Section: General Surgery

Original Research Article

EVALUATION OF POST-OPERATIVE SHOULDER TIP PAIN IN LOW PRESSURE (10 mmHg) VS. STANDARD PRESSURE (14 mmHg) PNEUMOPERITONEUM IN LAP CHOLECYSTECTOMY

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ABSTRACT

Background: Laparoscopic cholecystectomy using low-pressure pneumoperitoneum (7–10 mmHg) may reduce postoperative shoulder tip pain and physiological complications compared to standard pressure (12–14 mmHg), although it may affect operative exposure and duration. This study compared postoperative shoulder tip pain between low- and standard-pressure pneumoperitoneum in laparoscopic cholecystectomy. **Materials and Methods:** This cross-sectional study was conducted in 100 patients at Government Theni Medical College over 1 year. Patients undergoing elective laparoscopic cholecystectomy were divided into two groups: low-pressure and standard-pressure pneumoperitoneum. The surgeries followed a standard technique with uniform anaesthesia. Postoperative pain, including shoulder tip pain, was assessed using a visual analogue scale at 6, 12, and 24 hours, along with analgesic requirements. **Result:** Patients in Group A reported significantly lower postoperative shoulder tip pain scores at all measured time points from 1 h to 3 days ($p < 0.001$). Group A also had a shorter mean hospital stay (2.36 vs. 3.12 days, $p<0.001$), although the mean duration of surgery was longer (93.2 vs. 83.6 min, $p=0.012$). The incidence of shoulder tip pain was significantly higher in Group B (84%) than in Group A (48%) ($p<0.001$). While both groups were predominantly female, Group A had more patients aged >50 years, whereas Group B had more aged <40 years ($p=0.038$). **Conclusion:** Lowering pneumoperitoneum pressure to 10 mmHg during laparoscopic cholecystectomy significantly reduced postoperative shoulder tip pain and analgesic requirements without affecting surgical outcomes. Although it slightly prolongs the operative time, it improves patient comfort without a significant haemodynamic impact.

INTRODUCTION

Laparoscopic cholecystectomy (LC) is the commonly used method for removing the gallbladder in patients with symptoms of gallstones. After this procedure, many individuals report pain in the shoulder area, which can lead to longer hospital stays.[1] This surgery can be done using lower gas pressure in nearly 90% of cases.[2] One study showed that using lower gas pressure (below 10 mmHg) is both possible and safe, and it leads to less pain after the operation while taking about the same amount of time as the usual gas pressure level (12 to 16 mmHg).[3] Since there are different findings regarding the use of lower versus usual gas pressure during this surgery, a study was conducted to compare shoulder pain after surgery between patients who had the procedure with lower pressure (7–8 mmHg CO_2) and those who had it with usual pressure (12–14 mmHg CO_2).[4]

While performing a LC, enough space needs to be created inside the abdomen to allow clear visibility and safe handling of instruments. Common ways to make this space include filling the abdomen with gas (pneumoperitoneum) or using lifting tools like the laparotensor and laparolift.[1] Pneumoperitoneum is usually done by pushing carbon dioxide gas into the abdominal cavity and keeping it at a steady pressure until the surgery is finished, after which the gas is let out as the ports are removed.[1,2] Using the usual pressure range of 12–14 mmHg for long periods

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during surgery has been linked with problems like reduced lung flexibility, changes in blood gas levels, issues with heart and blood flow, a rise in liver enzymes, problems with kidney function, and higher pressure in abdominal veins.[5,6]

A recent approach involves using lower gas pressure during pneumoperitoneum, between 7–10 mmHg, instead of the usual levels, to reduce its effects on body functions while still allowing enough space to perform the surgery.[7,8] This technique seems to cause fewer problems with heart and lung function and may be better suited for older individuals or those with long-term heart or lung conditions. Some other possible benefits of using lower pressure include reduced shoulder pain after surgery and improved comfort in the week following the procedure.[9] However, using lower pressure might make it harder to see clearly during surgery, which can lead to longer procedures, more problems during the operation, and a greater chance of needing to switch to the usual pressure method or even to open surgery.[3]

Aim

This study aimed to determine the frequency and severity of shoulder discomfort following LC and to compare the effects of standard-pressure (14 mmHg) and low-pressure (10 mmHg) pneumoperitoneum on shoulder pain.

MATERIALS AND METHODS

This cross-sectional study included 100 patients with cholelithiasis in the Department of General Surgery at Government Theni Medical College for 1 year. Approval was granted by the Institutional Ethics Committee, and written consent was taken from all participants before they were included in the study.

Inclusion and Exclusion Criteria

Patients aged 18–60 years with cholelithiasis (uncomplicated), were included, while patients aged < 18 and > 60 years, with acute cholecystitis, and pregnancy were excluded.

