

Incidence of Surgical Site Infections in Laparoscopic VS Open Primary Ventral Hernia Repair

Haza Waqar Bhatti¹, Noman Ahmed Chaudhary², Marryam Riaz Farooqui³, Huma Sabir Khan⁴, Sajid Rashid⁵, Tayyab Riaz⁶, Naveed Akhtar Malik⁷

- 1 Resident Surgeon, Department of Surgery, Rawalpindi Medical University, Rawalpindi Pakistan
Conception of idea, study Design, data collection Statistical analysis
- 2 Graduate, Rawalpindi Medical University, Rawalpindi Pakistan
Manuscript writing, Literature review, Data interpretation
- 3 Resident Surgeon, Department of surgery, Rawalpindi Medical University, Rawalpindi Pakistan
Critical review of the article
- 4 Assistant Professor, Department of Surgery, Rawalpindi Medical University, Rawalpindi Pakistan
Manuscript writing, Literature review, Data interpretation
- 5 Associate Professor, Department of Surgery, Rawalpindi Medical University, Rawalpindi Pakistan
Critical review of the article
- 6 Senior Registrar, Department of Surgery, Abwa Medical College, Khurrianwala, Faisalabad Pakistan
Final reading of article, Manuscript approval
- 7 Professor, Department of Surgery, Rawalpindi Medical University, Rawalpindi Pakistan
Final reading of article, Manuscript approval

CORRESPONDING AUTHOR

Dr. Huma Sabir Khan
Assistant Professor, Department of Surgery,
Rawalpindi Medical University, Rawalpindi
Pakistan
Email: humasabirkhan@gmail.com

Submitted for Publication: 20-05-2024
Accepted for Publication 06-07-2024

How to Cite: Bhatti HW, Chaudhary NA, Farooqui MR, Khan HS, Rashid S, Riaz T, Malik NA. Incidence of Surgical Site Infections in Laparoscopic VS Open Primary Ventral Hernia Repair. APMC 2024;18(3):295-299. DOI: 10.29054/APMC/2024.1616

ABSTRACT

Background: The ventral hernias found along the midline in anterior abdominal wall, known as “primary midline ventral hernias”, are frequent in the general population. These hernias can be addressed through two primary surgical methods: laparoscopic ventral hernia repair, which involves “Intraperitoneal Onlay Mesh Hernioplasty (IPOM)”, and traditional open herniorrhaphy or hernioplasty. **Objective:** This study was performed to compare the incidence of surgical site infections between the traditional open repair method and the laparoscopic repair technique of ventral hernia. **Study Design:** Prospective randomized control study. **Settings:** Surgical Unit-II, Department of Surgery at Benazir Bhutto Hospital in Rawalpindi Pakistan. **Duration:** January 2020 to 2022. **Methods:** A total of 60 patients participated, with 30 undergoing “laparoscopic ventral hernia repair (LVHR)” and 30 undergoing “open ventral hernia repair (OVHR)”. Non-probability consecutive sampling technique was employed, and the outcome variable was surgical site infection. Data analysis was conducted using SPSS (Statistical Package for Social Sciences) version 25.0, with the significance determined using the Chi-square test. A p value of ≤ 0.05 was considered as significant. **Results:** Out of 60 patients, surgical site infection (SSI) was present in a total of 10 patients (16.6%). Out of these 10 patients, 6.6% (n=2) had SSI in the laparoscopic group and 26.6 % (n=8) in open repair. The distribution of these frequencies was significant (p=0.001). **Conclusion:** Laparoscopic ventral hernia repair has a lower rate of surgical site infection as compared to open ventral hernia repair.

Keywords: Ventral hernia, Surgical site infection, Laparoscopic repair of hernia.

INTRODUCTION

Ventral hernia is a common condition. The term "hernia" refers to the protrusion of an organ or a part of an organ from the walls of the containing cavity, such as the abdominal wall, chest wall, pelvis, or diaphragm.¹ In adults the commonest hernias are inguinal, umbilical, incisional, femoral and epigastric hernias respectively.¹ Ventral hernia includes both the incisional hernia and midline primary ventral hernia (PVH).² Primary hernia means a hernia that is not secondary to any incision. PVH includes umbilical, paraumbilical and epigastric hernias².

