



## ROLE OF ACTIVE CO<sub>2</sub> SUCTION POST-LAPAROSCOPIC CHOLECYSTECTOMY IN REDUCTION OF SHOULDER PAIN

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Article Received: 25 November 2025

Article Revised: 15 December 2025

Article Published: 01 January 2026



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DOI: <https://doi.org/10.5281/zenodo.18105806>

**How to cite this Article:** Dr. Karam Dawood Saleem, Dr. Luqman Mohammed Azeez, Dr. Kawa Mohammed Mawlood Bajalan. (2025). Role of Active Co<sub>2</sub> Suction Post-Laparoscopic Cholecystectomy In Reduction of Shoulder Pain. World Journal of Advance Healthcare Research, 10(1), XXX-XXX.

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### ABSTRACT

**Background:** Laparoscopic cholecystectomy is a minimally invasive surgical procedure used to remove a diseased gallbladder. One of the complications of pneumoperitoneum is shoulder pain, which is mild to moderate pain experienced post-laparoscopic surgery. **Aim of the study:** To evaluate the reduction of shoulder pain in patients who underwent active carbon dioxide suction in comparison to passive carbon dioxide deflation post laparoscopic cholecystectomy. **Patients and Methods:** A prospective randomized comparative study was done on 141 patients from January 2024 to January 2025 in Rizgary Teaching Hospital in Erbil. Patients were divided into two groups, one with active suction of CO<sub>2</sub> and the other with passive deflation of CO<sub>2</sub> then compared for shoulder tip pain in both groups. **Results:** A Total of 141 patients were divided into two groups: Group I (68), Group II (73). The mean age of patients in Group I was higher than in Group II. The percentage of females was higher than that of males in both groups. The study compared shoulder pain during 24 hours, with 55.9% reporting pain in group I and 74.0% in group II, with significant statistical differences (p=0.024). During 48 hours, 35.2% patients in group I felt discomfort, and 61.7% in group II, the difference was statistically significant (p=0.002). The study showed no significant difference in shoulder discomfort on the 7th day for both groups. **Conclusions:** Using the active suction technique to release the remaining CO<sub>2</sub> from the intra-abdominal cavity following laparoscopic cholecystectomy, helps to decrease shoulder pain and postoperative abdominal discomfort.

**KEYWORDS:** Cholecystectomy Shoulder pain, Pneumoperitoneum.

### INTRODUCTION

Laparoscopic cholecystectomy is an operation for the removal of a diseased gallbladder. It became the gold standard in gallbladder surgery.<sup>[1]</sup> Laparoscopic cholecystectomy replaced the open methods due to the advantage of its minimal access techniques, which leave minimal surgical scars, less post-operative pain, shorter hospital stay, early recovery, and lower morbidity rate.<sup>[2]</sup>

Despite improvements in laparoscopic cholecystectomy procedures, shoulder discomfort following the procedure is still a frequent complaint. Shoulder pain within the first twenty-four hours following laparoscopic surgery termed Post Laparoscopic Shoulder Pain (PLSP), generally lasts for two to three days following surgery

and can occasionally last up to five weeks. It is characterized by dull, aching pain, which is mild to severe. There is a significant incidence of PLSP following a number of laparoscopic surgeries, including 63% after laparoscopic cholecystectomy, 66% after laparoscopic gastrectomy, 57.1–65.5% after laparoscopic appendectomy.<sup>[3,5]</sup> and up to 80% after gynecological laparoscopy. PLSP is often underestimated, regardless of being a prevalent complaint.<sup>[6]</sup>

The causes of PLSP are not precisely identified, but most theories believe that it is due to phrenic nerve irritation.<sup>[7]</sup> In laparoscopic procedures, carbon dioxide (CO<sub>2</sub>) pneumoperitoneum leads to expansion of the peritoneal space with pressure on the diaphragm and produces

acidic environments, which irritate and injure the phrenic nerve, thus contributing to PLSP.<sup>[7,8]</sup> Also could lead to peritoneal microvascular rupture and hemorrhage, which results in the release of inflammatory mediators leading to shoulder tip pain.<sup>[9]</sup>

The phrenic nerve provides the main nerve supply to the diaphragm. The phrenic and supraclavicular nerves both share the same nerve roots; that's why noxious stimulation of the phrenic nerve could produce referred shoulder pain.<sup>[7]</sup>

