

ORIGINAL RESEARCH

Open versus closed method of pneumoperitoneum creation in laparoscopic surgery

¹Dr. Brajendra Swaroop, ²Dr. Manoj Kumar Sharma, ³Dr. Rajesh Kumar Badal

^{1,3}Assistant Professor, Department of General Surgery, Government Medical College, Datia MP, India

²Assistant Professor, Government Medical College, Datia, MP, India

Corresponding author

Dr. Rajesh Kumar Badal

Assistant Professor, Department of General Surgery, Government Medical College, Datia MP, India

Received: 23 June, 2023

Accepted: 27 July, 2023

ABSTRACT

Background: To study and compare the efficacy of closed and open method of pneumoperitoneum creation in laparoscopic surgery. **Materials & Methods:** The research utilized a deliberate sampling approach, concentrating on patients diagnosed with cholelithiasis who were advised to undergo laparoscopic cholecystectomy and gave their consent. The age of subjects was between 20 to 65 years. The results were analysed using SPSS software. The p-value less than 0.05 was considered significant. **Results:** The age group of 31-50 years witnessed the highest number of patients who underwent laparoscopic cholecystectomy using either technique. Specifically, 50% of the cases were in group A, while 60% were in group B. **Conclusion:** The open method for creating pneumoperitoneum is equally safe and efficient when compared to the closed technique.

Keywords: Open method, laparoscopic surgery, pneumoperitoneum.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution- Non Commercial- Share Alike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

INTRODUCTION

The word laparoscopy originated from the Greek word Laparo - which means abdomen, and scopion-meaning to examine. Laparoscopy is the art of evaluating the abdominal cavity and its contents. This is achieved by creating a pneumoperitoneum where the abdominal cavity is insufflated with gas to establish sufficient space and visualize the abdominal contents using an illuminated telescope field.¹ Currently, laparoscopy is widely used in the practice of medicine for both diagnostic and therapeutic purposes. This minimally invasive approach has become the method of choice for treating many abdominal diseases that require surgery. However, laparoscopic procedures are not risk-free as laparoscopic entry is a blind procedure and presents its problem. The most crucial step of a laparoscopic procedure is the creation of a pneumoperitoneum. Complications related to laparoscopic surgery are rare and commonly occur when accessing the peritoneal cavity.² Hasson first described the open laparoscopy in 1971 and it remains the favourite entry method for many laparoscopic surgeons.³ In open technique 1-1.5 cm sub-umbilical incision is made, subcutaneous fat is dissected, rectus sheath and then peritoneum are incised under direct vision. The laparoscopic sheath

without its trocar is then inserted into the peritoneal cavity followed by insufflations. After completion of the intended procedure the rectus sheath is closed with interrupted absorbable or purse string suture followed by the skin closure. Laparoscopic cholecystectomy (LC) is the gold standard operation for gallstone disease. Primary port placement into the abdomen through small incisions for insertion of laparoscopic surgical instruments which is a blind procedure is challenging and fraught with complications. Access is associated with injuries to the gastrointestinal tract structures and major blood vessels, and at least 50% of these major complications occur before commencement of the intended surgery.^{4,5}

Access into the abdomen is the one challenge of laparoscopy that is particular to the insertion of surgical instruments through small incisions. Laparoscopy is currently widely used in the practice of medicine, for both diagnostic and therapeutic purposes. The minimally invasive approach has become the method of choice for treating most benign abdominal diseases that require surgery. However, it is obvious that laparoscopic procedures are not risk free. Laparoscopic entry is a blind procedure, and it represents a problem for all the related complications. Complications arising from laparoscopic surgery are

rare and commonly occur when attempting to gain access to the peritoneal cavity.⁶ Creation of the pneumoperitoneum is the first and most critical step of a laparoscopic procedure because that access is associated with injuries to the gastrointestinal tract and major blood vessels and at least 50% of these major complications occurs prior to commencement of the intended surgery. This complication rate has remained the same during the past 25 years.⁷ The open laparoscopic entry is considered particularly safe in patients with previous abdominal surgery, especially midline incisions. Vascular injuries are nearly entirely prevented by the open entry technique, with anecdotal cases of aortic laceration being reported. These injuries have been attributed to an insufficient elevation of the abdominal wall, with the skin incision passing directly through skin, fascia, and into the underlying vessels.^{8,9} Hence, this study was conducted to compare the efficacy of closed and open method of pneumoperitoneum creation in laparoscopic surgery.

