

## Comparing Post-Op Analgesic Efficacy of the Pulmonary Recruitment MANOEUVRE and Intraperitoneal Hydrocortisone in Laparoscopic Surgeries

Amandeep Kaur<sup>1</sup> Mohit Garg<sup>2</sup>

<sup>1</sup>Assistant Professor, Department of Anaesthesia, Adesh Medical College and Hospital, Shahabad, Haryana, India

<sup>2</sup>Assistant Professor, Department of Anaesthesia, Adesh Medical College and Hospital, Shahabad, Haryana, India

---

Received: 14-12-2023 Revised: 20-01-2024 / Accepted: 19-02-2024

Corresponding author: Dr.Mohit Garg

Conflict of interest: Nil

---

### Abstract

**Aim:** The objective of the current study was to examine the hypothesis that the pulmonary recruitment maneuver provides a greater reduction in postoperative pain compared to intraperitoneal hydrocortisone instillation in patients who had undergone laparoscopic cholecystectomy surgery.

**Methods:** In the Department of Anesthesiology, the current investigation was carried out. The sample consisted of 150 patients, including 50 patients in each group. This study included patients classified as American Society of Anesthesiologists (ASA) physical status I and II, ranging in age from 20 to 55 years. These patients were scheduled to have diagnostic laparoscopic cholecystectomy operations as part of gall bladder disease.

**Results:** The demographic profile baseline values of haemodynamic variables and surgery time were similar throughout the study groups, and there was no statistically significant distinction observed among the three groups. Both the hydrocortisone and pulmonary recruitment groups showed a statistically significant difference compared to the control group in terms of total analgesic use 24 hours after surgery, with a P value of 0.001. Additionally, there was a substantial decrease in the initial request for analgesia in both the hydrocortisone and pulmonary recruitment groups compared to the control group, as indicated by a P value of less than 0.001. There was no notable disparity in the overall intake of analgesics between the two intervention groups. The frequency of postoperative nausea and vomiting was found to be similar among the patients in all three groups.

**Conclusion:** The utilization of both intraperitoneal hydrocortisone administration and the pulmonary recruitment procedure has demonstrated efficacy in alleviating postoperative pain subsequent to laparoscopic surgery.

**Keywords:** Hydrocortisone, pain, pulmonary recruitment

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

---

### Introduction

Laparoscopic surgery is a minimally invasive procedure that enables the surgeon to do the procedure without the need for a substantial incision. A laparoscope, a slender, illuminated tube equipped with a camera, is introduced into the abdominal cavity by a minor surgical cut. The camera facilitates the transmission of internal body images to a television monitor situated within the operating theater, so enabling the surgeon to visually see and perform procedures on the abdominal organs without necessitating the utilization of a lengthy incision. Additional little incisions may be performed in the abdominal region to facilitate the insertion of very precise

specialist surgical equipment. The appeal of laparoscopic operations is increasing due to their ability to facilitate early recovery. [1]

Pain is a prevalent medical factor contributing to the postponement of patient release following ambulatory surgery. Regrettably, the prevention and management of postoperative pain remains a significant obstacle. [2] The pain experienced following laparoscopy is commonly attributed to the incision site, the pneumoperitoneum, and the site of the surgery. The occurrence of pneumoperitoneum might lead to the manifestation of referred shoulder discomfort originating from the sub diaphragmatic region, with a potential

