



Original Article

Port Site Complications Following Laparoscopic Surgery: Incidence, Risk Factors, and Clinical Outcomes

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ABSTRACT

Introduction: Laparoscopic surgery has become the preferred approach for many surgical procedures because it offers less postoperative pain, shorter hospital stay, faster recovery, and better cosmetic outcomes. However, port-site complications such as infection, serous discharge, hematoma, hernia, and subcutaneous emphysema continue to occur and may affect postoperative recovery. Identifying these complications and their associated risk factors is important for improving surgical outcomes. **Aim and Objectives:** To assess port-site complications following laparoscopic surgery. (1) To determine the pattern of port-site complications following laparoscopic surgery. (2) To identify the risk factors associated with these complications. **Materials and Methods:** This hospital-based observational study was conducted in the Department of General Surgery, Muzaffarnagar Medical College and Hospital, over 18 months. A total of 100 patients aged 15–60 years who underwent laparoscopic surgery were included. Demographic, clinical, and operative data were recorded, and patients were followed for three months to identify port-site complications. Data were analysed using SPSS version 20, with a p-value <0.05 considered statistically significant. **Results:** Port-site complications were observed in 28% of patients. Serous discharge and port-site infection were the most common complications (28.57% each), followed by hematoma, subcutaneous emphysema, hypertrophic scar, and port-site hernia (10.71% each). The umbilical port was the most commonly affected site (60.71%), and most complications were detected between postoperative days 3 and 5. Higher body mass index ($p=0.0211$), diabetes mellitus ($p=0.0234$), and smoking ($p=0.0175$) were significantly associated with port-site complications, whereas age, gender, type of surgery, port size, port entry technique, and umbilical port use showed no significant association. Most complications (92.86%) were managed successfully with conservative treatment. **Discussion:** The study shows that port-site complications are generally minor and occur mainly in patients with modifiable risk factors such as obesity, diabetes, and smoking. Careful patient optimization, meticulous surgical technique, and early postoperative wound assessment can help reduce these complications. **Conclusion:** Port-site complications following laparoscopic surgery are usually minor and can be managed conservatively. Obesity, diabetes mellitus, and smoking are significant risk factors, while procedural factors showed no significant impact. Optimizing patient-related risk factors and maintaining good perioperative care can further improve the safety and outcomes of laparoscopic surgery.

Keywords: Laparoscopic surgery, Port-site complications, Port-site infection, Port-site hernia, Body mass index, Diabetes mellitus, Smoking.

INTRODUCTION

Laparoscopic surgery, also known as minimally invasive or keyhole surgery, has become the preferred approach for many surgical procedures because it offers several advantages over open surgery, including less postoperative pain, smaller scars, shorter hospital stay, faster recovery, and earlier return to normal activities [1-2]. Advances in laparoscopic equipment and surgical techniques have further expanded its use in general surgery, gynecology, and urology [3].

Despite these benefits, port-site complications (PSCs) remain an important cause of postoperative morbidity [4-5]. These complications include port-site infection, serous discharge, hematoma, subcutaneous emphysema, hypertrophic scar, port-site hernia, and, rarely, port-site metastasis [6]. Although most are minor, they can delay wound healing, prolong recovery, and increase healthcare costs.

The reported incidence of port-site complications ranges from 5% to 17%, with port-site infection being the most frequently encountered complication [7,8]. Several patient- and procedure-related factors, including obesity, diabetes mellitus, smoking, prolonged operative time, inadequate aseptic technique, larger port size, and improper fascial closure, have been associated with an increased risk of these complications [8-11]. The umbilical port is particularly prone to complications because it is commonly used for camera insertion and specimen retrieval.

Most port-site complications can be prevented by meticulous surgical technique, strict aseptic precautions, appropriate sterilization of instruments, prophylactic antibiotics when indicated, and routine closure of fascial defects measuring 10 mm or more [14-15]. Early recognition and timely management are equally important to prevent progression to more serious complications.

Although laparoscopic surgery is considered a safe and effective technique, port-site complications continue to be encountered in routine practice. Identifying their pattern and associated risk factors is essential for improving patient care and minimizing postoperative morbidity [16-17].

