Comparison of CO₂- and N₂O-Induced Discomfort During Peritoneoscopy Under Local Anesthesia

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The most comfortable gas for peritoneoscopy has been the subject of debate. We subjected 46 patients to double-blind comparison of carbon dioxide and nitrous oxide during initial pneumoperitoneum. The discomfort from local anesthesia was similar in both patient groups. The patient's and the physician's assessment of discomfort during gas insufflation showed that carbon dioxide was more uncomfortable as perceived by the patient (p = 0.02), the physician (p = 0.0006), and objectively assessed by degree of abdominal splinting (p = 0.006). The presence of intraabdominal adhesions had no relationship to discomfort. We conclude that nitrous oxide is more comfortable for institution of pneumoperitoneum during peritoneoscopy under local anesthesia.

Gastroenterologists are utilizing diagnostic laparoscopy at an increasing rate for evaluation of intraabdominal disease. We prefer to perform the procedure under local anesthesia with mild analgesia to reduce patient morbidity. Thus one of our principal concerns is the amount of discomfort the patient experiences during the procedure.

The use of CO₂ is associated with the development of hypercarbia (7) and cardiac arrythmias (4) due to the absorption of CO₂ from the peritoneal surface. Neither of these occurs with N₂O. On the other hand, CO₂ may be theoretically safer during electrocautery (8), and in case of inadvertent gas embolism, pneumothorax, or subcutaneous emphysema since it is more rapidly absorbed (9). The incidence of these latter complications, particularly gas embolism (10), appears to be very small and of only minor importance in selecting the type of gas. Since we do not routinely perform electrocautery during peritoneoscopy, our sole reason for selecting a gas is on the basis of patient comfort.

We undertook this study to analyze both patient and physician assessment of gas-induced discomfort during peritoneoscopy in a double-blinded approach. Previous studies of discomfort have been hampered by either more than one physician making observations or obtaining retrospective information from the patient about his total recollection of the procedure, rather than the discomfort of gas insufflation alone (5). We designed our study to overcome these difficulties.

Materials and Methods

Forty-six consecutive patients (25 male, 21 female, age range 19–75 yr, mean 47 yr) undergoing peritoneoscopy were randomly assigned to receive either CO₂ or N₂O for peritoneal gas insufflation. These studies were approved by the Institutional Research Committee and Human Experimentation Committee at Wilford Hall USAF Medical Center on 31 March 1980. All patients were told before peritoneoscopy that they would be asked to grade their pain on a linear scale from 0
to 10 for each of three specific events during the procedure: the initial local anesthetic; the brief period of insertion of the Veres insufflation needle; and then during the 3–5-min period of actual gas insufflation. They were asked to record their impressions immediately after the procedure. Patient’s raw pain scores were converted to a category according to: 0 = none; 1–3 = mild; 4–7 = moderate; 8–10 = severe.

All patients received preoperative analgesia consisting of 1.5 mg/kg meperidine and 0.15 mg/kg diazepam intramuscularly 30 min before the procedure. Each patient was given roughly the same amount of 1% lidocaine for local anesthesia (20 ml). Additional meperidine was given intravenously as needed for patient discomfort. The gas was administered via a Wolf Automatic CO2 Insufflator (Richard Wolf Medical Instrument Corporation, Rosemont, Ill., 60018) where both the volume administered (liters) and intraabdominal pressure (mmHg) were constantly monitored during insufflation. The volume of gas administered at the point where intraabdominal pressure rose 5 mmHg (at end expiration) above the baseline was the end point of insufflation (usually from 15–18 mmHg). Gas tanks were disguised so that both physician and patient were blinded as to the gas used.

Blood pressure and pulse were recorded before any medication, before abdominal manipulation, immediately before gas insufflation, and 5 min after gas insufflation.

In addition to the patient’s response to the procedure, one physician (J. R. S.) observed each procedure and assessed pain by visible or audible signs of discomfort, or both, and degree of abdominal splinting (by palpation and observing intraabdominal pressure). He recorded his subjective impressions as either none, mild, moderate, or severe, before questioning the patient about his response.

Physiologic data were analyzed by Student’s t-test with two-tailed tests of significance. Outcome variables of physician and patient estimates of discomfort were analyzed by ridit analysis with two-tailed tests of significance (11). The Student’s t-test could not be used for the latter because the distribution of the response was multimodal.

