Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 1s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

A comparative study between open versus closed method of creation of pneumoperitoneum in laparoscopic surgeries

Dr. Deepak Kumar Singh[1], Dr. Hridyanath Desai[2], Dr. Rushit Patel[3], *Dr. Narayan Kamath[4], Dr. Nadeem Amin[5], Dr. Kiran Patel[6]

[1] Junior Resident (3rd year), Department of General Surgery, NAMO Medical Education and Research Institute & SVBCH, Silvassa – 396230, India

[2] Associate Professor, NAMO Medical Education and Research Institute, Silvassa – 396230, India

[3] Intern, NAMO Medical Education and Research Institute, Silvassa – 396230, India

[4] Professor and Head, Department of Microbiology, NAMO Medical Education and Research Institute, Silvassa – 396230, India

[5] Laboratory Physician, Specialist Microbiology, Dhaman Health Assurance Hospital Ahmadi, Kuwait

[6] Professor and Head, Department of General Surgery, NAMO Medical Education and Research Institute, Silvassa – 396230, India

***Corresponding Author:**

Dr. Narayan Kamath, Professor and Head,

Department of Microbiology, NAMO Medical Education and Research Institute, Silvassa – 396230, India

Email ID: nktallur@gmail.com

Cite this paper as: Dr. Deepak Kumar Singh, Dr. Hridyanath Desai, Dr. Rushit Patel, Dr. Narayan Kamath, Dr. Nadeem Amin, Dr. Kiran Patel, (2025) A comparative study between open versus closed method of creation of pneumoperitoneum in laparoscopic surgeries. *Journal of Neonatal Surgery*, 14 (1s), 1155-1164.

ABSTRACT

Background: Gaining access to the peritoneal cavity is a critical step in laparoscopic surgeries and is associated with the risk of complications. The two most commonly used techniques for pneumoperitoneum creation are the open (Hasson cannula) and closed (Veress needle) methods. This study aims to compare these techniques in terms of procedural efficiency, intraoperative and postoperative complications, and long-term outcomes.

Methods: This randomized controlled trial included 50 patients undergoing elective laparoscopic surgeries at a tertiary care hospital. Patients were randomized into two groups: 25 underwent the open technique, and 25 underwent the closed technique. Key parameters, including time for pneumoperitoneum creation, number of attempts, intraoperative complications, postoperative outcomes, and follow-up findings over three months, were recorded and analyzed using appropriate statistical methods.

Results: The open technique demonstrated a significantly shorter duration for pneumoperitoneum creation (101.54 seconds vs. 122.58 seconds; $p<0.01$) and surgical access (6.68 minutes vs. 7.96 minutes; $p<0.01$). The mean total procedure time was also lower in the open group (118.24 minutes vs. 142.48 minutes; $p<0.01$). Gas leaks were more frequent in the open group (32% vs. 8%; $p=0.024$), while port-site hemorrhage occurred in 8% of open group cases but was absent in the closed group ($p=0.49$). No significant differences were observed in postoperative complications such as port-site infections (8% vs. 0%; $p=0.49$) or bleeding (16% vs. 4%; $p=0.34$). Long-term complications, including wound infections and port-site hernias, were absent in both groups during the three-month follow-up.

Conclusions: Both the open and closed techniques are safe and effective for pneumoperitoneum creation. The open technique offers significant time-saving advantages but is associated with a higher incidence of minor complications, such as gas leaks and port-site hemorrhage. The choice of technique should be guided by patient-specific factors, surgeon expertise, and procedural requirements. Further large-scale studies are needed to provide definitive recommendations for clinical practice.

Keywords: *Laparoscopy, Pneumoperitoneum, Open Technique, Closed Technique, Veress Needle, Hasson Cannula, Surgical Complications.*

