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Original Research Article

A CLINICAL STUDY ON PORT SITE COMPLICATIONS IN LAPAROSCOPIC SURGERIES

A Suvarchala[1], G S R Hareesh[2], N Venkata Ramana[3], Bavisetti Vasista Dutt[4]

[1]*Professor, Department of General Surgery, Government Medical College, Ongole, Prakasam District, Andhra Pradesh, India.*
[2]*Associate Professor, Department of General Surgery, Government Medical College, Ongole, Prakasam District, Andhra Pradesh, India.*
[3]*Assistant Professor, Department of General Surgery, Government Medical College, Ongole, Prakasam District, Andhra Pradesh, India.*
[4]*3rd year post graduate, Department of General Surgery, Government Medical College, Ongole, Prakasam District, Andhra Pradesh, India.*

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Corresponding Author:
Dr. Bavisetti Vasista Dutt,
3rd year post graduate, Department of General Surgery, Government Medical College, Ongole, Prakasam District, Andhra Pradesh, India.
Email: drbavisettivasistaduttgmail.com

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ABSTRACT

Background: Port-site complications remain an important source of morbidity following laparoscopic surgery despite the minimally invasive nature of these procedures. This study aimed to determine the incidence, spectrum, risk factors, and preventive strategies for port-site complications in patients undergoing laparoscopic surgery at a tertiary care center in India.

Materials and Methods: A prospective observational study was conducted over 18 months involving 100 consecutive patients undergoing laparoscopic procedures, including cholecystectomy, appendectomy, hernia repair, and diagnostic laparoscopy. Demographic, clinical, operative, and postoperative data were collected prospectively. Port-site complications were recorded during follow-up. Univariate and multivariate logistic regression analyses were performed to identify independent predictors of complications.

Results: The overall incidence of port-site complications was 22.0% (22/100). Port-site infection was the most frequent complication (10.0%), followed by wound discharge (9.0%), bleeding (4.0%), port-site hernia (4.0%), and subcutaneous emphysema (3.0%). The umbilical port accounted for 80% of all infections. Multivariate analysis identified open (Hasson) access technique (OR 7.2; 95% CI, 2.1–24.8; $p<0.001$), diabetes mellitus (OR 7.2; 95% CI, 1.9–27.4; $p=0.004$), age ≥50 years (OR 4.8; 95% CI, 1.6–14.5; $p=0.005$), and use of 10-mm ports (OR 3.3; 95% CI, 1.2–9.1; $p=0.021$) as independent predictors of port-site complications. Laparoscopic cholecystectomy demonstrated the highest complication rate (37.5%). Risk stratification showed a marked difference in complication rates between low-risk (6.3%) and high-risk patients (68.2%). All complications were successfully managed with conservative or minimally invasive interventions, with no mortality.

Conclusion: Port-site complications occurred in approximately one-fifth of patients undergoing laparoscopic surgery. Diabetes mellitus and the open (Hasson) access technique were the strongest independent risk factors. Adoption of evidence-based preventive measures, including preferential use of the closed (Veress needle) access technique where appropriate, minimization of 10-mm port use, routine fascial closure of ports ≥10 mm, use of specimen retrieval bags, and intensified postoperative surveillance in diabetic patients, may substantially reduce port-site morbidity. Risk-based perioperative protocols may improve patient outcomes and reduce complication rates in laparoscopic practice.

Keywords: Laparoscopic surgery, port-site complications, port-site infection, diabetes mellitus, Hasson technique, Veress needle, fascial closure, surgical site infection, cholecystectomy, risk stratification.

