

Assessing Open versus Closed Techniques for Pneumoperitoneum Creation in Laparoscopic Surgery

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Conflict of interest: Nil

Abstract:

Background and Aim: Research has consistently documented instances of visceral perforation across various studies employing both open and closed techniques. The condition is linked to a significant mortality rate, primarily because numerous injuries may go unrecognized during surgical procedures. This study was conducted to assess the effectiveness of open versus closed techniques for intraperitoneal access in creating pneumoperitoneum during laparoscopic surgery.

Material and Methods: The study included all patients undergoing abdominal laparoscopic surgeries, specifically those aged between 18 and 70 years, regardless of gender. The study involved fifty patients who underwent laparoscopic cholecystectomies and decision to divide the patients into two groups was made with careful consideration of the surgeon's preference and expertise, resulting in 25 patients being assigned to either the open or closed method for creating pneumoperitoneum. To assess the score for Surgical Site Infection (SSI), the Southampton Wound Scoring System was employed, and the Visual Analogue Scale was used to measure the pain level experienced at the port site.

Results: The time taken to close the umbilical port differed between the two groups, with the open group averaging 5.3 ± 12.1 minutes and the closed group averaging 6.4 ± 09.4 minutes. Our study revealed that the average time taken to close the umbilical port was 8.12 ± 0.24 minutes for the open group, compared to 9.22 ± 3.54 minutes for the closed group. The difference observed was found to be highly statistically significant.

Conclusion: In the context of laparoscopic cholecystectomy, our findings indicate that the open technique provides faster access to the pneumoperitoneum compared to the closed approach when evaluated under similar conditions.

Keywords: Laparoscopic Cholecystectomy, Pneumoperitoneum, Surgical Site Infection, Visual Analogue Scale.

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Introduction

Ongoing research and development efforts are actively focused on enhancing the laparoscopic technique. Since that time, the laparoscopic procedure has experienced significant advancements and has established itself as a standard practice across various surgical subspecialties. This is because it provides many advantages over traditional laparotomy, such as a smaller scar, reduced hospital stay, decreased risk of wound infection, less postoperative pain, and a quicker recovery following surgery. [1,2]

There is substantial evidence suggesting that laparoscopy typically results in a lower incidence of complications. There remains a potential for complications to develop as a result of the procedure undertaken. While the risk of injury is reduced, it is important to acknowledge that significant injuries to the bowel, bladder, and major

vessels can still occur. It has been noted that injuries may occur during the initial port insertion in most cases. At this stage, the creation of pneumoperitoneum is a critical and careful procedure. The initial approach involved the use of a veress needle, commonly known as the closed method. However, subsequently, a technique was developed that involved opening the peritoneal cavity while directly observing the patient. The dimensions of the opening were very similar to those of a trocar. [3,4]

This marks the initial phase of the Lap process, a stage that presents both challenges and significance. During the surgical procedure, a small incision is made to facilitate the insertion of the first trocar. To prevent or lessen the impact of these complications, this step represents half of the potential issues. Throughout history, various

techniques have been established to facilitate access to the peritoneal cavity. Direct trocar insertion is one of the techniques available, alongside the closed and open methods. Alongside the enhancement of the visual entry system, the implementation of disposable shielded trocars, radially expanding trocars, and other comparable technologies. The comparison involved five to six distinct studies, and the resulting analysis was ultimately inconclusive. [5,6]

While the open Hasson technique is said to eliminate the risk of vascular injury, it is important to note that Hanney and colleagues reported instances of aortic injury associated with the use of the Hasson cannula. It is important to note that the use of the verses needle has been associated with an increased risk of vascular injury. Research has consistently documented instances of visceral perforation across various studies employing both open and closed techniques. The condition is linked to a significant mortality rate, primarily because numerous injuries may go unrecognized during surgical procedures. [7,8]

In the process of creating pneumoperitoneum, various gases can be used, but carbon dioxide is the most commonly employed option. Due to its accessibility, affordability, and efficient absorption into the bloodstream, carbon dioxide gas has emerged as the preferred option. Furthermore, there is a decrease in the likelihood of air embolism occurring. [9] Adjustments to the ventilator can serve as a valuable tool for assessing its impact on blood pH levels. This study was conducted to assess the effectiveness of open versus closed techniques for intraperitoneal access in creating pneumoperitoneum during laparoscopic surgery.

Materials and Methods

The current study was conducted through observational research in the general surgery unit of TMU hospital in Moradabad. Before including the participants in the study, the ethical committee of the institute received detailed information about the procedure and the study's purpose. Furthermore, an ethical clearance certificate was secured. Before the patients took part in the study, they received detailed information about the procedure and the goals of the research project, and they were requested to give their written informed consent. The criteria outlined below were utilized to establish the inclusion and exclusion of participants in the study: The study included all patients undergoing abdominal laparoscopic surgeries, specifically those aged between 18 and 70 years, regardless of gender.

