

## Article

# A comparative study of onlay versus sublay mesh repair in cases of ventral hernia in adults

Rajesh kumar Dora<sup>1</sup>, Vishwajeet Sahanee<sup>2</sup>, Debashisha Roy<sup>3</sup>, Amar Kumar Behera<sup>4,\*</sup> and Bharat Kumar Behera<sup>5</sup>

<sup>1</sup> Associate Professor, Department of Surgery, Government Medical College and Hospital Keonjhar.

<sup>2</sup> Senior Resident, Department of Surgery, M.K.C.G Medical college, Berhampur.

<sup>3</sup> Associate Professor, Department of Surgery, SCB Medical College and Hospital, Cuttack, Odisha.

<sup>4</sup> Associate Professor, Department of Surgery, Government Medical College and Hospital, Sundargarh, Odisha, India.

<sup>5</sup> Professor, Department of Surgery, Government Medical College & Hospital Sundargarh, Odisha, India.

\* Correspondence: amar\_behera@yahoo.co.in

Received: 11 December 2022; Accepted: 23 April 2023; Published: 29 April 2023.

**Abstract: Background:** Ventral hernias of the abdomen are defined as a non-inguinal, non-hiatal defect in the fascia of the abdominal wall. Annually, there are about 350,000 ventral hernia operations. The repair of these abdominal wall defects is a common surgery performed by general surgeons. Common causes of acquired ventral hernias include previous surgery causing an incisional hernia, trauma, and repetitive stress on naturally weak points of the abdominal wall. These naturally occurring weak points in the abdominal wall include the umbilicus, semilunar line, ostomy sites. Obesity is a large component of hernias as well because it stretches the fascia of the abdomen causing it to weaken. While repair of ventral hernias with mesh is considered routine, there is no consensus on the best location to place the mesh. Hence, this study aims to compare the outcome of the onlay versus sublay mesh repair for treatment of ventral hernias.

**Materials and methods:** All subjects undergoing onlay and sublay mesh repair for ventral hernias will be evaluated intraoperatively for duration of surgery and postoperatively for complications like surgical site infections, seroma formation, flap necrosis, duration of hospital stay and recurrence. To find the significance in categorical data Chi-Square test was used.

**Aim of the study and objectives:** To compare the duration of surgery and postoperative complications of sublay and onlay meshplasty in the treatment of ventral hernias.

**Results:** Out of 50 patient's majority were female 29 (58%) and belong to the age group of 46-55 yrs (32%). The most common diagnosis among them is supraumbilical hernia (52%). The duration of surgery for sublay group is longer about 117.4 min whereas it about 92.52 min in onlay group. Seroma formation, Surgical site infection, Flap Necrosis in 20%, 16% and 16% patients respectively in onlay mesh repair group and in 4%, 4% and nil patients respectively in sublay mesh repair group. Duration of Hospital Stay was 5 days in onlay group in comparison to 4 days in sublay group. Recurrence was seen in 8% patients in onlay group whereas it was encountered 4% in the sublay mesh repair group.

**Conclusion:** Sublay mesh repair is a good alternative to onlay mesh repair that may be applicable to all forms of ventral hernia as the mesh related overall complication rate like seroma, surgical site infections, flap necrosis, hospital stay and recurrence are less compared to onlay meshplasty.

**Keywords:** Sublay mesh repair; Onlay mesh repair; Surgical site infections; Ventral hernias.

## 1. Introduction

Ventral hernias of the abdomen are defined as a non-inguinal, non hiatal defect in the fascia of the abdominal wall. Annually, there are about 350,000 ventral hernia operations. The repair of these abdominal wall defects is a common surgery performed by general surgeons. Surgery is typically recommended for individuals with acceptable operative risk, symptomatic hernias, or those at elevated risk of developing complications from a hernia. They can affect an individual's quality of life and can lead to hospitalizations and even death in some cases [1–3]. Aetiologies of a ventral hernia can be broken down into

2 main categories; acquired or congenital. The vast majority of hernias that general surgeons see and treat are acquired; however, some individuals live with their ventral hernias from birth for prolonged periods of time before having them surgically repaired. Common causes of acquired ventral hernias include previous surgery causing an incisional hernia, trauma, and repetitive stress on naturally weak points of the abdominal wall. These naturally occurring weak points in the abdominal wall include the umbilicus, semilunar line, ostomy sites. Obesity is a large component of hernias as well because it stretches the fascia of the abdomen causing it to weaken. Specifically, the action of repetitive weight gains and loss leads to weakening [4].