MATERIALS & METHODS

The research utilized a deliberate sampling approach, concentrating on patients diagnosed with cholelithiasis who were advised to undergo laparoscopic cholecystectomy and gave their consent. The age of subjects was between 20 to 65 years. The research encompassed 40 instances of cholelithiasis that met the defined criteria and opted for planned cholecystectomy. Out of these, 20 cases were managed using the closed technique, while the

remaining 20 underwent the open technique. Instances where pneumoperitoneum was established through the closed approach were labeled as group A, while those involving the open approach were labeled as group B. Several factors were examined to juxtapose the safety and efficacy of these two approaches. Evaluations of the patients occurred on the day following the surgery, a week after post-operation, and after 2 months. Follow up was done. The results were analysed using SPSS software. The p- value less than 0.05 was considered significant.

RESULTS

The age group of 31-50 years witnessed the highest number of patients who underwent laparoscopic cholecystectomy using either technique. Specifically, 50% of the cases were in group A, while 60% were in group B. In group A, the majority of patients experienced pneumoperitoneum setup within the 6-10 minute range, accounting for 18 patients. The average time taken to induce pneumoperitoneum in this group was 9.42 minutes, and the calculated standard deviation was 1.02. Conversely, in group B, the process of creating pneumoperitoneum took anywhere from 5 to 10 minutes. The highest number of patients, totaling 17 individuals, underwent pneumoperitoneum setup within the 6-10 minute timeframe. The mean time for pneumoperitoneum induction in this group was 5.86 minutes. The calculated standard deviation was 0.91, and the corresponding p-value was 0.04, signifying statistical significance.

Table 1: Age distribution percentage (%)

Age (years)	Closed method		Open method	
	Frequency	Percentage	Frequency	Percentage
20-30	2	10	1	5
31-50	10	50	12	60
50-65	8	40	7	35
Total	20	100	20	100

Table 2: Time taken for access

Time taken (min.)	Closed method		Open method		P -value
	Frequency	Percentage (%)	Frequency	Percentage	
1-5	0	0	3	15	0.04*
6-10	18	90	17	85	
>10	2	10	0	0	
Total	20	100	20	100	
Mean	9.42		5.86		0.001**
SD	1.02		0.91		

*: significant, **: highly significant

DISCUSSION

A transversely placed sub/supraumbilical stab skin incision of about 5-6mm was employed, and then, subcutaneous tissue was bluntly dissected until fascia was palpable. The abdominal wall was lifted with one hand, while the Veress needle was held in the right hand like a dart and inserted through the fascia into the peritoneal cavity. The angle of Veress needle

insertion varied from 45° in non-obese to 90° in obese.¹⁰ The Veress needle was noted to have made two distinct clicks as it sequentially passed through the umbilical fascia and then the peritoneum. To verify the accurate positioning of the Veress needle, the confirming criterion involved ensuring that the intraperitoneal pressure remained below 8 mm Hg and that gas was able to flow unrestrictedly. Hence, this

study was conducted to compare the efficacy of closed and open method of pneumoperitoneum creation in laparoscopic surgery.

