

# Sodium Bicarbonate-Based Warm Saline Versus Warm Saline for Peritoneal Irrigation in Diagnostic Hysteroscopy-Laparoscopy: A Prospective Randomized Controlled Trial

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## ABSTRACT

**Introduction:** Diagnostic hysteroscopy-laparoscopy is an essential tool in management of infertility. Mainly, postoperative pain related to insufflated cold carbon dioxide (CO<sub>2</sub>), as it creates acidic milieu causing mucosal, sub-diaphragmatic and phrenic nerve irritation. Sodium bicarbonate is an alkaline solution, neutralizing the acidic effects, hence reduces postoperative pain and irritation symptoms.

**Objectives:** This study aimed to assess the efficacy of adding sodium bicarbonate to washing warm saline in hysteroscopic-laparoscopic patients regarding incidence and intensity of postoperative pain and gastrointestinal irritation symptoms.

**Patients and methods:** 66 patients were enrolled, one was excluded due to ovarian bleeding. 33 patients in sodium bicarbonate (Na) group received 50 ml sodium bicarbonate 8.4% in 1000 ml warm saline as peritoneal irrigation solution. While 32 patients in saline (S) group the peritoneal irrigation solution was 1000 ml warm saline only.

**Results:** Patients' demographic, hemodynamic data were comparable. Postoperative pain profile regarding shoulder tip pain, visual analogue score (VAS), and total pethidine consumption were lower in Na group. Also, postoperative nausea and vomiting (PONV) was lower in Na group.

**Conclusion:** Adding sodium bicarbonate to warm saline as a peritoneal washing solution during hysteroscopy-laparoscopy procedure resulted in better postoperative pain reduction specially shoulder tip pain and reduced the incidence of PONV. These results would improve patients' recovery and experience towards operative practice.

**Keywords:** Laparoscopy, Pain, VAS, Sodium bicarbonate, PONV.

## INTRODUCTION

Infertility is a common health problem affecting nearly 10% of women at reproductive age. The hysteroscopy and laparoscopy are becoming very important in the management of such pathology<sup>(1)</sup>. While, it seems simple procedure, postoperative pain is an agonizing complication<sup>(2)</sup>.

Pneumoperitoneum and insufflated cold carbon dioxide create gas pockets, beside acidic milieu, mucosal irritation and phrenic nerve damage. All of these factors are associated with postoperative visceral and shoulder tip pain<sup>(3, 4)</sup>. Many trials investigated different ways to reduce such pain. Systemic analgesic drugs, local analgesia, peritoneal wash, regional blocks and gas washing techniques had been prescribed, with variable results and also, side effects<sup>(5-9)</sup>.

Therefore, the clinical significance of pain control after laparoscopic surgery remains controversial. Sodium bicarbonate has a neutralizing effect against the acid milieu of the peritoneal cavity and the phrenic nerve damage. Also, warm saline counteracts the cold effect of carbon dioxide, which consecutively will lead to a reduction of post laparoscopic pain<sup>(10)</sup>.

In this trial, we assessed efficacy of adding sodium bicarbonate to washing warm saline in hysteroscopic-laparoscopic patients regarding incidence and intensity

of postoperative pain and gastrointestinal irritation symptoms.

## PATIENTS AND METHODS

This study was conducted at Mansoura University Hospital. Sixty six patients were enrolled in this study, which adheres to the applicable CONSORT guidelines (figure 1).

### Ethical approval:

**This study was approved by the Institutional Review Board, Mansoura Faculty of Medicine (IRB # R.20.02.737, February 15-2020).** Informed consents were obtained from all subjects participating in the trial. Before patients' enrolment, the trial was registered in the Pan African clinical trial registry (PACTR-202003752686494, date of registration: March 2-2020). Included females were ASA I or II aging 18-45 years, scheduled for diagnostic hysteroscopic-laparoscopic procedures.

**Exclusion criteria:** Patient refusal, allergy to used drugs, addiction, altered liver or kidney function, psychological troubles or complicated procedure. Candidate patients were randomly allocated into two groups [33 for saline group (S group), 33 for sodium bicarbonate group (Na group)] by random number



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generator of software program with closed envelop technique received with patients file.

Patients had preoperative assessment for anesthetic fitness and matching the inclusion and the exclusion criteria. At the operative suite, patients received pantoprazole (Zurcal 40 mg, AUG pharma, Spain), dexamethasone (Dexamethasone, Sigmatic, Egypt) 8 mg and 3 mg of midazolam (Midathetic, 1044mount pharmaceuticals).

