

Open Versus Closed Pneumoperitoneum in Laparoscopic Cholecystectomy

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Objective: To present experience of open versus closed pneumoperitoneum in laparoscopic cholecystectomy. **Design:** This is an observational, comparative study. **Place and duration:** South Surgical Unit, Mayo Hospital, Lahore, from Jan 2001 to Dec 2002. **Subjects and methods:** This observational, comparative study was conducted in South Surgical Unit, Mayo Hospital, Lahore. Hundred patients under-going laparoscopic cholecystectomy using conventional pneumoperitoneum techniques from January 2001 to december 2002 were included in this study. The closed and open techniques of establishing pneumoperitoneum have been compared for the time required for each technique, complications and post-op hospital stay. **Results:** In this study 72 patients out of 100 underwent closed establishment of pneumoperitoneum and in 28 patients open technique was employed. Time required to establish pneumoperitoneum was one to two minutes with a mean of 1.18 minutes in closed technique. It was two to three minutes with a mean of 2.21 minutes in open technique. Paired-t test was applied and value of t was -1.721, df 98 and p-value 0.000. So the difference was significant. Time required to close the wound was one to three minutes with a mean of 2.24 in closed and two to five minutes with a mean of 3.32 in open technique. T-value was -8.752, df 97 and p-value 0.000. So the difference was significant. Post-op day of discharge was one to five in closed and one to seven in open technique. t-value was -1.390, df 98 and p-value 0.168. So the difference was not significant. Complications in 13 out of 72 patients occurred in closed while 6 patients out of 28 developed complications with open technique. Chi square test was applied p-value was found 0.9948 in open pneumoperitoneum. This shows that the difference is not significant. **Conclusions:** It is concluded from this study that the closed technique is better than open technique as regards the time required to establish the pneumoperitoneum and to close the wound. As there is no significant difference for complications and post-op hospital stay, so the closed technique can be used safely as well.

Key Words; Laparoscopic Cholecystectomy(LC) Pneumoperitoneum(PNM) Open Versus Closed

The favoured method of establishing a pneumoperitoneum in laparoscopic surgery is the closed technique³. This involves insufflation of the peritoneal cavity through a spring loaded (Veress) needle which is blindly placed intraperitoneally. Subsequently a trocar is inserted blindly to allow introduction of a laparoscope. Adhesions between viscera and the abdominal wall resulting from previous inflammation or surgery, patients with a thin abdominal wall and poor technique are factors which predispose to visceral or vascular injury due to perforation by the Veress needle or the first trocar⁴. Such injury may cause major morbidity and even death, particularly when unrecognized at the time of operation.

The open technique is an alternative method for creating pneumoperitoneum. In this technique the peritoneal cavity is opened under direct vision and a blunt-tipped (Hasson's) trocar introduced⁵. Although the open technique appears to be safer than the closed method, most laparoscopic surgeons prefer to use the Veress needle and insert the first trocar blindly because they feel that the closed technique is faster, requires a smaller incision and is not associated with leakage of carbon dioxide. The purpose of this study is to assess the complications of closed and open establishment of pneumoperitoneum.

Patients and Methods:

Hundred patients under-going laparoscopic cholecystectomy using conventional pneumoperitoneal

techniques from January 2001 to december 2002 were included in this study. The closed and open techniques of establishing pneumoperitoneum have been compared for the time required for each technique, complications and post-op hospital stay.

Results:

Total 100 patients were included in this study, 11 admitted through emergency and 89 through OPD. 87 patients were female and 13 were male. 23 patients had acute cholecystitis, 77 had symptomatic cholelithiasis. The age range of patients were from 19 to 70 years with a mean age of 43.38 years.

In 72 patients closed pneumoperitoneum was established using De-Verres needle. In 28 patients open pneumoperitoneum was established using Hasson's canula.

Time required to establish pneumoperitoneum in closed technique took one to two minutes with a mean of 1.18 minutes. In open technique it took two to three minutes with a mean of 2.21 minutes. Paired-t test was applied. t-value was -11.721 with a degree of freedom 98 and p-value was 0.000. So time difference required to establish pneumoperitoneum was significantly less in closed variety (Table 1).

