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COMPARISON BETWEEN CLOSED AND OPEN METHODS FOR CREATING PNEUMOPERITONEUM IN LAPAROSCOPIC SURGERY

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Abstract

Introduction:

Laparoscopic surgery has evolved significantly since its inception, with pneumoperitoneum creation being a critical step. The study compares the safety and efficiency of the closed (Veress needle) and open (Hasson) methods for creating pneumoperitoneum.

Methods:

This retrospective study included 50 patients undergoing laparoscopic surgery, divided into two groups: closed method (n=25) and open method (n=25). The study analyzed access time, postoperative pain, total operating time, wound closure time, and complications. Statistical analyses included T-tests, Mann-Whitney U tests, and Chi-square tests to compare continuous and categorical variables.

Results:

The open method demonstrated a significantly shorter mean access time of 6.8 minutes compared to 8.9 minutes for the closed method ($p<0.001$). The closed method had a 12% failure rate, while the open method had no instances of gas leaks or technique failure. No significant differences were found between the two methods regarding total operating time, wound closure time, or hospital stay duration. Importantly, neither method resulted in visceral or vascular injuries.

Conclusion:

The open method is faster in establishing pneumoperitoneum and may be safer, particularly for less experienced surgeons. Both methods are generally safe and effective, but further studies with larger sample sizes are needed to confirm these findings and develop definitive guidelines.

INTRODUCTION:

Inaugural laparoscopy in a human was conducted by jacobeus of sweden in 1910.[1] Subsequently, laparoscopic procedures have seen continuous development. In recent decades, it has become the favored choice for many surgical operations. Laparoscopic cholecystectomy is now the preferred therapy worldwide for uncomplicated symptomatic cholelithiasis.[2-5], inclusive. It is efficient, linked to less problems, cost-efficient, and also provides aesthetic advantages.[5] Although the advantage of laparoscopic cholecystectomy compared to open cholecystectomy is well-established, it is not entirely free of problems, many of which are associated with the method of entry and the creation of pneumoperitoneum. [6,7] . An obstacle encountered in laparoscopic surgery involves the introduction of surgical tools through limited incisions. More than 50% of the difficulties occur during this period [8,9], with the bulk of these issues happening after the placement of the first umbilical trocar.[8] In order to deal with these complexities, many methods have developed to obtain entry into the peritoneal cavity.

Several studies have been conducted to compare the effectiveness and safety of different access strategies. However, meta-reviews of these research have been inconclusive, indicating the need for more data.[10,11]. Due to the lack of assurance, the decision on which procedure to use is typically based on the surgeon's personal taste. This is effective for seasoned surgeons but might be perplexing for trainees and less experienced surgeons. The open and closed techniques are the most often employed ways worldwide [12-14]. The open approach entails creating an incision and subsequently dissecting the fascia to access the peritoneal cavity, allowing for the direct visualization and insertion of the Hasson cannula. [15]. The closed approach, known as the Veress needle technique, includes the insertion of the Veress needle into the peritoneal cavity without direct visualization.[16]. Therefore, it is not possible to create any local standards that are based on facts. Given the above uncertainties and lack of available literature, it is necessary to create specific rules at the local level. The purpose of this study was to assess the safety and effectiveness of the open and closed procedures in terms of getting access and creating pneumoperitoneum.

METHODOLOGY

This retrospective study is designed to evaluate patients undergoing pneumoperitoneum in laparoscopic surgeries, aiming to compare two methods to determine which is safer. The total sample size consists of 50 patients, divided into two groups of 25 each. Descriptive statistics are used to summarize the data. Mean, median, and standard deviation are calculated for continuous variables, while frequencies and percentages are used for categorical variables. Comparative analysis is conducted to identify any significant differences between the two groups Continuous Variables: T-tests or Mann-Whitney U tests are employed to compare the time taken to achieve pneumoperitoneum and pain scores between the groups. Categorical Variables: Chi-square tests or Fisher's exact tests are used to compare the incidence of complications.

The aim of this comprehensive analysis is to determine which method for achieving pneumoperitoneum is safer by considering the efficiency (time taken), patient comfort (postoperative pain), and the safety profile (incidence of complications). The findings will provide valuable insights into optimizing surgical procedures to enhance patient outcomes and safety.

