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A comparison study between retro-rectus and onlay mesh repair outcomes for ventral hernia in a tertiary care center

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Abstract

BACKGROUND: Ventral hernias refer to a weakening or defect in the abdominal wall through which abdominal contents can protrude. Ventral hernia is a frequent problem in surgical practice which includes primary and incisional. Mesh repair is still the gold standard. Open approaches include retro-rectus (Rives-Stoppa) and onlay repair.

OBJECTIVES: The purpose of this study is to evaluate and compare the outcomes of both repairs in terms of efficacy and techniques, time taken for surgery, postoperative pain, length of hospital stays, complications, and recurrence.

MATERIALS AND METHODS: A retrospective study of 40 patients was carried out in all ventral hernia patients based on clinical and demographic parameters with a Tanaka index less than 25% and defect size less than 10 cm.

RESULTS: The results overall were more promising toward retro-rectus repair in terms of surgical site infections, skin necrosis, seroma, hematoma, and duration of drain placement (mean duration 2.85 ± 0.75 days in retro-rectus group and 5.1 ± 2.47 days in onlay group). However, onlay repair was associated with less time taken for surgery (mean duration 97.25 ± 10.69 min for retro-rectus and 70.25 ± 8.66 min for onlay), less postoperative pain, and shortened hospital stay (4.85 ± 1.31 days for retro-rectus group and 3.10 ± 1.02 days for onlay). There was no recurrence in both groups in our study.

CONCLUSION: Both approaches have their own pros and cons. The rate of complications and recurrence is lower with retro-rectus repair; however, onlay repair has less intricacies associated with surgery, a lesser learning curve, and an overall straightforward procedure compared to the one mentioned before.

Keywords:
Mesh, onlay, retro-rectus, ventral hernia

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Introduction

A ventral hernia is a protrusion of abdominal contents through the defect in the anterior abdominal wall. It can be a primary or incisional hernia. Primary hernia occurs at the potential weak embryological site, mainly the umbilical and epigastric region. The development of primary hernias involves various factors, including non-modifiable elements like age, gender, anatomical differences, and genetics, as well as modifiable factors such as obesity and smoking.[1] Currently, the most accepted hernia classification is of the European Hernia Society (EHS) which divides primary abdominal wall hernias and a division of subgroups of incisional abdominal wall

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hernias, concerning the localization of the hernia.[2] Primary ventral hernias (PVH) typically occur along the midline through the linea alba, often appearing as either umbilical or epigastric hernias. Umbilical hernias are primary hernias where the defect is centered on the belly button. These are relatively common and can be found in up to 25% of the population through clinical examination and ultrasound, although most cases are asymptomatic. Umbilical hernias can affect individuals of any age, but they are most commonly seen in infants (0–5 years), older men (61–70 years), and middle-aged women (31–40 years). Hernias near the umbilicus, but not directly originating from it, are often referred to as paraumbilical hernias. Depending on their location, they may also be described as supraumbilical or infraumbilical hernias. An epigastric hernia is another type of primary hernia, typically located just above the umbilicus and in the region extending from 3 cm below the xiphoid process to 3 cm above the umbilicus.[3,4] These hernias are rarer in children and are more frequently observed in middle-aged to older adults, typically between the ages of 51 and 70 for men and 40 to 50 for women.[4] The prevalence of epigastric hernias is estimated to range about 3–5%, and they account for 3.6–6.9% of all abdominal wall hernia surgeries.[5] Incisional hernia occurs at the site of scar of earlier abdominal surgeries due to several factors, including technical and patient-related. Various factors, including those that affect collagen in the lungs, are linked to poor wound healing and an increased likelihood of hernia formation. Wound infections have also been associated with a higher incidence of hernias.[6] However, studies suggest that the incidence of ventral hernias after a midline incision ranges from 15% to 20%, and the risk is doubled when accompanied by a surgical site infection (SSI).[7] A meta-analysis of 11 studies examining the incidence of ventral hernias following various types of abdominal incisions reported the risk rate to be 10.5% for midline, 7.5% for transverse, and 2.5% for paramedian incisions.[8] Risk factors for hernia formation include surgical site occurrences, excessive physical exertion, obesity, and chronic cough. It is essential to involve patients in shared decision-making, considering their history of weight management, the severity of symptoms, and their acceptance of the associated risks. Like obesity, smoking contributes to increased wound complications, infections, and hernia recurrence. Therefore, it is recommended that smokers cease smoking for 4–6 weeks before elective hernia repair surgery. For patients with diabetes, preoperative blood sugar control is crucial. Expert recommendations suggest that diabetic patients with an HbA1c of 6.5% or higher should optimize their health before surgery, and surgery should be postponed if the HbA1c exceeds 8.0%.[9] Technical factors, including type of suture material, type of fascial closure, length of suture, failed meshplasty, and SSIs, are surgeon dependent. So, an incisional hernia is iatrogenic in nature and often involves multifactorial etiology. Patient-related factors are morbid obesity, malnutrition, anemia, smoking, immunocompromised state, diabetes, liver disease, and other systemic diseases. Obesity is linked not only to the formation of PVH but is also a contributing factor to postoperative wound complications, hernia recurrence, longer hospital stays, and readmission after surgical repair.[7,10] Expert panels have previously recommended not offering surgery to patients with a body mass index (BMI) exceeding 50 kg/m². According to recent joint guidelines from the EHS and AHS, weight loss and achieving a BMI of less than 35 kg/m² should be recommended before elective hernia repair is considered.[11] Treating ventral hernias requires an exquisite understanding of anterior wall anatomy and physiology. A recent Delphi consensus on ventral hernia repair suggests meshplasty for primary ventral hernia with a defect size >2 cm and all incisional hernias.[12] Mesh exploits the body's natural healing processes to strengthen and reinforce the repaired area. It causes tissue integration, collagen deposition, inflammatory response, redistribution of forces, and tension-free repairs. The anterior wall anatomy leaves the surgeon with a choice to place the mesh in three different planes; those are onlay, inlay, and sublay. Studies suggest that inlays may not be as effective as other mesh repair. Onlay repair consists of placing the mesh over the anterior rectus sheath after creating sufficient planes beneath the subcutaneous and suturing the defect, while sublay mesh is placed between the rectus muscle and posterior rectus sheath (PRS) after approximating both sides PRS. A key principle in abdominal wall reconstruction is the restoration of the linea alba. Realigning the linea alba to the midline not only helps achieve a functional abdominal wall but also protects the mesh from superficial wound complications and may contribute to a more durable repair. The goal of this study is to compare the results of onlay versus retro-rectus repair in terms of efficacy of both techniques, time taken for surgery, postoperative pain, length of hospital stays, complications (SSI, hematoma, seroma, and skin necrosis), and recurrence.