Individuals with a history of prior abdominal surgeries, those with local skin infections, individuals who have experienced abdominal or pelvic tuberculosis, patients with co-existing

medical conditions, and those presenting with umbilical and ventral hernias were excluded from participating in the study.

The study involved fifty patients who underwent laparoscopic cholecystectomies, all classified with an ASA grade 1 and a body mass index (BMI) below 35. The decision to divide the patients into two groups was made with careful consideration of the surgeon's preference and expertise, resulting in 25 patients being assigned to either the open or closed method for creating pneumoperitoneum.

In the process of establishing pneumoperitoneum, one surgeon employed the open technique, whereas the other surgeon opted for the closed technique. All information related to each individual patient was securely stored in sealed envelopes. Each surgeon chose an envelope at random and then carried out the operation using the techniques that best suited their expertise. During the research project, we ensured that patients were recruited until we had a minimum of 25 cases for each technique.

The duration taken to establish pneumoperitoneum was documented for both groups, along with the time needed to close the umbilical port. No signs of vascular or visceral injury were present. The complications observed after the procedure included haematomas at the port site, infections at the port site, and skin pain at the port site. To assess the score for Surgical Site Infection (SSI), the Southampton Wound Scoring System was employed, and the Visual Analogue Scale was used to measure the pain level experienced at the port site.

After gathering the data and entering it into a master chart, a comparative analysis was conducted to evaluate several key metrics. These included the average time taken to create a pneumoperitoneum, the average duration for closing an umbilical port, and the rates of various complications such as port site haematoma, visceral or vascular injury, port site infection, and skin pain at the port site on days 1, 10, and 30.

Results

The average time taken to establish pneumoperitoneum in this study was 6.4 minutes, with a standard deviation of 6.10 minutes for the open method, and 7.16 minutes, with a standard deviation of 4.72 minutes for the closed method. The distinction between the two methods was found to be highly statistically significant.

The time taken to close the umbilical port differed between the two groups, with the open group averaging 5.3 ± 12.1 minutes and the closed group averaging 6.4 ± 09.4 minutes. Our study revealed that the average time taken to close the umbilical port was 8.12 ± 0.24 minutes for the open group,

compared to 9.22 ± 3.54 minutes for the closed group. The difference observed was found to be highly statistically significant.

In one patient from the open group and one patient from the closed group, a haematoma at the port site was observed.

The analysis revealed no significant difference between the two groups regarding the occurrence

of port site haematoma. Instances of vascular or visceral injury were observed in every case, irrespective of whether the pneumoperitoneum was established through an open or closed technique.

In every group, there was one patient who experienced a port site infection, and this was effectively managed with treatment. The analysis revealed that there was no meaningful difference in the incidence of pain at the port site.

Table 1: Time taken to create pneumoperitoneum

Time taken	Open group (n = 25)	Closed group (n = 25)
1 to 5 mins	5	1
6 to 10 mins	14	13
> 10 mins	6	11

Table 2: Time taken for umbilical port closure in both the groups

Time taken	Open group (n = 25)	Closed group (n = 25)
1 to 5 mins	5	3
6 to 10 mins	13	12
> 10 mins	7	10

Discussion

Endoscopic surgeries have emerged as a widely accepted procedure due to the significant advancements made in the field over the last twenty years. This surgical method is favored by patients, especially younger individuals, due to its minimal access approach, which is usually conducted as a day-care procedure. It offers cosmetic benefits, leaves minimal scarring, and presents a lower risk of post-operative complications and wound infections.

The primary trocar insertion and the creation of pneumoperitoneum are critical steps in this blind procedure, highlighting their importance in ensuring a successful outcome. It is important to recognize that this procedure carries the risk of significant injuries that may occur during the operation. These can include bowel perforation, major vascular injuries, and haematoma in subcutaneous layers, subcutaneous emphysema, and other related complications. [10,11]

Our findings align with those reported by Channa et al., who showed that the open method, when compared to the closed method, decreased the time needed to access the pneumoperitoneum during laparoscopic cholecystectomy treatment. The study's findings indicate that the Veress needle presents a slightly lower risk compared to the Hasson cannula. The limited sample size in this study presents a notable limitation.