Therefore, the present study was undertaken to assess the port-site complications following laparoscopic surgery and to identify the risk factors associated with their occurrence, with the aim of improving the safety and outcomes of laparoscopic procedures.

AIM AND OBJECTIVES

Aim

To assess port-site complications following laparoscopic surgery.

Objectives

- To determine the pattern of port-site complications following laparoscopic surgery.
- To identify the risk factors associated with port-site complications following laparoscopic surgery.

MATERIALS AND METHODS

Study Design

This hospital-based observational study was conducted in the Department of General Surgery, Muzaffarnagar Medical College and Hospital, Muzaffarnagar, to evaluate the pattern of port-site complications and identify the associated risk factors following laparoscopic surgery.

Study Duration and Population

The study was conducted over a period of 18 months, including 12 months of data collection followed by 6 months of data compilation and analysis. The study population comprised patients who underwent elective or emergency laparoscopic surgical procedures during the study period.

Sample Size and Sampling Technique

A total of 100 patients were enrolled using purposive sampling based on predefined inclusion and exclusion criteria.

Inclusion Criteria

- Patients aged between 15 and 60 years who underwent laparoscopic surgery.
- Patients who provided written informed consent to participate in the study.
- Patients who underwent elective or emergency laparoscopic procedures during the study period.

Exclusion Criteria

- Patients aged below 15 years or above 60 years.
- Patients with pre-existing skin disorders.

- Patients with co-morbidities such as intestinal tuberculosis, coagulopathies, HIV, hepatitis, or other immunocompromised conditions.
- Patients with a history of previous abdominal surgeries.

Data Collection

All relevant demographic, clinical, operative, and postoperative data were systematically recorded in a structured proforma for analysis.

Statistical Analysis

The collected data were analyzed using SPSS version 20 and StatCalc 2 software. Descriptive statistics were used to summarize the data, and appropriate statistical tests were applied to assess the association between risk factors and port-site complications. A p-value of <0.05 was considered statistically significant.

RESULTS

Age Distribution of Patients According to Port-Site Complications

Table 1: Age Distribution of Patients According to Port-Site Complications

Age	Port site complication		No complication	
	Frequency	Percentage	Frequency	Percentage
15-20 years	6	21.43%	9	12.50%
21-30 years	6	21.43%	10	13.89%
31-40 years	3	10.71%	15	20.83%
41-50 years	5	17.86%	19	26.39%
51-60 years	8	28.57%	19	26.39%
Total	28	100.00%	72	100.00%
p-value	0.4655			

Port-site complications were most common in patients aged 51–60 years (28.57%), followed by those aged 15–20 years and 21–30 years (21.43% each). Among patients without complications, the highest proportion was observed in the 41–50 and 51–60 year age groups (26.39% each). There was no statistically significant association between age and port-site complications ($p = 0.4655$) (table 1).

Gender Distribution of Patients According to Port-Site Complications

Table 2: Gender Distribution of Patients According to Port-Site Complications

Gender	Port site complication		No complication	
	Frequency	Percentage	Frequency	Percentage
Male	6	21.43%	20	27.78%
Female	22	78.57%	52	72.22%
p-value	0.5157			

Females accounted for a higher proportion of patients with port-site complications (78.57%) than males (21.43%). A similar female predominance was observed among patients without complications (72.22%). However, the association between gender and port-site complications was not statistically significant ($p = 0.5157$) (table 2).

Distribution of Type of Laparoscopic Surgery According to Port-Site Complications

Table 3: Distribution of Type of Laparoscopic Surgery According to Port-Site Complications

Type of Laparoscopic Surgery	Port site complication		No complication	
	Frequency	Percentage	Frequency	Percentage
Laparoscopic Cholecystectomy	16	57.14%	52	72.22%
Laparoscopic Appendectomy	9	32.14%	15	20.83%
Laparoscopic Hernia Repair	3	10.71%	5	6.94%
p-value	0.3487			

Laparoscopic cholecystectomy was the most commonly performed procedure in both groups, accounting for 57.14% of patients with port-site complications and 72.22% of those without complications. Laparoscopic appendectomy and hernia repair were less common. There was no statistically significant association between the type of laparoscopic surgery and the occurrence of port-site complications ($p = 0.3487$) (table 3).