Materials and Methods

A retrospective analysis was performed on 40 patients who underwent open ventral hernia repair from March 2021 to April 2023 at a tertiary care hospital in East India. The study used a convenience sampling approach, where participants were selected based on availability and accessibility in the retrospective dataset. An Excel sheet template was designed which included demographic data, symptoms, investigation, diagnosis, type of surgical approaches, operative times, pain on postoperative day (POD) 1, 2, and 3, complications (early and late), and follow-up visits. All the parameters of the aim were compared. The

patients were followed up with outpatient department visits at 1 and 3 months and later on phone calls for period of 1 year.

Inclusion criteria

All adult patients, regardless of gender with ventral hernia, were included which consisted of post-laparotomy incisional hernia, recurrent hernia, and primary hernia (umbilical, paraumbilical, epigastric) with fascial defect size of <10 cm.

Exclusion criteria

All complicated hernia (obstructed, strangulated, with signs of peritonitis), groin hernias, lateral and Spigelian hernia, preexisting skin infection, uncontrollable diabetes mellitus, and fascial defect size of >10 cm.

Group A (onlay repair)

An incision is made over the hernial site. The incision length can vary, but it is generally as long as the largest dimension of the hernial defect. The hernial sac is identified and opened, and its contents are repositioned into the abdominal cavity. Any excess sac is excised. The defect is then closed primarily using prolene (1–0) RB sutures. A subcutaneous plane is created, extending 5–6 cm beyond the defect in every direction. A prolene mesh is tailored and securely fixed over the anterior rectus sheath with at least a 5 cm overlap to the defect using prolene (2–0) RB sutures. A subcutaneous suction drain is positioned over the mesh, and the skin is sutured closed [Figure 1].

Group B (retro-rectus repair)

A midline laparotomy incision is made extending 5 cm cranially and caudally to the defect, ensuring caution to avoid injury to any adhered contents within the sac. The contents are then reduced. The PRS is incised over the rectus muscle, and a retro-rectus plane is created by sweeping the muscle upwards from the PRS and pre-peritoneum below the arcuate line. Laterally, the dissection is extended medially to the neurovascular bundle, and care is taken to not injure it. For M4 and M5 hernia, the inferior extent is the Cooper's ligament to which mesh is fixed. The PRS is closed using PDS 3-0 RB suture, and a prolene mesh is tailored and fixed with prolene 2-0 RB sutures, providing a 5 cm overlap with the defect. Trans-fascial sutures are administered if deemed necessary. A suction drain is placed on either side of the mesh. The anterior rectus sheath is closed using loop prolene, a subcutaneous suction drain is placed as indicated, and the skin is closed [Figure 2].