Many suture repairs failed mechanically, and recurrence rates were found to be as high as 54% [5,6]. The advantages of mesh implantation have first been confirmed by an influential trial by Luijendijk *et al.*, [7]

Open mesh repair is superior to suture repair in terms of recurrences and an insufficient evidence as to which type of mesh or which mesh position (on- or sublay) should be used [8,9].

The main goal of this study is to compare the outcome of mesh repair in sublay and onlay position of mesh reconstruction in care of small and large hernia. Ventral hernia repair is among the most common surgical operations performed worldwide, and the two operative techniques most frequently used in case of ventral hernia are the onlay and sublay repair.

Many studies demonstrate an increased risk for wound complications with mesh placement including surgical site infections, seroma and flap necrosis. The risks of these complications are affected by where the mesh is placed. For example, mesh exposed to intra-abdominal contents potentially increases the risks of adhesions, bowel obstruction, and fistula formation [10]. While repair of ventral hernias with mesh is considered routine, there is no consensus on the best location to place the mesh. Hence, this study aims to compare the outcome of the onlay versus sublay mesh repair for treatment of ventral hernias.

## 2. Aims and Objectives

The aim of this study is to compare the duration of surgery and postoperative complications between sublay and onlay meshplasty in the treatment of ventral hernias. The primary objective is to evaluate the differences in duration of surgery, postoperative complications such as seroma, surgical site infections, flap necrosis, duration of hospital stay, and recurrence between the two techniques. The secondary objective is to determine which method of ventral hernia repair is the most effective in terms of operative time and postoperative complications.

## 3. Materials and Methods

### 3.1. Study Design

This is a single-center, prospective study.

### 3.2. Study Population

All patients who underwent onlay or sublay mesh repair for ventral hernias, including incisional hernia, umbilical hernia, supraumbilical hernia, and epigastric hernia, at the elective theatre of the Department of General Surgery at M.K.C.G Medical College, Berhampur were included in this study.

### 3.3. Sample Size

A total of 50 patients were included in the study, with 25 patients in Group A (Onlay meshplasty) and 25 patients in Group B (Sublay meshplasty).

### 3.4. Inclusion Criteria

Patients who underwent onlay or sublay mesh repair for ventral hernias, including incisional hernia, umbilical hernia, supraumbilical hernia, and epigastric hernia, were included in this study.

### 3.5. Exclusion Criteria

Patients with active infections (local or systemic), infraumbilical cases, severe renal or hepatic failure, cancer cases, recurrent hernias, planned other gastrointestinal surgery, or patient loss to follow-up were excluded from the study.

### 3.6. Study Period

The study period was 2 years, from July 2019 to June 2021, including a 6-month follow-up period.

### 3.7. Study Center

The study was conducted at the Department of General Surgery, M.K.C.G. Medical College & Hospital, Berhampur.

### 3.8. Ethical Clearance

The study was approved by the Institutional Ethics Committee (I.E.C. No- 953) of M.K.C.G. Medical College and Hospital, Berhampur, for human subject research.

### 3.9. Study Procedures

Patients were assigned to either Group A (Onlay meshplasty) or Group B (Sublay meshplasty) based on their consent and surgeon's preference. Standard techniques were used for each procedure, and surgeries were performed by experienced surgeons. The duration of surgery, postoperative complications such as seroma, surgical site infections, flap necrosis, and recurrence were recorded during the 6-month follow-up period. The duration of hospital stay was also noted for each patient. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) software, and descriptive statistics such as mean, standard deviation, and percentages were used to analyze the data. The t-test was used to compare the means of the two groups for normally distributed continuous variables.