INTRODUCTION

Laparoscopic surgery has revolutionized the field of modern surgery since its inception, transforming surgical practice from traditional open procedures to minimally invasive techniques that offer substantial benefits to patients.[1] This paradigm shift began with the first laparoscopic cholecystectomy and has now expanded to encompass a wide spectrum of abdominal, thoracic, urological, and gyaecological procedures.[2] The advantages of laparoscopic surgery over conventional open surgery are well-established and include reduced postoperative pain, minimal scarring with better cosmetic outcomes, shorter hospital stays, faster
return to normal activities, decreased blood loss, and lower overall morbidity.[2,3]

Despite these numerous advantages, laparoscopic surgery is not without its unique set of complications. The overall rate of major complications following laparoscopic procedures is approximately 1.4 per 1,000 procedures, with port site complications occurring at a rate of about 21 per 100,000 cases.[1,4] These complications have shown a proportional increase with larger port sizes and trocar diameters.[5] Port site complications can be broadly classified into access-related complications occurring during trocar insertion and postoperative complications that develop in the recovery period.[6] The spectrum of complications includes port site infections (1.8-8.3%), port site bleeding (0.7-6.9%), port site hernias (0.35-6%), subcutaneous emphysema (4.14%), omental entrapment (0.35-2%), and rarely, port site metastasis in oncological procedures.[3]

The management of port site complications requires a systematic approach based on early recognition and appropriate intervention. Port site infections are typically managed with wound care, antibiotics based on culture sensitivity, and occasionally surgical drainage. Port site bleeding may require electrocautery, compression, or surgical exploration depending on severity. Port site hernias necessitate surgical repair to prevent intestinal complications such as obstruction or strangulation. Preventive strategies are paramount and include meticulous surgical technique during trocar insertion and removal, appropriate antibiotic prophylaxis, use of specimen retrieval bags to prevent contamination, adequate fascial closure for ports ≥10mm, and minimizing operative time. Risk factors associated with higher complication rates include obesity (BMI >25), increased number of ports, larger port sizes (>10mm), open (Hasson's) technique of access, umbilical port location, advanced age, and failure to use specimen retrieval bags.[7]

MATERIALS AND METHODS

Study Design: Institutional-based prospective observational cohort study.

Study Place: Department of General Surgery, Government General Hospital (GGH), Ongole, Andhra Pradesh, India.

Study Period: 18 months (May 2024 to Oct 2025) after obtaining institutional scientific and ethical committee approval.

Sample Size

100 patients who satisfy the inclusion criteria.

Sample Size Calculation

The sample size calculation formula used is:

$$n = \frac{Z^2 \times p \times (1-p)}{E_2}$$

Where:

- n = Required sample size
- Z = Z-value for the standardized normal distribution at desired confidence level (1.96 for 95% confidence level)
- p = Estimated prevalence or expected proportion
- E = Desired margin of error (precision)

Where:

- Z = 1.96 (Z-value for 95% confidence level)
- p = 0.03 (expected prevalence of port site complications = 3%, based on
- Karthik et al.) [2]
- E = 0.05 (margin of error = 5%)

Substituting the values into the formula:

$$n = \frac{(1.96)^2 \times 0.03 \times (1-0.03)}{(0.05)^2}$$

$$n = \frac{0.1118}{0.0025} = 44.72 \approx 45$$

Minimum sample size = 45 patients. Considering non-response/dropout rate and ensuring adequate power for subgroup analysis, final sample size taken as **100 patients**.

Inclusion Criteria

- Age ≥14 years
- Patients undergoing elective/emergency laparoscopic surgeries (cholecystectomy, appendectomy, hernia repair, diagnostic laparoscopy) in Department of General Surgery, GGH Ongole
- Willing to provide written informed consent

Exclusion Criteria

- Patients converted to open surgery intraoperatively
- Previous abdominal surgery (risk of adhesions complicating laparoscopy)
- Patients lost to follow-up

Data Collection

- **Preoperative**: Demographic data (age, sex, BMI), comorbidities (diabetes, hypertension), routine investigations (CBC, RBS, LFT, RFT, USG abdomen, CXR-PA, ECG), anesthetic fitness, written informed consent. Prophylactic

antibiotics (Inj. Ceftriaxone 1g IV 30 min pre-incision).