The amount of residual CO<sub>2</sub> influences the magnitude of pain experienced.<sup>[10]</sup> but its pathophysiology remains unclear. One of the theories explains that CO<sub>2</sub> is an irritant gas causing acidosis because it converts to carbonic acid in the presence of fluid in the abdominal cavity, and this will irritate the phrenic nerve, resulting in shoulder pain.<sup>[11]</sup> The amount of Residual gas volume has a direct effect on pain intensity.<sup>[12]</sup> There are Several techniques to evacuate residual gas, either by active suction or passive deflation.<sup>[13]</sup>

Several studies focus on active suction of gas postoperatively is useful in decreasing PLSP, resulting in less analgesic requirements.<sup>[14,15]</sup> Other studies claim that injection of saline solution into the abdominal cavity significantly reduces the incidence of shoulder pain.<sup>[16]</sup>

The aim of our study is to assess the effect of active suction of CO<sub>2</sub> on the reduction of shoulder pain in comparison with passive deflation.

## PATIENTS AND METHODS

**Study design:** A prospective randomized comparative study was carried out on 141 patients. From 1<sup>st</sup> January 2024 until 1<sup>st</sup> January 2025, patients aged between 20-60 years were admitted to the surgical wards of the Rizgary Teaching Hospital in Erbil, for elective laparoscopic cholecystectomy.

An agreement was obtained from the Scientific Council of Arab Board for Medical Specialization before the conduction of the study, a consent was taken from the patients and labelled on questionnaire.

### Inclusion and Exclusion criteria

All patients with elective laparoscopic cholecystectomy were included in the study. Pregnant women, patients complaining of Chronic obstructive pulmonary disease (COPD), those who converted to open cholecystectomy, patients with previous upper abdominal surgery, and emergency cases were excluded from our study.

The total number of patients was (141) patients (45) male and (96) female. These patients were divided into two groups

- (i) Group I patients with active CO<sub>2</sub> suction (n = 68).
- (ii) Group II patients with passive CO<sub>2</sub> deflation (n = 73).

In group I, active suction of residual gas was done by a multiporous suction cannula connected to a negative pressure(-40) for 2-3 min under vision of the camera port mainly in the subphrenic region before closure of port sites.

In group II, passive deflation of CO<sub>2</sub> through port sites was done before closure of the abdominal wall.

The same standardized anesthetic and postoperative analgesic regimen was used for both groups analgesic requirements were recorded, those patients who experienced severe pain, received a bolus dose of diclofenac sodium (75 mg) or narcotics if needed.

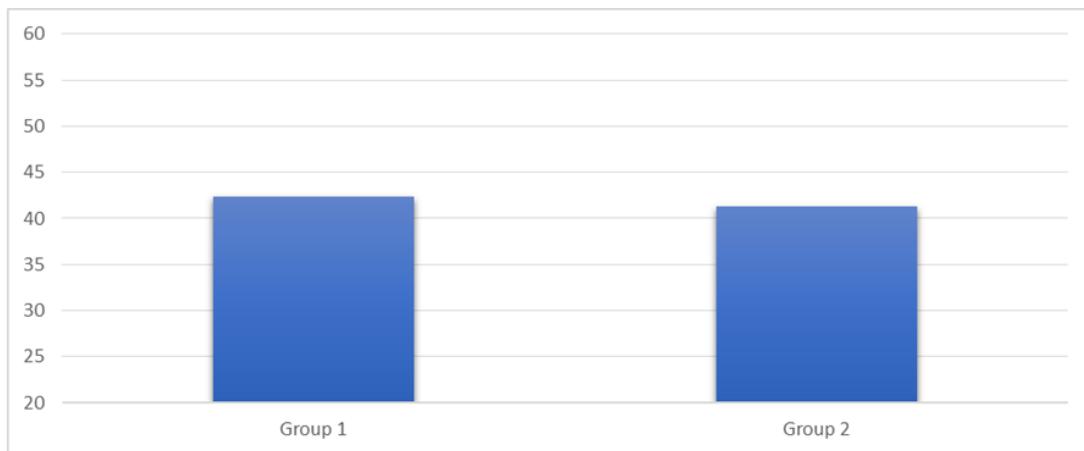
Shoulder pain and discomfort following surgery were assessed at 24, 48 hours and on the 7<sup>th</sup> day. The severity of pain was assessed using a verbal ranking scale (VRS) with numerical values ranging from 0 (no pain) to 10 (the most sever one). The pain is categorized as mild pain those scores between(0-3) moderate (4-6) and severe between (7-10) degree.