In the present study, the age group of 31-50 years witnessed the highest number of patients who underwent laparoscopic cholecystectomy using either technique. Specifically, 50% of the cases were in group A, while 60% were in group B. In group A, the majority of patients experienced pneumoperitoneum setup within the 6-10 minute range, accounting for 18 patients. The average time taken to induce pneumoperitoneum in this group was 9.42 minutes, and the calculated standard deviation was 1.02. A study by Agarwal PK et al, out of 60 patients, 31 underwent the closed method, while 29 underwent the open method. Minor complications like gas leak during the procedure was observed more in the open method. The mean access time in the open-method group was less than in the closed-method group. Other complications like visceral injury, vascular injury, need for conversion, umbilical port site hematoma, umbilical port site infection, and hernia were not observed in either group during the allocated follow-up period in the study. Conclusion: Open technique for pneumoperitoneum is as safe and effective as the closed technique.¹¹

In the present study, in group B, the process of creating pneumoperitoneum took anywhere from 5 to 10 minutes. The highest number of patients, totaling 17 individuals, underwent pneumoperitoneum setup within the 6-10 minute timeframe. The mean time for pneumoperitoneum induction in this group was 5.86 minutes. The calculated standard deviation was 0.91, and the corresponding p-value was 0.04, signifying statistical significance. Another study by Bonjer HJ et al, collected data on closed laparoscopy in 489335 patients and on open laparoscopy in 12444 patients. Rates of visceral and vascular injury were respectively 0.083 and 0.075 per cent after closed laparoscopy, and 0.048 per cent and zero after open laparoscopy. Mortality rates after closed and open laparoscopy were respectively 0.003 per cent and zero. Pearson chi 2 analysis demonstrated a statistically significant difference in terms of visceral and vascular injury between closed and open laparoscopy ($P = 0.002$); there was no such difference for mortality rates. Open establishment of pneumoperitoneum is advocated in laparoscopic surgery because it is safer than the closed method.¹² Taye MK et al, comparative study conducted at three hospitals in Dibrugarh district, Assam, India from January 2012 to December 2014. Total 3000 cases were included in the study with 1500 cases of open laparoscopy and 1500 cases of closed laparoscopy. In closed laparoscopy group minor complications occurred in 80 (5.33%) and major complications in 20 (1.33%) cases. In open laparoscopy group minor complications were observed in 60 (4%) and major complications in 2 (0.13%). The p-value of the difference between the two groups for minor complications was 0.0834 and

for major complications was 0.0001 (significant). Open laparoscopy was seen to be better than closed laparoscopy in terms of not only the rate of occurrence of complications but also the nature and severity of the complications. Open technique can be performed in all cases irrespective of previous operative scar, suspected intra peritoneal adhesions or obesity. Favourable outcome may be achieved in closed technique in cases of normal BMI, absence of postoperative scar in the abdomen, absence of abdominal and genital tuberculosis and pelvic inflammatory disease.¹³ Buruah A et al, closed/Veress and open/Hasson's method of establishing pneumoperitoneum in laparoscopic cholecystectomy is equally safe in terms of major complications. The closed/Veress method gives faster access to the abdomen as compared to the open method (5.62 ± 2.23 minutes and 7.18 ± 2.52 minutes, respectively, p value < 0.0001). The open/Hasson's method is associated with more primary port site complications (9/200 vs. 0/200, p value 0.0036) and troublesome intraoperative gas leaks (39/200 vs. 2/200, p value < 0.0001). The open technique for primary peritoneal access port for laparoscopic cholecystectomy does not impart any additional benefits in terms of safety and morbidity profile in patients undergoing LC. The closed/Veress method of establishing pneumoperitoneum in laparoscopic cholecystectomy is equally safe in terms of major complications and gives quicker access to the abdomen as compared to the open method.¹⁴ Jamil M et al, There were 850 patients, with 425 (50%) in each of the two groups. The overall mean age was 38.78 ± 5.41 years, and 667 (78%) were females. The mean access time in Group A was 6.58 ± 1.78 min and in Group B it was 5.49 ± 1.82 min. The mean closure time was 7.60 ± 2.12 min in Group A and 6.91 ± 1.40 min in Group B ($p < 0.00$). Access problem in Group A was significantly high ($p = 0.001$). Abdominal wall complications were 13 (3.05%) in Group A and 24 (5.64%) in Group B ($p = 0.064$). Visceral injury happened in 5 (1.17%) patients in Group A and 1 (0.23%) in Group B ($p = 0.101$). Open method of pneumoperitoneum was found to be safe and less time-consuming compared to the closed method.¹⁵

CONCLUSION

The open method for creating pneumoperitoneum is equally safe and efficient when compared to the closed technique, making it a viable substitute for the closed approach.