## 4. Methodology

Patients who met the inclusion and exclusion criteria were enrolled in this single center prospective study after obtaining informed consent. The study included all cases operated for ventral hernias, including incisional hernia, umbilical, supraumbilical, and epigastric hernias, who underwent onlay or sublay mesh repair. Intraoperative duration of surgery and postoperative complications such as surgical site infections, seroma formation, flap necrosis, duration of hospital stay, and recurrence were evaluated.

### 4.1. Operative technique

#### 4.1.1. Onlay meshplasty

Under general anesthesia, a skin incision was made over the bulge or defect, and subcutaneous flaps were raised above the anterior rectus sheath. The hernia sac was dissected, and its contents were reduced. The margins of the defect were held by Kocher forceps, and the sac was dealt with and reduced. The defect in the linea alba was closed with non-absorbable suture, and a prolene mesh of appropriate size was placed on the rectus sheath and secured with stitches. Hemostasis was secured, and the wound was closed over a suction drain. All patients were given 1 gm of third-generation cephalosporin antibiotic preoperatively at the time of induction, which was continued until the third postoperative day twice daily.

#### 4.1.2. Sublay meshplasty

After the hernia sac was dissected and delineated, the defect was opened, and the preperitoneal space was created between the posterior rectus sheath and the rectus muscle for the placement of the mesh. The posterior rectus sheath and the peritoneum were closed with non-absorbable sutures. A prolene mesh tailored to the size was placed in the already created plane behind the recti. The mesh was secured with a few interrupted 2/0 polypropylene sutures. The anterior rectus sheath was closed with continuous 1/0 polypropylene suture, and the skin was closed.

#### 4.2. Statistical analysis

The collected data were tabulated according to the pre-designed proforma and analyzed with IBM SPSS statistics software version 23.0. The Chi-Square test was used to find the significance in categorical data. The significant level was set at a probability value of .05.

#### 4.3. Observations

Fifty patients were enrolled in the study, with 25 cases in each group (only meshplasty and sublay meshplasty). The duration of surgery and early postoperative complications, including surgical site infections, flap necrosis, seroma, and duration of hospital stay, along with late complications such as recurrence in both groups, were evaluated and compared.

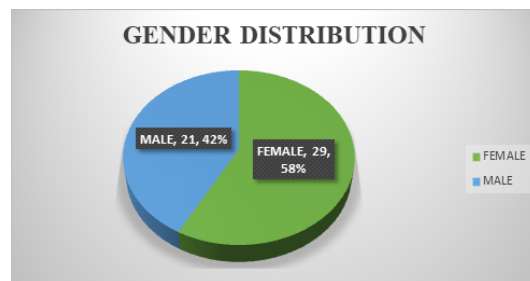
#### 4.4. Age range distribution

From this study it was inferred that most of the patients belong to 46-55 yrs age group about 32%, see Table 1.

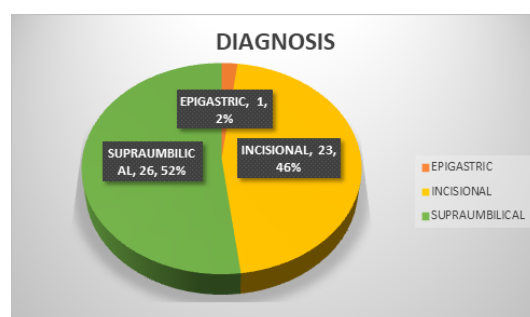
**Table 1.** showing age range distribution

Age range	Frequency	Percent
Upto 35 yrs	10	20.0
36-45 yrs	15	30.0
46-55yrs	16	32.0
Above 55 yrs	9	18.0
Total	50	100.0

From this study, majority were female 29 (58%) whereas males were about 21(42%).



**Figure 1.** Pie chart showing gender distribution



**Figure 2.** Pie chart showing diagnosis frequency

Majority cases were supraumbilical (52%) hernia followed by incisional hernia (46%) and least cases belong to epigastric hernia (2%).

**4.5. Sex distribution among sublay and onlay meshplasty group**

Out of 25 patients in sublay group 15(60%) were females and 10(40%) are males whereas in onlay group females are 14(56%) and males were 11(44%).