In operating room, patients were connected to basic monitor including ECG, NIBP and pulse oximeter. Anesthesia was induced using propofol 1-2 mg/kg<sup>-1</sup> (Diprivan, Fresenius KABI), Fentanyl 1 µ/kg<sup>-1</sup> (fentanyl Hameln, Hameln pharmaceuticals, Germany), Atracurium 0.6 mg/kg<sup>-1</sup> (Atrabesylate, Egypharm, Egypt). A proper sized endo-tracheal tube was inserted and fixed in place after confirmation of correct positioning. Patients were ventilated using volume controlled ventilation mode to keep EtCO<sub>2</sub> between 33-35 mmHg. Anesthesia was maintained using sevoflurane 1-2% in 40% oxygen-air gas mixture. Top-up dose of atracurium was given on needs and Ringer acetate infusion at rate 4ml/kg<sup>-1</sup>/h<sup>-1</sup> was started in a suitable peripheral intravenous line.

Surgeon was allowed to start hysteroscopic examination then start abdominal insufflation with carbon dioxide slowly at a rate 1-1.5 l/min with maximum insufflating pressure 13-15 mmhg under close hemodynamics observation by the researcher anesthesiologist.

According to randomization received in the closed envelop with the patient file, wash out solution used in peritoneal irrigation prepared by independent anesthesia technician as 1000 ml warm saline in (S) group and 50 ml sodium bicarbonate 8.4% added to 1000 ml warm saline in sodium bicarbonate group (Na group). Surgeon was allowed to use the wash solution during the procedure, while both surgeon and researcher anesthesiologist were blinded of its content. After completion of the procedure, patients were kept in supine position. Surgeon was asked to ensure exsufflation by doing gentle abdominal pressure, remove the trocars and infiltrate trocars site by 10 ml lidocaine 2% to relief pain. Reversal of muscle relaxation was done using neostgmin 0.05 mg/kg<sup>-1</sup> + atropine 0.02 mg/kg<sup>-1</sup>, and awake extubation after fulfillment of extubation criteria. Postoperative analgesia based on 1gm of paracetamol every 8 hours, rescue analgesia used pethidine 0.5 mg/kg<sup>-1</sup> IV when VAS ≥ 4.

Collected data included postoperative shoulder tip pain at 1, 6, 12 and 24 hours postoperatively as a primary outcome objective. Other data included overall pain assessment using VAS score, heart rate (HR), mean arterial blood pressure (MAP) immediate after recovery and at 1, 2, 4, 6, 12 and 24 hours as well as total pethidine consumption and incidence of postoperative

nausea and vomiting within 24 hour. All postoperative data were recorded by trained nurses, who were blinded to intervention techniques.

In this trial, we hypothesized that adding sodium bicarbonate to warm saline for peritoneal irrigation will improve postoperative pain control, reduce gastrointestinal irritation symptoms with stable hemodynamics.

### Sample size Statistical analysis and data collection

The incidence of shoulder tip pain after laparoscopic gynecologic surgery ranged from 30% to 80% <sup>(4)</sup>. Using a 60% incidence and assuming a reduction of 40% when sodium bicarbonate is used for peritoneal irrigation, the required sample size to achieve a study power of 0.8 with an alpha error of 0.05 was 56 cases. Additional 10 cases were added to compensate for dropouts, with total enrolment of 66 cases. G\*power software version 3.1.9.4 was used for sample size calculation.

Perioperative data will be tabulated and analyzed using IBM SPSS software version 22. Continuous data were presented as mean ± SD or median IQR according to normality of distribution. Nominal and categorical data were presented as numbers and percentages. Independent sample T test, Mann-Whitney test or chi square test were utilized to detect statistical differences between the studied groups.

### RESULTS

This study enrolled 66 patients scheduled for diagnostic hysteroscopy-laparoscopy, one patient was excluded from intervention due to ovarian bleeding during ovarian drilling, presented in **figure (1)**. Patients' demographics, basal hemodynamic data, and duration of anesthesia are presented in **table (1)** without significant difference between the studied groups.

Postoperative hemodynamic measurements (HR, MAP) are illustrated in **figure (2)**, without significant difference between the studied groups.

Postoperative patients' characteristics are illustrated in **table (2)**, shoulder tip pain was significantly lower in Na group at 1, 6 and 12 post-operative hours (P value 0.001, 0.001, 0.001 consecutively). Total pethidine consumption was significantly lower in Na group (P value 0.041), and PONV was significantly lower in NA group (P value 0.007).