Time required to close the wound after closed pneumoperitoneum took one to three minutes with a mean 2.24 minutes. While in closed technique it took two to five minutes with a mean 3.32 minutes. Paired-t test was

applied. *t*-value was -8.752 with a degree of freedom 97 and *p*-value 0.000. So time required to close wound after completion of procedure was significantly less after closed technique than after open technique (Table 2).

Post-op day of discharge after open technique ranged from one to five with a mean of 1.65 days. After open technique it was from day one to seven with a mean of 1.96 days. In paired-*t* test *t*-value was -1.390, degree of freedom 98 and *p*-value 0.168. This shows that there is no significant difference in post-op. day of discharge between the two techniques (Table 3).

Per and post-operatively some patients developed complications. In closed technique 59 out of 72 patients had no per-op or post-op complication. In open technique 22 out of 28 patients didn't develop any complication per or post-operatively (Table 4).

Table 1: Time required to establish pneumoperitoneum

Time required	Closed technique	%age	Open technique	%age
1 min.	60	83.33	0	0
2 min.	12	16.67	19	67.86
3 min.	0	0	9	32.14

P-value: 0.000, *Paired-*t* test was applied. *t*-value was -11.721 with *df* 98 and *p*-value 0.000. So the difference is significant.

Table 2: Time required to close the wound

Time required	Closed technique	%age	Open technique	%age
1 min.	5	6.94		
2 min.	48	66.67	2	7.14
3 min.	19	26.34	16	57.14
4 min.			9	32.14
5 min.			5	17.86

*Paired-*t* test was applied. *t*-value was -8.752, *df* 97 and *p*-value 0.000. So difference is significant.

Table 3: Post-op day of discharge

Day	Closed technique	%age	Open technique	%age
1	46	63.89	9	32.14
2	13	18.06	13	46.43
3	6	8.33	5	17.86
4	6	8.33		
>4	1	1.39	1	3.57

*Paired-*t* test was applied. *t*-value was -1.390, *df* 98 and *p*-value 0.168. So the difference is not significant.

Table 4: Complications

Complications	Closed technique	%age	Open technique	%age
No	59	81.94	22	78.57
Visceral injury	1	1.39	0	0
Post-op fever	4	5.56	3	10.71
Wound infection	4	5.56	2	7.14
Sub-phrenic collection	1	1.39	0	0
Sub-hepatic collection	1	1.39	0	0
Post-op ileus	3	4.17	0	0
Incisional hernia	0	0	1	3.57

*Chi-square test was applied. value was 0.004, *df* 1 and *p*-value 0.948.

Discussion:

First report of laparoscopic cholecystectomy was reported almost a 16 years ago by Muhe⁷. Since then this procedure has rapidly gained popularity and is replacing the conventional open cholecystectomy^{7,8}. Studies on thousands of people are now available to get meaningful results⁸. This new technique is associated with a different set of complications. Injuries during introduction of Verres needle or Hasson's canula is one of them.

Open laparoscopy was first described by Hasson in 1971⁸. In spite of the simplicity of open technique, closed laparoscopy remained the preferred method of establishing a pneumoperitoneum⁹.

This study was conducted on patients undergoing laparoscopic cholecystectomy. Open and closed techniques of pneumoperitoneum were compared for the time required to establish pneumoperitoneum, time required to close the wound, complications and post-op day of discharge.

A study comprising of 6512 laparoscopic cholecystectomies took data from French Society of International Surgery and French Society of Endoscopic Surgery and Operative Radiology. It showed that 87 patients out of 6512 required conversion to open cholecystectomy. Out of these 87 three were due to visceral injury related to entry of first trocar. Some of these three conversions were due to haemorrhage, which also included bleeding from mesenteric vessels due to trocar injury.

In a survey in 1982 by the American Association of Gynaecologic Laparoscopists¹⁰, only 4% of all laparoscopic procedures were done using open laparoscopy. Review of literature revealed only 12444 cases of open laparoscopy, compared with 489335 cases of closed laparoscopy. In my study we see that again more patients underwent closed laparoscopy.