RESULTS:

TABLE 1: Age Distribution

AGE	CLOSED METHOD (n=25)		OPEN METHOD (n=25)	
18-31	4	16%	3	12%
32-45	12	48%	14	56%
46-60	9	36%	8	32%

The age distribution of patients in the study was categorized into three groups. For the Closed Method group (n=25), 16% of patients were aged 18-31, 48% were aged 32-45, and 36% were aged 46-60. In contrast, for the Open Method group (n=25), 12% of patients were in the 18-31 age range, 56% were in the 32-45 age range, and 32% were in the 46-60 age range. This distribution highlights a slightly younger population in the Closed Method group compared to the Open Method group, with a higher percentage of patients aged 32-45 in the Open Method group.

TABLE 2: Sex Distribution

SEX	CLOSED METHOD (n=25)		OPEN METHOD (n=25)	
FEMALE	18	72%	17	68%
MALE	7	28%	8	32%

The sex distribution among patients in the study was categorized as follows: In the Closed Method group (n=25), 72% were female and 28% were male. Conversely, in the Open Method group (n=25), 68% were female and 32% were male. This indicates a slightly higher proportion of females in both groups, with a marginally higher percentage of males in the Open Method group compared to the Closed Method group.

TABLE 3: Comparison of Time Taken for Access Between Closed and Open Methods

TIME TAKEN FOR ACCES	CLOSED METHOD (n=25)		OPEN METHOD (n=25)		P VALUE
1-5	1	4%	3	12%	
6-10	21	84%	22	88%	
>10	3	12%	0	0%	0.049
MEAN	8.9		6.8		<0.001
SD	1.1		1.0		

The time taken to achieve access was analyzed for both the Closed Method and Open Method groups. In the Closed Method group (n=25), 4% of patients had access times between 1-5 minutes, 84% had access times between 6-10 minutes, and 12% had access times exceeding 10 minutes. In the Open Method group (n=25), 12% of patients had access times between 1-5 minutes, 88% had access times between 6-10 minutes, and none had access times exceeding 10 minutes. The p-value for this comparison was 0.049, indicating a statistically significant difference between the two methods. The mean time taken for access was 8.9 minutes (SD 1.1) in the Closed Method group and 6.8 minutes (SD 1.0) in the Open Method group, with a p-value of <0.001, highlighting a significant difference in access times.

TABLE4: Comparison of Postoperative Metrics Between Closed and Open Methods

VARIABLES	CLOSED METHOD (n=25)		OPEN METHOD (n=25)		P VALUE
	RANGE	MEAN + SD	RANGE	MEAN + SD	
TIME REQUIRED TO CLOSE THE WOUND (IN MIN)	6-10	7.06+1.03	5-15	7.13+1.99	0.857
TOTAL OPERATIN TIME (IN MIN)	60-120	98.35+14.7	60-120	93.68+16.98	0.263
HOSPITAL STAY (IN DAY)	2-12	4.25+2.46	1-8	3.48+1.54	0.148

The study evaluated various postoperative metrics between the Closed Method and Open Method groups. For the time required to close the wound, the Closed Method group (n=25) had a range of 6-10 minutes with a mean ± SD of 7.06 ± 1.03 minutes, while the Open Method group (n=25) had a range of 5-15 minutes with a mean ± SD of 7.13 ± 1.99 minutes. The p-value for this comparison was 0.857, indicating no statistically significant difference.

Regarding total operating time, the Closed Method group had a range of 60-120 minutes and a mean ± SD of 98.35 ± 14.7 minutes, whereas the Open Method group had a range of 60-120 minutes with a mean ± SD of 93.68 ± 16.98 minutes. The p-value for this comparison was 0.263, suggesting that the difference in operating times is not statistically significant.

For hospital stay duration, the Closed Method group had a range of 2-12 days and a mean ± SD of 4.25 ± 2.46 days, compared to the Open Method group with a range of 1-8 days and a mean ± SD of 3.48 ± 1.54 days. The p-value for this metric was 0.148, indicating no significant difference in hospital stay between the two methods.