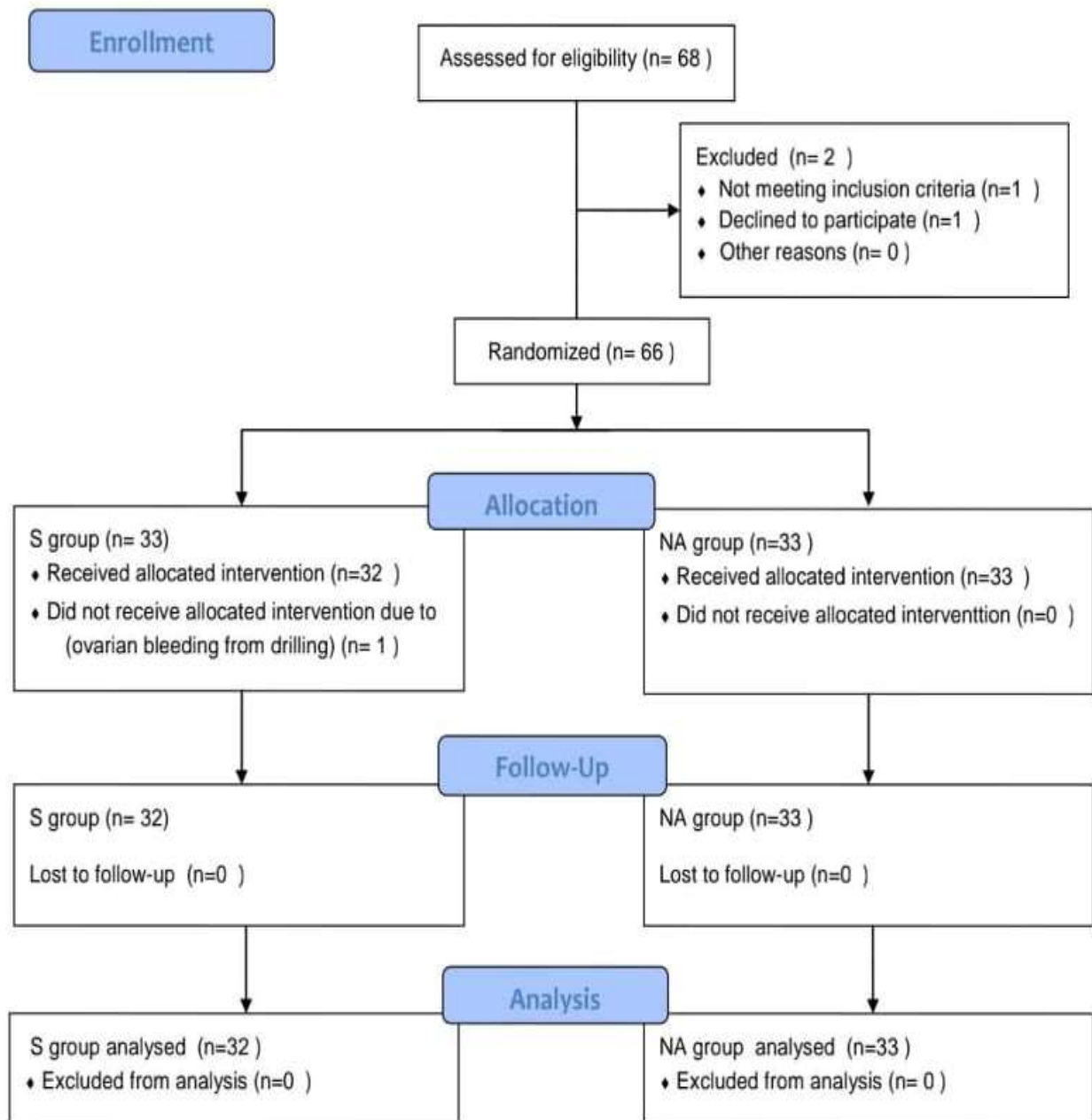
Postoperative VAS score is presenting in **table (3)**, VAS score was lower in Na group immediate postoperative, and at 1, 2 and 4 hours postoperatively (P value, 0.001, 0.001, 0.001, 0.003 consecutively), while it was comparable among both groups at other times of assessment.

None of the studied patients showed any side effects or unanticipated complications related to techniques used.