duration of up to twenty-four hours. The intensity of incisional discomfort is greatest immediately after surgery and diminishes with time. [3] Various techniques have been employed to alleviate postoperative pain in laparoscopic procedures, including passive exsufflation of carbon dioxide (CO<sub>2</sub>), intraperitoneal administration of medications such as hydrocortisone [4], and the utilization of the pulmonary recruitment maneuver (PRM). The pulmonary recruitment maneuver effectively eliminates any remaining carbon dioxide (CO<sub>2</sub>) following laparoscopic surgery, hence minimizing irritation to the phrenic nerve and subsequently alleviating post-laparoscopic pain in the shoulder and upper abdomen. [5] Laparoscopic surgery has several advantages, such as reduced discomfort in comparison to open abdominal surgery, decreased occurrence of problems, diminished scarring, shorter durations of hospitalization, and expedited recovery. Laparoscopic cholecystectomy surgery is a viable option for treating various gall bladder conditions that previously necessitated extensive incisions. The peak severity of visceral discomfort occurs within the initial hours following surgery and is further intensified by activities such as coughing, respiratory movements, and mobilization. The presence of several components in pain necessitates the use of multimodal analgesic approaches to provide effective postoperative pain relief. [6] The effectiveness of pain management through the intraperitoneal route is currently a subject of debate. Several studies have demonstrated the efficacy of intraperitoneal delivery of medicines. [7,8]

The objective of the current study was to examine the hypothesis that the pulmonary recruitment maneuver provides a greater reduction in postoperative pain compared to intraperitoneal hydrocortisone instillation in patients who had undergone laparoscopic gynecological surgery.

### Materials and Methods

The present study was conducted in the Department of Anesthesiology, Adesh medical college and Hospital, Shahabad, Haryana, India. 150 patients were included (50 in each group). The patients of American Society of Anesthesiologists (ASA) physical status I and II, aged between 20 and 55 years, scheduled for diagnostic laparoscopic cholecystectomy surgeries done as a part of gall bladder disease were enrolled to participate in this study. Patients refusing to participate in the study, patients with a history of chronic pain, those with chronic respiratory disease, advanced renal, hepatic or cardiac diseases, and patients on opioids, tranquilisers, or steroids were excluded from the study.

In the pre-anaesthesia room 1 h before the procedure, a 20 gauge cannula was inserted peripherally and the patients were premedicated with intravenous (IV) midazolam 0.02 mg/kg, pantoprazole 40 mg, 10 mg metoclopramide before induction of general anaesthesia. After preoxygenation with 100% oxygen (O<sub>2</sub>) for 3 min, anaesthesia was induced with IV 1 µg/kg of fentanyl, propofol 2 mg/kg followed by 0.5 mg/kg of atracurium to facilitate endotracheal intubation. Anaesthesia was maintained with isoflurane 1-1.5% in 50:50 O<sub>2</sub>: N<sub>2</sub>O and a state of muscle relaxation was maintained by IV atracurium 0.1 mg/kg every 30 min with volume-controlled mode of mechanical ventilation and adjusted parameters to keep end-tidal CO<sub>2</sub> between 35 and 40 mm Hg. All patients were continuously monitored by electrocardiogram (ECG), repeated non-invasive arterial blood pressure measurement every 5 min, and continuous end-tidal CO<sub>2</sub> and arterial oxygen saturation (SpO<sub>2</sub>) by pulse oximetry. IV paracetamol 1g in 100 ml infusion over 15-20 min, was given 30 min before the end of surgery.

Laparoscopy was done using CO<sub>2</sub> as a distension medium. First, the Veress needle was introduced through the UPPER border of the umbilicus. A water test was done to confirm intraperitoneal placement. Then, the correct distension pressure was ensured when no dullness was felt over the lower border of the liver. The intraabdominal pressure was maintained between 12 to 14 mmHg. The patient was placed in the Trendelenburg position to provide optimum conditions for the laparoscopic view. A 10 mm laparoscopic trocar was introduced in epigastrium and a zero camera was introduced through the cannula trocar. The second puncture was done to insert other ports. Total four incisions were made in abdomen.

By the end of the operation, using a computer-generated randomization schedule, patients were randomly assigned into three equal groups:

Group (A) (hydrocortisone group), in which patients received intraperitoneal 100mg hydrocortisone in 150 ml normal saline in addition to routine method to remove CO<sub>2</sub>.

