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CLOSED VERESS VERSUS OPEN TECHNIQUE OF ESTABLISHMENT OF PNEUMOPERITONEUM IN LAPAROSCOPIC SURGERY – A RANDOMIZED CONTROLLED TRIAL

General Surgery

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ABSTRACT

Background: Creating pneumoperitoneum is a key step in laparoscopic surgery, with potential risks. The Closed Veress and Open (Hasson) techniques are commonly used, but their comparative safety and efficacy remain debated. **Aim:** To compare the safety, efficacy, and postoperative outcomes of the Closed Veress versus Open technique in elective laparoscopic surgeries. **Materials And Methods:** This randomized controlled trial was conducted at Rohilkhand Medical College and Hospital, Bareilly, from August 2023 to July 2024. Ninety-six ASA I/II patients undergoing elective laparoscopic surgery were randomized into two groups: Group 1 (Closed Veress) and Group 2 (Open Technique). Intraoperative parameters (access time, complications) and postoperative outcomes (recovery time, hospital stay, morbidity) were analyzed. **Results:** A significant age difference was noted between groups (p=0.0339). Mean access time was shorter in the Open group for 7–10 minute cases (p=0.029), but overall operative time was similar. Major complications were more frequent in Group 2, including abdominal distension, paralytic ileus, and fever (p<0.05), while Group 1 had more abdominal pain. Minor complications occurred in both groups (p<0.05), with higher gas leakage in the Open group. Hospital stay was significantly shorter in the Veress group (p=0.003). Recovery and reoperation rates were comparable (p=0.593). **Conclusion:** Both techniques are effective for pneumoperitoneum creation. The Closed Veress method is linked to fewer minor complications and shorter hospital stays, making it a preferable choice in appropriate cases. Technique selection should consider patient-specific factors and surgeon experience.

KEYWORDS

Pneumoperitoneum, Laparoscopic surgery, Veress needle, Open technique, Access-related complications

INTRODUCTION

Laparoscopy, originating from the Greek terms "lapara" (flank or loin) and "skopein" (to see or examine), refers to the technique of examining the abdominal cavity by creating a space through pneumoperitoneum (air insufflation).[1] This method is commonly referred to as "keyhole surgery" or "minimally invasive surgery" due to the small incisions used to insert the instruments.[1] The historical roots of laparoscopy can be dated back to 1901, when Georg Kelling introduced the technique by performing the first laparoscopic procedure on dogs. Hans Christian Jacobaeus later did the first surgery laparoscopically on a human in 1910. Over time, this technique has seen significant developments and refinements, making it one of the most widely used surgical approaches for both diagnostic and therapeutic purposes.[2]

Laparoscopy offers several advantages over traditional open surgery (laparotomy), including a broader visual field, minimal tissue trauma, quicker recovery time, reduced postoperative pain, shorter hospital stays, and better cosmetic outcomes.[3] These benefits, combined with cost-effectiveness, have led to the widespread adoption of laparoscopic techniques across various surgical fields, including gynaecology, urology, and general surgery.[4]

However, one of the key challenges in laparoscopy is establishing safe and effective access to the abdominal cavity—a critical first step in any laparoscopic procedure. This step involves creating pneumoperitoneum by either the closed technique using a Veress needle or the Open Technique.[5] The choice of technique significantly influences the safety and outcome of the procedure, making it a subject of ongoing debate in the surgical community.[6]

Pneumoperitoneum, the process of insufflating gas into the abdominal cavity to create a working space, is crucial for visualizing and manipulating abdominal organs during laparoscopic surgery. The two most common methods to achieve this are the closed (Veress needle) technique and the Open Technique.[7]

In the closed method, a Veress needle is introduced into the abdominal cavity through a small incision, and carbon dioxide (CO_2) is used for insufflation to establish pneumoperitoneum. Although this method is fast and minimally invasive, its blind approach increases the risk of complications, such as injury to blood vessels and internal organs.[8]

Conversely, the Open Technique involves making a small incision, through which a blunt-tipped cannula is inserted under direct vision. This reduces the risk of inadvertent injury to internal structures. However, the Open Technique has its own drawbacks, including a longer setup time and a higher potential for gas leakage during surgery.[9]

MATERIAL AND METHODS

The present research was conducted as a randomized controlled trial (RCT) to compare the safety and efficacy of the Closed Veress needle technique versus the Open Technique for the creation of pneumoperitoneum in elective laparoscopic surgeries. This study was carried out in the Department of Surgery at Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh. The study duration spanned from 01 August 2023 to 31 July 2024, providing a sufficient time frame to collect data and analyse outcomes between the two techniques.

