ORIGINAL ARTICLE

Extracorporeal Abdominal Transillumination in Laparoscopic Ventral Hernia Repair: A Tool to Achieve More Confidence and Safety

Maged Rihan

Received on: 10 February 2022; *Accepted on*: 14 September 2022; *Published on*: 07 December 2022

Abstract

Background: Two-port laparoscopic ventral hernia repair is currently practiced with preferable results. This study was conducted aiming to add to the general safety of trocar placement, and trying to solve the problems of the blind insertion of the primary trocar. This can be achieved by extracorporeal transillumination of the anterior abdominal wall before insertion of the primary trocar; thus, delineating whether the abdominal wall harbors any underlying tissues, and accordingly trying to visualize what is being performed rather than doing it blindly.

Materials and methods: This is a single-center study. Patients' enrollment was carried out between March 2018 and June 2019. They were randomized into two groups: Laparoscopic repair using transillumination before inserting the primary (camera) trocar (group I) and laparoscopic repair only (group II). The primary endpoint was the length of the direct distance between the primary port and the left midaxillary line. This distance is inversely proportional to the distance that will exist between the camera port and the hernial defect. Secondary outcomes involved the duration of the operation and adverse events.

Results: The analysis included 46 patients, of whom 23 were randomized to group I and 23 to group II. No significant differences were present regarding patient characteristics or operation times. The direct distances between the primary trocar and the left midaxillary line were significantly less in group I, a median of 35 mm (15–65 mm) than in group II, a median of 75 mm (45–85 mm) ($p = 0.013$).

Conclusion: Extracorporeal abdominal wall transillumination is a promising approach for achieving more safety and confidence in the two-port laparoscopic ventral hernia repair and represents an auxiliary tool for surgeons as a trial to visualize if there are structures adherent to the inner aspect of the anterior abdominal wall to improve abdominal entry safety.

Keywords: Laparoscopy, Parallel-design study, Transillumination, Two-port technique, Ventral hernia.

World Journal of Laparoscopic Surgery (2022): 10.5005/jp-journals-10033-1536

Introduction

Ventral hernia in adults is the second most common hernia after inguinal hernia, it includes primary and incisional hernias,[1,2] Laparoscopic approach for ventral hernia repair is associated with low postoperative complications, hospital stay, and recovery time.[3–5]

Although it is classically done by three or four ports in the abdominal wall,[6,7] the newly described "two-port technique" is considered to be the least invasive.[8,9]

Access to the abdominal cavity through small incisions is a challenge for the laparoscopic surgeon. At least 50% of associated gastrointestinal and major blood vessels injuries occur during entry to the abdominal cavity before the beginning of the intended surgery,[10,11] and there are many concerns related to bowel injury, especially in patients with intraabdominal adhesions like those who have incisional hernias,[12]

There is no certain consensus concerning the technique of port placement and laparoscopic entry, It is dictated by the surgeons' predilection based on personal experiences.[13] To facilitate convenient instrumental manipulations with appropriate visualization during laparoscopy, the operation target site should be 15–20 cm away from the optical port, and the remaining trocars are placed at 5–7 cm on either side of the optical trocar.[14]

It is important to keep the primary port as far away from the targeted operation site as possible. This point is of great importance in laparoscopic ventral hernia repair, because in some cases where the defect is large, a big mesh is required for repair, and therefore, the lateral border of the mesh will be too close to the optical port, which may cause some technical difficulties during fixation. Hence, the optical port should be as far away as possible from the hernia.

Transillumination has been used by pediatric surgeons as a fast and simple technique for diagnosing pneumoperitoneum and other abdominal diseases to obviates the necessity of frequent radiographs.[15] Here we document our experience in using transillumination of the abdomen prior to insertion of the first trocar in two-port laparoscopic ventral hernia repair.

This study was conducted aiming to improve the outcome, add to the general safety of trocars placement, and try to solve the problems of the blind insertion of the primary trocar and the

Department of General Surgery, Faculty of Medicine, Kasr Al-Ainy, Cairo University, Cairo, Egypt

Corresponding Author: Maged Rihan, Department of General Surgery, Faculty of Medicine, Kasr Al-Ainy, Cairo University, Cairo, Egypt, Phone: +00966596519744, e-mail: magedrihan@hotmail.com

How to cite this article: Rihan M. Extracorporeal Abdominal Transillumination in Laparoscopic Ventral Hernia Repair: A Tool to Achieve More Confidence and Safety. World J Lap Surg 2022;15(3): 207–210.