1. INTRODUCTION

Laparoscopic surgery, a cornerstone of minimally invasive surgical techniques, has revolutionized operative management across a wide range of specialties. By enabling surgeons to visualize and treat intra-abdominal pathologies through small incisions, laparoscopy has reduced postoperative pain, shortened hospital stays, and improved overall patient outcomes [1,2]. A critical first step in nearly all laparoscopic procedures is gaining access to the peritoneal cavity—an endeavor that must balance efficiency against the risk of injury. Although the process appears straightforward, the creation of a pneumoperitoneum can be fraught with complications, including damage to abdominal viscera and major blood vessels [3–8]. Indeed, as many as half of the serious intraoperative complications associated with laparoscopy occur before the intended surgical intervention even begins [3–9]. These entry-related injuries have persisted at a relatively constant rate over the past two decades, highlighting the necessity of refining our access techniques [8]. Two of the most commonly employed methods to establish pneumoperitoneum are the "closed" technique, using a Veress needle followed by a trocar insertion, and the "open" technique described by Hasson, which involves a small, direct umbilical incision for blunt trocar placement [10,11]. Proponents of the open (Hasson) method emphasize its direct visualization and potential for more controlled insertion, thus theoretically reducing the likelihood of inadvertent vascular or bowel injury [11]. Conversely, the closed (Veress needle) approach is lauded for its simplicity and speed, and remains the traditional mainstay of peritoneal entry in many centers worldwide. Both techniques, however, carry the risk of serious complications, and the literature remains divided on which approach offers a superior safety profile [12]. While extensive reviews have attempted to clarify this issue, a definitive consensus is lacking due to limited large-scale, randomized controlled trial data. This study aims to address this persistent uncertainty by directly comparing the outcomes and complications of open versus closed peritoneal access techniques during laparoscopic surgeries. Through a systematic evaluation of operative time, entry-related injuries, and postoperative sequelae, we seek to inform surgical practice and improve patient safety. In doing so, we hope to contribute meaningful evidence that can guide surgeons in selecting the most effective, reliable, and least hazardous method of pneumoperitoneum creation.

2. MATERIALS AND METHODS:

Study Setting and Duration

This study was conducted in the Department of General Surgery at Vinoba Bhave Civil Hospital, Silvassa. The study spanned an 18-month period from September 2022 to February 2024. Ethical clearance was obtained from the Institutional Ethics Committee prior to the initiation of the study.

Study Design

This investigation was designed as a non-blinded, randomized controlled trial comparing two established methods of creating pneumoperitoneum—the open (Hasson cannula) and closed (Veress needle) techniques—in patients undergoing elective laparoscopic surgeries.

Study Population

The study population consisted of adult patients (>18 years of age) of both genders who were scheduled for elective laparoscopic procedures (e.g., laparoscopic cholecystectomy, appendectomy, diagnostic laparoscopy) at our institution. Informed written consent was obtained from all participants prior to enrollment. Patients with significant co-morbidities, those requiring emergency laparoscopic interventions, or those unwilling to provide consent were excluded.

Sample Size Determination

The sample size was calculated based on the prevalence of gas leak associated with each pneumoperitoneum-creation technique, as reported in previous literature [24]. The following formula and parameters were used:

n=(Zα/2+Zβ)2×P×Qd2n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \times P \times Q}{d^2}

Where:

- Zα/2Z_{\alpha/2} = 1.96 (for 5% level of significance)
- ZβZ_{\beta} = 0.84 (to achieve 80% power)
- P1P_1 = Prevalence of gas leak in open group = 19% [24]
- P2P_2 = Prevalence of gas leak in closed group = 8% [24]
- P=P1+P22=19%+8%2=13.5%P = \frac{P_1 + P_2}{2} = \frac{19\% + 8\%}{2} = 13.5\%
- Q=1−P=86.5%Q = 1 - P = 86.5\%
- dd = effect size = 0.20

Plugging these values into the formula yielded a minimum sample size of approximately 23 patients per group. To accommodate potential dropouts and enhance the robustness of the data, we decided on a sample size of 25 patients in each

group, making a total of 50 participants.

Randomization and Allocation

A computer-generated random number sequence was used to ensure unbiased allocation of participants into the two intervention groups. Consecutive eligible patients were assigned to one of the two groups—either the open (Hasson) technique group or the closed (Veress needle) technique group—on the basis of the sequence generated. Opaque, sealed envelopes were used to conceal allocation until the time of surgery.

Intervention Procedures

All surgeries were performed under standard operating room conditions by surgeons experienced in both open and closed pneumoperitoneum techniques. Both groups underwent standard preoperative evaluations and received similar perioperative care.