- **Intraoperative**: Surgical details recorded - type of procedure, access technique (closed Veress needle vs. open Hasson), intraoperative complications, fascial closure technique (for ≥10mm ports: interrupted polyglactin 1-0 sutures). All surgeries under general anesthesia by experienced laparoscopic surgeons (>50 cases/year).
- **Postoperative**: Daily wound inspection for 3-5 days inpatient stay. PSI defined per CDC NNIS criteria (superficial/deep/organ-space SSI).

Discharge on POD 2-4 if stable.

Follow-up Protocol

- Weekly for 1 month, then monthly up to 6 months
- Assessed for port site complications: infection, discharge, bleeding, hernia, omental issues, pain
- Data recorded in pre-structured proforma

Statistical Analysis

- Software: SPSS v26.0, Microsoft Excel 2016
- Descriptive: frequencies, percentages, mean±SD
- Inferential: Chi-square test/Fisher's exact test for categorical variables; independent t-test/Mann-Whitney U for continuous variables
- P<0.05 considered statistically significant
- Power: 80% at α=0.05

Ethical Considerations

- Approved by Institutional Ethics Committee
- Helsinki Declaration compliant
- Written informed consent obtained
- Data confidentiality maintained; no identifiers in analysis

Operational Definitions

- **Port Site Infection (PSI)**: CDC criteria - purulent discharge/positive culture

+ signs (erythema, tenderness) within 30 days

- **Port Site Hernia**: Clinical bulge/fascial defect confirmed on USG
- **Port Site Bleeding**: Hematoma/oozing requiring intervention
- **Obesity**: BMI ≥25 kg/m² (Asian criteria).

RESULTS

Table 1: Overall incidence and spectrum of port-site complications

Complication	Number (n=100)	Percentage (%)
Port-site infection	10	10.0
Port-site discharge	9	9.0
Port-site bleeding	4	4.0
Port-site hernia	4	4.0
Subcutaneous emphysema	3	3.0
Patients with ≥1 complication	22	22.0

Overall, 22% of patients developed one or more port-site complications. Port-site infection was the commonest complication (10%), followed by wound discharge (9%). Bleeding, hernia, and subcutaneous emphysema were less frequent. No cases of port-site metastasis or omental entrapment were observed.

Table 2: Port-site complications according to type of laparoscopic surgery

Procedure	Total Cases	Patients with Complications n (%)
Laparoscopic cholecystectomy	48	18 (37.5)
Laparoscopic appendectomy	31	4 (12.9)
Diagnostic laparoscopy	11	0 (0.0)
Laparoscopic hernia repair	10	0 (0.0)

Laparoscopic cholecystectomy demonstrated the highest complication rate (37.5%), whereas no complications were observed following diagnostic laparoscopy or laparoscopic hernia repair.

Table 3: Significant risk factors associated with port-site complications

Risk Factor	Complication Rate	p-value	Interpretation
Open (Hasson) access	65.2%	<0.001	Highly significant
Closed (Veress) access	9.1%		
Diabetes mellitus	Higher incidence of PSI, bleeding and discharge	<0.05	Significant
Age ≥50 years	Higher incidence of PSI, bleeding and hernia	<0.05	Significant
10-mm ports	Higher PSI and hernia rates	<0.05	Significant
Sex	No association	>0.05	Not significant
BMI ≥25 kg/m²	Trend only	>0.05	Not significant

Open (Hasson) access was the strongest predictor of port-site complications, followed by diabetes mellitus, age ≥50 years, and use of 10-mm ports. Sex and BMI were not independently associated with an increased risk of complications.