Distribution of Port Entry Technique According to Port-Site Complications.

Table 4: Distribution of Port Entry Technique According to Port-Site Complications.

Port Entry Technique	Port site complication		No complication	
	Frequency	Percentage	Frequency	Percentage
Veress needle (Closed)	18	64.29%	47	65.28%
Hasson technique (Open)	10	35.71%	25	34.72%
p-value	0.9255			

The Veress needle (closed) technique was the most commonly used method of port entry in both groups, accounting for 64.29% of patients with port-site complications and 65.28% of those without complications. The Hasson (open) technique was used in the remaining patients. There was no statistically significant association between the port entry technique and port-site complications ($p = 0.9255$) (table 4).

Distribution of Port Size According to Port-Site Complications

Table 5: Distribution of Port Size According to Port-Site Complications

Port Size (mm)	Port site complication		No complication	
	Frequency	Percentage	Frequency	Percentage
5 mm	11	39.29%	28	38.89%
10 mm	13	46.43%	22	30.56%
5 and 10 mm	4	14.29%	22	30.56%
p-value	0.1733			

Port-site complications were observed more frequently in patients in whom 10 mm ports were used (46.43%), followed by 5 mm ports (39.29%). Among patients without complications, the combined use of 5 mm and 10 mm ports was more common (30.56%). However, port size was not significantly associated with the development of port-site complications ($p = 0.1733$) (table 5).

Distribution of Patients According to Umbilical Port Use

Table 6: Distribution of Patients According to Umbilical Port Use

Umbilical Port Used	Port site complication		No complication	
	Frequency	Percentage	Frequency	Percentage
Yes	16	57.14%	35	48.61%
No	12	42.86%	37	51.39%
p-value	0.4434			

The umbilical port was used in 57.14% of patients with port-site complications and 48.61% of those without complications. Although complications were slightly more common among patients in whom an umbilical port was used, the association was not statistically significant ($p = 0.4434$) (table 6).

Distribution of Body Mass Index According to Port-Site Complications

Table 7: Distribution of Body Mass Index According to Port-Site Complications

BMI (kg/m ²)	Port site complication		No complication	
	Frequency	Percentage	Frequency	Percentage
Underweight (<18.5)	3	10.71%	8	11.11%
Normal (18.5–24.9)	11	39.29%	49	68.06%
Overweight (25.0–29.9)	7	25.00%	10	13.89%
Obesity (≥30.0)	7	25.00%	5	6.94%
p-value	0.0211			

Patients with a normal body mass index (BMI) were less likely to develop port-site complications and made up the majority of the non-complication group (68.06%). In contrast, overweight and obese patients accounted for half of all patients who developed port-site complications (50.00%). This difference was statistically significant, indicating that a higher BMI was associated with an increased risk of port-site complications ($p = 0.0211$) (table 7).

Distribution of Diabetes Mellitus According to Port-Site Complications

Table 8: Distribution of Diabetes Mellitus According to Port-Site Complications

Diabetes Mellitus	Port site complication	No complication
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	Frequency	Percentage	Frequency	Percentage
Yes	5	17.86%	3	4.17%
No	23	82.14%	69	95.83%
p-value	0.0234			

Diabetes mellitus was more common among patients who developed port-site complications (17.86%) than among those without complications (4.17%). This difference was statistically significant, suggesting that diabetes mellitus is associated with an increased risk of port-site complications ($p = 0.0234$) (table 8).

Distribution of Smoking History According to Port-Site Complications

Table 9: Distribution of Smoking History According to Port-Site Complications

Smoking History	Port site complication		No complication	
	Frequency	Percentage	Frequency	Percentage
Yes	6	21.43%	4	5.56%
No	22	78.57%	68	94.44%
p-value	0.0175			

Patients with a history of smoking were more likely to develop port-site complications than non-smokers (21.43% vs. 5.56%). This association was statistically significant, suggesting that smoking increases the risk of port-site complications following laparoscopic surgery ($p = 0.0175$) (table 9).