1. **Open Technique (Hasson Cannula):**
2. In the open group, a small infra- or supra-umbilical incision was made under direct vision. The fascia was grasped and incised, exposing the peritoneum. The peritoneal cavity was entered under direct visualization, and a blunt Hasson cannula was introduced. After confirming intraperitoneal placement, pneumoperitoneum was established by insufflating CO_2 to achieve an intra-abdominal pressure of 12–15 mmHg.
3. **Closed Technique (Veress Needle):**

In the closed group, a Veress needle was introduced at the umbilical area (or an alternative site if needed, depending on patient anatomy and known adhesions). The correct placement was confirmed using the "drop test" or assessing the intraperitoneal pressure. Once correct placement was confirmed, CO_2 was insufflated until the desired intra-abdominal pressure of 12–15 mmHg was achieved. Following adequate pneumoperitoneum, the primary trocar was inserted.

Data Collection

A comprehensive, standardized, pre-designed case record form was employed to systematically collect all relevant intraoperative and postoperative data for the study. Intraoperative data included the time required to establish pneumoperitoneum, the number of attempts needed to achieve successful pneumoperitoneum, instances of extraperitoneal insufflation, port-site bleeding, gas leaks, and any visceral or vascular injuries identified during the surgical procedure. Postoperative data encompassed the incidence of port-site wound infections, which were clinically assessed, and the formation of port-site hernias. Additional postoperative complications were also recorded.

Follow-up assessments were conducted over a three-month period post-surgery. Patients were evaluated during outpatient visits scheduled at one week, one month, and three months postoperatively. During these visits, clinical examinations and port-site evaluations were carried out to monitor for any delayed complications, including infection, hernia, or other adverse events. All collected data were documented meticulously to ensure completeness and accuracy, providing a reliable basis for subsequent analysis.

Follow-Up

All patients were followed up in the outpatient department for a minimum of 3 months postoperatively. Follow-up visits were scheduled at 1 week, 1 month, and 3 months, during which port-site examinations and clinical evaluations were performed to detect any delayed complications, including wound infections or hernias.

Statistical Analysis

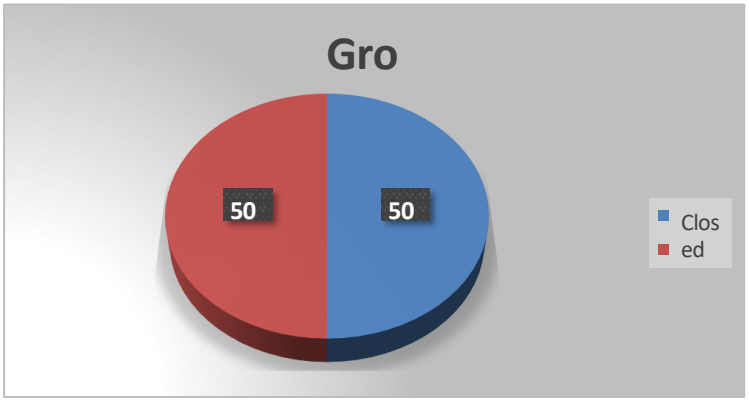
Data were analyzed using SPSS software (Version 26.0, IBM Corp., Armonk, NY). Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were represented as frequencies and percentages. The Chi-Square test was used to evaluate associations between categorical variables. For continuous variables, the unpaired t-test was applied if the data passed the normality test; otherwise, the Mann-Whitney U test was employed. A p-value < 0.05 was considered statistically significant.

Microsoft Excel 2021 was utilized for data entry and generation of graphs where applicable. All analyses were interpreted in conjunction with the clinical context, and results were used to determine whether one pneumoperitoneum-creation technique offered measurable benefits over the other in terms of patient safety, procedure efficiency, and overall outcomes.

3. RESULTS

This study compared the outcomes and complications associated with open (Hasson cannula) and closed (Veress needle) techniques for creating pneumoperitoneum during laparoscopic surgeries. A total of 50 participants were enrolled, with 25 randomized to each group. The results are summarized in tables and graphs, providing a detailed comparative analysis of various intraoperative and postoperative parameters.

