

ORIGINAL RESEARCH ARTICLE

Patients with low body mass index are more likely to develop shoulder pain after laparoscopy

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Abstract

Introduction: Shoulder pain is one of the most common complications after laparoscopy. Previous studies have found a number of methods to reduce shoulder pain after laparoscopic surgery, but these methods have not been targeted to specific populations. The purpose of this study was to identify people who are more likely to develop shoulder pain.

Material and methods: A total of 203 patients underwent laparoscopy for benign gynecological diseases between July 2020 and February 2021. Patients were divided into two groups according to the Chinese overweight standard, body mass index less than 24 kg/m² group and 24 kg/m² or more group. The baseline characteristics and intraoperative data between the two groups were compared. The intensity of the shoulder pain was quantified using a visual analog scale (VAS).

Results: The incidence and the VAS scores of shoulder pain were significantly higher in the less than 24 kg/m² group (63.64% vs 38.03%, $p < 0.001$ in incidence; median 5 (interquartile range [IQR] 3–7) vs 3 (IQR 2–5), $p < 0.001$ in VAS scores), and the chance of shoulder pain within 24 hours after laparoscopy was higher in the less than 24 kg/m² group (89.29% vs 66.67%, $p = 0.013$). In univariate and multivariate logistic regression analysis, BMI less than 24 kg/m² was an independent risk factor of shoulder pain after laparoscopic surgery ($p = 0.001$, $p = 0.031$, respectively). Shoulder pain scores were inversely correlated with BMI ($r = -0.300$, $p = 0.001$).

Conclusions: Patients with low body mass index are more likely to develop shoulder pain after laparoscopy, with earlier onset and higher pain scores.

KEYWORDS

body mass index, laparoscopy, post-laparoscopic shoulder pain, shoulder pain, strategy, visual analog scale

Abbreviations: BMI, body mass index; VAS, visual analog scale; ASA, American Society of Anesthesiologists.

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1 | INTRODUCTION

Laparoscopic surgery is widely used in gynecological disease diagnosis and treatment because of the advantages of less trauma, fewer postoperative complications, quicker recovery of daily activities, and shorter hospital stays. However, laparoscopic surgery can also induce postoperative shoulder pain, vascular injury, intestinal injury, urinary tract injury, air embolism, and other related complications. Among these complications, post-laparoscopic shoulder pain is one of the most common complications of laparoscopic surgery, with an incidence rate of 34.1%–82.4%.^{1,2}

Many previous studies have confirmed that there are many strategies to reduce the incidence of shoulder pain after laparoscopic surgery, such as using analgesics,³ lowering intraoperative CO₂ pressure,⁴ special position,^{5,6} pulmonary recruitment maneuver,^{7,8} reducing residual CO₂ in the abdominal cavity by pressing the abdomen or abdominal drainage.^{1,9,10} However, these strategies for reducing shoulder pain after laparoscopic surgery are not individualized to a specific population, and this may result in patients who do not develop shoulder pain being exposed to these interventions without any benefits. For example, low pneumoperitoneal pressure in obese patients who are less prone to postoperative shoulder pain may result in poor intraoperative visualization or postoperative indwelling of unnecessary abdominal drainage that increases the chance of infection. Therefore, identification of the group who are most likely to develop shoulder pain after laparoscopy, and use of individualized methods to reduce shoulder pain could maximize the benefits and minimize the harm.

Few studies have reported the relation between body mass index (BMI) and shoulder pain after laparoscopic surgery.¹¹ Therefore, it is of clinical importance to identify the relation between BMI and shoulder pain after laparoscopic surgery for benign gynecological diseases, and to identify the patient group most likely to experience postoperative shoulder pain.

2 | MATERIAL AND METHODS

2.1 | Study design

This is a retrospective cohort study conducted by a university-affiliated hospital.

2.2 | Participants

2.2.1 | Inclusion criteria

Patients underwent laparoscopic surgery for benign gynecological diseases in the Department of Gynecology, People's Hospital of Shapingba District, Chongqing, China, from July 2020 to February 2021. Patients with malignant gynecological diseases or shoulder

Key message

Patients with low body mass index are more likely to develop shoulder pain after laparoscopy, with earlier onset and higher pain scores.

diseases or a history of these, those transited to laparotomy, and those refusing to provide any data were excluded from the study.