An umbilical hernia is most commonly observed in newborns or infants. Paraumbilical hernias are among the most frequent types of hernias in adults. Paraumbilical can occur both above or below the umbilicus.² Paraumbilical and umbilical hernias make up 10 % of all the hernias.³

The primary ventral hernia is diagnosed by a history of lump/swelling or pain at the umbilical or epigastric region. It is further confirmed by clinical examination.⁴ Among the hernia patients about 39% of the patients are asymptomatic. In the symptomatic patients (61%)

experience dragging pain pressure, nausea, and vomiting or constipation. Out of these symptomatic patients, 44% present with pain, 20% experience pressure and 9% have nausea and vomiting.⁴

The standard management for hernia is surgical repair, which can be performed using simple suture repair (primary repair), Mayo's repair⁵ (double breasting), or by using mesh. Research indicates a high rate of recurrence for simple suture repair^{3,6} and a 10-year recurrence of up to 40-54% for Mayo repair of umbilical and incisional hernias.^{7,8} Whereas, a randomized control trial showed a recurrence rate of just 1% for mesh repair, suggesting it as the preferred surgical technique for ventral hernia.^{9,10}

Since the advent of minimal access surgery, most of the surgical procedures are now done laparoscopically. Laparoscopic repair of hernias is also gaining popularity. This is true for all hernias including inguinal, ventral, and diaphragmatic hernias. The "intraperitoneal onlay mesh (IPOM)" method for laparoscopic repair of the ventral hernia was first documented by Leblanc and Booth in 1993¹¹. Laparoscopic repair of the ventral hernia has been found to have fewer postoperative complications, such as less pain, early return to normal activity, and fewer seromas and wound infections as compared to open repair.^{12,13,14} As a result, laparoscopic ventral hernia repair (LVHR) is now considered an effective and preferable method.

In Pakistan, the concept of laparoscopic ventral hernia repair (LVHR) has still not been fully adopted especially in public sector hospitals and there has been little research on the topic in this part of the world. The rationale of the study is to assess the laparoscopic technique as compared to traditional open surgery repair in the management of primary ventral hernia in terms of surgical site infection. The purpose of this study is to establish the safety of laparoscopic ventral hernia repair in terms of infection rate in a public sector hospital.

METHODS

Our study was a prospective randomized control study conducted at the Department of Surgery Unit-II Benazir Bhutto Hospital, Rawalpindi, Pakistan from January 2020 to January 2022 after ethical approval vide letter no. 3/11/2019/BBH. There was a total of 60 cases with 30 patients in each group "laparoscopic ventral hernia group (LVHR)" and "Open ventral hernia repair group (OVHR)". Sample size was calculated using online sample size calculator for randomized controlled trials taking effect size of 0.8, alpha error of 0.05 and power of study 80%. All the patients admitted from outpatient department, of both genders aged above 20 years of age and below 65 years who were diagnosed as having primary ventral hernia on basis of clinical examination

and the anterior abdominal wall defect proven radiologically by ultrasound abdomen were included in the study. Primary ventral hernia was defined as, protrusion of a hernia sac containing gut or omentum above or below a patient's umbilicus or in the epigastric region, through a weak place in his/her linea alba, diagnosed on clinical examination and on ultra-sonogram as anterior abdominal wall defect. While the surgical site infection (SSI) was followed at 30 days postoperatively and defined according to CDC criteria as "superficial surgical site infection", "deep surgical site infection" and "organ space infection".³ All the pregnant females, patients having huge incisional hernias requiring component separation, patients who were unfit (ASA Class IV or above), who were having any general contraindication to laparoscopic surgery or respiratory insufficiency were excluded from the study. We hypothesized that LVHR for PVH has fewer SSI as compared to OVHR for PVH.