The current study used pressure of inflation inside the abdomen with CO<sub>2</sub> between 10-14 mmHg.

The statistical assessment was accomplished by using IBM SPSS version 26, with standard deviations for numerical data calculated, while frequencies as well as percentages were used to express the nominal data. The t-test for independent two means was used to assess the difference between numerical data, and chi-square test with the Freeman-Halton Exact test was used for the nominal data. p-value  $\leq 0.05$  is regarded as significant.

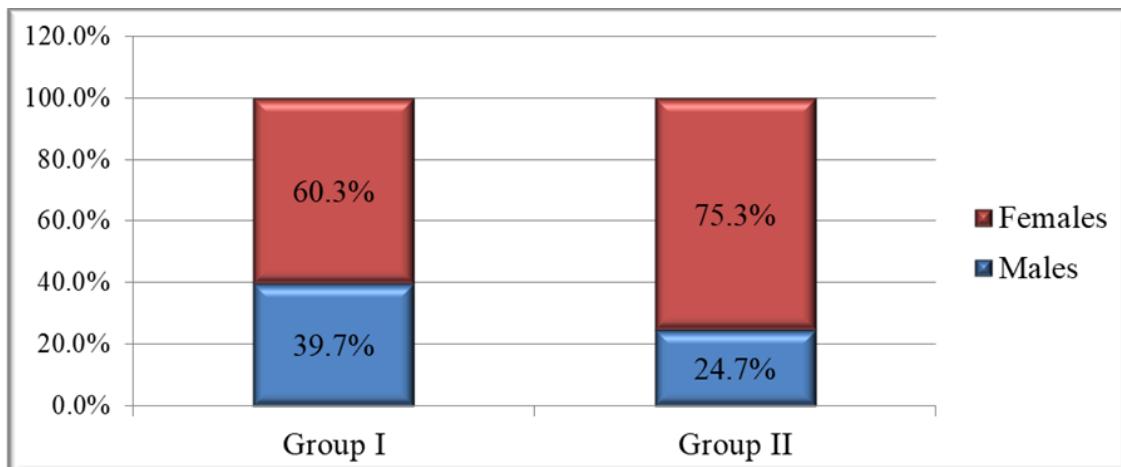
## RESULTS

A total of 141 patients were included in this study. The mean age among group I was (42.38 $\pm$ 4.525) years, and in group II was (41.25 $\pm$ 5.884) years. This revealed that the age of patients in group I was older than that of group II, this statistically was not significant (p=0.206). as shown in figure 1.



**Figure 1: The mean age among the studied groups.**

The number of males in group I was 39.7% and females were 60.3%. In group II number of males was 24.7% and females 75.3%; this was statistically not significant ( $p=0.055$ ) as shown in Figure 2.



**Figure 2: The Gender among the studied groups.**

Comparison of Shoulder pain during 24 hours between the studied groups was demonstrated in Table (1). In group I, 55.9% had shoulder pain, while in group II, 74.0% complained of shoulder pain; this difference was statistically significant ( $p=0.024$ ). Moreover, in both

groups, 57.9% group 1 and 57.4% group 2 had mild pain, 7.9% of group I and 16.7% of group II found to have severe pain, so number of patients and severity of pain were more in group 2, but the difference concerning the pain severity was statistically not significant ( $p=0.414$ ).

**Table 1: Comparison of shoulder pain during the first 24 hours between the studied groups.**

Shoulder pain during 24 hour	Group I (n=68)	Group II (n=73)	p-value*
	No. (%)	No. (%)	
No pain	30(44.1)	19(26.0)	0.024
Shoulder pain	38(55.9)	54(74.0)	
Severity of pain	No. (%)	No. (%)	p-value**
Mild	22(57.9)	31(57.4)	
Moderate	13(34.2)	14(25.9)	
Severe	3(7.9)	9(16.7)	0.414

\*Chi square test; \*\*Freeman-Halton Exact test.