2.3 | Surgery and perioperative management

All operations were performed by the same surgical team. The intraoperative pneumoperitoneal pressure was 12 mm Hg, and the flow rate was 3 L/min. At the end of the operation, abdominal compression was used to discharge residual CO₂ in the abdominal cavity, and abdominal drainage was unnecessary. All patients underwent postoperative pulmonary recruitment maneuvers. Perioperative management according to the Recovery and Surgical Optimization Protocol for Minimally Invasive Gynecologic Surgery: An AAGL White Paper.¹² When patients presented with shoulder pain, oral non-steroidal anti-inflammatory drugs were used first, and if these were ineffective, intravenous pain medications such as intra-opioids were administered.

2.4 | Data collection

The patients' baseline characteristics and intraoperative data were extracted from the electronic medical record system, and the postoperative information was obtained by the same investigator asking the patients. The collected data included: age, height, weight, partner, parity, American Society of Anesthesiologists classification, type of surgery, operative time, operative blood loss, postoperative shoulder pain, when shoulder pain started and disappeared, shoulder pain scores, oral or intravenous pain medication, and length of hospital stay. Shoulder pain data for all patients were collected 72 hours after surgery. The visual analog scale (VAS: 0–10 points, ranging from “no pain” to “pain as bad as it could be”) was used to quantify the shoulder pain.

2.5 | Statistical analyses

SPSS version 26.0 was used for analysis. Continuous variables were analyzed by a two-sample *t* test or Mann–Whitney *U* test, and categorical variables were analyzed by a chi-squared test or Fisher exact test. Univariate and multivariate logistic regression analyses were used to detect the independent risk factors for shoulder pain among age, BMI, parity, education, operative time, operative blood loss, and length of hospital stay. Data were shown as mean ± standard deviation, median (interquartile range [IQR]), or the number of

patients (%). A value of p less than 0.05 was considered statistically significant.

2.6 | Ethics statement

The trial was approved by the Ethics Committee of the People's Hospital of Shapingba District, Chongqing, China on April 26, 2022 (Institutional Review Board reference no. KY202204). We obtained informed consent from patients to use their personal information and clinical data upon admission.

3 | RESULTS

A total of 203 patients with BMI ranging from 15.42 to 36.05 kg/m² were included. According to the Chinese definition of overweight, patients were divided into a less than 24 kg/m² group and a 24 kg/m² or more group. The former comprised 132 patients and the latter 71 patients. The number of patients with a partner was not statistically different, nor was the American Society of Anesthesiologists' Classification between the two groups ($p = 0.615$, $p = 0.643$). Patients in the less than 24 kg/m² group were younger, more educated, had fewer births, shorter operative times, lower levels of operative blood

loss, and shorter length of hospital stay ($p < 0.001$, $p < 0.001$, $p < 0.001$, $p < 0.001$, $p = 0.001$, $p < 0.001$). No patients had prolonged hospital stays or readmissions for shoulder pain. Table 1 presents the baseline characteristics and intraoperative data of the two groups.

About 84 (63.64%) patients in the less than 24 kg/m² group had shoulder pain after surgery, while 27 (38.03%) patients in the 24 kg/m² or more group had shoulder pain after surgery ($p < 0.001$). The relative risk was 1.673 (Table 2).

Univariate and multivariate logistic regression analysis showed that having a BMI less than 24 kg/m² was an independent risk factor for shoulder pain after laparoscopic surgery (univariate odds ratio 2.85 [95% CI 1.57–5.18], $p = 0.001$; multivariate odds ratio 2.16 [95% CI 1.07–4.26], $p = 0.031$) (Table 3).

A total of 111 patients developed shoulder pain after surgery, 84 patients in the less than 24 kg/m² group and 27 patients in the 24 kg/m²

TABLE 2 Number of patients with shoulder pain after laparoscopy

Shoulder pain	BMI <24 kg/m ² , n (%)	BMI ≥24 kg/m ² , n (%)	<i>p</i> value
Yes	84 (63.64%)	27 (38.03%)	
No	48 (36.36%)	44 (61.97%)	
Total	132	71	<0.001