Group	N	%
Closed	25	50.0%
Open	25	50.0%
Total	50	100.0%



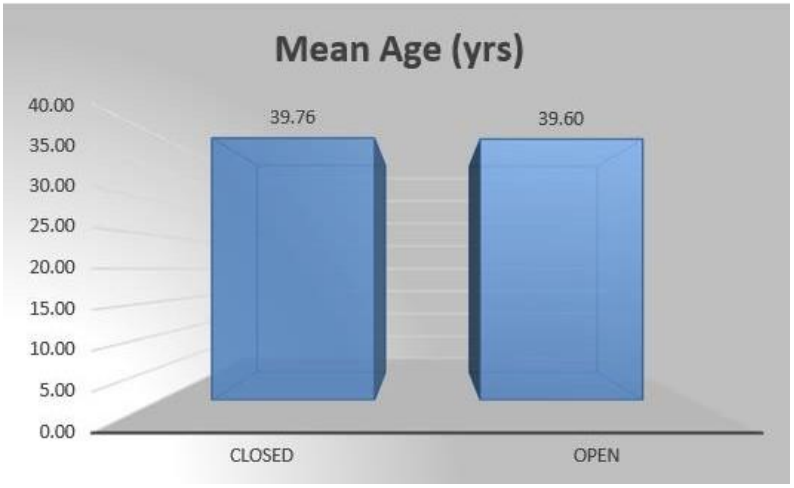
GRAPH 1: Distribution of study groups

Participant Demographics

The mean age of participants in the open group was 39.6 years, while that of the closed group was 39.76 years. There was no significant difference in the age distribution between the groups, with a p-value of 0.96, indicating comparability (Table 2; Graph 2).

Table 2. Mean age comparison among study groups

Variables	Group	N	Mean	SD	p- value
Age (yrs)	**Closed**	25	39.76	10.41	**0.96**
	Open	25	39.60	10.10	

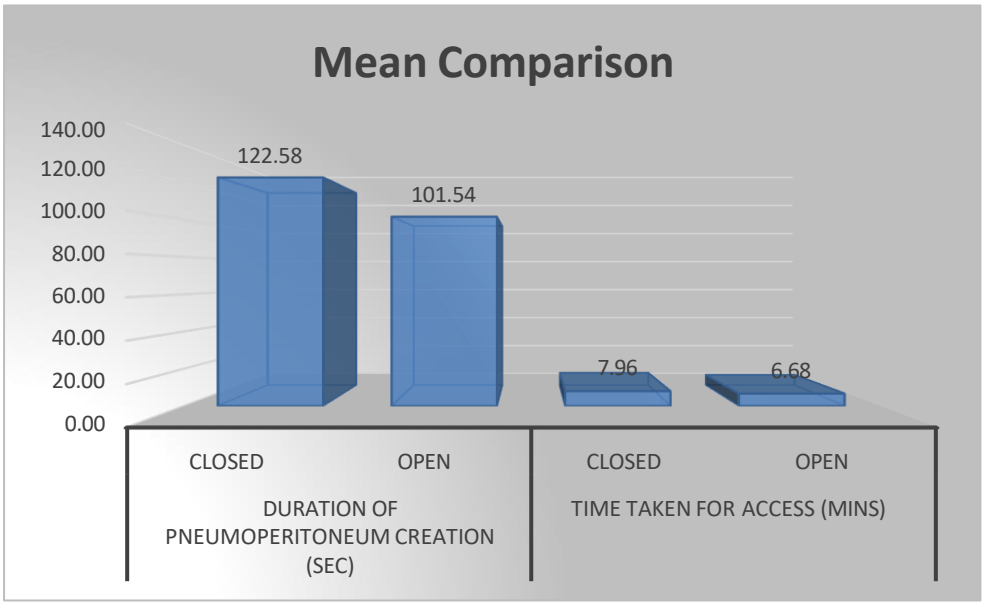


GRAPH 2: Mean age comparison among study groups Duration of Pneumoperitoneum Creation and Access Time

The mean duration required to establish pneumoperitoneum was significantly shorter in the open group (101.54 seconds) compared to the closed group (122.58 seconds), with a p-value of <0.01. Similarly, the time required for surgical access was shorter in the open group (6.68 minutes) than in the closed group (7.96 minutes), again showing a statistically significant difference (p<0.01). These results highlight the efficiency of the open technique in establishing pneumoperitoneum and providing surgical access (Table 3; Graph 3).