TABLE 5: Comparison of Complications and Hospital Stay Between Closed and Open Methods

VARIABLES	CLOSED METHOD (n=25)		OPEN METHOD (n=25)		P VALUE
	NO OF CASE	PERCENTAGE	NO OF CASE	PERCENTAGE	
INJURY DURING INDUCTION	1	4%	0	0%	0.151

FAILURE OF TECHNIQUE	3	12%	0	0%	0.039
HOSPITAL STAY (IN DAY)	1	4%	2	8%	0.555

The incidence of complications and hospital stay were compared between the Closed Method and Open Method groups. For injury during induction, the Closed Method group (n=25) had 1 case (4%), while the Open Method group (n=25) had no cases (0%), with a p-value of 0.151, indicating no significant difference.

In terms of failure of technique, the Closed Method group experienced 3 cases (12%), whereas the Open Method group had no cases (0%). This resulted in a p-value of 0.039, suggesting a statistically significant difference between the methods.

Regarding hospital stay, the Closed Method group had 1 case (4%) with a prolonged stay, while the Open Method group had 2 cases (8%) with a prolonged stay. The p-value for this comparison was 0.555, indicating no significant difference in hospital stay duration between the two methods.

DISCUSSION

Laparoscopic cholecystectomy, a minimally invasive surgical treatment, has largely supplanted open cholecystectomy since the early 1990s [17]. Laparoscopic cholecystectomy is now widely accepted as the most effective method for treating gallstone disease [18]. Nevertheless, laparoscopy is a relatively recent technique, which has led to issues and debates, especially over the most effective approach for creating the pneumoperitoneum. The formation of the pneumoperitoneum is the crucial phase in the laparoscopic operation. Laparoscopic operations continue to provide a challenge for surgeons due to the occurrence of iatrogenic injuries during access to the peritoneal cavity [19]. The traditional closed pneumoperitoneum technique requires blindly inserting the Veress needle into the peritoneal cavity, which poses the highest risk of harm during the first blind entrance. Over 50% of the difficulties associated with a laparoscopic procedure are found to arise prior to the start of the actual surgery, namely during the establishment of pneumoperitoneum and trocar entrance. The most worst outcome for laparoscopic surgeons would involve an iatrogenic harm to the major blood arteries or damage to the hollow organs, which would ultimately need a switch to an open surgical approach. In order to avoid these unforeseeable complications, various alternative techniques for creating pneumoperitoneum have been developed in recent decades. These include the open method of pneumoperitoneum pioneered by Harrith Hasson, optical trocars, direct trocar insertion, radically expanding trocars, and the utilization of disposable shielded trocars [20-23]. Therefore, there are several approaches of creating pneumoperitoneum. Currently, the Veress needle and Hasson's pneumoperitoneum approach are the prevailing techniques employed [24]. The morbidity rate for generating pneumoperitoneum and primary trocar insertion is expected to be less than 1%. However, the exact frequency of complications such as vascular and visceral injuries for both techniques is unclear [25]. This observational research examined the time it took to produce pneumoperitoneum, the time necessary to heal wounds, the overall operating time, and the problems associated with each procedure. In 1974, Harrith Hasson pioneered the open approach of pneumoperitoneum. Despite the lesser risk of visceral or vascular harm, this approach did not become widely accepted due to its documented association with a substantial gas leak and being time-consuming. The technique was specifically advised for individuals who had undergone prior surgery in the upper abdomen [24].

In group A (closed approach), the time required to create pneumoperitoneum and implant the camera port was 8.9 ± 1.1 minutes, while in group B (open method), it was 6.8 ± 1.0 minutes. In 1990, Borgatta reported that the average time for pneumoperitoneum using the closed approach was 130 seconds (2.2 minutes) [26]. In 1993, Byron et al. stated that the average access time for successful pneumoperitoneum using the closed approach was

The duration is 5.9 ± 2.2 minutes, as reported in reference [27]. According to a research conducted by Ann-Cathrin Moberg and published in a Scandinavian publication, the blind Veress technique of pneumoperitoneum takes around 214-300 seconds (3.5-5 minutes) to get entry to the abdominal cavity [28]. In 2004, Soomro et al. found that the average duration for establishing pneumoperitoneum with a Veress needle (closed approach) was 5 minutes, whereas the open method took 8 minutes [29]. In their study, Akbar et al. (2007) documented the average duration needed to achieve a successful pneumoperitoneum.

