

In Laparoscopic Surgery, a Comparative Study of the Open vs Closed Approach of Pneumoperitoneum Generation

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Abstract

Aim: A comparative study of the open versus closed method of pneumoperitoneum creation in laparoscopic surgery.

Methods: This comparative study conducted in multiple institutes of Bihar, India, for 12 months. 100 patients of either sex were selected who undergone operative procedure for laparoscopy surgery were included in this study. The patients were diagnosed on the basis of clinical symptoms, physical examination and haematological as well as radiological investigations. All patients undergoing elective laparoscopic surgery and hemodynamically stable patients.

Results: Technical difficulties like multiple attempts, gas leak at port site and port site bleeding are more in open method than in closed method, which is attributed to larger size of incision in open method, Furthermore, a significant higher incidence of such minor complications is found in case of BMI >25 $p=5.44$ ($p<0.05$) at confidence level of 95%). Duration for pneumoperitoneum creation in open method group is shorter as compared to closed method group for pneumoperitoneum creation in laparoscopic surgery; p -value is 0 ($p<0.05$) at confidence level of 95%). Minor technical difficulties like multiple attempts ($p=0.041$), gas leak at port site ($p=0.047$), and minor complications like port site bleeding are more with open method. While one case pre peritoneal insufflation is noted in case of closed method. Here $p<0.05$ in most of the cases. Hence, it is statistically significant.

Conclusion: In our study, we can conclude that both methods i.e. open and closed methods of creating pneumoperitoneum in laparoscopic surgery are safe to perform. The open technique has slightly more incidence of minor complications due to large incision size but has advantage of lesser duration needed for procedure.

Keywords: pneumoperitoneum, laparoscopic surgery, open and closed method

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Introduction

Laparoscopy is the type of surgical procedure that allows a surgeon to access the inside of the abdomen and pelvis without having to make a large incision on the skin, hence is known as key-hole surgery[1]It is derived from the Greek word *laparo* meaning abdomen and *skopein* meaning to see. Laparoscopy is preferred to laparotomy wherever feasible because of its advantages like decreased postoperative hospitalisation, less postoperative pain, faster improvements in quality of life, better cosmetic results, and smaller scars[2]This procedure consists of creating a pneumoperitoneum therefore distending the abdominal cavity, primary and secondary port placements, and different port closure techniques. There are five basic ways available at present to create pneumoperitoneum - blind Veress needle insertion, direct trocar insertion, optical trocar insertion, open method, and modified open method, out of which direct Veress needle insertion is the most commonly used[3]The most significant risks for laparoscopy consist of trocar injuries during insertion into the abdominal cavity, port site complications like port site infection, port site oedema, port site haematoma, and port site pain, and a greater risk of hypothermia and peritoneal trauma due to increased exposure to cold and dry gases during insufflation[4]The risk of such injuries, especially those during trocar entry, is increased in patients who have low body mass index or have a history of prior abdominal surgery[5,6]However, the overall incidence of complications in laparoscopic surgery is still less compared to open surgery. Past studies indicate that the open method is better than closed method in terms of duration of the surgery and frequency and severity of complications, especially in patients with low BMI, scars of previous surgery, abdominal tuberculosis, and pelvic inflammatory disease[7,10]

Material and methods

This comparative study conducted in the multiple institutes of Bihar, India, for 12 months, after taking the approval of the protocol review committee and institutional ethics committee.

Methodology

100 patients of either sex were selected who undergone operative procedure for laparoscopy surgery were included in this study. The patients were diagnosed on the basis of clinical symptoms, physical examination and haematological as well as radiological investigations. Per operative findings like method of pneumoperitoneum creation and its duration, multiple attempts, incision size, extra peritoneal insufflation, port site bleeding, gas leak, total gas used were recorded. Per operative complications like visceral or vascular injury, port site hematoma, conversion to open surgery noted. Patients were assessed in post-operative period for wound hematoma, wound infection, gas embolism and port site incisional hernia noted in follow up to 3 months. Criteria for selection includes, all patients undergoing elective laparoscopic surgery and hemodynamically stable patients; And excludes Patients undergoing emergency laparoscopic surgery, Past history of abdominal tuberculosis or puerperal sepsis, cases of machinery failure for establishment of pneumoperitoneum, Patients having intestinal obstruction. Methods used for getting statistical significance are Chi square test.

Results

Technical difficulties like multiple attempts, gas leak at port site and port site bleeding are more in open method than in closed method, which is attributed to larger size of incision in open method, Furthermore, a significant higher incidence of such minor complications is found in case of BMI >25 $p=5.44$ ($p<0.05$) at confidence level of 95%) (table 1)

Table 1: Size of incision in both methods

	Open methods	Closed methods
AVG SIZE OF INCISION (mm)	13	12.5
Maximum size of incision mm	14.5	13.5
Minimum size of incision mm	12.5	12.5

Duration for pneumoperitoneum creation in open method group is shorter as compared to closed method group for pneumoperitoneum creation in laparoscopic surgery; p value is 0 ($p < 0.05$) at confidence level of 95%) (table 2.)