Table 3. Mean comparison of duration of pneumoperitoneum creation & time for access

Variables	Group	N	Mean	SD	p- value
Duration of Pneumoperitoneum Creation (sec)	**Closed**	25	122.58	23.72	**<0.01**
	Open	25	101.54	16.83	
Time taken for Access (mins)	**Closed**	25	7.96	1.54	**<0.01**
	Open	25	6.68	1.11	



GRAPH 3: Mean comparison of duration of pneumoperitoneum creation & time for access

Number of Attempts

Intraoperative observations revealed that a single attempt to gain access was successful in 88% of cases in the closed group compared to 72% in the open group. Although the success rate of single attempts was higher in the closed group, the difference was not statistically significant (p=0.28) (Table 4; Graph 4).

Table 4. Comparison of study groups as per number of attempts

Attempts	Group		Total
	Closed	Open	
Multiple	3	7	10
	12.0%	28.0%	20.0%
	22	18	40

Single	88.0%	72.0%	80.0%
Total	25	25	50
	100.0%	100.0%	100.0%
p- value - 0.28			

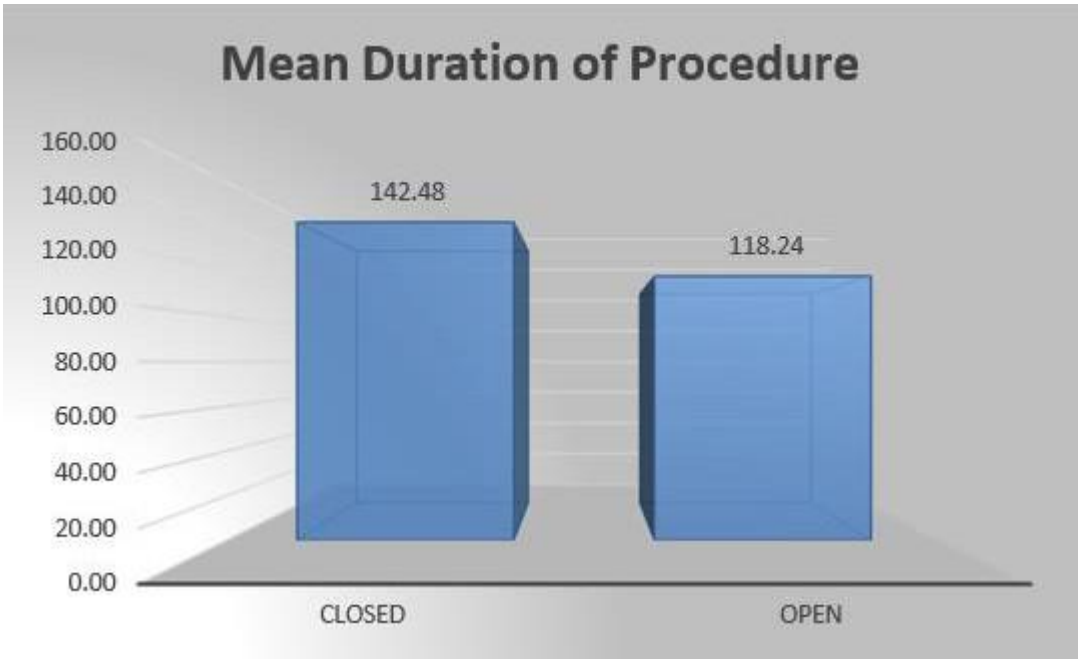
GRAPH 4: Comparison of study groups as per number of attempts

Duration of Procedure

The overall mean duration of laparoscopic procedures was significantly shorter in the open group (118.24 minutes) compared to the closed group (142.48 minutes), with a p-value of <0.01. This underscores the time efficiency of the open technique during surgery (Table 5; Graph 5).