TABLE 1 Baseline characteristics and intraoperative data of the two groups

	BMI <24 kg/m ² (n = 132)	BMI ≥24 kg/m ² (n = 71)	<i>p</i> value
Age (years), median (IQR)	34 (26–42)	47 (41–52)	<0.001
Partner			
No	12 (9.09%)	5 (7.04%)	0.615
Yes	120 (90.91%)	66 (92.96%)	
Parity (births)			
0	39 (29.55%)	6 (8.45%)	<0.001
1	61 (46.21%)	27 (38.03%)	
≥2	32 (24.24%)	38 (53.52%)	
Education			
Low	13 (9.85%)	27 (38.03%)	<0.001
Moderate	69 (52.27%)	38 (53.52%)	
High	50 (37.88%)	6 (8.45%)	
ASA Classification			
1–2	125 (94.70%)	69 (97.18%)	0.643
3–4	7 (5.30%)	2 (2.82%)	
Operative time (min)	76 (51–107)	128 (81–164)	<0.001
Operative blood loss (mL)	10 (10–50)	30 (20–50)	0.001
Length of hospital stay (days)	5 (4–7)	7 (6–9)	<0.001

Note: Partner: Having a boyfriend or a husband is defined as having a partner. Low education includes illiteracy and primary education.

Moderate education includes middle school, high school and technical secondary school education. High education includes a college degree, a bachelor's degree or above.

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; IQR, interquartile range.

m² or more group. Shoulder pain occurred in 75 (89.29%) patients in the less than 24 kg/m² group within 24 hours after surgery, compared with 18 (66.67%) in the 24 kg/m² or more group ($p = 0.013$). The post-operative shoulder pain scores were higher in the less than 24 kg/m² group than the 24 kg/m² or more group (median 5 [IQR 3–7] vs 3 [IQR 2–5], $p < 0.001$). The less than 24 kg/m² group seemed to be

more likely to need pain medication (27.38% vs 11.11%, $p = 0.082$). Unfortunately, there were no statistically significant differences in shoulder pain relief after 72 hours between the two groups (33.33% vs 22.22%, $p = 0.276$; Table 4).

We also found a weak, significant, inverse relation between shoulder pain scores and BMI ($r = -0.300$, $p = 0.001$; Figure 1).

TABLE 3 Univariate and multivariate logistic regression analysis for shoulder pain

Variables	Univariate, p	Univariate, OR	Multivariate, p	Multivariate OR
Age (years)	0.002	0.96 (0.94–0.99)	0.176	0.98 (0.94–1.01)
BMI				
≥ 24 kg/m ²		1		1
< 24 kg/m ²	0.001	2.85 (1.57–5.18)	0.031	2.16 (1.07–4.26)
Parity (births)	0.150	0.79 (0.57–1.09)	0.362	1.22 (0.80–1.85)
Education				
Low		1		1
Moderate	0.154	1.71 (0.82–3.58)	0.412	0.64 (0.22–1.87)
High	0.008	3.17 (1.36–7.38)	0.359	0.71 (0.34–1.48)
Operative time (min)	0.039	1.00 (0.99–1.00)	0.911	1.00 (0.99–1.01)
Operative blood loss (mL)	0.512	1.00 (1.00–1.00)	0.869	1.00 (1.00–1.00)
Length of hospital stay (days)	0.016	0.86 (0.77–0.97)	0.774	0.98 (0.83–1.14)

Abbreviations: BMI, body mass index; OR, odds ratio.

	BMI < 24 kg/m ² ($n = 84$)	BMI ≥ 24 kg/m ² ($n = 27$)	p value
Pain appearance within 24 h, n (%)	75 (89.29%)	18 (66.67%)	0.013
Pain scores, median (IQR)	5 (3–7)	3 (2–5)	< 0.001
Pain medication, n (%)	23 (27.38%)	3 (11.11%)	0.082
Pain relief after 72 h, n (%)	28 (33.33%)	6 (22.22%)	0.276

TABLE 4 Pain after laparoscopy

Abbreviations: BMI, body mass index; IQR, interquartile range.