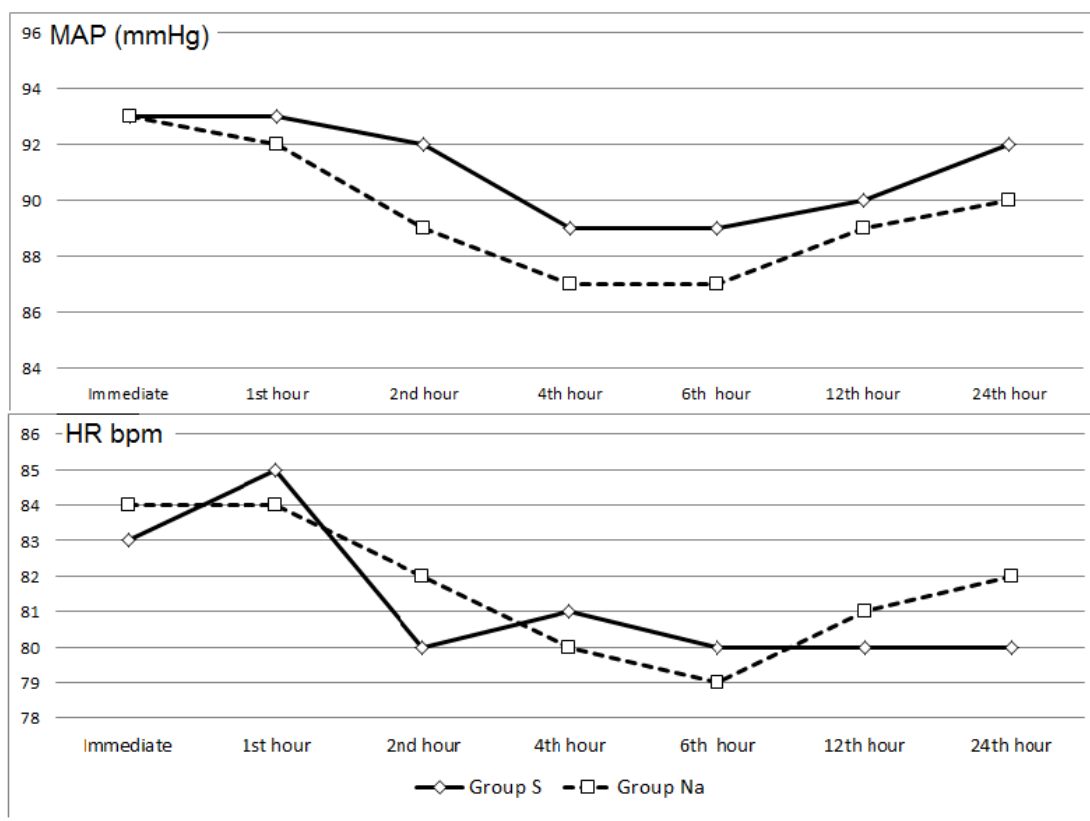
**Table (1):** Patients’ demographic data, basal hemodynamic data, and duration of anesthesia

	Group S	Group NA	<i>P</i>
Age (years)	30.68±2.83	29.45±4.98	0.2
BMI (kg/m <sup>2</sup> )	23.13±1.59	23.42±1.97	0.5
Basal HR (bpm)	79.81±5.60	81.54±6.57	0.3
Basal MAP (mmHg)	90.43±4.36	90.03±5.45	0.7
Duration of anesthesia (minutes)	57.06±4.88	55.96±4.68	0.4

BMI: body mass index, HR: heart rate, MAP: mean arterial blood pressure. \*P value is significant if less than 0.05



**Figure (1):** Consort flow diagram for the study



**Figure (2):** Postoperative hemodynamics data (HR & MAP) of the included patients

**Table 2:** Postoperative data for the study groups. Data are presented as numbers (percentage %), median (interquartile range).

	Group S	Group NA	<i>P</i>
Pethidine consumption	80.0 (62.5)	40.0 (47.5)	0.041*
PONV	12 (37%)	3 (9%)	0.007*
Shoulder tip pain			
-1 hour	21 (66%)	8 (24%)	0.001*
-6 hours	23 (72%)	7 (21%)	0.001*
-12 hours	13 (41%)	2 (6%)	0.001*
-24 hours	4 (12%)	0 (0%)	0.053

PONV: postoperative nausea and vomiting. \**P* value is significant if less than 0.05

**Table 3:** Postoperative visual analogue score (VAS) for the study groups. Data are presented as median (interquartile range).

	Group S	Group NA	<i>P</i>
VAS0	5 (2)	3 (2)	0.001*
VAS 1h	4 (1)	3 (1)	0.001*
VAS 2h	3 (1)	2 (1)	0.001*
VAS 4h	2 (1)	2 (0)	0.003*
VAS 6h	2 (1)	1 (1)	0.077
VAS 12h	1 (2)	1 (1.5)	0.727
VAS 24h	0 (1)	0 (1)	0.693

VAS: visual analogue score.