Spectrum of Port-Site Complications

Table 10: Spectrum of Port-Site Complications

Port site complication	Frequency	Percentage
Serous discharge at port site	8	28.57%
Port site infection	8	28.57%
Port site hematoma	3	10.71%
Subcutaneous emphysema	3	10.71%
Hypertrophic scar	3	10.71%
Port site hernia	3	10.71%
Total	28	100.00%

Serous discharge and port-site infection were the most frequently observed complications, each occurring in 28.57% of patients with port-site complications. Less common complications included port-site hematoma, subcutaneous emphysema, hypertrophic scar, and port-site hernia, each accounting for 10.71% of cases (table 10).

Distribution of Port-Site Complications According to Site

Table 11: Distribution of Port-Site Complications According to Site

Site of Complication	Frequency	Percentage
Umbilical	17	60.71%
Lateral	6	21.43%
Epigastric	5	17.86%

The umbilical port was the most common site of port-site complications, accounting for 60.71% of cases. This was followed by the lateral ports (21.43%) and the epigastric ports (17.86%), suggesting that the umbilical port is more prone to postoperative complications (table 11).

Distribution of Port-Site Complications According to Time of Detection

Table 12: Distribution of Port-Site Complications According to Time of Detection

Time of Detection of Complication	Frequency	Percentage
POD 1	3	10.71%
POD 3–5	12	42.86%
POD 5–7	7	25.00%
1-2 weeks	5	17.86%
2-3 weeks	1	3.57%

Most port-site complications were identified within the first postoperative week, with the highest number detected between postoperative days 3–5 (42.86%), followed by days 5–7 (25.00%). Only a few cases were detected on the first postoperative day (10.71%), and relatively few patients developed complications after the first week (table 12).

Management of Port-Site Complications

Table 13: Management of Port-Site Complications

Management	Frequency	Percentage
Conservative	1	3.57%
Conservative / Dressings ± Antibiotics	26	92.86%
Surgical repair	1	3.57%

Most port-site complications were successfully managed with conservative treatment, including dressings with or without antibiotics (92.86%). Only one patient (3.57%) required surgical repair, while another (3.57%) was managed with observation alone. These findings indicate that the majority of port-site complications were minor and responded well to non-operative management (table 13).

DISCUSSION

The present hospital-based observational study evaluated port-site complications following laparoscopic surgery in 100 patients. Overall, port-site complications were infrequent and predominantly minor, with most patients recovering successfully through conservative management.

Age and gender were not significantly associated with port-site complications ($p > 0.05$), suggesting that demographic characteristics alone do not influence postoperative outcomes. Similar findings have been reported by Vaidyula SS et al. (2025) [21], Arora K et al. (2025) [23], and Chandra Mohan P et al. (2023) [19], indicating that patient demographics are poor predictors of port-site morbidity.

Laparoscopic cholecystectomy was the most commonly performed procedure and accounted for the largest proportion of complications. However, neither the type of surgery, port-entry technique (Veress needle or Hasson), port size, nor use of the umbilical port showed a statistically significant association with port-site complications. Comparable observations have been reported by Karthik S et al. (2013) [27], Khoshnoudi H et al. (2024) [26], Gupte N et al. (2017) [9], and Mathew T et al. (2024) [20], suggesting that meticulous surgical technique and adherence to aseptic principles are more important than the operative approach itself.

In contrast, patient-related factors had a significant impact on postoperative outcomes. Higher body mass index (BMI), diabetes mellitus, and smoking were all significantly associated with an increased risk of port-site complications. These findings are consistent with reports by Chandra Mohan P et al. (2023) [19], Majhi H et al. (2021) [18], Chandra J N et al. (2024) [24], Mudgal et al. (2018) [25], Sasmal et al. (2015) [5], Khoshnoudi H et al. (2024) [26], and Shankser A et al. (2025) [22], who identified obesity, diabetes, and smoking as important modifiable risk factors due to their adverse effects on wound healing and susceptibility to infection.

The most common complications observed in the present study were serous discharge and port-site infection, followed by hematoma, subcutaneous emphysema, hypertrophic scar, and port-site hernia. Similar patterns have been described by Karthik S et al. (2013) [60], Arora K et al. (2025) [23], and Shankser A et al. (2025) [22], where superficial wound complications predominated and major complications remained uncommon.