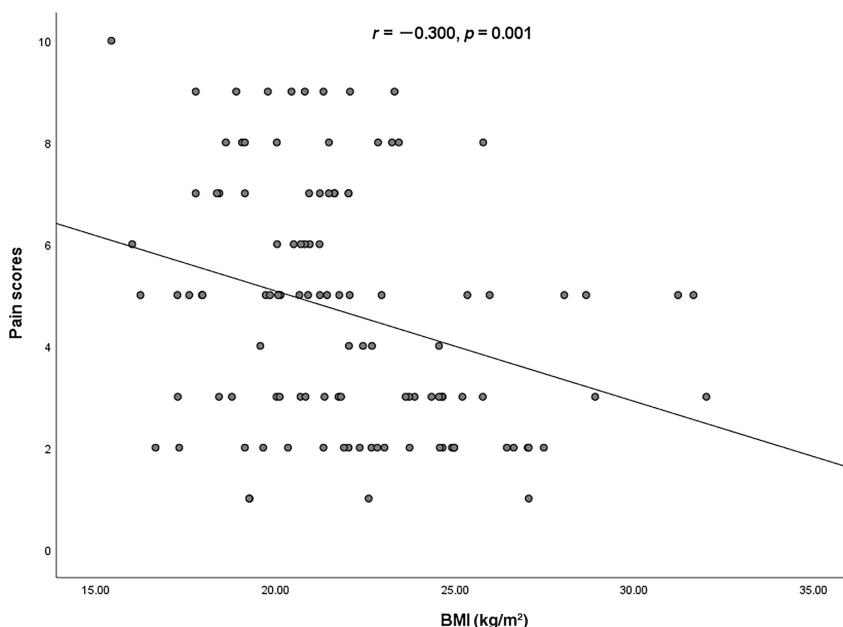


FIGURE 1 Associations of shoulder pain scores and body mass index (BMI).

4 | DISCUSSION

Our study found that post-laparoscopic shoulder pain was more common in patients with low BMI, and these patients had earlier onset and higher pain scores after surgery. Univariate and multivariate logistic regression analysis showed that BMI less than 24 kg/m² was an independent risk factor for shoulder pain after laparoscopic surgery. Shoulder pain scores were significantly, weakly, inversely correlated with BMI. Patients whose BMI was less than 24 kg/m² seemed to be more likely to require pain medication.

Li et al reported that thin patients had a higher incidence of shoulder pain after laparoscopic infertility surgery,¹¹ which is consistent with our findings. However, our study evaluated all patients with benign gynecological diseases, and the results reflected risk factors for shoulder pain after laparoscopic surgery more accurately. Thin patients have a large space in the upper abdomen, and gas is likely to remain here after laparoscopic surgery, whereas obese patients have a tiny upper abdominal area covered by the omentum. The stretching of CO₂ gas can irritate the diaphragm, causing shoulder pain.¹³

Many previous trials have found that there are many ways to reduce the occurrence of shoulder pain after laparoscopic surgery, such as perioperative use of anesthetics,^{14,15} pulmonary recruitment maneuver,^{8,16} intraoperative use of low pneumoperitoneal pressure,^{17,18} and postoperative intraperitoneal drainage.^{1,9} These interventions did not stratify the population and this may result in patients who would not experience shoulder pain being exposed to these interventions without benefit or even with possible harm. For example, nausea, vomiting, and urinary retention caused by the routine use of analgesics after surgery or unnecessary drainage tubes indwelling in the pelvis increasing the chance of pelvic infection. We found that patients with low BMI were more likely to develop shoulder pain after laparoscopic surgery and had higher pain scores, so we believe that strategies to reduce shoulder pain would be more appropriate for patients with low BMI.

We also found that patients with BMI less than 24 kg/m² were younger, had lower parities, and were more educated, maybe with the rapid development of China's economy in the past 30 years, young people have more opportunities for education and lower willingness to bear children. Our study also found that patients with BMI less than 24 kg/m² had shorter operative times, lower levels of operative blood loss and shorter length of hospital stay, mainly because patients with a BMI less than 24 kg/m² had more adnexal surgeries, patients with BMI of 24 kg/m² or more were more likely to undergo uterine surgery, the proportion of uterine surgery between the two groups was 19.7% vs 49.3%, $p < 0.001$ (data not shown in tables). We did not find any association between operative time and postoperative shoulder pain. In contrast, patients with BMI of 24 kg/m² or more had longer operative times and were less likely to develop shoulder pain, which may be related to the fact that less gas is likely to remain in the upper abdomen covered by omentum.

This study is the first to describe the relation between BMI and shoulder pain after laparoscopic surgery for benign gynecological

diseases. The disadvantage of this study is that it is a retrospective study with a small sample size, and a prospective study with a larger sample size is hoped to confirm the results further.

5 | CONCLUSION

Patients with low BMI are more likely to develop shoulder pain after laparoscopy, with earlier onset and higher pain scores. If future studies confirm the results of the present study, doctors could selectively apply many measures to relieve shoulder pain after laparoscopic surgery in patients with low BMI.

AUTHOR CONTRIBUTIONS

YJ and QL designed the study. YQ and YW collected the data. YJ and SL performed the statistical analysis. YJ, QL, and YC drafted the paper. All authors interpreted the data, critically revised the article, and approved the final version.

