Efficacy of nitrous oxide (N_2O) over carbon dioxide (CO_2) for pneumoperitoneum during laparoscopic surgery

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Abstract

The present research was under taken with the aim to assess the efficacy of Nitrous (N_2o) over carbon dioxide (Co_2) which develops many health hazards like cardiovascular, respiratory and hemodynamic effects. In order to overcome these health effects during laparoscopy, nitrous oxide compound could be the promising and better alternative agent.This study has shown that nitrous oxide for pneumoperitoneum (pp) is safe and better compound than carbon dioxide. Nitrous oxide patients had less pain scores and physiological effects on heart, respiratory and renal systems. Amount of anaesthesia required for nitrous oxide patients was less as compared to carbon dioxide group,so the present study shows and suggests that nitrous oxide pneumoperitoneum is advantageous and better option for pneumoperitoneum during laparoscopic procedures.

Keywords: Nitrous oxide, Carbon dioxide, Laparoscopy, Pneumoperitoneum, Pain score.

Introduction

Laparoscopy is an advanced and standard surgical technique used to treat symptomatic gallstones. It is also used to treat the patients with underlying diseases. As we know that by using carbon dioxide during pneumoperitoneum can have adverse health risks. Hence, we can use other gasses like nitrous oxide during laparoscopy. Carbon dioxide is presently common agent for creating pneumoperitoneum during laparoscopy. However, it creates lot of health problems in different physiological and metabolic dynamics which results in different health abnormalities. Hence, to overcome these effects during laparoscopy by using nitrous oxide for pneumoperitoneum is more efficient and trust worthy chemical agent. Therefore, the present research paper mainly discusses many merits of nitrous oxide (N_2o) over carbon dioxide (Co_2) during laparoscopic surgery.

Materials and methods

After taking the permission from the scientific and ethical committee of the selected hospital and with consent from the parents, we selected patients randomly under controlled conditions for surgery. This was done on trial basis and opportunity was given to patients to participate in this trial in order to get the data to find out the given hypothesis. For the analysis, a district government hospital namely Government Baramulla District Hospital (GBDH), Kashmir was selected for a period of two months i.e., June to July-2024. During the research trial, 80 random patients were categorized into two groups i.e., A and B.

During the research trial, Patients were given pre operative medicines like Lorazepam at 2 mg orally. Moreover, Glyco-pyrrolate (injection) at 0.2mg was given to patients at the time of surgery. Blood pressure, pulse and heart beat rate were monitored continuously while performing the surgery with standard devices. Even during surgery, intra abdominal pressure was maintained at 2-14mm Hg and some diclofenac tablets at 50mg, 100mg and 400mg were given to patients in order to subside and relive the pain to body. The post operative pain was assessed by using the visual analog scale for pain score i.e., 0-10 scale at 2h, 4h and 24hrs respectively.

Results

During the present study, 80 numbers of patients were selected, screened and put into two categories i.e. A and B respectively. Group-A received nitrous oxide and Group- B carbon dioxide as chemical agent for pneumoperitoneum. These two categories of patients had heterogeneous structure i.e., different phenotypic characters and also these two groups were matched with different and advanced surgery procedures.

Table 1: Different surgery techniques

Procedure	Nitrous oxide (40)	Carbon dioxide (40)
Laproscopic Cholecystectomy	15	22
Appendectomy	20	13
Inguinal and umbilical Hernia	5	5
Total	**40**	**40**

Table2: The patients showed heterogeneous characteristics during different laparoscopic surgeries.

Variables	Nitrous oxide (40)	Carbon dioxide (40)
Age of patients (yrs)	42(24-70)	45(25-70)
Sex (male/female)	21/19	23/17
Weight (Kg)	$63.5_{\pm}11.3$	65.2±9.5
Duration of PP (min)	50.3±24.1	53.1±23.9
Anaesthetic risk (ASA>2)	4.24(10.5%)	4.1(10.3%)
Duration of hospitalization (days)	1.9±0.3	1.8±0.4

The study also showed significant difference or variation between Group A and B with respect to physiological and cardiovascular changes by using N_2o and Co_2 as chemical for pneumoperitoneum.

Table 3: Cardiovascular changes duringN_2O and CO_2

Cardiovascular Characters	Nitrous oxide (40)	Carbon dioxide (40)
Heartbeat Rate (heart beats\minute) (mean value)	4±7.2	9.1±9.3
Arterial pressure (mm/Hg) (meanvalue)	4.3±7.4	10.3±10.5

The amount anesthetic compound i.e., isoflurane needed during laparoscopic surgery was lower in N_2o (1.5 MAC-h) as compared to Co_2 (3.0 MAC-h) and nitrous oxide amount was almost double to Co_2 level.