**Table 2.** Chi-Square Tests

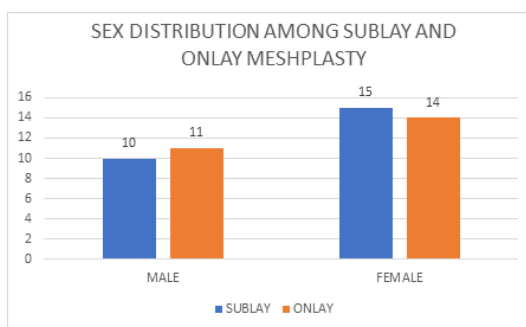
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1- sided)
Pearson Chi-Square	.082a	1	.774	1.000	.500
Continuity Correction <sup>b</sup>	0.000	1	1.000		
Likelihood Ratio	.082	1	.774		
Fisher’s Exact Test					
N of Valid Cases	50				

- a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.50.
- b. Computed only for a 2x2 table

**Table 3.** Diagnosis frequency among onlay and sublay meshplasty

CROSS TABS		Groups			Total
Diagnosis		Sublay	Onlay		
Epigastric	Count	1	0		1
	% within Groups	4.0%	0.0%		2.0%
Incisional	Count	10	13		23
	% within Groups	40.0%	52.0%		46.0%
Supraumbilical	Count	14	12		26
	% within Groups	56.0%	48.0%		52.0%
Total	Count	25	25		50
	% within Groups	100.0%	100.0%		100.0%

Table showing chi square test for sex distribution among onlay and sublay meshplasty



**Figure 3.** Sex distribution among Sublay & Onlay

In Sublay group, out of 25 patients 1(4%) patient has epigastric hernia, 10(40%) patient has incisional hernia and 14(56%) patient has supraumbilical hernia in comparison to 0(0.0%), 13(52%) and 12(48%) cases in onlay group out of 25 patients respectively.

**Table 4.** Chi-Square tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.545a	2	.462
Likelihood Ratio	1.933	2	.380
N of Valid Cases	50		

- a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is .50.

Table showing chi square test for diagnosis frequency among onlay and sublay meshplasty

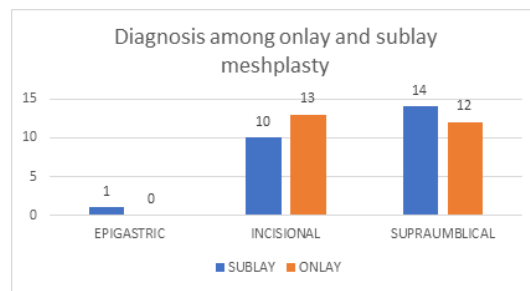


Figure 4. showing diagnosis frequency among onlay and sublay meshplasty

## 5. Duration of surgery

### 5.1. Mean Duration of Surgery

Mean duration of surgery in our series, in cases that underwent onlay mesh repair was 92.52 min, while in cases with pre-peritoneal mesh repair took more time and the duration of surgery was 117.40 min in present series.

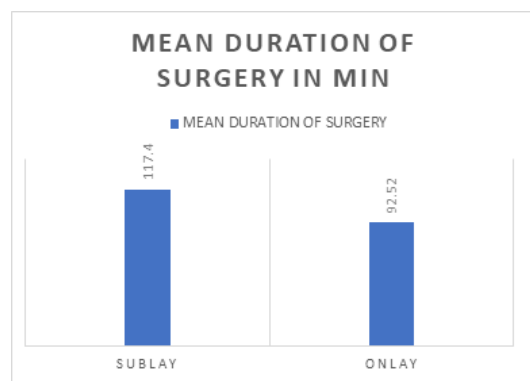


Figure 5. Figure showing mean duration of surgery among sublay and onlay meshplasty groups

## 6. Seroma

The most common complication observed was seroma in 6 patients. 1 (4%) were in pre-peritoneal and 4 (20%) in Onlay mesh repair group. This complication was managed with seroma drainage. Onlay technique had more of seroma formation thanks due to the very fact that Onlay techniques require significant subcutaneous dissection to put the mesh, which might result in devitalized tissue with seroma formation or infection. The superficial location of the mesh also puts it in peril of becoming infected if there's a superficial wound infection.