Source of support: Nil

Conflict of interest: None

surgeon's confusion between the desire to insert it as lateral as possible, and the fear from injuring the colon or other adherent tissues. This can be achieved by extracorporeal transillumination of the anterior abdominal wall before insertion of the primary trocar, thus exploring and delineating whether the abdominal wall harbors any underlying tissues, and accordingly trying to visualize what is being performed rather than doing it blindly. We recommend the implementation of extracorporeal abdominal transillumination before insertion of the primary trocar as a protective step aiming to eliminate the incidence of gastrointestinal or other tissue injuries.

Materials and Methods

This is a single-center, blinded outcome assessment, two-group parallel-design study conducted at the department of surgery, Al Jedaani hospital (private hospital in Jeddah, Saudi Arabia). The research and ethics review committee at the hospital gave approval to this study. Patients' enrollment was carried out between March 2018 and June 2019. Patients' ages ranged from 20 to 65 years, undergoing elective laparoscopic midline ventral hernia repair with a defect of 2–7 cm in diameter, were eligible for inclusion. Midline ventral hernia was defined as an abdominal wall hernia located between the xiphoid process and the s*ymphysis pubis*. Exclusion criteria were: complicated hernias for emergency surgery, severe comorbidities, pregnancy, and body mass index (BMI) exceeding 35 kg/m^2. Informed consent was obtained from all patients.

The patients were randomized into two arms as follows: Laparoscopic repair using transillumination step before inserting the primary trocar (group I) and laparoscopic repair only (group II). Randomization for eligible patients was done by using computerized simple sequence randomization. Blocking was not done in this study. Random allocation was hidden by using sealed envelopes with sequential numbers. Each envelope was opened later on sequentially just before the operation.

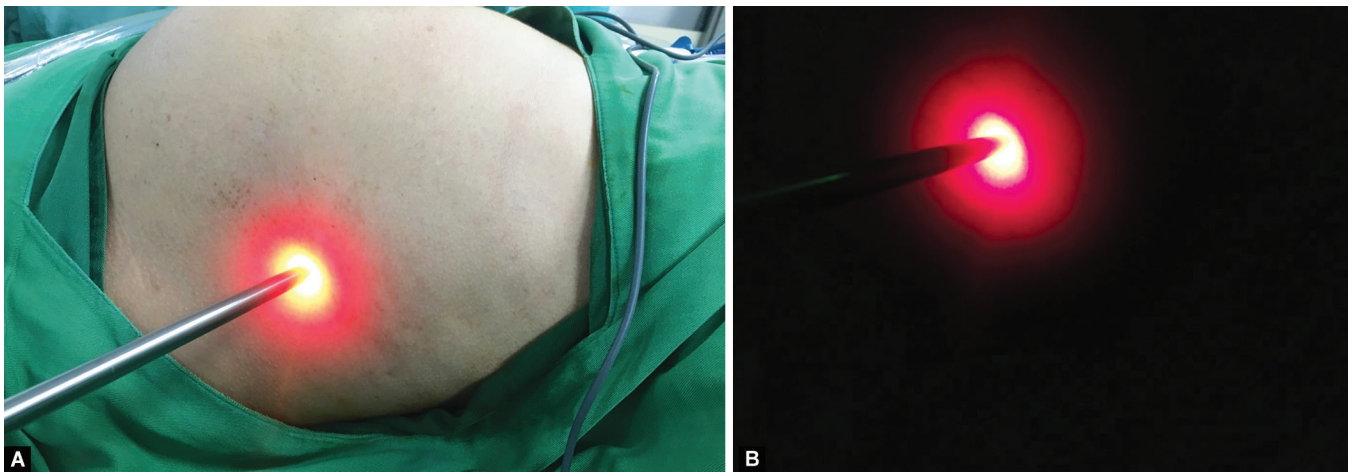
Operative Technique

The procedure is performed under general anesthesia, a prophylactic dose of antibiotic is administered upon induction. The patient is in supine position, with adducted left arm and a roll under the left loin. The dimension of the hernia defect is marked, and the four corner points that will be used for mesh fixation are marked on the skin with overlap at approximately 5 cm from the edge of the defect. Disinfection of the skin is done without erasing the markings.