Table 2: Duration of pneumoperitonium creation in both methods

	Open methods	Closed methods
Avg duration of Pneumoperitonium creation (sec)	110	135
Maximum duration of pneumoperitonium creation (sec)	210	175
Minimum duration of pneumoperitonium creation (sec)	80	80

Minor technical difficulties like multiple attempts ($p=0.041$), gas leak at port site ($p=0.047$), and minor complications like port site bleeding are more with open method. While one case pre peritoneal insufflation is noted in case of closed method. Here $p < 0.05$ in most of the cases. Hence, it is statistically significant. In our study no case of visceral/vascular injury and port site hematoma was reported. Wound infection (clear discharge) occurred in three cases, one in open method and two in closed method group and were treated successfully by antibiotics and dressing. Port site hernia is reported in none of the cases on the follow up period till date but longer period of follow up is needed. Previous surgery especially laparoscopic surgery and surgery around umbilicus and their scar may cause adhesions between viscera and scar and may increase likelihood of injury during pneumoperitoneum. Hence it is better to perform open method of creating pneumoperitoneum in these patients. Type of the laparoscopic procedure has no impact in our study as there were no specific selection criteria for type of laparoscopic procedure.

Discussion

Over the past few years, there are many techniques, instruments and guidelines have been introduced to reduce the risks associated with pneumoperitoneum creation in laparoscopic surgery. No single technique or instrument has been proved to eliminate laparoscopic entry associated injuries and complications. Besides the classic (closed) blind veress technique, there are other techniques like Hasson technique (open), direct trocar insertion, use of disposable shielded trocars, radially expanding and optical trocars.

The advantage of open technique is that peritoneal cavity access is gained under direct vision, preventing most severe injuries. Injury to intra-abdominal structures is potentially avoidable complication of laparoscopy. Many of these injuries are related to the blind placement of the veress needle or sharp primary trocar into the abdomen when performing a technique referred as closed laparoscopy. Most laparoscopists still feel it safer to use classic blind veress needle entry to create pneumoperitoneum first before inserting the trocar as routine laparoscopic approach. This study showed that minor complications are slightly more with open method of pneumoperitoneum creation like

multiple attempts, gas leak at port site and port site bleeding as compared to closed method. One case of pre peritoneal insufflation noted in case of closed method. There were two cases of port site infection in open method and one in closed method, which were treated with antibiotics and dressing. There were no major complications in both methods. There is less duration of pneumoperitoneum creation and less gas is used in open method as compared to closed method, which makes it difficult to give conclusive evidence about the superiority between the two techniques.

The complications in open method were due to the larger incision size associated with the open method. Indeed, the incision is a mini laparotomy as opposed to the needle puncture the closed technique. The results conform to those found in other studies. Schafer et al while comparing the complications of both techniques concluded that the open access method failed to show any superiority over the closed technique.¹¹ However, Bonjer et al in their comparison between open and closed techniques found that the rates of visceral and vascular injury were respectively 0.08% and 0.07% after closed laparoscopy, and 0.05% and 0% after open laparoscopy (p=0.002). There was no significant difference in the mortality rates[12]In this study, there was no mortality in either of the two study arms. Chapron et al on the other hand, reported that the bowel and major vessel injury rates were 0.04% and 0.01% in the closed technique (n=8324) and 0.19% and 0% in the open technique (n=1562), respectively. They concluded that open laparoscopy does not reduce the risk of major complications during laparoscopic access[12]Chandler et al. also found that the open technique had no advantage over the closed technique in terms of safety[13]In this study, we encountered no major complication in either of the groups.

The European association for endoscopic surgery states that, the randomized

controlled trials comparing closed versus open approach have an inadequate sample size to find a difference in serious complications[14,15]In large outcomes studies, there were fewer complications in the closed group, although randomized controlled trials found the open approach faster and were associated with a lower incidence of minor complications. The panel did not favour the use of either technique over the other. In this study, we found that the open technique was faster than the closed technique. This is also similar to previous studies. Petigen et al found that the open technique took half the time required by the closed technique and recommended its use on the basis of it being more cost- effective[16]

The European association for endoscopic surgery also concluded that the insertion of the first trocar with the open technique is faster compared to the veress needle method. Sigman et al. also found that less time was required for the open method and advocated its use on this basis[17]Zakherah et al in his study concluded that the open technique is safe alternative to the closed entry technique for the creation of pneumoperitoneum[18]Such an approach has further advantages such as less cost and instrumentation and rapid creation of pneumoperitoneum. In his study he reported no major injury occurs but minor complications were more with open technique which is comparable to our study. Moberg A et al in his study reported no major injuries using open technique[19]He also reported lesser incidence of minor complications like gas leak. However, time taken for access was significantly more in case of patients with BMI >25 for open technique. In our study, time for access is more with patients having BMI >25. Shailesh Kumar et al concluded in his study that veress needle (closed technique) is comparable or even superior to open technique in terms of access related complications[20]Ilias et al concluded that although minor complications occurred using open technique, it was

faster[21]Which is comparable to our study. The entry of open method was faster in this study, but in one out of ten cases, we encountered the problem of 'gas leak. This was resolved by tightening and anchorage of the cut fascia to the trocar. This consumes time and causes disturbance in the middle of the procedure.

Conclusion

In our study, we can conclude that both methods i.e. open and closed methods of creating pneumoperitoneum in laparoscopic surgery are safe to perform. The open technique has slightly more incidence of minor complications due to large incision size but has advantage of lesser duration needed for procedure. But major vascular and visceral injury did not occur in any of the groups. Hence, open technique is as good as closed technique, and is good alternative to closed technique for pneumoperitoneum creation in laparoscopic surgery.

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