The effects of CO2 pneumoperitoneum at different temperature and humidity on hemodynamic and respiratory parameters and postoperative pain in gynecological laparoscopic surgery: A Prospective Randomized Controlled Study

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Abstract

Objective*: It is recommended to heat and humidify CO_2 in laparoscopic surgery to prevent postoperative pain and hypothermia but information about its effects on hemodynamic and respiratory parameters is limited. We aimed to investigate the effects of standard and heated-humidified CO_2 on hemodynamic and respiratory parameters.*

Study design*: One hundred patients who underwent laparoscopic hysterectomy for benign pathology were divided into two groups: Group CD (cold-dry) patients were administered standard CO_2, while Group HH (heated-humidified) patients were administered 95% humidified insufflation at 37°C. Hemodynamic and respiratory parameters, body temperature, pain score and blood count parameters were recorded.*

Results: *A total of 96 patients were included in the study, taken from the 100 patients. Group HH (n:47) had only higher systolic blood pressure at 75 min, mean blood pressure at 50 and 55 min and a lower heart rate between 15 and 45 min (p:0.049, 0.037, 0.013 respectively). Pain score, morphine consumption, end-tidal CO_2 and arterial blood gas values were not different between the groups, with only body temperature from 40 min and minimum value being significantly higher (at a difference of 0.86-1.04°C) in Group HH. Postoperative leukocyte, neutrophil and NLR (neutrophil-leukocyte ratio) were found to be higher in this group ($p<0.05$).*

Conclusion: *It has been found that both standard and heated-humidified CO_2 do not constitute a problem in terms of hemodynamic and respiratory parameters. However, the standard CO_2 group had a lower core body temperature and inflammatory response.*

Keywords: *Gynecological laparoscopy, standard CO_2, heated-humidified CO_2, hemodynamic, respiratory parameters*

Introduction

Laparoscopy surgery has been associated with less postoperative pain, less systemic immunological depression, less wound infection, shorter hospital stays and earlier return to normal activities; however, the hemodynamic changes caused by pneumoperitoneum, patient's position and hypercarbia have always been a concern for surgeon and anesthesiologists. Hypercarbia and increased intraabdominal pressure affect cardiac output, central venous pressure, heart rate (HR), mean blood pressure (MBP) and systemic vascular resistance through various mechanisms in laparoscopic surgery. The hemodynamic effects of mild hypercarbia are less serious than the mechanical effects of increased intraperitoneal pressure, although moderate and severe hypercarbia lead to significant hemodynamic changes, both directly by the cardiovascular system and indirectly by the autonomic system. Its effects on the sympathetic nervous system cause increased blood pressure, heart rate and risk of arrhythmia. Especially, patients with cardiac or pulmonary diseases are at increased risk because of reduced cardiac output, increased central venous pressure, respiratory pressure and acidosis [1-4].

Standard carbon dioxide (CO_2) is often preferred at room temperature (20–25°C) and dry (at 0-5% relative humidity) in laparoscopic surgery [5,6]. Recent years have witnessed devices that provide heat (35-37°C) and humidity (95-98%) to prevent postoperative pain and intraoperative hypothermia. However, the number of studies on the effects of heated CO_2 on hemodynamic and respiratory parameters is limited [7-9], and these studies do not include humidified CO_2. We aimed to test whether heated (37°C)-humidified (95%) CO_2 would diffuse more easily into the blood from the abdomen and cause more hypercarbia compared to standard CO_2 in cases with constant intraabdominal pressure and whether it would affect hemodynamic, given the vasodilation that could occur, and respiratory parameters.

Although laparoscopy surgery is known to cause less systemic inflammation, some studies have reported that the use of standard CO_2 during laparoscopy led to a higher local or systemic inflammatory response compared to heated-humidified CO_2. This response has been stated to be particularly due to drying and damage in the peritoneum and has been associated with postoperative pain [4,5,10]. The second aim of this study was to examine simple indicators of inflammation, i.e., leukocyte and their subtype (neutrophil and lymphocyte counts) and neutrophil-lymphocyte ratios (NLRs) [11-14] in standard CO_2 and heated-humidified CO_2 and to evaluate their correlation with postoperative pain., and to evaluate their correlation with postoperative pain.

Materials and Methods

After approval of Ethics Committee (19-3.1/40, 17.04.2019), written informed consent was obtained from patients. The sample consisted of 100 American Society of Anesthesiologists (ASA) physical status I-II patients aged 40-65 who underwent laparoscopic hysterectomy for benign pathology. Patients with chronic obstructive pulmonary disease, asthma, advanced liver and kidney disease, infection,

bleeding disorder and drug allergies were excluded. The patients were divided into two groups according to a randomization scheme created by a computer: Group CD (cold-dry) patients were administered dry CO_2 via insufflator (Electronic CO_2 Endoflator SCB, Karl Storz, Germany) at room temperature (21°C), while Group HH (heated-humidified) patients were administered 95% humidified CO_2 insufflation (Endoflator 50, Karl Storz, Germany**)** at 37°C. The study was planned as a randomized and double-blind study, where patients were not informed of their group. During the operation and in the postoperative period, the patients were followed up by two different anesthetists. All patients were given information and training on the anesthesia method, the use of the patient-controlled-analgesia (PCA) device (Abbott Laboratories, USA) and the visual analog scale (VAS) the day before the operation. The patients' demographic data (age, weight, height, etc.) and their basal systolic, diastolic and mean blood pressures and heart rates were measured prior to the operation and recorded on the case report form.