The umbilical port was the most frequent site of complications, accounting for more than half of all cases. This finding agrees with Karthik S et al. (2013) [27], Ravindranath GG et al. (2016) [7], and Chandra Mohan P et al. (2023) [19], who also identified the umbilical port as the most vulnerable site because of repeated instrument manipulation, specimen retrieval, and its larger port size.

Most complications were detected within the first postoperative week, particularly between postoperative days 3 and 5, consistent with the observations of Gupte N et al. (2017) [9], who reported that early postoperative wound complications are usually related to bacterial contamination and respond well to prompt treatment.

Nearly all complications in the present study were managed conservatively with local wound care, dressings, and antibiotics, while surgical intervention was required only for isolated cases such as port-site hernia. Similar management outcomes have been reported by Vaidyula SS et al. (2025) [21] and Shankser A et al. (2025) [22], confirming that most port-site complications are minor and can be effectively treated without reoperation.

Overall, the findings indicate that laparoscopic surgery remains a safe procedure with a low incidence of clinically significant port-site complications. Careful surgical technique, strict aseptic precautions, and optimization of modifiable

risk factors such as obesity, diabetes mellitus, and smoking are essential to further reduce postoperative morbidity and improve patient outcomes.

CONCLUSION

The present study demonstrates that laparoscopic surgery is a safe and effective surgical approach with a low incidence of port-site complications. Most complications were minor, occurred during the early postoperative period, and responded well to simple conservative treatment without the need for further surgery. Among the various factors evaluated, higher body mass index, diabetes mellitus, and smoking emerged as significant risk factors, while age, gender, type of laparoscopic procedure, port-entry technique, port size, and use of the umbilical port did not significantly influence the occurrence of complications. These findings highlight the importance of identifying and optimizing modifiable patient-related risk factors before surgery, together with meticulous surgical technique and careful postoperative wound care. Such measures can further reduce port-site morbidity, enhance patient recovery, and maximize the benefits of minimally invasive surgery.