All the cases meeting the above-mentioned inclusion/exclusion criteria were included after taking informed consent. They were randomized by lottery method to either laparoscopic or open paraumbilical hernia repair and all this information was recorded on a pre-designed proforma. All patients undergoing surgery for ventral hernia repair either by open or laparoscopic technique were administered the same antibiotics (Injection ceftriaxone 1g) 1 dose preoperatively and 2 doses post-operatively. Open ventral hernia repair was done by closing the defect by proline 1/0 and then by placing and securing a polypropylene mesh over the anterior rectus sheath (on lay mesh hernioplasty). Laparoscopic intraperitoneal on lay mesh hernioplasty was done by creating pneumo-peritoneum, reduction of the hernia contents, and placing and securing a composite mesh over the anterior abdominal wall with the help of tackers. When the defect was large, it was closed with proline 1/0. Before placement of mesh. Consultant surgeons having similar experience performed the surgeries. Injection Ketorolac 30 mg I/V was used immediately postoperatively as a pain killer and then given 8 hourly (2 doses). Then patients were discharged on a prescription of oral antibiotics and analgesics for five days. Patients were followed up for 30 days postoperatively.

The data analysis was done using SPSS version 25.0. The analysis encompassed qualitative variables such as gender and the frequency of infection between two groups, as well as ASA grade, and quantitative variables such as age. Mean and standard deviation were used to measure the quantitative variables, while categorical data, including gender, ASA class, and SSI, were expressed in terms of frequency and percentage. The significance was calculated using the Chi-square test.

Additionally, variables like age, ASA grade, and gender were stratified to control effect modification. A p-value of 0.05 or less is considered significant when interpreting the results.

RESULTS

Total 60 cases, 30 in each group, were included in the study to compare the frequency of surgical site infection between post-operative patients of LVHR and OVHR repair.

The mean age for LVHR was 37.22±10.19 and in OVHR was 36.12±10.89 years. Patients were then distributed according to gender showing that 30% (n=10) in LVHR and 36.6% (n=11) in the OVHR group were males while 70% (n=21) in LVHR and 63.3% (n=19) in the OVHR group were females as shown in table 1. ASA classification was recorded which showed that class I were 66.6% (n=20) in the LVHR group and 56.6% (n=17) in the OVHR group while ASA class II patients were 33.3% (n=10) in LVHR and 43.3 (n=14) in OVHR group.

Table 1: Demographic data of the patients in LVHR group and OVHR group

Variables	Patients No. (%)		P-value
	LVHR, n:30	OVHR, n:30	
Age mean (SD) years	37.22 ± 10.19	36.12 ± 10.89	0.88
Gender			
Male	9 (30)	11 (36.6)	0.50
Female	21 (70)	19 (63.3)	
ASA class			
I	20 (66.6)	17 (56.6)	0.62
II	10 (33.3)	13 (43.3)	

LVHR: laparoscopic ventral hernia repair, OVHR: open ventral hernia repair, ASA: American Society of Anaesthesiologists

Total surgical site infection rate was present in 10 out of 60 patients (16.6%). A comparison of the frequency of surgical site infection between post-operative patients of LVHR and OVHR was done showing that 6.6% (n=2) had SSI in LVHR and 26.6% (n=8) in open repair. The distribution of these frequencies was significant (p=0.001). The open repair group also had a higher incidence of seroma (table 2).

Table 2: Incidence of SSI in LVHR and OVHR groups

Variable	Patients No. (%)		P value
	LVHR no. (%)	OVHR No. (%)	
SSI			
Superficial	1 (3.3%)	4 (13.3%)	0.001
Deep	1 (3.3%)	3 (10%)	
Organ space infection	0 (0%)	1 (3.3%)	
Overall	2 (6.6%)	8 (26.6%)	
Seroma	1 (3.3%)	5 (16.6%)	0.02

SSI: Surgical site infection, LVHR: laparoscopic ventral hernia repair, OVHR: open ventral hernia repair

Patients were stratified according to age demonstrating that 60% (n=18) in LVHR group and 63.3% (n=19) in OVHR group lied in 20-40 years of age group while 40% (n=12) in Laparoscopic and 36.67% (n=11) in open repair group were of 41-65 years old. The difference in frequencies of SSI between the two techniques was significant in both age groups 20-40 years and 41-65 years (p=0.01, p=0.04 respectively) in females (p=0.04) and ASA class I patients (P=0.01). (Table- III). The risk stratification showed an odds ratio (OR) of gender in LVHR group to be 2.5. Age groups and ASA classes had OR < 1 (table IV).

