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Original Article

Comparison Between Open and Closed Methods of Establishing Pneumoperitoneum for Laparoscopic Cholecystectomy

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Abstract:

Background: The initial phase in laparoscopic surgery, including cholecystectomy, is pneumoperitoneum. There are two widely utilized procedures to produce pneumoperitoneum closed and open techniques. Both have advantages and disadvantages.

Aims: Comparing open and closed techniques of creating a pneumoperitoneum for laparoscopic cholecystectomy is the goal.

Methods: The Surgery Department of Sylhet MAG Osmani Medical College Hospital conducted this prospective comparative observational study from September 2018 to August 2019. This study comprised a total of 138 hospitalized patients, of whom had symptomatic gallstone disease and required cholecystectomy. The patients were split into two groups; 69 were chosen for the closed approach and were referred to as Group A, while the remaining 69 were chosen for the open method and were referred to as Group B.

Results: The average age was 44.88 ±12.61 in Group A and 47.12 ±11.62 in Group B. In groups A and B, the male-to-female ratio was 1:2.3 and 1:1.6, respectively. The difference between the two groups was statistically insignificant ($p>0.05$). The average access time was 7.43 minutes for Group A and 3.14 minutes for Group B. The average access time was substantially longer in group A ($p <0.05$). 27 patients (39.1%) in group A and 38 patients (55.1%) in group B had gas leaking. The difference was not statistically significant ($p>0.05$) between the two groups. 15 (21.7%) patients in group A and 5 (7.2%) patients in group B had extraperitoneal insufflation. Extraperitoneal insufflation in group A was considerably ($p<0.05$) greater. The average surgery was 81.83± 20.21 minutes for Group A and 53.42± 11.63 minutes for Group B. The mean time frames spent on wound closure in groups A and B were 6.61± 1.49 and 2.55 ±0.8 respectively. The mean duration of the procedure and the mean time to close the wound were considerably ($p<0.05$) higher in group A. No group had any cases of visceral damage, conversion need, haematoma, seroma, subcutaneous emphysema, gas embolism, or port site hernia. In groups A and B, respectively, one (1.4%) patient each had wound discharge and wound infection. The difference between the two groups was not statistically significant ($p>0.05$).

Conclusion: It was preferable to create pneumoperitoneum openly. Considering access time, operating time, times for wound closure, primary port infection, and haemorrhage.

Keywords: Pneumoperitoneum, open method, closed method.

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Introduction:

The word laparoscopy originated from the Greek word (Laparo-abdomen, scopion-to examine).

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Examining the abdominal cavity and its contents is the goal of laparoscopy. This is accomplished by sufficiently extending the abdominal cavity (pneumoperitoneum) and viewing the contents of the abdomen using a telescope that is lighted. A pneumoperitoneum must be created to do the surgery (Soomro, 2004)[1].

Jacobeus of Sweden performed the first laparoscopic operation on a human that was described in the literature in 1910 (Harrell and Heniford, 2005)[2].

In the world today, laparoscopic cholecystectomy is the preferred course of treatment for uncomplicated symptomatic cholelithiasis (Cuschieri et al. 1991)[3].

It is cost-efficient, effective, associated with fewer problems, and has cosmetic advantages (Grace et al. 1991)[4]. Despite being better than open cholecystectomy, there are still certain difficulties, many of which are connected to the entrance technique and the creation of pneumoperitoneum (Marakis et al. 2007; Zaraca et al. 1999) [5,6]. The introduction of surgical equipment through small incisions is one of the problems of laparoscopic cholecystectomy. A significant portion of the difficulties this time around more than 50% occur after implantation of the primary umbilical trocar (Nuzzo et al. 1997; Jansen et al. 2004) [7,8].

Jansen et al. conducted a clinical experiment in which they compared closed and open entry procedures, and the complication rates were 0.07 and 0.17 per cent, respectively (Jansen et al. 2004)[8].

The rate of vascular damage during laparoscopy is 2 per 10,000 procedures, and a major complication that results in death occurs in 3.3 per 100,000 procedures (Wherry et al. 1996) [9]. The mortality rate for intestinal damage caused by laparoscopy is 3.6%. (Chapron et al. 2003)[10]. Finding a safe entry technique is a priority not only for the life of the patients but also for the increasing rate of laparoscopy procedures. There are two methods for creating a pneumoperitoneum, the closed method and the open method (Vilos et al. 2007; Merlin et al. 2003)[11,12].