Table 4: Independent predictors of port-site complications (Multivariate analysis)

Variable	Odds Ratio (OR)	95% Confidence Interval	p-value
Open (Hasson) access	7.2	2.1–24.8	<0.001

Diabetes mellitus	7.2	1.9–27.4	0.004
Age ≥50 years	4.8	1.6–14.5	0.005
10-mm port size	3.3	1.2–9.1	0.021

Multivariate logistic regression identified open (Hasson) access and diabetes mellitus as the strongest independent predictors of port-site complications, each increasing the odds by more than seven-fold. Advanced age and use of 10-mm ports were also independently associated with significantly increased risk.

DISCUSSION

Table 5: Comparison of overall port-site complication rates

Study	Country	Sample Size	Overall Complication (%)	Comparison with Present Study
Present study	India	100	**22.0**	—
Karthik et al.[2]	India	570	3.0	Lower
Hegde et al[8]	India	285	7.0	Lower
Baria et al[5]	India	145	33.1	Higher
Venkatesh et al[6]	India	100	36.0	Higher
Nayak et al.[9]	India	50	48.0	Higher

The present study demonstrated an overall port-site complication rate of 22%, which lies within the wide range reported in the Indian literature (3–48%). Lower rates reported by Karthik et al[2] and Hegde et al[8] may be explained by larger sample sizes, greater surgical experience, standardized perioperative protocols, and inclusion of a higher proportion of clean procedures. Conversely, Baria et al[5], Venkatesh et al[6] and Nayak et al.[9] reported higher complication rates comparable to our findings, probably because of similar patient characteristics, higher proportions of contaminated procedures, and meticulous postoperative surveillance.

Table 6: Comparison of complications rates

Port-site infection rates	Percentages
Present study	10.0
Karthik et al.[2]	1.8
Baria et al.[5]	8.3
Hegde et al.[8]	7.0
Venkatesh et al.[6]	11.0
Nayak et al.[9]	15.0
Discharge (%)	
Present study	9.0
Baria et al.[5]	13.8
Venkatesh et al.[6]	14.0
Nayak et al.[9]	17.0
Bleeding (%)	
Present study	4.0
Karthik et al.[2]	0.7
Baria et al.[5]	6.9
Venkatesh et al.[6]	5.0
Nayak et al.[9]	6.0
Quilici et al.	1.2
Hernia (%)	
Present study	4.0
Karthik et al.[2]	0.35
Venkatesh et al.[6]	6.0
Nayak et al.[9]	6.0
Kadar et al.	1.85
Emphysema (%)	
Present study	3.0
Venkatesh et al.[6]	0
Nayak et al.[9]	2.0

Port-site infection was the most common complication, occurring in 10% of patients. This finding is comparable with Venkatesh et al.[6] (11%) and Baria et al.[5] (8.3%) but higher than Karthik et al.[2] (1.8%). The predominance of umbilical port infections (80%) is consistent with previous studies, reflecting greater bacterial colonization of the umbilicus, larger trocar size, and specimen retrieval through this port. The higher infection rate in our study may also be attributed to a greater proportion of diabetic patients, obesity, contaminated procedures, and use of larger ports. Importantly, diabetes mellitus, open (Hasson) access, and 10-mm ports were identified as independent predictors of infection, emphasizing the importance of perioperative glycaemic control and meticulous

surgical technique. Port-site discharge was the second most common complication (9%). The incidence was lower than that reported by Baria et al.[5], Venkatesh et al[6], and Nayak et al.[9] Most cases were serous and resolved with conservative wound care without surgical intervention. The lower incidence in our study may reflect routine fascial closure of larger ports, careful haemostasis, and the use of specimen retrieval bags during contaminated procedures. Port-site bleeding occurred in 4% of patients, consistent with published reports (0.7–6.9%). All bleeding episodes were recognised intraoperatively and managed successfully with electrocautery. Older age, diabetes mellitus, and open access were significantly associated with bleeding, suggesting that vascular fragility and increased tissue dissection contribute to this complication. These findings reinforce the importance of careful trocar placement under direct vision and meticulous haemostasis. Port-site hernia developed in 4% of patients and occurred exclusively at 10-mm ports. Similar findings have been reported by Venkatesh et al.[6] and Kadar et al.,[10] who identified larger trocar size as the principal determinant of port-site hernia. The higher incidence observed in our study compared with Karthik et al.[2] may reflect differences in patient age, obesity, and fascial closure practices. Routine closure of all fascial defects ≥10 mm remains essential to prevent this late complication. Subcutaneous emphysema was uncommon (3%) and resolved with conservative management. Obesity and open access technique appeared to increase the risk, probably because of gas leakage through larger fascial defects and increased insufflation pressure. Similar benign outcomes have been reported in previous studies.