Table 3: Stratification for frequency of surgical site infection (SSI) between LVHR group and OVHR group with regards to age, gender and ASA classification

Variable	Groups (n: LVHR, OVHR)	SSI in LVHR n:2	SSI in OVHR n=8	P-value
Age	20-40 years n: (18, 19)	1 (5.5%)	5 (26.3%)	0.01
	41-65 years n: (12, 11)	1 (8.3%)	3 (27.2%)	0.04
Gender	Male n: (9, 11)	1 (11%)	1 (9%)	1.0
	Female n: (21, 19)	1 (4.6%)	3 (15.7%)	0.04
ASA Classification	I n: (20, 17)	0 (0%)	5 (29.4%)	0.01
	II n: (10, 13)	2 (20%)	3 (23%)	0.8

SSI: Surgical Site Infection, ASA: American Society of Anaesthesiologists, LVHR: laparoscopic ventral hernia repair, OVHR: open ventral hernia repair

Table 4: Risk stratification in LVHR and OVHR with respect to age, gender and ASA class

Variable	SSI in LVHR (OR) (95 % CI)	SSI in OVHR (OR) (95 % CI)
Age		
20-40 yrs.	0.6	0.95
41-65 yrs.		
Gender		
Males	2.5	0.53
Females		
ASA classification		
I	0.2	1.38
II		

SSI: Surgical Site Infection, ASA: American Society of Anaesthesiologists, LVHR: laparoscopic ventral hernia repair, OVHR: open ventral hernia repair

DISCUSSION

The available treatment options for “primary midline ventral hernias (PMVH)” or “primary ventral hernias (PVH)”, which include paraumbilical and epigastric hernias, encompass primary suture repair, open mesh hernioplasty, and laparoscopic repair, employing intraperitoneal placed on lay mesh hernioplasty (IPOM)

technique. In our study, we carefully examined and compared the rates of surgical site infections (SSI) in patients who underwent open repair with mesh versus those who underwent laparoscopic mesh repair.

In our study there were more female patients of primary ventral hernia in both laparoscopic and open repair groups (60% and 63% respectively) as compared to males as shown in table-II. This finding is corroborated by previous studies. In a study by Ahmed Alenazi *et al.* of all the patients diagnosed with hernia more than 54.2% of the participants were females.¹⁵ According to another study by Bedewi *et al.*, conducted in Riyadh, Saudi Arabia, the specific prevalence of para-umbilical hernia cases among males was 23.3% while 29.4% among females.¹⁶ Various studies have demonstrated that the incidence of paraumbilical hernia is five times higher in females due to the strong influence of pregnancy.¹⁷

The overall surgical site infection rate in all the surgeries was 16.6 %; 10 out of 60 patients in our study. SSI in LVHR was found to be 6.6%(n=2) and 26.6 %(n=8) in open repair. In a study by Cassie *et al.*, the overall wound infection rate in open and laparoscopic hernia repair was just 2.2%.¹⁸ EW Taylor *et al.* documented a surgical site infection rate of 5.3% in groin hernia repairs.¹⁹ The overall surgical site infection in our study was generally when compared to other studies.^{18,19} This may be because our study setting was a tertiary care public hospital. This is supported by a study in Australia where public hospitals had a significantly higher infection rate than private hospitals.^{20,21} Other contributing factors include improper surgical theatre and instrument sterilization, inadequate facilities, a shortage of surgical tools, inadequate supplies for wound care, improper aseptic techniques utilized by the surgeons, poor hospital hygiene, and a high concentration of pathogenic organisms in the hospital. The incidence of seroma was found to be more in OVHR as compared to LVHR in this study.²¹ This may be because of the fact that a lot of dissection is performed in the open repair as compared to the laparoscopic repair technique.²

In a local study conducted by Malik *et al* in Karachi, Pakistan, the laparoscopic repair of para-umbilical hernia was compared with traditional open repair. The study included a total of 337 patients, with 200 patients underwent treatment at a public sector hospital and the remaining 137 patients receiving surgery at two private facilities. The study's findings indicated an absence of mortality and a relatively low occurrence of both operational and postoperative complications in the laparoscopic repair method.²² These results serve to validate the conclusions drawn from our research.