However, there is no consensus on the best method to access the abdominal cavity to create a pneumoperitoneum. In the open technique (Hasson cannula), an incision is made followed by an incision through the fascia to the abdominal cavity for the insertion of a Hasson cannula under direct vision (Hasson, 1971)[13]. In the closed method, a veress needle is blindly inserted into the abdominal cavity (Palmer, 1974)[14].

But, there is little published data on whether open methods are superior to closed methods. Zakherah et al. in their study concluded that the open approach is a safe alternative to the closed approach for creating a pneumoperitoneum. Such an approach has other advantages such as reduced cost and instrumentation, and rapid formation of the pneumoperitoneum. He reported no major injuries in his study, but minor complications with open techniques comparable to mine (Zakherah, 2010) [15].

Moberg et al. reported no major injuries using the open technique in their study. He also reported a reduced incidence of minor complications such as gas leaks. However, access time was significantly longer with the open technique in patients with a BMI >25 (Moberg et al. 2012)[16].

M. Larobina and P. Nottle, in a meta-analysis of 760,890 closed laparoscopies and 22,465 open laparoscopies, found that the incidence of vascular injury was 0% for open laparoscopies compared with 0.44% for closed laparoscopies. The incidence of bowel injury was 0.7% vs 0.5%. The authors concluded that the open technique (Hasson) eliminated the risk of vascular injury and gas embolism and reduced the risk of bowel injury, and recommended the open technique for initial laparoscopic approaches (Larobina and Nottle, 2005)[17].

The European Association for Endoscopic Surgery also concluded that initial trocar insertion is faster with the open technique than with the Veress needle technique (Neudecker et al. 2002)[18].

Therefore, this study was designed to monitor the experience of a single institution to compare open versus closed techniques for establishing pneumoperitoneum and achieving maximal benefit from laparoscopic cholecystectomy.

Objectives

General Objectives:
Comparison of open and closed methods of establishing pneumoperitoneum in laparoscopic cholecystectomy.

Specific Objectives:

To detect the time required to create pneumoperitoneum. (From incision to laparoscope insertion), to record time spent on closing the wounds. (From removal of the last trocar to the final skin stitch), to record total operating time. (From the first incision to the last skin stitch), to record port site wound infection, and to record any complications.

Materials and methods:

This prospective comparative observational study was carried out in the Different surgery units of Sylhet MAG Osmani Medical College Hospital, Sylhet from September 2018 to August 2019. the sampling technique was Random sampling and the sample size was determined by Guilford and Frucher`s formula. An aggregate of 138 admitted cases with characteristic gallstone complaints who passed laparoscopic cholecystectomy was included in this study. The admission registration number was taken as the sampling frame, every odd number of the patient was taken as Group A and the even number of the patient was taken as Group B. Among them, 69 cases named for the closed system were considered Group A and the rest 69 cases named for the Open system were considered Group B for establishing Pneumoperitoneum for Laparoscopic Cholecystectomy. The patient was informed in detail regarding the procedure of the study and written consent was obtained. Progressed 18- 70 years of both sex, characteristic cholecystitis, no substantiation of common bile duct stone, abdominal wall skin free from any infection, normal umbilicus, and no history of the former laparotomy were enrolled in this study. Age< 18 years and> 70years, acute cholecystitis, substantiation of common bile duct stone, history of peritonitis, bleeding diseases, all laparoscopic surgeries getting converted to open surgeries, history of laparotomy, umbilical hernia, granuloma or abscess and severe systemic illnesses (COPD, DM, HTN) were barred from the study.

Results:

Table I: Distribution of the study patients by age (n=138)

Age (in a year)	Group A (n=69)		Group B (n=69)		P value
	n	%	n	%	
21-30	9	12.9	7	9.9	
31-40	21	30.1	15	21.5	
41-50	22	31.8	25	36.2	
51-60	8	11.5	16	23.1	
61-70	9	12.9	6	8.6	
Mean±SD	44.88±12.61		47.12±11.62		0.279ns
Range(min-max)	25-70		22-70		

Ns=not significant

P-value reached from unpaired t-test

Figure 1 shows the age distribution of the study patients, it was observed that almost one-third (31.8%) of patients belonged to age 41-50 years in group A and 25(36.2%) in group B. The mean age was 44.88±12.61 years in group A and 47.12±11.62 years in group B. The difference was statistically not significant (p>0.05) between the two groups.