Table 5. showing frequency of seroma among onlay and sublay meshplasty groups

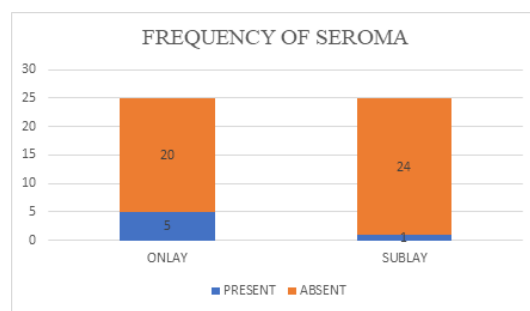
Cross tabs		Groups		Total	
		Sublay	Onlay		
Seroma	Absent	Count	24	20	44
		% within Groups	96.0%	80.0%	88.0%
	Present	Count	1	5	6
		% within Groups	4.0%	20.0%	12.0%
Total		Count	25	25	50
		% within Groups	100.0%	100.0%	100.0%

**Table 6.** Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1- sided)	
Pearson Chi-Square	3.030a	1	.082		.095	
Continuity Correctionb	1.705	1	.192			
Likelihood Ratio	3.275	1	.070			
Fisher’s Exact Test						.189
Linear-by-Linear Association	2.970	1	.085			
N of Valid Cases	50					

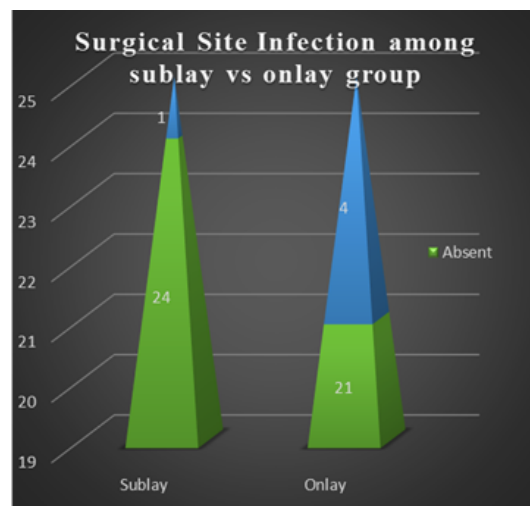
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 3.00.

Table showing chi square tests for frequency of seroma among onlay and sublay meshplasty groups



**Figure 6.** Chart showing frequency of seroma among onlay and sublay meshplasty groups

**7. Surgical site infections (SSI)**



**Figure 7.** Showing frequency of wound infection among onlay and sublay meshplasty

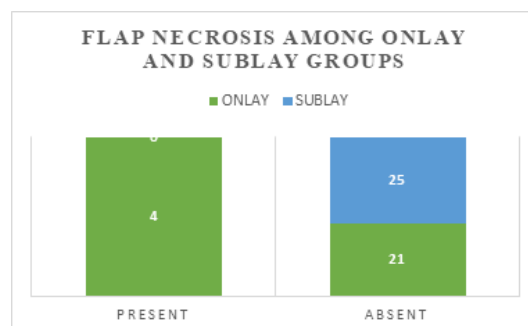
**Table 7.** Cross tabulation showing frequency of surgical site infections among onlay and sublay meshplasty groups

Crosstabs		Groups			Total
		Sublay	Onlay		
SSI	Absent	Count	24	21	45
		% within Groups	96.0%	84.0%	90.0%
	Present	Count	1	4	5
		% within Groups	4.0%	16.0%	10.0%
Total		Count	25	25	50
		% within Groups	100.0%	100.0%	100.0%

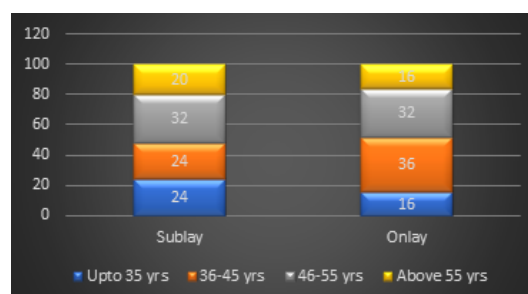
Wound infection was found in 5 cases. Out of those, 1 (4%) were in an exceedingly pre-peritoneal group and 4 (16%) were in onlay group. These patients were treated with appropriate antibiotics and regular dressing. No patient required removal of mesh because the infection was superficial and responded well to antibiotic.