Given the low occurrence of various complications associated with laparoscopic cholecystectomy, the authors found it challenging to perform a thorough comparison of the two methods regarding their safety profiles. The findings of Akbar et al. indicate

that the Hasson method is notably faster than the Veress method. Furthermore, it was found that the Hasson method offers greater security compared to the Veress method. [12,13] Our research indicated that the time needed to close show no significant difference between the open and closed methods. Jamil et al. and Akbar et al. observed that participants in the open method group experienced a shorter duration to conclude the experiment in comparison to those in the closed method group 4 and 11. Conversely, research conducted by Agarwal et al. indicated that the open method group required a longer duration to conclude the experiment in comparison to the closed method group. [14]

The studies conducted on open and closed techniques for pneumoperitoneum during laparoscopic cholecystectomy have shown conflicting results, as previously noted. A comprehensive analysis was conducted to identify the underlying reasons for this disparity. Our research indicated that in laparoscopic cholecystectomy, the open technique provided faster access to the pneumoperitoneum compared to the closed approach during the procedure.

The findings of this study indicate that both open and closed approaches demonstrate comparable safety regarding significant outcomes, including vascular damage, visceral injury, omental injury, and port site hernia. Conversely, the research indicated that the open approach is associated with a greater incidence of port-site wound infection, port-site haematoma, and gas leakage when compared to the closed approach.

Conclusion

In the context of laparoscopic cholecystectomy, our findings indicate that the open technique provides faster access to the pneumoperitoneum compared to the closed approach when evaluated under similar conditions. The findings of this study indicate that both the open and closed methods present a similar risk of experiencing significant complications. The complications observed encompassed vessel injury, visceral injury, muscle injury, and port site hernia. In contrast, when compared to the closed approach, the open method showed a greater occurrence of gas leakage, port-site haematoma, and wound infection. There was an increased frequency of each of these complications.

References

1. Charondo LB, Brian R, Syed S, et al. confronting new challenges: faculty perceptions of gaps in current laparoscopic curricula in a changing training landscape. *Surgery Open Science*. 2023; 16:1-7.
2. Cheema MJ, Hassan MMU, and Asim A, et al. Innovations in Hybrid Laparoscopic Surgery: Integrating Advanced Technologies for Multidisciplinary Cases. *Cureus*. 2024; 16(6).
3. Perugini RA, Callery MP. Complications of laparoscopic surgery. *Surgical treatment: evidence-based and problem-oriented: Zuckschwerdt*; 2001.
4. Madhok B, Nanayakkara K, Mahawar K. Safety considerations in laparoscopic surgery: A narrative review. *World journal of gastrointestinal endoscopy*. 2022; 14(1):1.
5. Ahmad G, Phillips K, Watson A. Laparoscopic entry techniques. *Cochrane database of systematic reviews*. 2019(1).
6. Krishnakumar S, Tambe P. Entry complications in laparoscopic surgery. *Journal of gynecological endoscopy and surgery*. 2009; 1(1):4.
7. Hanney R, Carmalt H, Merrett N, Tait N. Use of the Hasson cannula producing major vascular injury at laparoscopy. *Surgical endoscopy*. 1999; 13:1238-1240.
8. Pring C. Aortic injury using the Hasson trocar: a case report and review of the literature. *Annals of the Royal College of Surgeons of England*. 2007; 89(2):W3.
9. Yang X, Cheng Y, Cheng N, et al. Gases for establishing pneumoperitoneum during laparoscopic abdominal surgery. *Cochrane Database of Systematic Reviews*. 2022(3).
10. Rosenberg N, Gelijns AC, Dawkins H. From the scalpel to the scope: Endoscopic innovations in gastroenterology, gynecology, and surgery. *Sources of medical technology: universities and industry: National Academies Press (US)*; 1995.
11. Kumar A, Yadav N, Singh S, Chauhan N. Minimally invasive (endoscopic-computer assisted) surgery: Technique and review. *Annals of maxillofacial surgery*. 2016; 6(2):159-164.
12. Bahdi F, Labora A, Shah S, et al. From Scalpel to Scope: How Surgical Techniques Made Way for State-of-The-Art Endoscopic Procedures. *Gastro Hep Advances*. 2024; 3(3):370-384.
13. Katwal G, Thapa Y, Shrestha A, Bhattarai A, Tamrakar KK, Neupane HC. Open Cholecystectomy among Patients undergoing Laparoscopic Cholecystectomy in a Tertiary Care Centre: A Descriptive Cross-Sectional Study. *JNMA: Journal of the Nepal Medical Association*. 2022; 60(249):444.
14. Hemal AK, Agarwal MM, Babbar P. Impact of newer unidirectional and bidirectional barbed suture on vesicourethral anastomosis during robot-assisted radical prostatectomy and its comparison with polyglecaprone-25 suture: an initial experience. *International urology and nephrology*. 2012; 44:125-132.