Our study's conclusions are reinforced by the findings of a study by Hajibandeh *et al.*, which demonstrated that

open surgery was associated with a significantly higher rate of wound infection (with an odds ratio of 2.35) compared to laparoscopic surgery.²³ Additionally, our results align with another study conducted by Williams *et al.*, which revealed a surgical site infection (SSI) rate of 1.5% in the patients treated by open surgery and 0.9% in those treated by laparoscopic surgery. These consistent findings across different studies provide robust support for the impact of the laparoscopic surgical approach on the incidence of wound infections.

In a study by EW Taylor *et al.*, it was found that an increase in the "American Society of Anaesthesiologist's (ASA)" class of fitness for surgery does not pose as a risk factor for infection, aligning with the outcomes of our study.¹⁹ Our research also indicated a lack of significant association between surgical site infection (SSI) and age and gender. Similarly, Medina M. *et al.* assessed the risk for SSI and concluded that the risk was independent of ASA grade and gender in patients undergoing herniorrhaphy for abdominal wall hernias,²⁵ corroborating our findings. In our study SSI was significantly higher in both age stratus with risk stratification showing OR< 1. Additionally, our study revealed a notable difference in SSI incidence among male and female patients. The risk stratification showed an OR: 2.5 in LVHR group showing greater propensity of SSI for males in LVHR group. This could possibly be because our sample was not matched for gender groups.

This study has shown that the "laparoscopic ventral hernia repair" has a lower incidence of surgical site infection (SSI) as compared to the "open ventral hernia repair" for primary ventral hernias. This shows one of the major benefits of the laparoscopic repair as surgical site infections result in greater morbidity, longer hospital stays and delayed return to work.

CONCLUSION

Laparoscopic ventral hernia repair (LVHR) has less surgical site infection rates than open ventral hernia repair (OVHR). Hence laparoscopic repair for ventral hernia can be safely used in public sector hospitals in our country.

LIMITATIONS

A limitation of this study was that possible confounding factors such as hernia size and obesity were not taken into consideration.

SUGGESTIONS / RECOMMENDATIONS

We recommend that further studies longer duration for follow-up should be conducted to assess long term complications like recurrence should be conducted to declare laparoscopic approach as the gold standard.

CONFLICT OF INTEREST / DISCLOSURE

None.

ACKNOWLEDGEMENTS

None.