REFERENCES

1. Open versus closed method of establishing pneumoperitoneum for laparoscopic surgery. Juneja I, Bhatt J, Vaishnani B, Patiwal F. https://ijorim.com/siteadmin/article_issue/14606120334%20fazal.pdf.pdf Int J Res Med. 2016;5(1):9-13.
2. Laparoscopic entry techniques: clinical guideline, national survey, and medicolegal ramifications. Varma R, Gupta JK. Surg Endosc. 2008;22:2686-2697.

3. Hasson HM. A modified instrument and method for laparoscopy. *American Journal of Obstetrics and Gynaecology*. 1971;110(6):886–87.
4. Jansen F. W., Kapiteyn K., Trimbos-Kemper T., Hermans J., Trimbos J. B. Complications of laparoscopy: a prospective multicentre observational study. *BJOG: An International Journal of Obstetrics and Gynaecology*. 1997;104(5):595–600.
5. Jansen F. W., Kolkman W., Bakkum E. A., de Kroon C. D., Trimbos-Kemper T. C., Trimbos J. B. Complications of laparoscopy: an inquiry about closed versus open-entry technique. *American Journal of Obstetrics and Gynecology*. 2004;190(3):634–638.
6. Varma R, Gupta JK. Laparoscopic entry techniques: clinical guideline, national survey, and medicolegal ramifications. *Surgical Endoscopy and Other Interventional Techniques*. 2008;22(12):2686–2697.
7. Krishnakumar S, Tambe P. Entry complications in laparoscopic surgery. *Journal of Gynecological Endoscopy and Surgery*. 2009;1(1):4–11.
8. Hanney RM, Alle KM, Cregan PC. Major vascular injury and laparoscopy. *Australian and New Zealand Journal of Surgery*. 1995;65(7):533–535.
9. Hanney RM, Carmalt HL, Merrett N, Tait N. Use of the hasson cannula producing major vascular injury at laparoscopy. *Surgical Endoscopy*. 1999;13(12):1238–1240.
10. Hurd W. W., Bude R. O., DeLancey J. O., Pearl M. L. The relationship of the umbilicus to the aortic bifurcation: implications for laparoscopic technique. *Obstetrics & Gynecology*. 1992;80(1):48–51.
11. Agarwal PK, Golmei J, Goyal R, Maurya AP. Comparison Between Closed and Open Methods for Creating Pneumoperitoneum in Laparoscopic Cholecystectomy. *Cureus*. 2023 Mar 10;15(3):e35991.
12. Bonjer HJ, Hazebroek EJ, Kazemier G, Giuffrida MC, Meijer WS, Lange JF. Open versus closed establishment of pneumoperitoneum in laparoscopic surgery. *Br J Surg*. 1997 May;84(5):599-602.
13. Taye MK, Fazal SA, Pegu D, Saikia D. Open Versus Closed Laparoscopy: Yet an Unresolved Controversy. *J Clin Diagn Res*. 2016 Feb;10(2):QC04-7.
14. Baruah A, Topno N, Ghosh S, Naku N, Hajong R, Tongper D, Khongwar D, Baruah P, Chishi N, Sutradhar S. A Study of the Safety and Morbidity Profile of Closed versus Open Technique of Laparoscopic Primary Peritoneal Access Port in Patients Undergoing Routine Laparoscopic Cholecystectomy at a Tertiary Care Hospital in Northeastern India. *Minim Invasive Surg*. 2022 Jul 12;2022:1017551.
15. Jamil M, Niaz K, Tahir F. Closed vs. open method of pneumoperitonium at infra-umbilical site in laparoscopic surgery - A comparative study. *J Pak Med Assoc*. 2018 Oct;68(10):1478-1482.