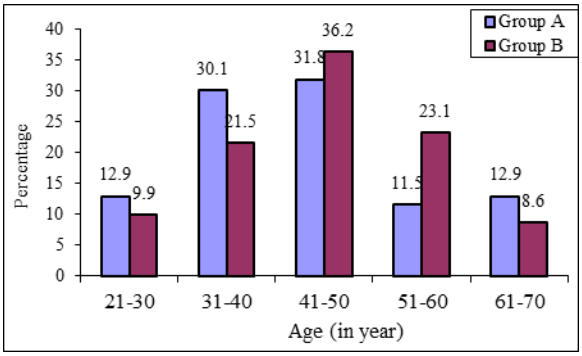

Figure 1: Bar diagram showing the age of the study patients

Table II: Distribution of the study patients by gender (n=138)

Gender	Group A (n=69)		Group B (n=69)		P value
	n	%	n	%	
Male	21	30.4	27	39.1	0.283
Female	48	69.6	42	60.9	

ns=not significant

p-value reached from the Chi-square test

Figure 2 shows the gender distribution of the study patients, it was observed that more than two third (69.6%) of patients were female in group A and 42(60.9%) in group B. The difference was statistically not significant (p>0.05) between the two groups.

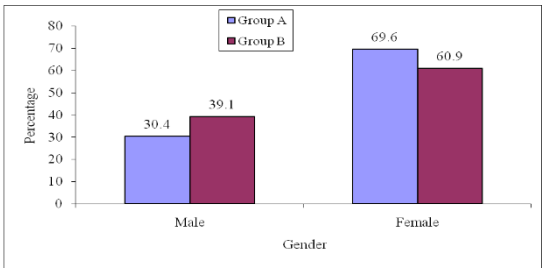

Figure 2: Bar diagram showing the gender of the study patients

Table III: Distribution of the study patients by access time (n=138)

Gender	Group A (n=69)	Group B (n=69)	P value
	Mean±SD	Mean±SD	
Access time (minutes)	7.43 ± 1.3	3.14±1.02	0.001[s]
Range (min-max)	5-10	2-9	

s= significant
P-value reached from Unpaired t-test

Table IV: Distribution of the study patients by gas leakage (n=138)

Gas leakage	Group A (n=69)		Group B (n=69)		P value
	n	%	n	%	
Yes	27	39.1	38	55.1	
No	42	60.9	31	44.9	0.061ns

ns= not significant
p-value reached from the Chi-square test

Table V: Distribution of the study patients by extraperitoneal insufflation (n=138)

Extraperitoneal insufflation	Group A (n=69)		Group B (n=69)		P value
	n	%	n	%	
Yes	15	21.7	5	7.2	0.015s
No	54	78.3	64	92.8	

s= significant
p-value reached from the Chi-square test

Table VI: Distribution of the study patients by duration of operation (n=138)

Gender	Group A (n=69)	Group B (n=69)	P value
	Mean±SD	Mean±SD	
Duration of operation (minutes)	81.83±20.21	53.42±11.63	0.001[s]
Range(min-max)	45-120	35-120	

s= significant
p-value reached from Unpaired t-test

Table VII: Distribution of the study patients by time spent on wound closure (n=138)

Gender	Group A (n=69)	Group B (n=69)	P value
	Mean±SD	Mean±SD	
Time spent on wound closure (minutes)	6.61±1.49	2.55±0.8	0.001[s]
Range(min-max)	4-10	1-5	

s= significant
p-value reached from Unpaired t-test

Table VIII: Distribution of the study patients by wound discharge/wound infection (n=138)

Wound discharge/Wound infection	Group A (n=69)		Group B (n=69)		P value
	n	%	n	%	
Yes	1	1.4	1	1.4	1.000ns
No	68	98.6	68	98.6	

ns=not significant
p-value reached from the Chi-square test

Discussion:

The present study findings were discussed and compared with previously published relevant studies.

In this present study, it was observed that 31.8% of patients belonged to age 41-50 years in group A and 36.2% in group B. The mean age was 44.88±12.61 years varying from 25-70 years in group A and 47.12±11.62 years varying from 22-70 years in group B. The difference was statistically not significant (p>0.05) between the two groups. Similarly, Chotai et al. (2017) showed the age of patients varied from 18–70 years in both groups i.e. veress needle group and

open method and maximum procedures were done in the age group of 21-30 years followed by 31-40 years of age19. Similar observations regarding the mean age and age range were also observed by Nawaz et al. (2016), Channa et al. (2009) and Akbar et al. (2008)[22,23,20].