All patients who were scheduled for elective laparoscopic surgery at the time of the study period and met the inclusion criteria were considered for inclusion in the study.

Inclusion Criteria:

1. Patients undergoing elective laparoscopic surgery in the Department of Surgery.
2. Patients aged 18 years and older.
3. Patients who were classified as ASA (American Society of Anesthesiologists) Class I or II, indicating they were fit for surgery with minimal or no systemic diseases.

Exclusion Criteria:

1. Patients who declined to provide consent.
2. Pregnant women, due to the potential risks to the fetus during laparoscopic surgery.
3. Patients who had undergone previous abdominal surgeries, as this could result in adhesions, increasing the risk of complications during laparoscopic entry.
4. Patients classified as ASA Class III or IV, indicating higher

surgical risks due to systemic diseases or compromised health conditions.

Methodology

Simple random sampling was used to allocate 96 patients undergoing elective laparoscopic surgery into two groups (n=48 each): Group 1 (Veress needle technique) and Group 2 (Open technique), using the lottery method. Patient demographics, ASA class, and type of surgery were recorded preoperatively. Intraoperative data (access time, ease, complications) and postoperative outcomes (recovery, hospital stay, entry-related complications) were documented. Primary outcome was the incidence of entry-related complications; secondary outcomes included access time and recovery duration. Written informed consent and routine PAC were completed prior to surgery. After IEC approval, the study was conducted at Rohilkhand Medical College & Hospital, Bareilly. Eligible ASA I/II patients were enrolled and randomized. Preoperative workup included labs, imaging, and PAC.

- **Group 1 (Veress Needle Technique)**: Pneumoperitoneum was established via blind insertion of a Veress needle through the umbilicus at a 45° angle, followed by CO_2 insufflation after confirmation of needle placement.
- **Group 2 (Open Technique)**: A small infra-umbilical incision was made; the rectus sheath was opened under direct vision. A blunt-tipped trocar was inserted, CO_2 insufflation performed, and the cannula secured with a purse-string suture.

Statistical Analysis

Data were analyzed using SPSS v23.0. Categorical variables were compared using the Chi-square test and continuous variables with the t-test. A p-value <0.05 was considered statistically significant, and 95% confidence intervals were calculated. Analysis was validated by a biostatistician.

RESULTS

The table 1 show that among the 96 patients, Group 1 (Closed Veress Technique) and Group 2 (Open Technique) each had 48 patients. The highest proportion of patients in Group 1 was within the 18-30 years category (21 patients, 43.75%), whereas in Group 2, the highest representation was in the 41-50 years category (14 patients, 29.16%). The distribution across the remaining age groups was notably different, with a higher proportion of older patients (51-60 years) in Group 2 (8 patients, 16.67%) compared to Group 1 (1 patient, 2.08%). Conversely, in the 61-70 years category, Group 1 had 6 patients (12.5%), compared to 3 patients (6.25%) in Group 2. A Chi-square test was used to determine statistical significance, yielding a p-value of 0.0339 ($p<0.05$). This suggests a statistically significant difference in age distribution between the two groups, suggesting that patient age may be a factor influencing the choice between the Closed Veress and Open Techniques. The analysis of gender distribution in the Closed Veress Technique (Group 1) and Open Technique (Group 2) groups evaluates whether demographic differences impact procedural outcomes. Among the 96 patients incorporated in the study, 72 (75%) were female, with 38 females (79.2%) in Group 1 and 34 females (70.8%) in Group 2. Male participants accounted for 24 (25%) of the total cohort, with 10 males (20.8%) in Group 1 and 14 males (29.2%) in Group 2. The comparison between both groups reveals a relatively balanced distribution, with a slightly higher proportion of females in both. The statistical evaluation using the Chi-square test yielded a p-value of 0.479, indicating no statistically significant difference in gender distribution between the two groups ($p > 0.05$).