Prospective randomized studies of open versus closed establishment of pneumoperitoneum have not been performed. The available comparative studies involve retrospective analysis of comparatively small numbers of patients^{1,11}. Since the incidence of visceral and vascular injuries due to Veress needle or trocar insertion is low, a prospective study comparing open and closed laparoscopy would require excessive number of patients to allow statistically significant statements to be made. Analysis of the existing literature is therefore, the only realistic way of comparing the complications of open and closed laparoscopy.

Surgeons who prefer closed technique believe that the open method is time consuming and compromised by leakage of carbon dioxide during laparoscopy. However, it was noted that open technique did not take more than 5 min in most of the patients but the difference was significant statistically. Two comparative studies of open and closed laparoscopy have shown that operative time of open laparoscopy is significantly shorter than that of closed laparoscopy^{1,12}. Insufflation of peritoneal cavity

through Veress needle is done with a low flow setting.. In open laparoscopy^{1,11}, insufflation through a Hasson's canula can be done with a high flow because of its diameter of 10 mm: this permits time saving. Gas leakage around Hasson's trocar is a potential disadvantage of open laparoscopy, but limiting the incision of fascia and anchoring of Hasson's canula to the abdominal fascia prevent such leakage.. In a situation of persistent gas leakage, a gauze swab inserted in the umbilical incision or an additional purse-string suture around the trocar usually solves the problem.

Closed laparoscopy may be difficult in obese patients due to various reasons¹³. Lifting of the abdominal wall before insertion of the Veress needle increases the distance between the abdominal fascia and the skin because the panniculus is usually loosely attached to the fascia. In addition the peritoneum is pushed by forwarding front of the needle because of excessive preperitoneal fat. These problems are not encountered at open laparoscopy, because the fascia and the peritoneum are lifted individually and subsequently incised. Moreover insertion of a blunt-tipped trocar under direct vision prevents lesions of blood vessels.

Gas embolism is a rare but often fatal complication of laparoscopy. It is caused by insufflating carbon dioxide into a blood vessel¹². The incidence of gas embolism was zero in both techniques but gas embolism is highly unlikely in open laparoscopy because the trocar through which the peritoneal cavity is insufflated is placed under direct vision.

Fascial closure of trocar site remains controversial¹³. In the study the incidence of incisional hernia is 3.57 percent in open laparoscopy. It is believed that inserting the trocar obliquely through the abdominal wall reduces herniation of the peritoneum or viscera. Closure of 10 mm trocar site may be difficult technically, particularly in obese patients. In open technique closure of wound is relatively simple due to stay sutures. In my study this is noted that wound closure took significantly less time in open pneumoperitoneum as compared to closed technique.

To prevent the perforation of vessels and viscera disposable trocars with safety shields were developed in the late 1980s. The safety shield is supposed to shoot forward after the peritoneum has been penetrated. However the shield can be held back for a considerable distance, particularly in cases of loose peritoneum¹⁴. This leaves the stylet of the trocar unprotected in the peritoneal cavity. In thin patients and when the abdominal wall is not lifted properly, the trocar can cause visceral or vascular injury¹⁵.

In recent years, disposable canulas with transparent tips and either plastic rims or mechanically triggered cutting blade for dissection of abdominal wall have been developed¹⁸. During introduction of trocar, the passage of subsequent anatomical layers can be viewed with the laparoscope. Although these devices appear to be safer

than trocars with a safety shield, discrimination of tissues during insertion through the abdominal wall is difficult, particularly the differentiation between peritoneum and bowel wall.

Conclusion:

On the basis of our experience of the laparoscopic cholecystectomy and closed versus open pneumoperitoneum, we conclude that; Closed pneumoperitoneum can be used safely for laparoscopic cholecystectomy. In our study it is noted that the time required to establish pneumoperitoneum and to close the wound postoperatively is significantly less in closed technique as compared to open technique. There is no significant difference of postoperative day of discharge and complications between the two techniques.

It is generally considered that open technique is safe as regards the per-op or post-op complications. In our study it is noted that no significant difference is present, but this study is on limited patients and there might be some significant difference if the patients number is increased and the study is expanded.

Results also depend upon the level of experience, the availability of facilities and post-op care of patient. Anyhow in our study we can say that the closed pneumoperitoneum is better than the open technique, keeping in mind the results that less time required to establish the pneumoperitoneum and to close the wound. Moreover no difference is noted in regard to post-op day of discharge and complications.

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