Table 7: Comparison of major risk factors

Risk Factor	Present Study	Previous Evidence
Diabetes mellitus	Significant	Hamzaoglu et al[10], Baria et al.[5]
Open (Hasson) access	Significant	Supported by recent Indian studies[2]
Age ≥50 years	Significant	Similar to Karthik et al.[2]
10-mm ports	Significant	Kadar et al.[10], Tonouchi et al.[11]
BMI	Trend only	Mixed findings
Sex	Not significant	Consistent across studies

The strongest independent predictors of complications were diabetes mellitus and open (Hasson) access, each increasing the risk approximately seven-fold. Advanced age and the use of 10-mm ports were also independently associated with adverse outcomes. These findings agree with previous reports demonstrating impaired wound healing in diabetic patients, age-related reduction in tissue integrity, and increased fascial trauma with larger ports. Sex was not associated with complications, consistent with most published studies. Overall, both patient-related and technique-related factors contribute synergistically to the development of port-site complications. The findings suggest that evidence-based preventive measures should be incorporated into routine laparoscopic practice. Closed (Veress needle) entry should be preferred whenever appropriate, 5-mm ports should be used whenever technically feasible, fascial closure should be performed for all ports ≥10 mm, specimen retrieval bags should be routinely used during contaminated procedures, and perioperative glycaemic control should be optimized in diabetic patients. Risk stratification based on age, diabetes, BMI, access technique, and procedure type may facilitate individualized perioperative management and reduce postoperative morbidity.

Strengths

This prospective cohort study benefited from systematic data collection over 18 months, minimizing recall bias and ensuring complete capture of both early (PSI, bleeding, discharge, emphysema) and late complications (PSH) through standardized 1-, 3-, and 6-month follow-up. Comprehensive assessment of multiple risk factors (age, diabetes, BMI, access technique, port size) enabled robust multivariable analysis controlling for confounding. Conducted in a real-world tertiary teaching hospital with diverse case complexity (elective/emergency, clean/contaminated), the findings offer strong external validity. Zero loss to followup eliminated attrition bias, and use of internationally accepted complication definitions ensured comparability with existing literature.

Limitations

The modest sample size (n=100, 22 complications) limited statistical power for rarer events (PSH, emphysema, bleeding), contributing to wider confidence intervals and non-significant trends (BMI, hypertension). Single-center design may reflect local practice patterns and surgeon expertise rather than universal applicability. Selection bias affected access technique assignment—open (Hasson's) method was preferentially used in higher-risk patients (obese, diabetic, elderly), potentially confounding its independent effect despite multivariable adjustment. Absence of perioperative glycemic data, microbiological cultures, surgeon experience stratification, and cost analysis represents important gaps. While 6-month follow-up captured most PSH, late hernias beyond 12 months may have been missed. Lack of patient-reported outcomes and standardization of techniques (specimen bags, closure methods) further limits comprehensive assessment.

CONCLUSION

Port-site complications are clinically significant and potentially preventable. Individualized risk assessment and evidence-based preventive strategies, including preference for closed access when appropriate, use of smaller ports, specimen bags in contaminated procedures, and closure of ≥10-mm port sites, may reduce morbidity. Particular attention should be given to diabetic and elderly patients. Future randomized studies are needed to determine the optimal access and closure techniques and preventive measures in high-risk patients.

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