Common procedure

The eligible patients were informed about the procedure's details, and written consent was obtained. All patients received prophylactic ceftriaxone 1 g and administered postoperatively twice daily along with amikacin 1 g once daily for 3 days. We used heavyweight microporous polypropylene mesh (weight – 95 g/m^2, mean pore size – 0.5 mm, strength – 1600 mm Hg, size – 6 cm × 11 cm or 15 × 15 cm accordingly for a 5 cm overlap to the defect) in all the cases. No external compression was applied. Dressing checks with wound assessments were conducted 48 h postoperatively. Drains were taken out if the output was less than 20 mL in 24 h and non-hemorrhagic. Suture removal was performed after 12–14 days. Postoperative visits were scheduled at 1, 6, and 12 months.

Statistical analysis

Analysis was performed using the Statistical Package for the Social Sciences, version 20 (SPSS). For all continuous data, the mean was calculated; for categorical categories, Mann–Whitney *U* test and percentages were used. The 95% confidence level was maintained, and statistical significance was assessed using a *P* value of less than or equal to 0.05.

Results

The data indicates a higher prevalence of hernia in middle-aged individuals notably the majority being the female group. The retro-rectus technique was

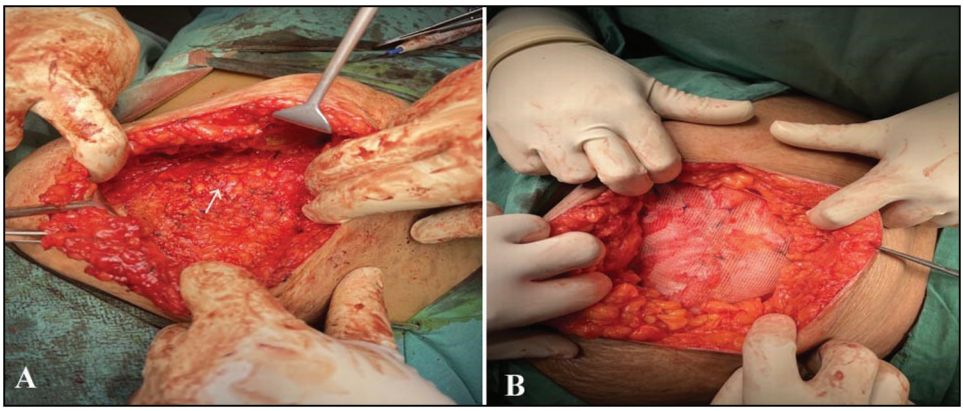

Figure 1: A. Subcutaneous plane creation after closing the defect; B. Mesh placed and fixed with non-absorbable suture on the anterior rectus sheath