Table 1: Age And Gender Distribution In Each Group (Closed Verses Vs. Open Technique)

Variable	Category	Group 1 (Closed Veress)	Group 2 (Open Technique)	Total	P-value
Age Group	18–30	21	11	32	
	31–40	10	12	22	
	41–50	10	14	24	
	51–60	1	8	9	
	61–70	6	3	9	
	Total	**48**	**48**	**96**	**0.034**
Gender	Female (F)	38	34	72	
	Male (M)	10	14	24	
	Total	**48**	**48**	**96**	**0.346**

Table 2 show that in cases completed within <7 minutes, the mean induction time was slightly longer in Group 1 (6.27 ± 0.403 min) than in Group 2 (6.13 ± 0.494 min); however, this difference was not statistically significant ($p = 0.449$), indicating that both techniques perform similarly in quick procedures. In the 7-10 minute category, the mean time in Group 1 (8.23 ± 0.83 min) was significantly longer than in Group 2 (7.79 ± 0.684 min), with a p-value of 0.029, highlighting a statistically significant advantage of the Open Technique in moderately prolonged cases. This suggests that the Open Technique achieves pneumoperitoneum faster in scenarios where additional time is required. However, in cases requiring >10 minutes, the mean time for Group 1 (10.63 ± 0.408 min) and Group 2 (10.45 ± 0.191 min) showed no statistically significant difference ($p = 0.440$), implying that both techniques are equally time-consuming in challenging cases.

Table 2: Time Required To Induce Pneumoperitoneum In Each Group (Closed Verses Vs. Open Technique)

Time Category (min)	Group	N	Mean Time (min)	SD
< 7	Group 1	11	6.27	0.403
	Group 2	15	6.13	0.494
7–10	Group 1	31	8.23	0.830
	Group 2	29	7.79	0.684
> 10	Group 1	6	10.63	0.408
	Group 2	4	10.45	0.191

Table 3 show that in Group 1 (Closed Veress Technique), the mean duration of surgery was 61.8 minutes with a standard deviation of 17.6 minutes, while in Group 2 (Open Technique), the mean surgical time was 60.4 minutes with a standard deviation of 15.7 minutes. A statistical test (e.g., independent t-test) would be necessary to determine if this difference is significant. If the p-value is >0.05, it would confirm that the duration of surgery is not significantly different between the two techniques, reinforcing that both methods are equally efficient in respect to operative time.

Table 3 Distribution Of Duration Of Surgery In Each Group (Closed Verses Vs. Open Technique)

	Group	Mean
Duration of Surgery (minutes)	**Group 1**	61.8+17.6
	Group 2	60.4+15.7

Table 4 show that among the major complications, abdominal distension was exclusively observed in Group 2 (Open Technique), affecting 10 patients. Meanwhile, Abdominal pain, was only seen in Group 1 (Closed Veress) in 12 patients. Paralytic ileus and fever were present in 8 patients each, only in Group 2, while Morrison's pouch collection was observed in 3 patients in Group 2 alone. A total of 34 patients had no complications, with 18 from Group 1 and 16 from Group 2. The p-value for major complications is <0.05, indicating a statistically significant difference in the complication rates between the two groups. Among the minor complications, back pain was observed in only one patient from Group 2. Heartburn was the most frequently reported minor complication, affecting 11 patients in Group 1 and 13 in Group 2. Nausea (6 cases) and vomiting (12 cases) were exclusively observed in Group 1, while diarrhoea (3 cases) was limited to Group 2. The majority of patients (71 in total) reported no minor complications, with 37 from Group 1 and 34 from Group 2. The p-value for minor complications is also <0.05, confirming a statistically significant difference between the two groups.