## 8. Flap necrosis

Among 25 patients who underwent onlay meshplasty, flap necrosis was reported in 4 patients (16%), compared to nil incidence in sublay mesh repair.

**Figure 8.** Figure showing flap necrosis frequency among onlay and sublay meshplasty groups

## 9. Age distribution

**Figure 9.** Showing age distribution among onlay and sublay meshplasty groups



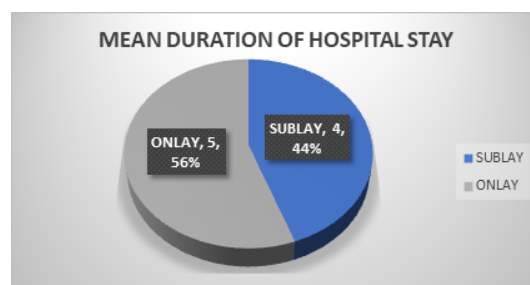
**Table 8.** Cross tabulation showing age distribution among onlay and sublay meshplasty groups

CROSS TAB		Groups			Total
		Sublay	Onlay		
Age	Upto 35 yrs	Count	6	4	10
		% within Groups	24.0%	16.0%	20.0%
	36 - 45 yrs	Count	6	9	15
		% within Groups	24.0%	36.0%	30.0%
	46 - 55 yrs	Count	8	8	16
		% within Groups	32.0%	32.0%	32.0%
	Above 55 yrs	Count	5	4	9
		% within Groups	20.0%	16.0%	18.0%
Total		Count	25	25	50
		% within Groups	100.0%	100.0%	100.0%

Out of 25 patients in sublay group majority 8(32%) patients were in the age group of 46-55 yrs in comparison to 9(36%) in age group of 36-45 yrs in onlay group and least cases 5(20%) in sublay and 4(16%) in onlay belongs to age group above 55 yrs.

### 10. Duration of hospital stay

Average post-operative hospital stay period in present series for onlay mesh repair was 5 days, as compared to 4 days' average hospital stay for pre-peritoneal mesh repair.

**Figure 10.** Pie chart showing mean duration of hospital stay among onlay and sublay meshplasty groups

### 11. Recurrence

Recurrence was present in 2(8%) cases out of 25 in onlay group whereas it was 1(4%) out of 25 in sublay group.

### 12. Discussion

When considering the best location for placement of mesh, a number of features are to be considered.

Firstly, techniques that avoid the devascularisation of flaps will prevent wound complications like infections, flap necrosis and surgical site infections. Secondly, technical ease and duration of surgery may affect the surgeon's choice. Sublay repair allows tissue integration from two load-bearing tissues from both sides: posterior rectus sheath and the anterior myo-fascial complex. In addition, Sublay mesh placement protects the mesh from exposure from superficial wound complications, intra-abdominal adhesions, and contamination. Creation of devascularizing skin flaps is avoided. Onlay allows for tissue in growth from two directions, the skin flaps are not load bearing. Mesh placed in the onlay location is vulnerable forcing the surgeon to create devascularizing skin flaps and leaving the mesh susceptible to superficial wound complication

### 13. Duration of surgery

Mean duration of surgery in our study, in cases that underwent onlay mesh plasty is 92.52 mins and in pre-peritoneal mesh repair it took more time and the average duration of surgery was 117.40 mins. The difference could be accounted to more time required for dissection for creating pre-peritoneal space. Ease of operation was largely subjective and depends on surgeons' experience, exposure, quality of assistance, and

conductive facilities. Godara *et al.*, [11], reported a mean duration of 49.35 min for onlay and a mean duration of 63.15 min for pre-peritoneal mesh repair ( $P < 0.0001$ ), while in Gleysteen [12] series the mean duration for onlay and pre-peritoneal mesh repair were 42 and 70.5 min, respectively.

#### 14. Seroma

The most common complication observed was seroma in 5 patients.