Methods

Patients were randomly divided into two groups: Group A (n=50) received low-pressure pneumoperitoneum at 10 mmHg, and Group B (n=50) received standard-pressure pneumoperitoneum at 14 mmHg. The surgeries were carried out by two senior surgeons. Initially, the first port was placed using a pressure of 14 mmHg. In Group B, this level was kept the same throughout, while in Group A, the pressure was lowered to 10 mmHg for the rest of the procedure. A regular LC was done using four ports inserted at the beginning. During surgery, heart rate (HR) and blood pressure (BP) were checked every 5 minutes without the use of invasive methods. The muscle layer at the 10 mm ports located at the belly button and upper abdomen was closed using dissolvable stitches. The skin at all port locations was closed using staples.

Both groups followed the same plan for anaesthesia. After surgery, pain relief was given using diclofenac every 12 hours, with extra doses if needed. Patients were encouraged to start walking early and could drink fluids six hours after surgery. Most were sent home the day after the procedure.

At the time of admission, LC and HR were noted. These were also checked during surgery, and the differences were calculated. Pain after surgery was checked at 6, 12, and 24 hours using a visual scale (VAS). The use of extra pain medicine beyond the regular dose and the number of people who had shoulder pain were also recorded.

Statistical Analysis

IBM SPSS (v25) was used to analyse the data. Data were presented in frequencies, percentages, means, and standard deviations. The Chi-square test was used to analyse categorical data, and a p-value <0.05 was considered significant.

RESULTS

Group A had a higher percentage of patients who were elderly (> 50 years), while the normal pressure group had a higher percentage of younger patients (< 40 years). The age distribution of the two groups differed significantly (p = 0.038). Despite the fact that women made up the majority in both groups, there was no significance (p = 0.387). Compared to the normal-pressure group, a significantly greater proportion of patients in group A had longer procedure (> 90 min) (p = 0.012). With 74% of patients being discharged within 2 days, Group A had a shorter overall hospital stay than the normal pressure group, which was significant (p < 0.001). (Table 1).

Table 1: Comparison of demographic and clinical characteristics between the groups

		Group A	Group B	P value
Age group (years)	< 40	14	23	0.038
	41-50	15	15	
	> 50	21	12	
Gender	Male	13	18	0.387
	Female	37	32	
Duration of surgery (minutes)	< 60	7	2	0.012
	61-90	17	38	
	> 90	26	10	
Hospital stays (days)	2	37	22	<0.001
	3	8	9	
	4	5	11	
	> 5	0	8	

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The mean age was significantly higher in group A (47.3 years) than in group B (42.8 years) (p = 0.038). The average duration of surgery was significantly longer in group A (93.2 min) than in group B (83.6 min) (p = 0.012). Patients in group A had a significantly shorter hospital stay (mean 2.36 days) than those in group B (mean 3.12 days) (p < 0.001). There were no significant intergroup differences in mean systolic BP (SBP) (p = 0.292), diastolic BP (DBP) (p = 0.425), or HR (p = 0.384). Across all time intervals (from 1 h to 3 days post-op), Group A consistently reported significantly lower VAS scores than Group B (p < 0.001 for all) (Table 2).

Table 2: Comparison of outcomes and parameters, and VAS score between groups

		Group A	Group B	P value
Age (years)		47.3 ± 11.1	42.8 ± 10.2	0.038
Duration of surgery (min)		93.2 ± 23.6	83.6 ± 11.9	0.012
Hospital stays (days)		2.36 ± 0.66	3.12 ± 1.19	<0.001
LC (mmHg)	SBP	130.5 ± 5.9	129.2 ± 6.0	0.292
	DBP	83.6 ± 9.1	82.3 ± 7.3	0.425
HR (bpm)		75.6 ± 5.9	74.6 ± 5.5	0.384
VAS score (hours)	1	3.40 ± 0.50	4.90 ± 1.00	<0.001
	4	2.56 ± 0.50	4.98 ± 1.06	<0.001
	8	2.18 ± 0.77	4.30 ± 0.76	<0.001
	12	2.08 ± 0.34	4.00 ± 0.61	<0.001
VAS score (Days)	1	1.98 ± 0.14	3.48 ± 0.81	<0.001
	2	1.32 ± 0.47	2.48 ± 0.81	<0.001
	3	1.83 ± 0.39	3.00 ± 0.00	<0.001

DISCUSSION

Our study examined pneumoperitoneum under low pressure and standard pressure during LC; older patients were in Group A (low pressure), while younger patients were in Group B (standard pressure). There was no significant variation in the proportion of males and females among the groups. The time taken to complete the surgery was longer in the low-pressure group, while the number of days spent in the hospital was shorter.

Similarly, Alatrakchi et al. observed no major differences in age, sex, or ASA grade between the both groups. The average age was 41.7 ± 12.3 years in Group A and 39.5 ± 11.9 years in Group B (p = 0.449), and the ratio of females to males was also similar (58:12 vs. 54:16; p = 0.582).10 Mahajan et al. also noted that both the high- and low-pressure groups were similar in terms of age, sex, and BMI, showing that the starting conditions were much the same. The average time for surgery was 62 ± 9.4 minutes in the high-pressure group and 63.17 ± 7.7 minutes in the low-pressure group (p > 0.05).[11] These results together indicate that using lower pressure may slightly increase the time needed for surgery, but can result in a shorter hospital stay, while the characteristics of patients need to be similar between the two groups.