Table 5. Mean comparison of duration of procedure

Variables	Group	N	Mean	SD	p- value
Duration of Procedure (mins)	**Closed**	25	142.48	27.58	**<0.01**
	Open	25	118.24	19.60	



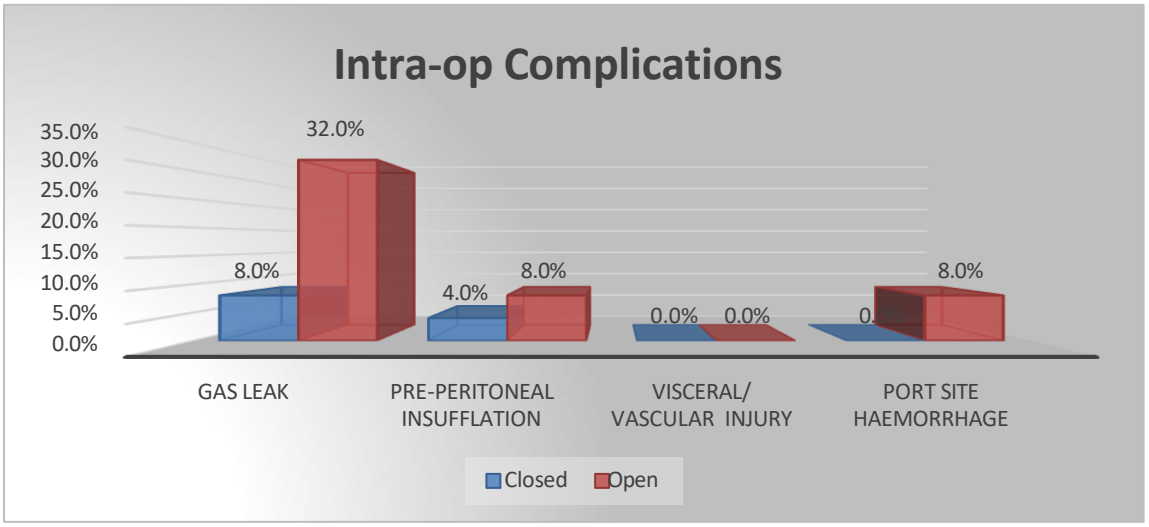
GRAPH 5: Mean comparison of duration of procedure

Intraoperative Complications

The incidence of gas leaks was significantly higher in the open group (32%) compared to the closed group (8%), with a p-value of 0.024. Pre-peritoneal insufflation was observed in 8% of open group cases and 4% of closed group cases, but this difference was not statistically significant (p=1.00). No cases of visceral or vascular injuries were reported in either group. Port-site hemorrhage was observed in 8% of open group cases but was absent in the closed group, although this difference was not statistically significant (p=0.49) (Table 6; Graph 6).

Table 6. Comparison of study groups as per intra-op complications

Intra-op Complications	**Group**		**Total**	**p-value**
	Closed	**Open**		
Gas Leak	2	8	10	**0.024**
	8.0%	32.0%	20.0%	
Pre-peritoneal Insufflation	1	2	3	**1.00**
	4.0%	8.0%	6.0%	
Visceral/ Vascular Injury	0	0	0	**NA**
	0.0%	0.0%	0.0%	
Port Site haemorrhage	0	2	0	**0.49**



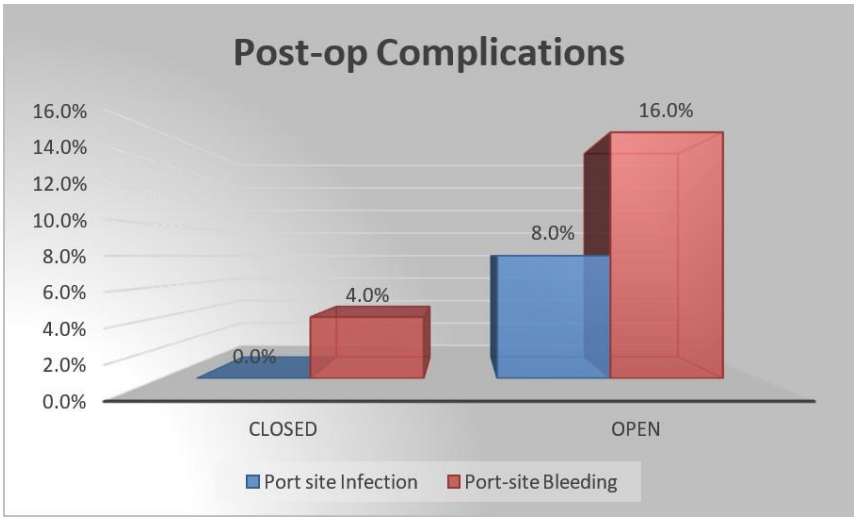
GRAPH 6: Comparison of study groups as per intra-op complications

Postoperative Complications

Immediate postoperative complications were minimal in both groups. Port-site infections were observed in 8% of open group cases and were absent in the closed group, while port-site bleeding occurred in 16% of open group cases and 4% of closed group cases. However, these differences were not statistically significant (p>0.05) (Table 7; Graph 7).