REFERENCES

1. Burnand KG, Black J, Corbett SA, Thomas WE, editors. *Browse's Introduction to the Symptoms & Signs of Surgical Disease*. CRC Press; 2014.
2. Liang MK, Berger RL, Li LT, Davila JA, Hicks SC, Kao LS. Outcomes of laparoscopic vs open repair of primary ventral hernias. *JAMA Surgery*. 2013 Nov 1;148(11):1043.
3. Aslani N, Brown CJ. Does mesh offer an advantage over tissue in the open repair of umbilical hernias? A systematic review and meta-analysis. *Hernia*. 2010 Oct 1;14(5):455-62.
4. Rodriguez JA, Hinder RA, Eds. *Operative Techniques of General Surgery*, Vol 6; Texas; Elsevier; 2004:156 -164.
5. Mayo WJ. VI. An operation for the radical cure of umbilical hernia. *Annals of surgery*. 1901 Aug;34(2):276.
6. Schumacher OP, Peiper C, Lörken M, Schumpelick V. Long-term results after Spitzzy's umbilical hernia repair. *Der Chirurg; Zeitschrift für alle Gebiete der operativen Medizin*. 2003 Jan;74(1):50-4.
7. Askar OM. A new concept of the aetiology and surgical repair of paraumbilical and epigastric hernias. *Annals of the Royal College of Surgeons of England*. 1978 Jan;60(1):42.
8. Luijendijk RW, Lemmen MH, Hop WC, Wereldsma JC. Incisional hernia recurrence following "vest-over-pants" or vertical Mayo repair of primary hernias of the midline. *World journal of surgery*. 1997 Jan;21(1):62-6.
9. Arroyo A, Garcia P, Perez F, Andreu J, Candela F, Calpena R. Randomized clinical trial comparing suture and mesh repair of umbilical hernia in adults. *British journal of surgery*. 2001 Oct;88(10):1321-3.
10. Sebastian AA, Perez F, Serrano P, Costa D, Oliver I, Ferrer R, Lacueva J, Calpena R. Is prosthetic umbilical hernia repair bound to replace primary herniorrhaphy in the adult patient?. *Hernia*. 2002 Dec 1;6(4):175-7.
11. Berney CR. Correspondence: Laparoscopic repair of abdominal wall hernia-"How I do it"-synopsis of a seemingly straightforward technique. *BMC surgery*. 2015 Dec;15:1-5.
12. Davies SW, Turza KC, Sawyer RG, Schirmer BD, Hallowell PT. A comparative analysis between laparoscopic and open ventral hernia repair at a tertiary care center. *The American Surgeon*. 2012 Aug;78(8):888-92.
13. Alexander AM, Scott DJ. Laparoscopic ventral hernia repair. *The Surgical clinics of North America*. 2013 Aug 20;93(5):1091-110.
14. Franklin ME, Gonzalez JJ, Glass JL, Manjarrez A. Laparoscopic ventral and incisional hernia repair: an 11-year experience. *Hernia*. 2004 Feb;8:23-7.
15. AhmedAlenazi A, Alsharif MM, Hussain MA, Alenezi NG, Alenazi AA, Almadani SA, et al. Prevalence, risk factors and character of abdominal hernia in Arar City, Northern Saudi Arabia in 2017. *Electronic physician*. 2017 Jul;9(7):4806.
16. Bedewi MA, El-Sharkawy MS, Al Boukai AA, Al-Nakshabandi N. Prevalence of adult paraumbilical hernia. Assessment by high-resolution sonography: a hospital-based study. *Hernia*. 2012 Feb;16:59-62.
17. Williams NS, Bulstrode CJ, O'Connell RP. *Bailey & Love's: Short Practice of Surgery*. Il Giornale di Chirurgia-Journal of the Italian Surgical Association. 2010 Apr 1;31(4):197.
18. Cassie S, Okrainec A, Saleh F, Quereshy FS, Jackson TD. Laparoscopic versus open elective repair of primary umbilical hernias: short-term outcomes from the American College of Surgeons National Surgery Quality Improvement Program. *Surgical endoscopy*. 2014 Mar 1;28(3):741-6.
19. Taylor EW, Duffy K, Lee K, Hill R, Noone A, Macintyre I, et al. Surgical site infection after groin hernia repair. *British journal of surgery*. 2004 Jan;91(1):105-11.
20. McLaws ML, Gold J, Irwig LM, Berry G, King K. The prevalence of nosocomial and community-acquired infections in Australian hospitals. *Medical Journal of Australia*. 1988 Dec;149(11-12):582-90.
21. Martins MR, Santos-Sousa H, do Vale MA, Bouça-Machado R, Barbosa E, Sousa-Pinto B. Comparison between the open and the laparoscopic approach in the primary ventral hernia repair: a systematic review and meta-analysis. *Langenbeck's Archives of Surgery*. 2024 Feb 3;409(1):52.
22. Malik AM. Laparoscopic versus open repair of para-umbilical hernia. Is it a good alternative?. *JPMA. The Journal of the Pakistan Medical Association*. 2015 Aug 1;65(8):865-8.
23. Hajibandeh S, Sreh A, Khan A, Subar D, Jones L. Laparoscopic versus open umbilical or paraumbilical hernia repair: a systematic review and meta-analysis. *Hernia*. 2017 Dec 1;21(6):905-16.
24. Williams KN, Hussain L, Fellner AN, Meister KM. Updated outcomes of laparoscopic versus open umbilical hernia repair in patients with obesity based on a National Surgical Quality Improvement Program review. *Surgical endoscopy*. 2020 Aug;34(8):3584-9.
25. Medina M, Sillero M, Martinez-Gallego G, Delgado-Rodriguez M. Risk factors of surgical wound infection in patients undergoing herniorrhaphy. *The European journal of surgery= Acta chirurgica*. 1997 Mar;163(3):191-8.