Group (B) (pulmonary recruitment group), in which CO<sub>2</sub> was exsufflated by pulmonary recruitment maneuver performed manually using five positive pressure ventilation at a maximum pressure of 40 cmH<sub>2</sub>O. The fifth positive pressure inflation was held by anaesthesiologist for approximately 5 s with the valves on the operative ports opened fully at end of surgery in addition to the routine method to remove CO<sub>2</sub>.

Group (C) (control group), in which the routine method was performed by applying gentle abdominal pressure and removing CO<sub>2</sub> by passive

exsufflation through the port site at the end of the surgery.

Patient was reversed with inj. glycol 10 µg/Kg + inj. Neostigmine 50 µg/Kg. Post-operative pain was assessed with VAS score. Pain with VAS  $\geq 3$  was managed with inj. Tramadol 100 mg.

- In ward post-operatively, time for first rescue analgesia and total need of analgesia by patient was recorded.
- The secondary objective was to observe the vitals of patients including MAP, HR along

with post-operative nausea and vomiting incidence.

Statistical Package for Social Sciences (SPSS) software was used for statistical analysis. Numerical data were presented as mean  $\pm$  standard deviation or median (interquartile range). Categorical data were presented as frequency (percentage). Analysis of variance (ANOVA) test was used to compare the three groups regarding normally distributed numerical data. Chi-square test was used to analyse categorical data.

## Results

**Table 1: Demographic data and baseline haemodynamic variables**

Demographic data	Group A (n=50) hydrocortisone	Group B (n=50) Pulmonary recruitment	Group C (n=50) Control	P
Age (years)	32 $\pm$ 3.7	28.4 $\pm$ 6	30.5 $\pm$ 3.7	0.931
Weight (kg)	72.8 $\pm$ 6.2	71.90 $\pm$ 5.7	70.4 $\pm$ 4.8	0.832
Duration of surgery (min)	55 $\pm$ 4.2	54.6 $\pm$ 8.2	54.1 $\pm$ 9.2	0.890
Baseline HR (min)	74.5 $\pm$ 5.5	73.7 $\pm$ 5.2	73.1 $\pm$ 5.3	1
Baseline MBP (mmHg)	75.5 $\pm$ 6.2	74.6 $\pm$ 6	73.5 $\pm$ 6	0.812
ASA 1/2	38/12	36/14	40/10	0.7

The study groups were comparable with respect to the demographic profile baseline values of haemodynamic variables and surgical duration; there was no statistically significant difference between the three groups.

**Table 2: Post-operative total analgesic profile**

Postoperative analgesic profile	Group A (n=50) Hydrocortisone	Group B (n=50) Pulmonary recruitment	Group C (n=50) control	P
Total analgesic (tramadol) consumption (mg)	22.8 $\pm$ 13.7	28.2 $\pm$ 12.8	54.6 $\pm$ 16.4	<0.001
Time to first rescue analgesia (min)	47.3 $\pm$ 7.3	46.4 $\pm$ 8.2	28.4 $\pm$ 8.4	<0.001

There was a statistically significant difference between both the hydrocortisone and the pulmonary recruitment groups in comparison with the control group as regards 24 h postoperative total analgesic consumption, P value <0.001. Also, the first request for analgesia was less in both the

hydrocortisone and the pulmonary recruitment groups as compared to the control group with a significant P value <0.001. There was no significant difference as regards the total analgesic consumption between the two intervention groups.

**Table 3: Postoperative nausea and vomiting (PONV)**

PONV	Group A (n=50) Hydrocortisone	Group B (n=50) Pulmonary recruitment	Group C (n=50) control	P
Yes	12	15	22	<0.001
No	38	35	28	<0.001

The patients in the three groups were similar regarding the frequency of postoperative nausea and vomiting.

## Discussion

Laparoscopy is among the most used minimally invasive procedures that can reduce postoperative pain, lessen the duration of hospital stay and facilitate recovery earlier than laparotomy.