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CONFLICT OF INTEREST

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

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REFERENCES

1. Yang SC, Chang KY, Wei LF, Shyr YM, Ho CM. To drain or not to drain: the association between residual intraperitoneal gas and post-laparoscopic shoulder pain for laparoscopic cholecystectomy. *Sci Rep*. 2021;11:7447.
2. Li X, Li K. Time characteristics of shoulder pain after laparoscopic surgery. *JSL*. 2021;25:e2021.00027.
3. Kim HY, Choi JB, Min SK, Chang MY, Lim GM, Kim JE. A randomized clinical trial on the effect of a lidocaine patch on shoulder pain relief in laparoscopic cholecystectomy. *Sci Rep*. 2021;11:1052.
4. Verguts J, Sanger N. Impact of different intraoperative CO₂ pressure levels (8 and 15 mmHg) during laparoscopic hysterectomy performed due to benign uterine pathologies on postoperative pain and arterial pCO₂: a prospective randomised controlled clinical trial. *BJOG*. 2019;126:1286.
5. Aydemir O, Aslan FE, Karabacak U, Akdas O. The effect of exaggerated lithotomy position on shoulder pain after laparoscopic cholecystectomy. *Pain Manag Nurs*. 2018;19:663-670.
6. Zeeni C, Chamsy D, Khalil A, et al. Effect of postoperative Trendelenburg position on shoulder pain after gynecological laparoscopic procedures: a randomized clinical trial. *BMC Anesthesiol*. 2020;20:27.
7. Lee J, Park C, Kim J, Ki Y, Cha SH, Kim JY. Effect of low-pressure pulmonary recruitment maneuver on postlaparoscopic shoulder pain: randomized controlled trial. *J Minim Invasive Gynecol*. 2020;27:173-177.

8. Garteiz MD, Rodriguez AE, Weber SA, Bravo TC, Carbo RR. Pulmonary recruitment can reduce residual pneumoperitoneum and shoulder pain in conventional laparoscopic procedures: results of a randomized controlled trial. *Surg Endosc*. 2021;35:4143-4152.
9. Hosseinzadeh F, Nasiri E, Behroozi T. Investigating the effects of drainage by hemovac drain on shoulder pain after female laparoscopic surgery and comparison with deep breathing technique: a randomized clinical trial study. *Surg Endosc*. 2020;34:5439-5446.
10. Li PC, Chen H, Ding DC. Shoulder pain after natural orifice transluminal endoscopic surgery decreased with abdominal compression and pulmonary recruitment maneuver: a retrospective study. *Taiwan J Obstet Gynecol*. 2021;60:878-881.
11. Li XY, Tian M, Li AZ, Han CL, Li KZ. The risk of shoulder pain after laparoscopic surgery for infertility is higher in thin patients. *Sci Rep*. 2021;11:13421.
12. Stone R, Carey E, Fader AN, et al. Enhanced recovery and surgical optimization protocol for minimally invasive gynecologic surgery: an AAGL white paper. *J Minim Invasive Gynecol*. 2021;28:179-203.
13. Jackson SA, Laurence AS, Hill JC. Does post-laparoscopy pain relate to residual carbon dioxide. *Anaesthesia*. 1996;51:485-487.
14. Nakhli MS, Kahloul M, Jebali C, Frigui W, Naija W. Effects of gabapentinoids premedication on shoulder pain and rehabilitation quality after laparoscopic cholecystectomy: pregabalin versus gabapentin. *Pain Res Manag*. 2018;2018:9834059.
15. Kim JE, Kim JY, Lee HS, Seok S, Kil HK. Analgesic effect of trigger point injection and EMLA for shoulder pain in patients undergoing total laparoscopic hysterectomy: a randomized controlled study. *Medicine (Baltimore)*. 2019;98:1-8.
16. Kihlstedt PE, Andersson E. Pulmonary recruitment maneuver reduces shoulder pain and nausea after laparoscopic cholecystectomy: a randomized controlled trial. *World J Surg*. 2021;45:3575-3583.
17. Hsu KF, Chen CJ, Yu JC, et al. A novel strategy of laparoscopic insufflation rate improving shoulder pain: prospective randomized study. *J Gastrointest Surg*. 2019;23:2049-2053.
18. Buda A, Di Martino G, Borghese M, et al. Low-pressure laparoscopy using the AirSeal system versus standard insufflation in early-stage endometrial cancer: a multicenter, retrospective study (ARIEL Study). *Healthcare (Basel)*. 2022;10:531.

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