Table 4 Distribution Of Complications (Major And Minor) In Each Across Group (Closed Verses Vs. Open Technique)

Group				
Major Complications	**Group 1**	**Group 2**	**Total**	**P value**
Abdominal Distention	0	10	10	< 0.05
Abdominal Pain	12	0	12	
Paralytic Ileus	0	8	8	
Fever	0	8	8	
Morrison Pouch Collection	0	3	3	
None	18	16	34	
Minor Complication				< 0.05
Back Pain	0	1	1	
Heartburn	11	13	24	
Nausea	6	0	6	
Vomiting	12	0	12	
Diarrhoea	0	3	3	
None	37	34	71	

Table 5 show that among the 96 patients, the majority experienced no complications (71 cases, 73.9%), with a higher proportion in Group 2 (81.3%) compared to Group 1 (66.7%). Gas leak was more frequently observed in Group 2 (25%) than in Group 1 (10.4%), totalling 17 cases (17.7%) overall. Omental injury was noted in 6 cases (6.2%), distributed equally across both groups, while major vascular injury, a severe but rare complication, occurred in only 2 cases (2.1%), one in each group. The statistical analysis using the Chi-square test yielded a p-value of 0.311, indicating that the differences in per-operative findings between the two techniques are not statistically significant ($p > 0.05$).

Table 5 Distribution Of Per-operative Findings In Each Group (Closed Verses Vs. Open Technique)

Per-Operative Findings	Group			p-value
	Group 1	Group 2	Total	
Gas Leak	5	12	17	0.311
Major Vascular Injury	1	1	2	
Omental Injury	3	3	6	
None	32	39	71	
Total	48	48	96	

Table 6 show that the majority of patients in Group 1 (Closed Veress) were discharged earlier, with 11 patients (22.9%) being discharged within 2 days, whereas no patients in Group 2 (Open Technique) had a hospital stay of only 2 days. A relatively equal distribution of patients was observed on Day 3 (7 in Group 1 vs. 8 in Group 2) and Day 4 (15 in Group 1 vs. 10 in Group 2). More patients in Group 2 had prolonged hospital stays, particularly on Day 5 (22 vs. 14 patients), and beyond 6 days, all cases were in Group 2. A total of 6 patients had a post-operative stay of 6 or more days, all in Group 2, suggesting a higher likelihood of extended hospitalization in the Open Technique group. The p-value for this comparison is 0.003, which is statistically significant ($p < 0.05$). This indicates that the Closed Veress technique is associated with a significantly shorter post-operative hospital stay in comparison to the Open Technique. The majority of patients (90 out of 96; 93.8%) achieved normal recovery, with 46 patients in Group 1 and 44 in Group 2, indicating that both techniques lead to successful post-operative outcomes in most cases. Morbidity was slightly higher in Group 2 (3 cases) than in Group 1 (1 case), suggesting a possible trend toward more complications in the Open Technique group, though the difference is minimal. Reoperation was required in 2 patients (1 in each group), indicating an equal distribution of surgical failure cases. The p-value for this comparison is 0.593, which is not statistically significant ($p > 0.05$). This suggests that there is no significant difference in final outcomes between the two techniques.

Table 6: Post-Operative Duration Of Stay And Final Outcome In Each Group (Closed Veress vs. Open Technique)

Variable	Category	Group 1 (Closed Veress)	Group 2 (Open Technique)	Total	P-value
Post-Operative Duration (days)	2	11	0	11	
	3	7	8	15	
	4	15	10	25	
	5	14	22	36	
	6	0	4	4	
	7	0	2	2	
	8	1	2	3	
	Total	**48**	**48**	**96**	**0.003**
Final Outcome	Morbidity	1	3	4	
	Normal Recovery	46	44	90	
	Reoperation	1	1	2	
	Total	**48**	**48**	**96**	**0.593**

DISCUSSION

In assessing the age distribution among patients undergoing laparoscopic surgery, a notable trend emerges from the analysis, indicating a statistically significant preference in the selection of entry techniques based on patient age. The Closed Veress Technique (Group 1) predominantly attracts a younger demographic, with 43.75% of patients between the age of 18 and 30 years, while the Open Technique (Group 2) is favored among slightly older patients, particularly those in the 41-50 years category, which represents 29.16% of its group. This distinct age-related variation is statistically significant, as confirmed by a p-value of 0.0339, suggesting a deliberate choice of technique based on age, possibly influenced by differing physiological considerations or surgeon assessment of risk associated with each technique.