The surgeon and the assistant are positioned on the left side, the assistant may change his position to the right or to the left side of the surgeon according to the stage. The laparoscopy tower is positioned on the right side of the patient. Pneumoperitoneum is induced with a Veress needle 3 cm under the left costal margin on the mid-clavicular line, initial pressure for insufflation is 15 mm Hg, after the insertion of the first trocar it will be reduced to 12 mm Hg, The first trocar (the visual trocar) is 10 mm in diameter, it is introduced at the defect level in the anterior axillary line in group II, and it is positioned according to the impression obtained from the transillumination in group I. The 5-mm working instrument trocar is introduced under vision below the left costal margin as laterally as possible. The peritoneal cavity is explored. The hernia sac content is then reduced, and the peritoneum around the hernia defect is cleared circumferentially for a distance of 5 cm to allow direct contact of the mesh to the parietal peritoneum.

We used Symbotex™ composite mesh, it is designed extracorporeally to cover the defect with a circumferential 5-cm overlay margin. The parietal surface of the mesh is stitched with 4 corners *absorbable* sutures with long threads. The mesh is placed on the skin, centered and marked over the defect, next to each knot a mini-incision of 2 mm is done on the skin, where the transfascial closure needle is passed to pull out the sutures. The mesh is damped in saline solution, the mesh is rolled with the polyester outer side the mesh is held with the atraumatic instrument, and it is introduced into the abdominal cavity through the 10-mm port, unfolded, and applied to the defect with the bioabsorbable collagen film to the visceral side, the transfascial closure needle is passed in the four skin incisions to pull out the threads with a distance of approximately 5 mm between the 2 threads at each corner, the abdomen is deflated to 8 mm Hg pressure. Threads are tied and buried in the subcutaneous plane. Helical absorbable fasteners are used by the tacker fixation device to attach the whole area of the mesh to the abdominal wall, and a compression bandage is applied to the defect. The patients were discharged 24–48 hours. Compression bandage could be changed but maintained for 7–10 days to prevent parietal seroma.

To achieve transillumination of the abdominal wall, the room light is turned off and the intensity of the light source is increased and the scope is rotated to contact the skin (Fig. 1). The light will be transmitted through the abdominal wall illuminating the abdominal cavity and backlighting the abdominal wall from inside to illustrate



Figs 1A and B: Abdominal wall transillumination before insertion of the primary trocar

that no intestinal, or other tissues is adherent to the back of the wall which will appear as a dark area in the shining field. Transillumination will also localize the course of the blood vessels traversing the abdominal wall a proactive step to avoid vascular injuries during trocar insertion. Once this procedure is completed, the scope's light source is returned back to the optimal intensity.

Patients' Assessment and Outcomes

Assessment of the patients was done at the operation, and a week; a month; and 3 and 6 months after the surgery. The primary endpoint was the length of the direct distance between the primary port and the left midaxillary line. As this distance is inversely proportional to the distance that will exist between the camera port and the hernial defect, the higher this last distance, the easier it will be to manipulate the instruments. Secondary outcomes involved the duration of the operation and adverse events.

Statistical Analysis

The power calculation was dependent on the measurement of the direct distance between the primary port and the left midaxillary line, by measuring a line starting from the center of the primary trocar wound toward and perpendicular to the midaxillary (Fig. 2). Statistical analysis was done using InStat, version 3.0 (GraphPad, New York, NY, USA). The independent *t*-test (age, BMI) and Mann–Whitney *U* test (distance measurements) were implemented to analyze the outcomes. The identified parameters were compared and the level of significance was set at the 0.05 alpha level. All the results are shown as median (interquartile range).

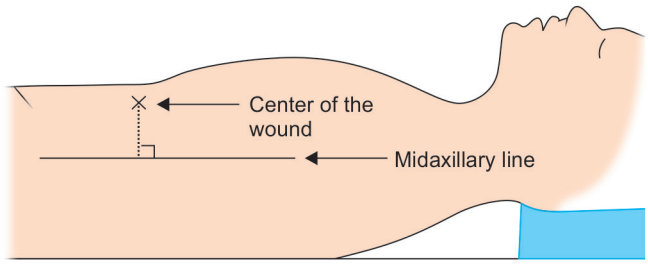


Fig. 2: Dotted line representing the distance between the wound and the midaxillary line

Results

Sixty-two patients were assessed for eligibility. The analysis included 46 patients for 6 months duration, of whom 23 were randomized to group I and 23 to group II. No significant differences were present between the two groups regarding patient characteristics or operation times (Table 1). The direct distances between the primary trocar and the left midaxillary line were significantly less in group I, median of 35 mm (15–65 mm) than in group II, median of 75 mm (45–85 mm) (p = 0.013). There were no significant differences between the two groups regarding postoperative complications. There were no complications or hernia recurrence within the 6 months follow-up in either group.