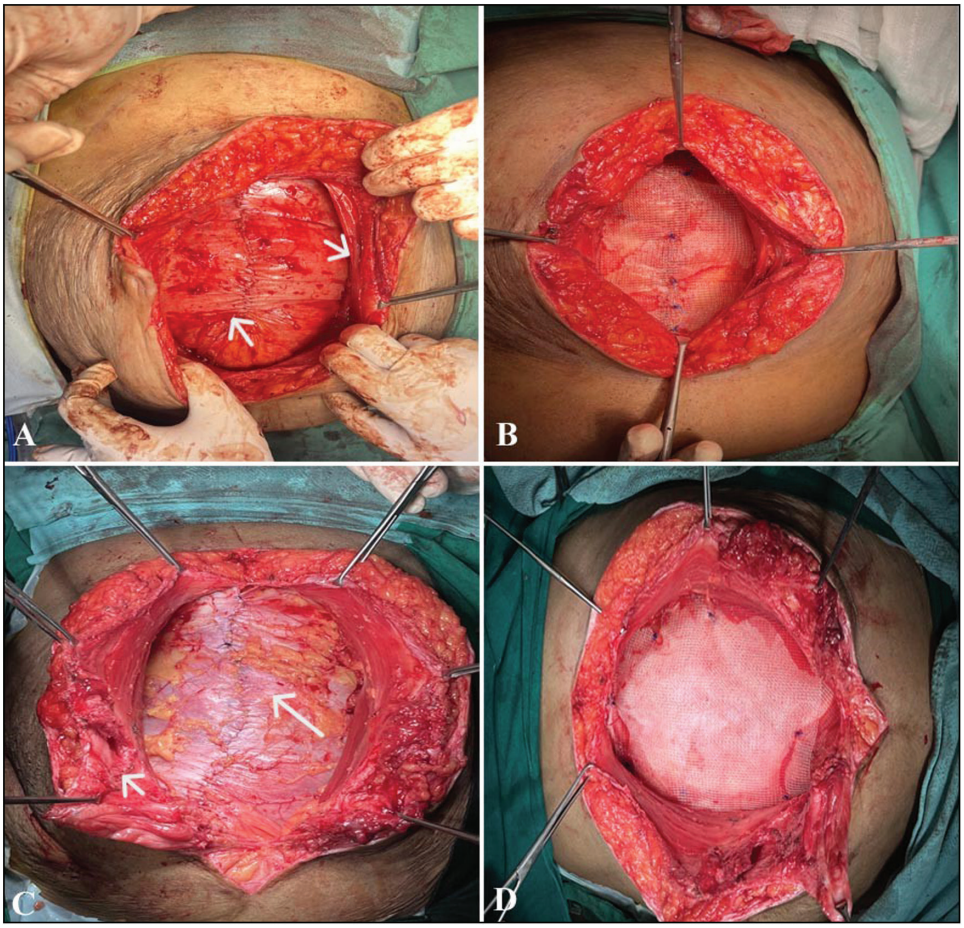

Figure 2: A. Posterior rectus sheath (PRS) closure after retro-rectus dissection with arcuate line seen, rectus muscle can be seen retracted anteriorly; B. After mesh placement; C. PRS closure in other patients with midline defect can be seen; D. After mesh placement

Table 1: Association between the groups and sociodemographic and anthropometry

Demographics		Number (%)	
		Onlay *N* = 20 (100)	Retro-rectus *N* = 20 (100)
Age group (in years)	20–30	0 (0%)	2 (10%)
	30–40	6 (30%)	1 (5%)
	40–50	4 (20%)	10 (50%)
	50–60	3 (15%)	6 (30%)
	60–70	6 (30%)	1 (5%)
	70–80	1 (5%)	0 (0%)
Sex	Female	14 (70%)	15 (75%)
	Male	6 (30%)	5 (25%)
Body mass index (mean ± SD) (in kg/m^2)		24.46 ± 2.8	25.12 ± 1.9

Table 2: Association between modes of intervention with co-morbidities

Co-morbidities	Number (%)		*P* value
	Onlay *N* = 20 (100)	Retro-rectus *N* = 20 (100)	
Hypertension	2 (10)	3 (15%)	1
Diabetes	2 (10%)	2 (10%)	1
Chronic obstructive pulmonary disease/asthma	0 (0%)	1 (5%)	1
Tuberculosis	1 (5%)	0 (0%)	1
Coronary artery disease	0 (0%)	2 (10%)	0.487
Hypothyroid	1 (5%)	0 (0%)	1
Smoking	5 (25%)	2 (10%)	0.407

utilized more frequently in the 40–60 years age groups compared to the onlay method. The onlay technique demonstrated a relatively balanced distribution across genders [Table 1]. There is no significant difference between the groups undergoing two different procedures with respect to age, sex, BMI, and co-morbidities; thereby, the two groups are comparable [Table 2]. Incisional hernias were the most prevalent, accounting for approximately 75% of cases. The onlay group had relatively more primary hernias. The retro-rectus repair was primarily employed for larger defect sizes (W2), highlighting its suitability for managing more complex hernias. Conversely, the onlay technique was preferred for primary hernias, indicating its appropriateness for smaller or less complicated defects. A total of 90% of the defects were in M3 and M4 regions for incisional hernia [Figure 3, Table 3]. Among patients with incisional hernias, gynecological surgeries

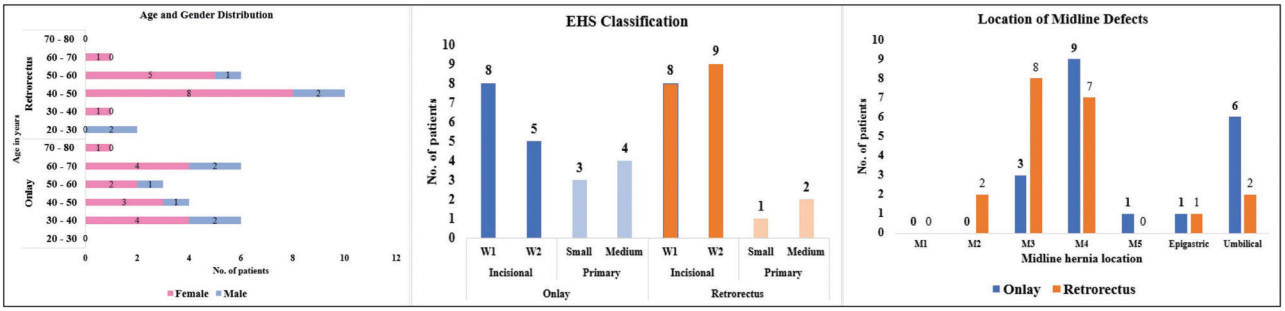

Figure 3: Age and gender distribution, European Hernia Society classification, location of midline defects