Table 7. Comparison of study groups as per Immediate post-op complications

Post-op Complications	Group		Total	p-value
	Closed	Open		
Port site Infection	0	2	50	0.49
	0.0%	8.0%	100.0%	
Port-site Bleeding	1	4	5	0.34
	4.0%	16.0%	10.0%	



GRAPH 7: Comparison of study groups as per Immediate post-op complications

Long-Term Complications

No long-term complications, such as wound infections or port-site hernias, were observed in either group during the three-month follow-up period. This indicates that both techniques are equally safe in terms of long-term outcomes (Table 8).

Table 8. Comparison of study groups as per long term complications

Long term Complications	Group		Total	p-value
	Closed	Open		
Wound infections	0	0	0	**NA**
	0.0%	0.0%	0.0%	
Port site Hernia	0	0	0	**NA**

The open technique demonstrated advantages in terms of shorter durations for pneumoperitoneum creation, surgical access, and the overall procedure. However, it was associated with a higher incidence of gas leaks and port-site hemorrhage compared to the closed technique. Both techniques had minimal immediate and no long-term complications, suggesting that they are overall safe and effective for laparoscopic surgeries. Further studies with larger sample sizes could provide more robust evidence to guide the choice of technique in specific clinical scenarios.

4. DISCUSSION

Laparoscopy has evolved from a diagnostic modality to a therapeutic mainstay, performing a diverse range of procedures across specialties, including general surgery. This evolution is attributed to its minimally invasive nature, leading to reduced postoperative pain, faster recovery times, and shorter hospital stays. However, the critical challenge in laparoscopy lies in gaining access to the abdominal cavity through small incisions, which carries the risk of complications such as visceral and vascular injuries. To mitigate these risks, various methods and tools have been developed over the past century, including shielded disposable trocars, optical Veress needles, radially expanding trocars, and the open (Hasson) and closed (Veress needle) techniques. Among these, the open and closed techniques are the most widely utilized worldwide and in India, with preferences varying based on surgeon expertise, regional practices, and patient-specific considerations [1,2,10].

The present study aimed to compare the open and closed techniques for creating pneumoperitoneum in laparoscopic surgeries, with a focus on intraoperative and postoperative outcomes. Fifty patients were randomized into two groups of 25, undergoing either the open (Hasson) or closed (Veress needle) technique. The study highlights important differences and similarities between the two approaches, providing insights into their safety and efficacy.

The open technique demonstrated a clear advantage in terms of time efficiency. The mean duration for pneumoperitoneum creation was significantly shorter in the open group (101.54 seconds) compared to the closed group (122.58 seconds; $p<0.01$). Similarly, the time to surgical access was reduced in the open group (6.68 minutes) versus the closed group (7.96 minutes; $p<0.01$). These findings align with the direct visualization and controlled nature of the open approach, which minimizes delays associated with additional maneuvers. The overall procedure duration was also significantly shorter in the open group (118.24 minutes) compared to the closed group (142.48 minutes; $p<0.01$), reinforcing the time efficiency of the open technique [1,11].

Interestingly, a single attempt to gain surgical access was successful in 88% of closed group cases compared to 72% in the open group. Although this difference was not statistically significant ($p=0.28$), it suggests that the closed technique may offer a slightly higher likelihood of success on the first attempt under certain circumstances [11,12].

While both techniques were generally safe, intraoperative complications were more common in the open group. Gas leaks occurred significantly more frequently in the open group (32%) compared to the closed group (8%; $p=0.024$). This may be attributed to the larger incision and blunt cannula used in the open technique. Pre-peritoneal insufflation was observed in 8% of open group cases and 4% of closed group cases, but this difference was not statistically significant ($p=1.0$). Importantly, no cases of visceral or vascular injuries were reported in either group, underscoring the safety of both approaches when performed by experienced surgeons. Port-site hemorrhage was noted in 8% of open group cases but was absent in the closed group ($p=0.49$) [8,9].