In this current study, it was observed that 69.6% of patients were female in Group A and 60.9% in Group B. The difference was statistically not significant ($p>0.05$) between the two groups, which indicates that females were predominant in his present study. Similar observations regarding female predominant were also observed by Akbar et al.(2008), Juneja et al. (2016) and Nawaz et al. (2016) [20,21,22].

In this present study, it was observed that the mean access time was 7.43±1.3 minutes in group A and 3.14±1.02 minutes in group B. The mean access time was significantly ($p<0.05$) higher in group A. Chotai et al. (2017) study showed the access time for the creation of pneumoperitoneum and insertion of the camera port was 5.12±2.5172 minutes in the closed method whereas 3.94±2774 minutes in the open method[19]. The time of access is significantly ($p<0.05$) low in the open method group as compared to veress group, which supports the present study.

In this current study, it was observed that 39.1% of patients had gas leakage in group A and 55.1% in group B. The gas leakage was lower in group A but the difference was not statistically significant ($p>0.05$) between the two groups. Similar observations regarding the gas leak noticed were also observed by Chotai et al. (2017), Juneja et al. (2016), and Nawaz et al. (2016)[19,21,22].

In this present study, it was observed that 21.7% of patients had extraperitoneal insufflation in group A and 7.2% in group B. The extraperitoneal insufflation was significantly ($p<0.05$) higher in group A. Chotaiet al. (2017) study found extraperitoneal insufflation during entry occurred in 7.93% of patients in veress needle method and 2.06% in the open method, which is consistent with the current study[19].

In this current study, it was observed that 100.0% of patients had no visceral or vascular or port site hernia in groups A and B respectively. Almost similar identical findings were also observed by Taye et al. (2016), Juneja et al. (2016), and Akbar et al. (2008)[26,21,20].

In this present study, it was observed that the mean duration of operation was 81.83±20.21 minutes in group A and 53.42±11.63 minutes in group B. The mean duration of operation was significantly ($p<0.05$) prolonged in group A.
In this current study, it was observed that the mean time spent on wound closure was 6.61±1.49 minutes in group A and 2.55±0.8 minutes in group B. The mean time spent on wound closure was significantly ($p<0.05$) higher in group A. Parveen et al. (2013) found the mean wound closure time spent was 9.88±1.98 minutes varied from 10–15 minutes in group A and 4.97±0.7 minutes varied from 10–15 minutes in group B, which is similar to the present study.

In this current study, it was observed that 1.4% of patients had wound discharge/wound infection in groups A and B respectively. The difference was not statistically significant ($p>0.05$) between the two groups. Chotai et al. (2017) reported that wound infection occurred at the port site in 3.17% of patients in veress needle group and 3.09% of patients in the open group, which was observed at 1 week follow-up period and treated with daily dressing and oral antibiotics[19].

In this present study, it was observed that 100.0% of patients had no subcutaneous emphysema and gas embolism in groups A and B respectively. Taye et al. (2016) study found 0.87% cases of subcutaneous emphysema and 0.13% occurred with closed laparoscopy, which supports the present study[26].

Several life-threatening coronary, cerebral or other gas embolisms have been reported in the literature in closed laparoscopy. Such type of complication has not been reported in open laparoscopy obtained by Toro et al. (2012)[29]. There was no systemic or abdominal infection and subcutaneous emphysema observed in the

groups observed by Parveen et al. (2013). Similar findings were also reported by Chotai et al. (2017)[19].

Conclusion

Access time, duration of operation, time spent on wound closure and extraperitoneal insufflation were significantly ($p<0.05$) higher in the closed method. Gas leakage was higher in the open method but not significant. Visceral injury, need for conversion, haematoma formation, seroma formation, subcutaneous emphysema and gas embolism were not observed in any group. Wound discharge/Wound infection occurred in 1 patient in both groups. The closed system and the open system for gaining access into the peritoneal cavity are safe. The open fashion has a time advantage over the closed system. still, there are further complications associated with it, like multiple attempts, and gas leaks. But major vascular and visceral injuries didn't do in any of the groups. Overall, the open technique is good and is a good alternative to the closed technique for pneumoperitoneum creation in Laparoscopic Cholecystectomy.

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