\**P* value is significant if less than 0.05

## DISCUSSION

This study investigated the effect of adding sodium bicarbonate to warm saline as irrigation fluids during peritoneal wash in diagnostic hysteroscopy-laparoscopy procedure, and its impact on postoperative pain. Our results showed that the incidence of postoperative shoulder tip pain was significantly lower in Na group at the first 12 postoperative hours. Also, VAS score was significantly lower in Na group at the first 4 postoperative hours, rescue analgesia consumption was significantly higher in S group, and overall incidence of PONV during the first postoperative 24 hours was higher in S group. Meanwhile, hemodynamics were comparable in both groups.

The hysteroscopy-laparoscopy is a simple and essential tool in diagnosis of infertility, it can reveal the presence of peritubal adhesions, periadnexal adhesions, tubal pathology, and endometriosis in 35–68% of cases even after normal hystero-salpingogram result<sup>(11)</sup>. Hence, it is a non-traumatic surgery, the insufflated cold carbon dioxide to create pneumoperitoneum for laparoscopy accounts for post laparoscopy pain. Coldness, acidic milieu and formed gas pockets lead to continuous mucosal, sub-diaphragmatic and phrenic nerve irritation with consecutive visceral and shoulder tip pain during

postoperative times<sup>(12-14)</sup>. Strategies applied to reduce such pain include local and systemic analgesic drugs, regional blocks, peritoneal irrigation, pulmonary recruitment maneuver and using humidified insufflating gases<sup>(5-9, 15-18)</sup>.

According to our results, using of sodium bicarbonate with warm saline in peritoneal irrigation during laparoscopy resulted in better postoperative pain profile with less gastro-intestinal irritation symptoms. This can be explained by counteracting effect to acidic milieu and cold effect of insufflated gas during the procedure. Sodium bicarbonate is an alkaline solution, used to neutralize PH in systemic acidity conditions when used by intravenous route<sup>(19, 20)</sup>. Also, it can counteract local acidity effect of injected local anesthesia drugs when used by subcutaneous route<sup>(2-23)</sup>. Based on this idea, sodium bicarbonate neutralized the acidic effect created by insufflated carbon dioxide when used with saline for peritoneal irrigation. Also, the used warm saline in both groups seems at decreasing the draw backs of cold carbon dioxide. As insufflating dry and cold CO<sub>2</sub> into the abdomen causes peritoneal damage, post-operative pain, hypothermia and post-operative adhesions<sup>(24)</sup>. Using both sodium bicarbonate and warm irrigation fluid create a more physiologic peritoneal environment and reducing the post-

operative pain and gastro-intestinal irritation symptoms. These results of pain reduction are important in improving patients' recovery and overall patients experience towards the operative practice, specially in such group of patients. Also, the reduction in rescue analgesia use will shorten the hospital stay, with less possibility of incidence of hospital stay complications, and less economic cost.

**Saadati K. et al.** <sup>(10)</sup> used sodium bicarbonate in peritoneal irrigation with laparoscopic cholecystectomy patients. They concluded that, intraperitoneal irrigation of sodium bicarbonate is a simple and safe method that provides pain relief in the postoperative period after laparoscopic cholecystectomy compared with none-washing. Also, intraperitoneal irrigation of sodium bicarbonate was found to have a better pain relief profile compared with normal saline. Also, the trials of peritoneal irrigation with normal saline resulted in better carbon dioxide wash with consecutive better postoperative pain profile <sup>(25-27)</sup>.

Regarding PONV, acidosis and tissue hypoxia increase its risk. Maneuvers to decrease these effects associated with better postoperative results with less peritoneal changes and gastro-intestinal irritation symptoms <sup>(28)</sup>. No unanticipated side effects or complications could be detected regarding both techniques.

Our study had some limitations; we did not detect intra-abdominal pressure, only depended on insufflating pressure. Also, we did not detect inflammatory mediators. The use of inflammatory mediators would add to the strength of the study. Also, the limited time for postoperative monitoring, only for 24 hours, may have concealed some clinical differences between the studied techniques. Larger scale studies with measurement of intra-abdominal pressure, and inflammatory mediators, and longer patient follow-up periods are recommended.

## CONCLUSION

Post laparoscopy pain is an agonizing complication. Many trials studied different techniques in management of such pain. Sodium bicarbonate is an alkaline solution that neutralize acidity of insufflated carbon dioxide. This will lead to reduction of overall postoperative pain sensation and postoperative gastro-intestinal irritation symptoms.

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