In our study, the average age and surgery duration were both high in the low-pressure group compared to the standard-pressure group. However, the average hospital stay was shorter in the low-pressure group. There were no major differences between the two groups in terms of average systolic or diastolic BP or HR. Goel et al. reported that the time taken for surgery was nearly the same in both the low- and standard-pressure groups (62.6 ± 4.5 vs. 60.45 ± 5.6 minutes; p = 0.78). But the low-pressure group had a lower HR and BP during the procedure and when the gas was released, and there was no significance at any point (p < 0.05).[12]

Mahajan et al. noted that there was no major difference in the time taken for surgery between the low-pressure group (63.17 ± 7.7 min) and the high-pressure group (62 ± 9.4 min) (p > 0.05). The amount of CO_2 used was a bit lower in the low-pressure group (103 ± 11.5 L vs. 108 ± 14.5 L), though this difference was not significant, and no damage to organs or blood vessels was seen in either group.11 Morey et al. found that patients with standard-pressure had more frequent and more severe shoulder pain after surgery at all checked times (2, 8, 24, and 48 hours; p < 0.05).[13] Alatrakchi et al. noted a slightly longer average surgery time in the low-pressure group (50.7 ± 12.7 vs. 47.4 ± 10.6 minutes; p = 0.729), with no notable differences in bile leakage (9 vs. 7 cases; p = 0.290) or days spent in the hospital (1.23 vs. 1.12 days; p = 0.322).10 Overall, low-pressure pneumoperitoneum seems to help with recovery and reduce pain after surgery, even though it may slightly increase the time required for the procedure, without affecting safety or hospital stay.

In our study, shoulder pain after surgery was lower among the low-pressure patients at all time points. From 1 hour to 3 days after the operation, VAS scores stayed lower in Group A compared to Group B, showing that using lower pressure helped reduce pain during the entire recovery period. Yasir et al. also reported fewer cases of shoulder pain in the group with low-pressure (5 vs. 14 patients; p = 0.001), along with lower average VAS scores at 4, 8, and 24 hours (4.2 vs. 4.43; 2.2 vs. 3.5; 0.2 vs. 0.64).14 While the number of pain relief injections needed was not much different, those patients with low-pressure received fewer on average (2.2 vs. 2.71).

Shaha et al. observed shoulder pain in 11.42% of patients with low-pressure compared to 31.42% in

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the standard group (p = 0.0414), along with much lower VAS scores at 4, 8, and 24 hours (4.2 vs. 4.43; 2.8 vs. 3.5; 0.2 vs. 0.63; all p < 0.05).[15] Agarwal et al. reported shoulder pain in 14% of patients who received low pressure, compared to 38% in those who received standard pressure. VAS scores were much lower at 6, 12, and 24 hours (0.40, 0.20, 0.13 vs. 1.94, 1.24, 0.92; all p < 0.05).4 Pain at 1 hour was very low in both groups and showed no major difference (p = 0.159).

Goel et al. observed that VAS scores were much lower in the low-pressure patients at 12 and 24 hours after surgery (0.45 vs. 2.12 and 2.67 vs. 4.01; p < 0.05), while there was no major difference at 48 hours (2.14 vs. 2.65; p = 0.65).[12] Mahajan et al. observed shoulder pain in 8% of those with low-pressure compared to 30% with high-pressure (p < 0.05), along with lower VAS scores at 2, 8, 24, and 48 hours. In the low-pressure group, the pain levels dropped close to zero by 48 hours.[11] Alatrakchi et al. reported shoulder pain in 19% of patients with low-pressure patients versus 33% with the high-pressure (p = 0.001). Pain levels at 12 and 24 hours were much lower in the low-pressure patients (12 h: 2.46 vs. 4.06; 24 h: 1.14 vs. 4.31; both p < 0.001), with the highest pain levels at 12 hours before getting better in both groups.[10] Using low-pressure pneumoperitoneum regularly leads to less pain in the shoulder and abdomen after surgery, with lower VAS scores and reduced need for pain relief, making recovery more comfortable for patients across various studies

Limitations

The limitations include a small sample size from a single centre and an imbalance in age distribution between groups, which may affect the results. Additionally, the short follow-up duration and absence of blinding could create bias and limit the assessment of long-term results.

CONCLUSION

Our study found that lowering pneumoperitoneum pressure to 10 mmHg during LC reduced shoulder pain after surgery and the need for pain relief, while still maintaining the quality of the procedure. It also shortens the operative time and hospital stay. Although intraoperative haemodynamic changes are minimal, this simple adjustment meaningfully reduces postoperative morbidity in an already well-established gold standard procedure.

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