted as per standard procedure prevailed in the institute. The time of beginning of surgery, pneumoperitoneum, end of pneumoperitoneum, end of surgery were noted to calculate durations. At the end of the surgery, when surgeons started deflating the pneumoperitoneum, gas sample was obtained using a 20 cc

syringe connected to trocar stopcock port of laparoscope via a three way and immediately fed in to the gas sampling port of anaesthesia gas analyzer attached to multipara monitor Mindray Benewiew T8 (Mindray Medical International Limited, Shenzhen, China) and the reading for CO_2 and N_2O was noted from the display. The data was finally analyzed using INSTAT (Graphpad prism Software Inc., La Jolla, CA, USA).

Results

Entire 22 (50% female) patients with mean ± standard deviation (SD) age and weight of 40.18 ± 8.96 years and 63.05 ± 6.09 kilogram fulfilled inclusion criteria and data were analyzed. The median ASA physical class was I (range I–III). The mean duration of surgery and pneumoperitoneum was 122.91 ± 13.51 and 107.5 ± 14.02 minutes respectively. No anaesthetic agent including N_2O was detected in the aspirated sample at the end of surgery. The mean CO_2 detected was 227.77 ± 2.78 mmHg. When compared, the concentration of CO_2 for the pneumoperitoneum durations less and more than 120 minutes, no statistical difference was found (mean ± SD pneumoperitoneum and respective CO_2 detected were 101.71 ± 9.25 versus 127.2 + 7.92 minutes; p <0.0001, and 227.59 ± 3.06 versus 228.4 ± 1.52 mmHg respectively; p 0.578).

Discussions

N_2O is an important and one of the oldest used gases in the hands of the anaesthesiologists. We tried measuring the gas from peritoneal samples. N_2O was not detected from any of the samples despite being delivered for more than 2 hours. However, animal model study conducted in domestic pig showed that N_2O can reach up to 29% by two hours of pneumoperitoneum.[3] Contrary to this, another study measuring the Fip N_2O in 50 laparoscopic gynecology, intraperitoneal hernia repair and cholecystectomy patients anaesthetized and managed with Fet N_2O was 65%–70% for a duration ranging 20 min to 3 h found that the Fip N_2O was 1-10%. The Fip N_2O increased with increasing duration of pneumoperitoneum.[4] The present study was however unable find N_2O or the concentration was so low that the anaesthesia gas analyzer could not detect it. This probably happened because; intact peritoneal cavity does not contain nitrogen, oxygen or air to be replaced by N_2O. In CO_2 pneumoperitoneum the empty potential space is filled with pure CO_2 and the blood gas coefficient of CO_2 is… and that Nitrous oxide is 0.47. In this context it is also to be taken into consideration that nitrous oxide enters the potential space by diffusion, rather than by vascular delivery.[5] We can therefore reasonably assume that in laparoscopic surgeries of moderate durations (< 3h), there is no significant movement of N_2O into peritoneal cavity by diffusion when CO_2 pneumoperitoneum is used.

This study however gives us a research question whether the N_2O will be accumulated in air and oxygen pneumoperitoneum? If yes, how much? Will it be significant clinically or will it differ significantly than CO_2 pneumoperitoneum. The limitation of the present study is that we have studied only few samples and the duration of pneumoperitoneum studied were also relatively shorter.

Conclusion

Amount of N_2O accumulated in CO_2 pneumoperitoneum used for laparoscopic surgeries are insignificant to nil for 3hour procedures.

Conflict of Interest: None.

References

1. Becker DE, Rosenberg M. Nitrous Oxide and the Inhalation Anesthetics. *Anesth Prog* 2008;55(4):124-31. doi:10.2344/0003-3006-55.4.124.
2. Myles PS, Leslie K, Chan MT, Forbes A, Peyton PJ, Paech MJ, et al. ANZCA Trials Group for the ENIGMA-II investigators. The safety of addition of nitrous oxide to general anaesthesia in at-risk patients having major non-cardiac surgery (ENIGMA-II): a randomised, single-blind trial. *Lancet* 2014;384:1446-54.
3. Diemunsch PA, Torp KD, Van Dorsselaer T, Mutter D, Diemunsch AM, Schaeffer R, et al. Nitrous oxide fraction in the carbon dioxide pneumoperitoneum during laparoscopy under general inhaled anesthesia in pigs. *Anesth Analg* 2000;90:951-3.
4. Weenig CS. N_2O Usage in Laparoscopic Cases. *Anesth Analg* 2000;91:1306-7.
5. Kaur S, Cortiella J, Vacanti CA. Diffusion of Nitrous oxide in to pleural cavity. *Br J Anaesth* 2011;87:894-6.

How to cite this article: Narayan A, Prakash A, Karim HMR, Kumar S. An observation into the accumulation of N2O in the pneumoperitoneum during laparoscopic surgeries. *Indian J Clin Anaesth* 2019;6(2):187-8.