Laparoscopy has been widely used in various abdominal surgeries, such as gastrectomy, cholecystectomy, appendectomy, hernia and gynecological surgery. [9-12]

The demographic profile baseline values of haemodynamic variables and surgery time were similar throughout the study groups, and there was no statistically significant distinction observed

among the three groups. Both the hydrocortisone and pulmonary recruitment groups showed a statistically significant difference compared to the control group in terms of total analgesic use 24 hours after surgery, with a P value of 0.001. Existing research concurs that post-laparoscopy pain is comprised of three distinct components that vary in terms of intensity, latency, and duration. [13] These components include visceral pain, which is characterized by a deep and dull sensation that is difficult to pinpoint, pain resulting from the trauma to the diaphragm, peritoneal inflammation and neuronal rupture leading to shoulder-tip pain, and incision pain, which manifests as surface or wound-type pain. [14] Various techniques, such as the administration of local anesthetics, are employed to alleviate pain. The administration of intraperitoneal local anesthetic immediately following the establishment of capnoperitoneum has been observed to reduce postoperative pain and expedite the recovery process. [15]

Additionally, there was a substantial decrease in the initial request for analgesia in both the hydrocortisone and pulmonary recruitment groups compared to the control group, as indicated by a P value of less than 0.001. There was no notable disparity in the overall intake of analgesics between the two intervention groups. The frequency of postoperative nausea and vomiting was found to be similar among the patients in all three groups. The procedure differed from our own, as it involved performing two manual inflations to a maximum pressure of 60cm H<sub>2</sub>O, with each inflate being held for a duration of 5 seconds. Tsai H et al [16] compared the effect of intraperitoneal normal saline instillation and pulmonary recruitment for shoulder and upper abdominal pain using VAS score for 48 h and concluded that the effect of intraperitoneal normal saline instillation (INSI) was longer-lasting and more persistent than that of PRM. INSI implemented an extra buffer system. Unlike PRM, INSI has a prolonged, uninterrupted, and physiological impact until the normal saline is absorbed. Numerous research have been conducted to examine the efficacy of intraperitoneal local anesthetics and other pharmaceutical interventions in mitigating postoperative shoulder discomfort. The study conducted by Jain S et al [17] revealed that the administration of a high-volume local anesthetic through intraperitoneal injection was successful in reducing shoulder pain in a significant number of patients. This is due to the fact that the high-volume anesthetic effectively covers a larger area of the sub-hepatic space, as well as the surrounding peritoneum.

### Conclusion

In summary, the utilization of both intraperitoneal hydrocortisone administration and the pulmonary recruitment procedure has demonstrated efficacy in

alleviating postoperative pain subsequent to laparoscopic surgery. However, it is worth noting that intraperitoneal hydrocortisone administration may potentially result in an extended duration of pain relief following cholecystectomy laparoscopies.