Postoperative complications, such as port-site infections and bleeding, were minimal and comparable between the groups. Port-site infections occurred in 8% of open group cases but were absent in the closed group, while port-site bleeding was

observed in 16% of open group cases compared to 4% in the closed group. However, these differences were not statistically significant ($p>0.05$). Long-term complications, such as port-site hernias or wound infections, were not observed in either group during the three-month follow-up period, highlighting the overall safety of both techniques [9,12].

The findings of this study emphasize that both the open and closed techniques are safe and effective for pneumoperitoneum creation in laparoscopic surgeries. The open technique offers the advantage of reduced procedural times, which can be particularly beneficial in high-volume surgical settings. However, it is associated with a slightly higher incidence of minor complications such as gas leaks and port-site hemorrhage. These complications are manageable and do not appear to compromise patient outcomes. Conversely, the closed technique may be preferred in scenarios where minimizing gas leaks is critical, such as in patients with compromised abdominal anatomy [10,11,12].

The results of this study are consistent with existing literature. Previous research has similarly demonstrated that the open technique is associated with shorter procedure times but a higher incidence of minor complications. The absence of visceral or vascular injuries in this study aligns with findings from earlier investigations, which attribute safety to the skill and experience of the surgical team [9,12].

5. CONCLUSION

In conclusion, both the open and closed techniques are viable options for pneumoperitoneum creation in laparoscopic surgeries. The open technique offers significant time-saving benefits, while the closed technique demonstrates a lower incidence of minor complications. Neither approach was associated with significant visceral or vascular injuries or long-term complications. The choice of technique should be guided by patient-specific factors, surgeon expertise, and the clinical context. Further large-scale randomized controlled trials are warranted to strengthen the evidence base and provide definitive recommendations for clinical practice.

REFERENCES

[1] Merdan I. Laparoscopic entry: a review of techniques, technologies, and complications. Bas J Surg. 2013;19:10-23.

[2] Gomel V. Operative laparoscopy: time for acceptance. Fertility and Sterility. 1989 Jul1;52(1):1-1.

[3] Jansen FW, Kapiteyn K, Trimbos-Kemper T, et al. Complications of laparoscopy: a prospective multicentre observational study. Br J Obstet Gynaecol 1997;104:595e600.

[4] Harkki-Siren P, Kurki T. A nationwide analysis of laparoscopic complications. Obstet Gynecol 1997;89:108e12.

[5] Chapron CM, Pierre F, Lacroix S, et al. Major vascular injuries during gynecologic laparoscopy. J Am Coll Surg 1997;185:461e5.

[6] Nuzzo G, Giuliante F, Tebala GD. Routine use of open technique in laparoscopic operations. J Am Coll Surg 1997;184:58e62.

[7] Magrina J. Complications of laparoscopic surgery. Clin Obstet Gynecol 2002;45:469e80.

[8] Jansen FW, Kolkman W, Bakkum EA, et al. Complications of laparoscopy: an inquiryabout closed versus open-entry technique. Am J Obstet Gynecol 2004;190:634e8.

[9] Fuller J, Scott W, Ashar B, et al. Laparoscopic trocar injuries: a report from a U. S. Food and Drug Administration (FDA) Center for Devices and Radiological Health (CDRH) Systematic Technology Assessment of Medical Products (STAMP) Committee. 8/25/2005;1e14.

[10] *Vilos, George A.; Ternamian, Artin; Dempster, Jeffrey; Laberge, Philippe Y. 2017). No. 193-Laparoscopic Entry: A Review of Techniques, Technologies, and Complications. Journal of Obstetrics and Gynaecology Canada, 39(7), e69–e84.*

[11] Kovachev S, Ganovska A, Atanasova V, Sergeev S, Mutafchiyski V, Vladov N. Openlaparoscopy: a modified Hasson technique. Akush Ginekol (Sofiia) 2015;54(4):52-56.

[12] Dunne N, Booth MI, Dehn TC. Establishing pneumoperitoneum: verres or hasson? The debate continues. Ann R Coll Surg Engl 2011 Jan;93(1):22-2