Table (2) showed a comparison of shoulder pain during 48 hours between the two groups. In group I, 35.2% had shoulder pain, while in group II (61.7%) suffered pain; this difference was statistically significant ( $p=0.002$ ). Moreover, (8.4%) patients of group I and (17.8%) of

group II experienced severe pain. Regarding mild pain (83.3%) of group 1 and (57.8%) of group 2 experienced mild pain, this difference in pain severity was statistically not significant ( $p=0.098$ ).

**Table 2: Comparison of shoulder pain during 48 hours between the studied groups.**

Shoulder pain for 48 hours	Group 1 (n=68)	Group2 (n=73)	p-value*
	No. (%)	No. (%)	
No pain	44(64.8)	28(38.3)	0.002
Shoulder pain	24(35.2)	45(61.7)	
Severity of pain	No. (%)	No. (%)	p-value**
Mild	20(83.2)	26(57.8)	
Moderate	2(8.4)	11(24.4)	0.098
Severe	2(8.4)	8(17.8)	

\*Chi square test; \*\*Freeman-Halton Exact test

A comparison of shoulder pain on the 7<sup>th</sup> post-operative day among the groups is shown in Table (3). This table shows that (4.4%) of group I had shoulder pain, in group

II (11.0 %) had shoulder pain, no statistically significant difference found between the groups as the P value was (p=0.147).

**Table 3: Comparison of shoulder pain at the 7<sup>th</sup> day between the studied groups.**

Shoulder pain on the 7 <sup>th</sup> day	Group 1 (n=68)	Group2 (n=73)	p-value*
	No. (%)	No. (%)	
No pain	65(95.6)	65(89.0)	0.147
Shoulder pain	3(4.4)	8(11.0)	
Severity of pain	No. (%)	No. (%)	p-value
Mild	3(100.0)	8(100.0)	
Moderate	0(0.0)	0(0.0)	-----
Severe	0(0.0)	0(0.0)	

\*Chi-square test.

## DISCUSSION

At the end of laparoscopic cholecystectomy, even after passive deflation of CO<sub>2</sub>, some may remain in the peritoneal cavity, causing distension and pain.<sup>[17]</sup> Eighty percent of patients who underwent laparoscopic surgery suffer shoulder pain McGrath et al.<sup>[18]</sup> A process of release of residual CO<sub>2</sub> volume has been shown to alleviate postoperative pain. It had been seen that the active aspiration approach in conjunction with manual abdominal wall compression at the end of laparoscopic surgery might decrease the need for analgesics after recovery.<sup>[19]</sup>

Radosa et al. found that five minutes of prolonged supported breathing with an open umbilical trocar valve decreased the intensity of shoulder pain during 24 hours postoperatively.<sup>[20]</sup>

In comparison between the 2 groups, our study showed that the severity of shoulder pain postoperatively was decreased 48 hours after surgery when residual CO<sub>2</sub> was removed by both active aspiration and passive deflation. Salman et al. found that aggressive peritoneal suction at the end of LC considerably lessens postoperative shoulder discomfort, 2.5 times. Additionally, the active aspiration and passive-valve release experienced much less shoulder discomfort at 4 and 24 hours after surgery.<sup>[22]</sup>

Some trials found that an intraperitoneal drain decreases postoperative pain following laparoscopic surgery and

decreases the need for analgesics postoperatively.<sup>[23]</sup> However intraperitoneal drain following a laparoscopic operation will raise the risk of infection and decrease mobility.<sup>[24,25]</sup>

Group 1 had lower abdominal discomfort after 30 minutes, 4 hours, and 24 hours in comparison to group 2. This was consistent with a study done by Tuvayanan et al.<sup>[26]</sup> According to a meta-analysis by Haneef et al.<sup>[13]</sup> on 367 individuals, active aspiration of gas resulted in reduced shoulder and abdominal pain and hospital stay duration. Arif et al.<sup>[27]</sup> study on 206 patients had the same results regarding postoperative abdominal and shoulder pain, which was significantly lower among groups of active suction of gas. in our study Most of our patients had no pain on the 7<sup>th</sup> postoperative day, and this is probably due to absorption of gas by the peritoneal membrane.

## CONCLUSION

Active aspiration of CO<sub>2</sub> from the intra-abdominal cavity following laparoscopic cholecystectomy will decrease both shoulder pain and postoperative abdominal discomfort.

**RECOMMENDATIONS:** We can use simple technique by actively suction the residual Co<sub>2</sub> from the intra-abdominal cavity that may decrease postoperative shoulder pain.

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