Out of patients, 1 (4%) were in preperitoneal and 5 (20%) in onlay mesh repair group. This complication was managed with seroma drainage. Onlay technique had more seroma formation, due to the fact that onlay technique requires significant subcutaneous dissection to place the mesh, which can lead to devitalized tissue. Liaqat ali zia *et.al* [13] in a study of 100 patients reported 14 percent in onlay group and 4% in sublay group. Julie L. Holihan [14] reported 18 and 4 percentages in onlay and sublay group respectively, which is similar with our study.

#### 15. Surgical site infections

The superficial location of the mesh also puts it in danger of becoming infected if there is a superficial wound infection. Wound infection was found in 5 cases. Out of these, 1 (4%) were in a pre-peritoneal group and 4 (16%) were in onlay group. Bantu Rajsiddharth *et al.*, [15] in a study of 60 patients found surgical site infection in 6 cases (10%). Out of these, 2 (6.66%) were in a pre-peritoneal group and 4 (13.33%). This is similar to our study. These patients were treated with appropriate antibiotics and regular dressing. No patient required removal of mesh because the infection was superficial and responded well to antibiotics.

#### 16. Flap necrosis

It was seen totally in 4 patients. All 4(16%) were seen in onlay group with a nil occurrence in sublay group. This is similar to a study conducted by Julie L. Holihan, Duyen H. Nguyen [16] in a group of 100 patients, 8(16%) developed discoloration of skin in onlay meshplasty with nil occurrence in sublay group. All the patients were treated conservatively for flap necrosis.

#### 17. Hospital stay

The duration of post-operative hospital stay is an indirect indication of the degree of morbidity in terms of postoperative complications. Average post-operative hospital stay period for onlay mesh repair was 5 days, as compared to 4 days for pre-peritoneal mesh repair ( $P < 0.0002$ ), which were comparable to series published by de Vries Reilingh *et al.*, and Gleysteen [12].

#### 18. Recurrence

The recurrence rates by onlay and sublay mesh repair techniques remain controversial. According to Basoglu *et al.*, [17] the recurrence rates are similar by onlay and sublay mesh repair techniques. In a randomized controlled trial with a 5-year follow-up, Weber *et al.*, [18] reported that sublay mesh repair has a significantly higher recurrence rate than onlay mesh repair (20% vs. 12%, respectively). Den Hartog *et al.*, reported recurrence rates of 7.4% by onlay mesh repair and 13.6% by sublay mesh repair. Moreover, Venclauskas *et al.*, reported recurrence rates of 10.5% using onlay mesh repair and 2% using sublay mesh repair. In a meta-analysis, Mathes *et al.*, [19] reported no difference in recurrence rates. Similarly, in the present study, the recurrence rates using onlay and sublay mesh repair techniques were found to be similar: 8% using onlay mesh repair and 4% using sublay mesh repair.

#### 19. Conclusion

Sublay mesh repair is a good alternative to onlay mesh repair that may be applicable to all forms of ventral hernia as the mesh related overall complication rate like seroma, surgical site infections, flap necrosis, hospital stay and recurrence are less compared to onlay meshplasty. Although time taken for surgery in sublay mesh repair is significantly higher compared to onlay mesh repair, complications and morbidity associated with it are significantly lower than onlay repair. Hence, sublay mesh repair can be used as the preferred method of choice for the treatment of ventral hernias.

**Author Contributions:** All authors contributed equally to the writing of this paper. All authors read and approved the final manuscript.