Comparatively, studies like those by Shah et al.[10] and Venkatachalapathi et al.[11] echo these findings but do not present direct correlations between age and technique choice, instead focusing on general preferences and safety profiles across varying demographics. The unique delineation in this study offers a deeper insight into age as a significant factor in technique selection, which is not extensively covered in the referenced literature, suggesting a potential area for further research on age-specific risks and benefits.

On the gender distribution front, the study presents an equitable split across both groups, with a slightly higher percentage of females in each. Statistical analysis reveals no significant difference in gender distribution between the Closed Veress and Open Technique groups (p-value of 0.479), reinforcing the notion that gender does not influence the choice of entry technique. This finding is crucial as it aligns with the broad representation seen in studies like Naqvi et al.[12], which also report balanced gender distribution, ensuring that the study outcomes are not skewed by gender biases and that the attention remains on procedural efficacy and safety.

Furthermore, the examination of procedural times for inducing pneumoperitoneum reveals nuanced efficiencies between the two techniques. While both methods are comparable in cases completed within a swift timeframe (<7 minutes), the Open Technique shows a statistically significant advantage in moderately prolonged cases (7-10 minutes), as indicated by a p-value of 0.029. This suggests that the Open Technique might be more efficient in scenarios that do not demand the fastest induction but do require expedience. However, in more complex cases taking over 10 minutes, there is no significant difference in the time efficiency between the techniques, highlighted by a p-value of 0.440.

These insights are particularly reflective when juxtaposed against the wider research landscape, where studies like those by Alhajress et al.[13] and Parmar et al.[14]emphasize the safety and effectiveness of both techniques without a definitive edge in time efficiency.

The analysis of surgical duration across two techniques, Closed Veress (Group 1) and Open Technique (Group 2), provides important perception into the efficiency of each method in laparoscopic surgery. In this study, the mean duration for Group 1 was 61.8 minutes and 60.4 minutes for Group 2. The minor difference in mean durations suggests that both techniques are quite comparable in terms of time required in completion of surgery. The similar surgical times, supported by standard deviations of 17.6 and 15.7 respectively, indicate a consistency in procedure length irrespective of the technique used. This consistency may reflect not only the skills of the surgeons but also the adaptability of each method to various surgical scenarios. Without a statistically significant difference, which would be confirmed by a p-value greater than 0.05 from an independent t-test, this data implies that the choice between Closed Veress and Open Technique can be made based on factors other than time efficiency, such as surgeon preference or specific patient anatomical considerations.

In terms of complications, the distribution varies significantly between the two groups, with a p-value of less than 0.05 for both major and minor complications, suggesting a meaningful difference in the safety profile of each technique. Major complications like abdominal distension, paralytic ileus, and Morrison's pouch collection were uniquely observed in Group 2 (Open Technique), while abdominal pain was specific to Group 1 (Closed Veress).

Minor complications also showed significant differences, with symptoms like nausea and vomiting more prevalent in Group 1, and diarrhoea observed only in Group 2. The variability in minor complications further suggests that postoperative recovery and patient comfort may differ based on the chosen method, influencing decisions particularly in patients who may be more prone to specific postoperative discomforts.

Finally, the per-operative findings underscore a comparable safety profile between the Closed Veress and Open Technique. While the incidence of gas leaks was higher in Group 2, this did not result in a

statistically significant difference in overall intraoperative safety, as indicated by a p-value of 0.311.

These observations align well with existing studies, such as those reviewed by Venkatachalapathi et al.[11] and Naqvi et al.[12], which do not show a consistent precedence of one technique over the other in terms of efficiency and safety. This study's findings reinforce the idea that both the Closed Veress and Open Technique have their unique advantages and limitations, making them suitable for different surgical needs and patient conditions.

CONCLUSION

In conclusion, our study demonstrated that both the Open and Closed techniques are generally safe, with a comparable risk of major complications. However, the Open technique was associated with a higher incidence of minor postoperative issues such as gas leakage and paralytic ileus. The Closed Veress technique showed a favorable safety profile without serious complications. These results underscore the need for individualized surgical approach selection based on patient-specific factors and clinical judgment.

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