### Results

Both patient groups were similar in age and sex (mean age N2O = 46.0 yr, CO2 = 45.9 yr; male/female ratio N2O = 1:1, CO2 = 1.36:1). The diagnoses and presence of adhesions for each group are listed in Table 1. Each patient underwent at least one liver biopsy. In 44 patients it was performed via a separate skin site and in 2 through the peritoneoscope. There was no difference between the two groups in the total amount of gas insufflated (N2O = 3.5 ± 0.8 L; CO2 = 3.7 ± 1.0 L), changes in blood pressure or pulse, or need for extra meperidine during insufflation. There was no difference in pain distribution of the two gas groups during anesthesia infiltration and insertion of the Veres needle (Figure 1).

The estimate of pain by the patient and the physician during the gas insufflation period showed a significant difference between the two gases with CO2 being responsible for a greater number of more painful responses (Figure 2A and 2B). The physician’s impression of the degree of abdominal splinting also showed that splinting was significantly more likely to be associated with CO2 (Figure 2C).

The presence of adhesions was unrelated to the distribution of the patient’s pain scores. It is of interest that the physician’s estimate of the patient’s degree of discomfort underestimated that of the patient regardless of which gas was used. This is
obtained by comparing the distributions in Figure 2 (A and B) and is significant at \( p = 0.0003 \).

**Discussion**

Few objective studies have attempted to answer the question of discomfort during peritoneoscopy under local anesthesia. In the study by Emerit et al. (5), 500 cm\(^3\) of CO\(_2\) or N\(_2\)O was insufflated after peritoneoscopy and the patients were asked to grade this discomfort. Although N\(_2\)O seemed to be more comfortable, the physician was not blinded, and the prior procedure and residual gas or pain could have affected the patient’s perception.

Sogge et al. reported on 26 patients noting no differences in pain perception between the two gases (6). In that study, several different physicians made the observations, and the patient was not asked to grade his discomfort until the following day. Moreover, a global recollection of the entire procedure was reconstructed rather than specifically the gas insufflation.

In a study of 15 women undergoing tubal ligation with local anesthesia the authors merely comment that patients who were examined with CO\(_2\) pneumoperitoneum “complained of much more abdominal and diaphragmatic discomfort…” than those who had N\(_2\)O (3). This was an unblinded study without objective data.

Patients may well develop increasing discomfort after the procedure has continued for 30 min. This discomfort would be subject to many more variables than simply the type of gas used (e.g., the amount of gas, length of time, local anesthesia, circulating analgesic levels, intraabdominal manipulation, etc.). In order to isolate the type of gas used, we were interested only in the patient’s assessment of the 3–5 min period of gas insufflation. We obtained an estimate of the patient’s perception of a similar painful stimulus (local anesthesia and Veres needle insertion) noting that the two groups were comparable. Then a single physician observed and assessed the patient’s subjective and objective response, recording the data immediately following the procedure.

Both the patient’s and the physician’s assessment of relative discomfort indicate a distribution for CO\(_2\) that is more uncomfortable than that for N\(_2\)O (Figure 2). Age, sex, and diagnosis had no relationship to pain and, importantly, neither did the presence of adhesions. Intramuscular diazepam is erratically absorbed with resultant variable circulating levels, but we believe that the number of patients in each group was sufficient to eliminate any bias based on diazepam levels.

Because of the short period of time involved it is unlikely that there was significant absorption of N\(_2\)O. At least, none of the patients appeared to demonstrate any “laughing gas” effects. We do not believe that the favorable experience with N\(_2\)O is due to a central effect; more than likely the unfavorable experience with CO\(_2\) is related to local acid–base changes in the peritoneal surface (7,8).

The study was interesting when we tried to predict in a given instance which gas the patient received...
based upon an assessment of his response. Three patients who had N₂O were assessed as having moderate to severe pain by the physician and 8 patients who had CO₂ were assessed as having no discomfort (Figure 2B). Clearly, patients who receive CO₂ can have a totally pleasant experience although that is not the rule. Conversely, N₂O appeared to be quite painful in a few patients. We have no explanation for these individual patient differences.

Two patients in the study underwent two procedures and received, by randomization, both gases. One patient judged N₂O to be more comfortable and the other gave CO₂ a lower pain score. In both patients the physician judged the pain responses the same for both procedures.

In conclusion, we believe that patients generally can expect to have less pain during gas insufflation when the gas is N₂O, although individual, unidentified patient differences may modify the expected discomfort.

References