**Conflicts of Interest:** "Authors declare no conflict of interests."

## References

- [1] Cho, J. E., Helm, M. C., Helm, J. H., Mier, N., Kastenmeier, A. S., Gould, J. C., & Goldblatt, M. I. (2019). Retro-rectus placement of bio-absorbable mesh improves patient outcomes. *Surgical Endoscopy*, 33(8), 2629-2634.
- [2] Petro, C. C., Haskins, I. N., Perez, A. J., Tastaldi, L., Strong, A. T., Ilie, R. N., ... & Rosen, M. J. (2019). Hernia repair in patients with chronic liver disease-A 15-year single-center experience. *The American Journal of Surgery*, 217(1), 59-65.
- [3] Schlosser, K. A., Arnold, M. R., Otero, J., Prasad, T., Lincourt, A., Colavita, P. D., ... & Augenstein, V. A. (2019). Deciding on optimal approach for ventral hernia repair: laparoscopic or open. *Journal of the American College of Surgeons*, 228(1), 54-65.
- [4] Berrevoet, F. (2018). Prevention of incisional hernias after open abdomen treatment. *Frontiers in surgery*, 5, 11.
- [5] Chitrambalam, T. G., Anguraj, P., Sundaraj, J., & Pethuraj, M. (2019). A comparative study between onlay and sublay meshplasty in ventral hernias: a randomized controlled trial. *International Surgery Journal*, 6(4), 1264-1268.
- [6] Shell IV, D. H., De La Torre, J., Andrades, P., & Vasconez, L. O. (2008). Open repair of ventral incisional hernias. *Surgical Clinics of North America*, 88(1), 61-83.
- [7] Luijendijk, R. W., Hop, W. C., Van Den Tol, M. P., De Lange, D. C., Braaksma, M. M., IJzermans, J. N., ... & Jeekel, J. (2000). A comparison of suture repair with mesh repair for incisional hernia. *New England Journal of Medicine*, 343(6), 392-398.
- [8] Millikan, K. W. (2003). Incisional hernia repair. *Surgical Clinics*, 83(5), 1223-1234.
- [9] Stoppa, R. E. (1989). The treatment of complicated groin and incisional hernias. *World journal of surgery*, 13(5), 545-554.
- [10] Chevrel, J. P., & Rath, A. M. (1997). The use of fibrin glues in the surgical treatment of incisional hernias. *Hernia*, 1(1), 9-14.
- [11] Godara, R., Garg, P., Raj, H., & Singla, S. L. (2006). Comparative Evaluation of sublay versus only Meshplasty in ventral hernias. *Internet J Surg*, 8(1), 222-223.
- [12] Gleysteen, J. J. (2009). Mesh-reinforced ventral hernia repair: preference for 2 techniques. *Archives of Surgery*, 144(8), 740-745.
- [13] Zia, L. A., Farooq, A., & Amin, I. (2016). Comparative Study between Sublay and Onlay Technique of Repairing Ventral Abdominal Hernia. *PAKISTAN JOURNAL OF MEDICAL & HEALTH SCIENCES*, 10(2), 670-672.
- [14] Liang, M. K., Holihan, J. L., Itani, K., Alawadi, Z. M., Gonzalez, J. R. F., Askenasy, E. P., ... & Berger, D. H. (2017). Ventral hernia management. *Annals of surgery*, 265(1), 80-89.
- [15] Rajsiddharth, B., Venkanna, M., Kumar, G. A., Patlolla, S. R., Sriramoju, S., & Reddy, B. S. (2015). Comparative study of onlay and pre-peritoneal mesh repair in the management of ventral hernias. *International Journal of Scientific Study*, 3(7), 121-128.
- [16] Holihan, J. L., Nguyen, D. H., Nguyen, M. T., Mo, J., Kao, L. S., & Liang, M. K. (2016). Mesh location in open ventral hernia repair: a systematic review and network meta-analysis. *World journal of surgery*, 40(1), 89-99.
- [17] Basoglu, M., Yildirgan, M. I., Yilmaz, I., Balik, A., Celebi, F., Atamanalp, S. S., ... & Oren, D. (2004). Late complications of incisional hernias following prosthetic mesh repair. *Acta Chirurgica Belgica*, 104(4), 425-448.
- [18] Wéber, G., Baracs, J., & Horváth, O. P. (2010). " Onlay" mesh provides significantly better results than" sublay" reconstruction. Prospective randomized multicenter study of abdominal wall reconstruction with sutures only, or with surgical mesh—results of a five-years follow-up. *Magyar sebeszet*, 63(5), 302-311.
- [19] Mathes, T., Walgenbach, M., & Siegel, R. (2016). Suture versus mesh repair in primary and incisional ventral hernias: A systematic review and meta-analysis. *World Journal of Surgery*, 40(4), 826-835.



© 2023 by the authors; licensee PSRP, Lahore, Pakistan. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).