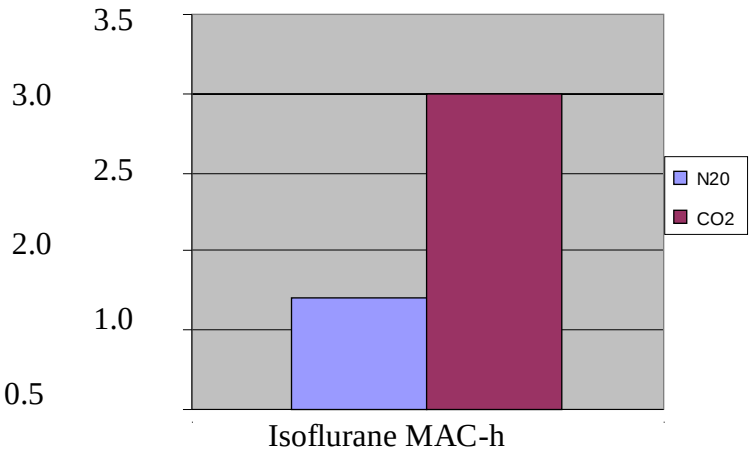

Chart 1: Showing the amount of anesthesia in two groups

The present study have also shown that analgesic level to relieve the pain was less by using nitrous oxide compared to carbon dioxide at 2h ,4h, and 24h respectively.
Post operatively (table 4) also shows pain score was high in carbon dioxide while in case of nitrous oxide it was less preoperatively (chart 2).

Table 4: Showing the pain relieving medicines (mg)

Analgesic	**N_2O**	**CO_2**
Diclofenac (IM +oral)	99.3±9.9	110.3±10.5
Tramadol(IV)	140.1±23.1	160.1±35.3
Acetaminophen(oral)	550±11.0	650±124

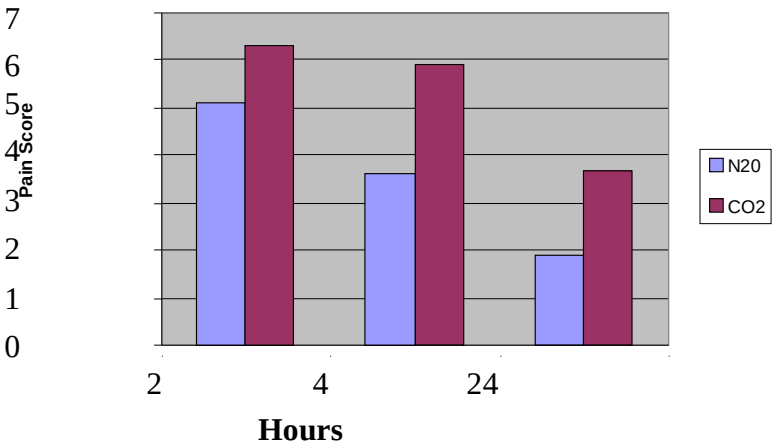

Chart 2: Depicting the pain score in two groups A and B (nitrous oxide and carbon dioxide.

Discussion

This study was a primary survey in selected hospital and it suggests that N_2o(pp) as achemical agent during laparoscopy surgery has definitely edge and great advantage over Co_2(pp). The first and great advantage of nitrous oxide was that the patients who received nitrous oxide as pneumoperitoneum gas had lower pain score as depicted in chart 2 even though, the consumption of analgesic was similar in both the groups i.e., A and B. This current medical observation was also recorded by other workers (5, 7, 18, 11). Further, other studies assessed pain score which was associated with diagnostic laparoscopic procedures

by using local anesthesia (5, 11). Both these research trials showed minimum pain with N2o as compared to Co_2. It was also shown by the another research trial (8), which studied randomly 40 patients and it was described that patients complained less pain and discomfort with the use of Nitous oxide (pp) as compared to carbon dioxide (pp).
Recently, one more study showed in its randomized selection less gastrointestinal pain with N_2o (pp) as compared to Co_2 (pp) (7). This could be because of local effects during laparoscopic surgery (12). Actually, Carbon dioxide can get transferred to irritant substance into body This observation is in accordance with other worker (13).
So, our study also has shown less introduced amount of N_2o during laparoscopic surgery in group-A i.e. Nitrous oxide group. This was supported by other studies (7,8).
In contradiction with Co_2(pp), high amount of Co_2 would be respiratory acidosis (14,15,16)even though Co_2 is commonly used but has number of side effects such as cardiovascular, respiratory and hemodynamic. The use of Co_2 has often put older and less healthy patients at risk of death (1,2, 3,4,5,6,7). During 1970-80's use of N_2o as pp gas was common preferred gas as pneumoperitoneum during surgery (9,10). A number of gynecological operations /procedures have been done by using nitrous oxide as preferred chemical without any risk (17, 18, 19).
Hence, to conclude use of nitrous oxide as pneumoperitoneum gas has great advantages over carbon dioxide as it is easy, safe and riskless compound and has proved to be an alternative compound for pneumoperitoneum during laparoscopic procedures.

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