Discussion

Two-port technique for laparoscopic ventral hernia repair is currently practiced with safe and preferable results regarding cosmesis, pain, and patient satisfaction. Several techniques and special devices including suture-passing devices have been utilized to perform the procedure without using additional ports.[8,9]

With careful patient selection and precise manner and patience, this technique was described by some authors as an amazing reality in surgical practice.[16]

It is a safe technique but has some limitations. For example, it should not be used in patients with previous abdominal surgeries with expected or encountered technical difficulties such as in cases with dense intra-abdominal adhesions or incarcerated/strangulated ventral hernias. Therefore, adequate assessment for technique feasibility is highly recommended before doing the two-port technique, and suspected difficult cases should revert to the three- or four-port technique or even the traditional open technique from the start.[8,9,17,18]

In an attempt to overcome these limitations, we adopted the application of the transillumination step before proceeding with

Table 1: Demographic data and outcomes in both groups I and II

	Group I	*Group II*	
	n = 23	*n = 23*	
Demographic data	*Number*	*Number*	*p-value*
Male sex	12	15	
Age*	46 (26–65)	44 (25–62)	0.873
BMI* (kg/m^2)	28 (26–33)	30 (27–35)	0.965
Hernia defect size			
<4 cm	16	16	
≥4 cm	7	7	
Type of hernia			
Primary	15	17	
Incisional	8	6	
Outcomes			
Distances between the primary trocar and the left midaxillary line*	35 (15–65 mm)	75 (45– 85 mm)	0.013
Duration of procedure* (min)	59 (45–80)	61 (50–75)	0.758

*Values are median

the primary trocar insertion. It highlights the abdominal wall areas which are free of tissues attachments where safe trocar insertion could be achieved. Generally, our results are comparable with previous two-port laparoscopic hernia repair studies regarding operating time and defect sizes.[9,17]

Transillumination of the abdomen had been used by pediatric surgeons as a helpful part of the physical examination of infants. Several studies have been reported demonstrating its helpfulness in detection of pneumoperitoneum, ascitic fluid and in differentiation between cystic and solid masses.[19] To our knowledge, there are no previous reports in the English literature describing transillumination in laparoscopic ventral hernia repair.

Our technique does not significantly vary from other two-port described techniques but this study focuses attention on the benefits of using abdominal transillumination before insertion of the first trocar to obtain optimal results. Authors stated that the ports in laparoscopic ventral hernia repair should be placed as laterally as possible opposite the hernia, preferably in the left side.[18,20]

The farther away the camera port is from the hernial defect location, the wider the field of view and the easier it is to handle the mesh. And this is precisely the goal of transillumination as it guarantees to a big extent the identification of the farthest most secure point for placing the trocar without the possibility of inducing any intraabdominal injuries. It gives more confidence to the surgeon to insert the primary trocar as lateral as it could be.

The main limitations of this study were the small sample size with BMI limited cases, and the single-center design. In addition, there was a level of intersurgeon variability.

Conclusion

Extracorporeal abdominal wall transillumination is a promising approach for achieving more safety and confidence in the two-port laparoscopic ventral hernia repair and represents an auxiliary tool for surgeons as a trial to visualize if there are structures adherent to the inner aspect of the anterior abdominal wall to improve abdominal entry safety. However, it does not substitute the essential safety principles for laparoscopy in general. The potential benefits of this technique are its reproducibility and practicality; also, it could be tried with alternative tools rather than the scope as a light source. More studies in various centers are required to optimize and validate this technique.

No financial support was received from any organization for the submitted work.

Disclosure: The authors declare no conflict of interest.