REFERENCES

1. Patil Jr, M., Gharde, P., Reddy, K., Nayak, K., & Patil, M. B. (2024). Comparative analysis of laparoscopic versus open procedures in specific general surgical interventions. *Cureus*, 16(2):e54433.
2. Buia, A., Stockhausen, F., & Hanisch, E. (2015). Laparoscopic surgery: a qualified systematic review. *World journal of methodology*, 5(4), 238-54.
3. Poprom, N., Wilasrusmee, C., Attia, J., McEvoy, M., Thakkestian, A., & Rattanasiri, S. (2020). Comparison of postoperative complications between open and laparoscopic appendectomy: an umbrella review of systematic reviews and meta-analyses. *Journal of Trauma and Acute Care Surgery*, 89(4), 813-820.
4. Himal, H. S. (2002). Minimally invasive (laparoscopic) surgery. *Surgical Endoscopy And Other Interventional Techniques*, 16(12), 1647-1652.
5. Sasmal, P. K., Mishra, T. S., Rath, S., Meher, S., & Mohapatra, D. (2015). Port site infection in laparoscopic surgery: A review of its management. *World Journal of Clinical Cases: WJCC*, 3(10), 864.
6. Hubballi, K., Togale, M. D., & Hubballi, B. G. (2023). Are we neglecting port-site complications in laparoscopic surgeries: a single centre study. *Med Sci*, 27(132), 1-10.
7. Ravindranath, G. G., & Reddy, S. R. (2016). Laparoscopic port site complications: a study in a tertiary care centre. *Int Surg J*, 3(3), 1121-4.
8. Sarheed AA, Hassan AK. (2021). Assessment of port site complications in laparoscopic surgery. *Ann RSCB*. 25(4):12236-49.
9. Gupte, N., Rathod, J., & Yagnik, V. (2017). A study of a prevalence of port site infections in laparoscopic surgery in a tertiary Care Centre in the Rural set up. *British Journal of Medicine and Medical Research*, 20(10), 1-9.
10. Wright, H. L., Thomson, R. M., Reid, A. B., Carter, R., Bartley, P. B., Newton, P., & Coulter, C. (2014). Rapidly growing mycobacteria associated with laparoscopic gastric banding, Australia, 2005–2011. *Emerging Infectious Diseases*, 20(10), 1612-9.
11. Albaqami, A. M., Hawra'a, A., Alhagbani, M. A., Fallatah, R. A., Aljarboa, A. M., Alghassab, M. A., ... & Al-Hawaj, F. (2021). Retracted: Laparoscopic Port Site Hernia: A Rare Etiology of Intestinal Obstruction. *Cureus*, 13(11):e19681.
12. Nayak J, Rajsamant NK, Panda S, Patra G. (2023). A clinical study on port site complications in laparoscopic surgery. *Int J Pharm Clin Res.*, 15(12):117–21.
13. la Chapelle, C. F., Swank, H. A., Wessels, M. E., Mol, B. W. J., Rubinstein, S. M., & Jansen, F. W. (2015). Trocar types in laparoscopy. *Cochrane Database of Systematic Reviews*, (12):CD009814.
14. Jeon, Y., Song, S., Han, K. W., Lee, D. H., & Baek, J. H. (2020). Evaluation of a novel trocar-site closure device in laparoscopic surgery. *JSLS: Journal of the Society of Laparoscopic & Robotic Surgeons*, 24(3), e2020-00033.
15. Trostle, S. S., Hendrickson, D. A., & Franke, C. (2002). The Effects of Ethylene Oxide and Gas-Plasma Sterilization on Failure Strength and Failure Mode of Pre-Tied Monofilament Ligature Loops. *Veterinary Surgery*, 31(3), 281-284.
16. Madhok, B., Nanayakkara, K., & Mahawar, K. (2022). Safety considerations in laparoscopic surgery: a narrative review. *World journal of gastrointestinal endoscopy*, 14(1), 1-16.
17. Surani, S. (2025). Timeliness and Appropriateness of Surgical Antibiotic Prophylaxis: A Systematic Review. *Journal of Health, Wellness and Community Research*, e595-e595.
18. Majhi H, Nayak TK, Raghib SS, et al. (2021). Assessment of port site complications in laparoscopic surgery – a prospective descriptive study from western Odisha. *J Evid Based Med Healthc*, 8(24):2106-2111.
19. Chandra Mohan P, Sindhuja B, Jagadeesh K. (2023). A clinical study on port site complications in laparoscopic surgery. *J Cardiovasc Dis Res*. 14(12):1–6.
20. Mathew DT. (2024). Port site complications in minimally invasive surgery: insights and outcomes from a teaching hospital. *JPTCP*. 31(8):2027-31.
21. Vaidyula SS, Prathyusha C, Sindhura S. (2025). A prospective study of port site complications in laparoscopic abdominal surgeries at Osmania General Hospital, Hyderabad. *Int J Curr Pharm Rev Res.*, 17(3):108–17.
22. Shanker A, Deep A, Mandal M, Kumar S. (2025). A critical study to evaluate the risk factors for port site complications in laparoscopic surgery. *SEEJPH*. XXVI (S2):2760-2772.

23. Arora, K., Khan, B., Badgoti, R., Sharma, R. R., Zaidi, M. A. A., Arora, R., & Chaudhary, S. (2025). Study of Prevalence of Port Size Complications in Laparoscopic Surgery. *Journal of Contemporary Clinical Practice*, 11, 503-508.
24. Chandra J N, Manivasagam SS, Choudhary S, Manocha P, Reddy BH. (2024). Insights Into Laparoscopic Port Site Complications: A Comprehensive Review. *Cureus.*, 16(6): e63431.
25. Mudgal, M. M., Kothiya, P. K., Kushwah, N., & Singh, R. (2018). Port site complications following laparoscopic surgeries: a prospective study. *Int Surg J*, 5(2), 598-601.
26. Khoshnoudi, H., Samsami, M., Ahmadi Ziviyari, M., Haghbin Toutounchi, A., Tahmasbi, H., Jouzdani, T., ... & Nematihonar, B. (2024). Port-Related Complications in Laparoscopic Surgeries: A Prospective Observational Study of the Iranian Population. *Iranian Journal of Colorectal Research*, 12(4), 123-127.
27. Karthik, S., Augustine, A. J., Shibumon, M. M., & Pai, M. V. (2013). Analysis of laparoscopic port site complications: A descriptive study. *Journal of minimal access surgery*, 9(2), 59-64.