The closed technique took 9.17 minutes, whereas the open method took 8.11 minutes [18]. In 2013, Angioli R et al. found that the average access time in the closed group was 212.4 seconds (3.54 minutes), whereas in the open group it was 161.7 seconds (2.69 minutes) [30]. In a study conducted in 2014, Ilias Juneja and colleagues found that the average duration for access using the closed technique was 2.83 minutes, whereas it was 2.52 minutes with the open method [31]. Dr. Neet R.

In 2015, Chotai et al. found that the average duration of the closed technique for access was 3.94 minutes, whereas the open approach took 5.12 minutes [32]. In 2016, Tariq Nawaz et al. found that the average time required to generate pneumoperitoneum using the closed approach was 4 ± 1 minutes, while the open method took 5 ± 1 minutes (p-value = 0.000). In a study conducted by Jamil et al. (2018), it was shown that the average access time using the closed technique was 6.58 ± 1.78 minutes, whereas the open method had an average access time of 5.49 ± 1.82 minutes [33]. Both procedures used in this investigation did not result in any reported damage to the internal organs or blood vessels. Conversion to open cholecystectomy was unnecessary.

Juneja also documented comparable results, indicating the absence of significant visceral/vascular damage or gas embolisms in all of the research groups [31]. In their study, Bonjer et al. found that the closed technique of pneumoperitoneum had a visceral damage rate of 0.08% and a vascular injury rate of 0.07%. On the other hand, the open method of pneumoperitoneum had a lower visceral injury rate of 0.05% and no reported cases of vascular injury (p=0.002) [34].
According to Chapron et al., the incidence of intestine injury is 0.04% and major vascular injury is 0.01% in the closed method of pneumoperitoneum. In contrast, the incidence of bowel injury is 0.19% and major vessel injury is 0% in the open technique of pneumoperitoneum. The researchers determined that the condition known as open pneumoperitoneum

The approach does not mitigate the possibility of difficulties during access [35]. Chandler et al. found no safety benefit of the open technique of pneumoperitoneum compared to the closed approach [36]. Jansen et al. reported that the incidence of problems related to the closed pneumoperitoneum method was 0.07%, while the open approach had a complication rate of 0.17%. The incidence of entry-related problems was much greater with the open procedure. Consequently, there is no evidence to justify the notion of discontinuing the closed entrance strategy. However, it is still advisable to carefully choose patients for an open or alternative surgery [37]. The meta-analysis did not provide sufficient evidence to show that an open way of entry is safer than a closed approach in terms of visceral and major vascular injuries [20].

The overall duration of operation in our study was shorter in the group that used the open technique. This can be attributed to a shorter duration of pneumoperitoneum initiation and a more rapid wound closure at the end. In addition, the regular execution of Veress needle entrance tests, such as aspiration and saline tests, inside closed method groups. The duration of wound closure in group A was longer compared to group B. In group B, the initial application of stay sutures to the edges of the sheath helped expedite the closure process. Conversely, in group A, it was challenging to maintain a grip on the facial borders at the umbilicus and perform deep incisions through the narrow orifice, making it akin to a treatment done without visual guidance.

The duration of hospitalization was marginally longer in group A. Nevertheless, these factors exhibited no statistical significance in either group, including total operating time, the time needed for wound closure, and the duration of the overall hospital stay.

CONCLUSION:

This retrospective study compared the closed and open methods for creating pneumoperitoneum in laparoscopic surgeries, focusing on access time, postoperative pain, and complications. The results demonstrate that the open method is significantly faster in establishing pneumoperitoneum, with a mean access time of 6.8 minutes compared to 8.9 minutes for the closed method. Although the open method had no instances of gas leak or technique failure, the closed method experienced a 12% failure rate. Both methods showed no significant differences in total operating time, wound closure time, or hospital stay duration. Importantly, neither method resulted in visceral or vascular injuries. These findings suggest that while the open method may offer a quicker and potentially safer approach for achieving pneumoperitoneum, especially for less experienced surgeons, both methods are generally safe and effective. Further studies with larger sample sizes are necessary to establish definitive guidelines and optimize surgical outcomes.

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