Orcid

Maged Rihan https://orcid.org/0000-0001-9323-9405

References

1. Pham CT, Perera CL, Watkin DS, et al. Laparoscopic ventral hernia repair: A systematic review. Surg Endosc 2009;23(1):4–15. DOI: 10.1007/s00464-008-0182-8.
2. Muysoms FE, Miserez M, Berrevoet F, et al. Classification of primary and incisional abdominal wall hernias. Hernia 2009;13(4):407–414. DOI: 10.1007/s10029-009-0518-x.
3. Berrevoet F, Doerhoff C, Muysoms F, et al. A multicenter prospective study of patients undergoing open ventral hernia repair with intraperitoneal positioning using the monofilament polyester composite ventral patch: Interim results of the PANACEA study. Med Devices (Auckl) 2017;10:81–88. DOI: 10.2147/MDER.S132755.
4. Christoffersen MMW. Clinical outcomes after elective repair for small umbilical and epigastric hernias. Dan Med J 2015;62(11):B5161. PMID: 26522486.
5. Bittner R, Bingener–Casey J, Dietz U, et al. Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias [International Endohernia Society (IEHS)] – Part 2. Surg Endosc 2014;28(1):2–29. DOI: 10.1007/s00464-013-3170-6.
6. Liberman MA, Rosenthal RJ, Phillips EH. Laparoscopic ventral and incisional hernia repair: A simplified method of mesh placement. J Am Coll Surg 2002;194(1):93–95. DOI: 10.1016/s1072-7515(01)01135-8.
7. Heniford BT, Park A, Ramshaw BJ, et al. Laparoscopic ventral and incisional hernia repair in 407 patients. J Am Coll Surg 2000;190(6):645–650. DOI: 10.1016/s1072-7515(00)00280-5.
8. Abir F, Eisenberg D, Bell R. Laparoscopic ventral hernia repair using a two (5-mm) port technique. JSLS 2005;9(1):94–96. PMID: 15791980.
9. Mehrotra PK, Ramachandran CS, Arora V. Two port laparoscopic ventral hernia mesh repair: An innovative technical advancement. Int J Surg 2011;9(1):79–82. DOI: 10.1016/j.ijsu.2010.08.010.
10. Jansen FW, Kapiteyn K, Trimbos–Kemper T, et al. Complications of laparoscopy: A prospective multicentre observational study. Br J Obstet Gynaecol 1997;104(5):595–600. DOI: 10.1111/j.1471-0528.1997.tb11539.x.
11. Jansen FW, Kolkman W, Bakkum EA, et al. Complications of laparoscopy: An inquiry about closed- versus open-entry technique. Am J Obstet Gynecol 2004;190(3):634–638. DOI: 10.1016/j.ajog.2003.09.035.
12. Mann CD, Luther A, Hart C, et al. Laparoscopic incisional and ventral hernia repair in a district general hospital. Ann R Coll Surg Engl 2015;97(1):22–26. DOI: 10.1308/003588414X14055925058913.
13. Supe AN, Kulkarni GV, Supe PA. Ergonomics in laparoscopic surgery. J Minim Access Surg 2010;6(2):31–36. DOI: 10.4103/0972-9941.65161.
14. Trejo A, Jung MC, Oleynikov D, et al. Effect of handle design and target location on insertion and aim with a laparoscopic surgical tool. Appl Ergon 2007;38(6):745–753. DOI: 10.1016/j.apergo.2006.12.004.
15. Wyman ML, Kuhns LR. Pneumoperitoneum demonstrated by transillumination. Am J Dis Child 1976;130(11):1237–1238. PMID: 984006.
16. Almaimani G, Oyais A. Laparoscopic umbilical hernia repair using a "two-port" technique: A single-center experience. J Curr Surg 2017;7(3):39–41. DOI: 10.14740/jcs329w.
17. Abhishek V, Mallikarjuna MN, Shivaswamy BS. Laparoscopic umbilical hernia repair: Technique paper. ISRN Minimally Invasive Surg 2012:2012(1):906405. DOI: 10.5402/2012/906405.
18. Theodoropoulou K, Lethaby D, Hill J, et al. Laparoscopic hernia repair: A two-port technique. JSLS 2010;14(1):103–105. DOI: 10.4293/108680810X12674612014860.
19. Wedge JJ, Grosfeld JL, Smith JP. Abdominal masses in the newborn: 63 cases. J Urol 1971;106(5):770–775. DOI: 10.1016/s0022-5347(17)61394-6.
20. Sharma A, Mehrotra M, Khullar R, et al. Laparoscopic ventral/incisional hernia repair: A single-centre experience of 1,242 patients over a period of 13 years. Hernia 2011;15(2):131–139. DOI: 10.1007/s10029-010-0747-z.