### References

1. Aarts JW, Nieboer TE, Johnson N, Tavender E, Garry R, Mol BW, Kluijvers KB. Surgical approach to hysterectomy for benign gynaecological disease. *Cochrane database of systematic reviews*. 2015(8).
2. Vadivelu N, Mitra S, Narayan D. Recent advances in postoperative pain management. *The Yale journal of biology and medicine*. 2010 Mar;83(1):11.
3. Mitra S, Khandelwal P, Roberts K, Kumar S, Vadivelu N. Pain relief in laparoscopic cholecystectomy—a review of the current options. *Pain Practice*. 2012 Jul;12(6):485-96.
4. Sarvestani AS, Amini S, Kalhor M, Roshanravan R, Mohammadi M, Lebaschi AH. Intraperitoneal hydrocortisone for pain relief after laparoscopic cholecystectomy. *Saudi journal of anaesthesia*. 2013 Jan 1;7(1):14-7.
5. Khanna A, Sezen E, Barlow A, Rayt H, Finch JG. Randomized clinical trial of a single pulmonary recruitment manoeuvre to reduce pain after laparoscopy. *Journal of British Surgery*. 2013 Sep;100(10):1290-4.
6. Pasqualucci A, De Angelis V, Contardo R, Colo F, Terrosu G, Donini A, Pasetto A, Bresadola F. Preemptive analgesia: intraperitoneal local anesthetic in laparoscopic cholecystectomy: a randomized, double-blind, placebo-controlled study. *The Journal of the American Society of Anesthesiologists*. 1996 Jul 1;85(1):11-20.
7. Chundrigar T, Hedges AR, Morris R, Stamatakis JD. Intraperitoneal bupivacaine for effective pain relief after laparoscopic cholecystectomy. *Annals of the Royal College of Surgeons of England*. 1993 Nov;75(6):437.
8. Goldstein A, Grimault P, Henique A, Keller M, Fortin A, Darai E. Preventing postoperative pain by local anesthetic instillation after laparoscopic gynecologic surgery: a placebo-controlled comparison of bupivacaine and ropivacaine. *Anesthesia & Analgesia*. 2000 Aug 1;91(2):403-7.
9. Tanaka T, Ueda S, Miyamoto S, Hashida S, Terada S, Konishi H, Kogata Y, Taniguchi K, Komura K, Ohmichi M. Comparison of Prognosis between Minimally Invasive and Abdominal Radical Hysterectomy for Patients with Early-Stage Cervical Cancer. *Curr Oncol*. 2022 Mar 24;29(4):2272-2283.

10. Luesma MJ, Fernando J, Cantarero I, Lucea P, Santander S. Surgical treatment of obesity. Special mention to roux-en-Y gastric bypass and vertical gastrectomy. *Frontiers in Endocrinology*. 2022 Mar 31;13:867838.
11. Demouron M, Selvy M, Dembinski J, Mauvais F, Cheynel N, Slim K, Sabbagh C, Regimbeau JM. Feasibility and Effectiveness of an Enhanced Recovery Program after Early Cholecystectomy for Acute Calculous Cholecystitis: A 2-Step Study. *J Am Coll Surg*. 2022 May 1;234(5):840-848.
12. Naidoo M, Thirayan V, Kong V, Govindasamy V, Dasrath A, Mills B, Bruce J, Laing G, Clarke D. Trends in Adoption of Laparoscopic Appendectomy in a Developing Country: Closing the Gap. *World J Surg*. 2022 May;46(5):1015-1021.
13. Dixon JB, Reuben Y, Halket C, O'Brien PE. Shoulder pain is a common problem following laparoscopic adjustable gastric band surgery. *Obes Surg*. 2005 Sep;15(8):1111-7.
14. Kim TH, Kang H, Park JS, Chang IT, Park SG. Intraperitoneal ropivacaine instillation for postoperative pain relief after laparoscopic cholecystectomy. *Journal of the Korean Surgical Society*. 2010 Aug 1;79(2):130-6.
15. Putta PG, Pasupuleti H, Samantaray A, Natham H, Rao MH. A comparative evaluation of pre-emptive versus post-surgery intraperitoneal local anaesthetic instillation for postoperative pain relief after laparoscopic cholecystectomy: A prospective, randomised, double blind and placebo controlled study. *Indian J Anaesth*. 2019 Mar;63(3):205-211.
16. Tsai HW, Chen YJ, Ho CM, Hseu SS, Chao KC, Tsai SK, Wang PH. Maneuvers to decrease laparoscopy-induced shoulder and upper abdominal pain: a randomized controlled study. *Arch Surg*. 2011 Dec;146(12):1360-6.
17. Jain S, Nazir N, Singh S, Sharma S. A prospective randomised controlled study for evaluation of high-volume low-concentration intraperitoneal bupivacaine for post-laparoscopic cholecystectomy analgesia. *Indian J Anaesth*. 2018 Feb;62(2):109-114.