Table 3: Location and size distribution of hernia defects

	European Hernia Society classification		Number (%)	
			Onlay *N* = 20 (100)	Retro-rectus *N* = 20 (100)
Location of midline defect	Primary	Epigastric	1 (0%)	1 (0%)
		Umbilical	6 (30%)	2 (10%)
	Incisional	M1	0 (0%)	0 (0%)
		M2	0 (0%)	2 (10%)
		M3	3 (15%)	8 (40%)
		M4	9 (45%)	7 (35%)
		M5	1 (0%)	0 (0%)
Width of defect	Primary	Small	3 (15%)	1 (5%)
		Medium	4 (20%)	2 (10%)
		Large	0 (0%)	0 (0%)
	Incisional	W1	8 (40%)	8 (40%)
		W2	5 (25%)	9 (45%)
		W3	0 (0%)	0 (0%)

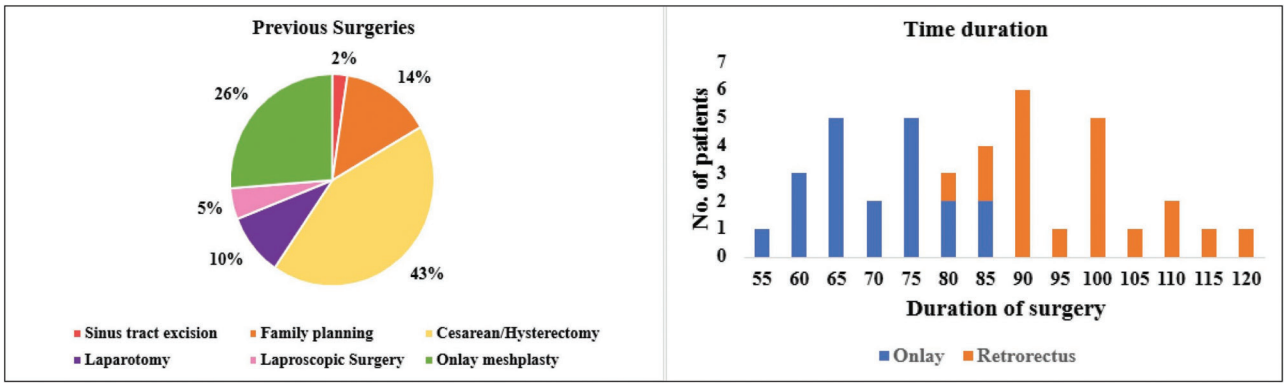

Figure 4: Distribution of previous surgeries, duration of surgery

accounted for approximately 57% of cases. All patients with recurrent hernias in this study had a history of previous onlay meshplasty, with one patient having undergone an intra peritoneal onlay mesh repair. Overall, previous meshplasty procedures constituted approximately 26% of the prior surgical interventions. Retro-rectus repair exhibited a significantly longer average duration (mean = 97.25 ± 10.69 min) compared to onlay repair (70.25 ± 8.66 min) (P value < 0.001) [Figure 4]. This is likely attributable to the creation of a space between the muscle and the PRS, necessitating more intricate surgical steps. The graph represents the mean postoperative pain scores measured using the visual analog scale (VAS) across three postoperative days for two groups. The onlay group consistently reported lower pain scores compared to the retro-rectus group on all postoperative days (P value < 0.001). Both groups show a similar trend of decreasing pain over time, but the mean decrease in VAS score is less pronounced in the retro-rectus group (4.65 ± 0.67, 3.15 ± 0.59, 1.90 ± 0.45) compared to the onlay group (2.75 ± 0.64, 1.85 ± 0.49, 1.05 ± 0.22) on POD 1, 2, and 3, respectively. The onlay group demonstrated a higher incidence of seroma formation and skin necrosis

but was not statistically significant (*P* value > 0.05), likely attributable to more extensive subcutaneous dissection. SSI was more in the onlay group but was not significant statistically (*P* value > 0.05). Recurrence was not observed in either group during the 1-year follow-up period [Table 4]. However, it is noteworthy that all recurrent hernias in our study had previously undergone onlay mesh repair. We did not observe any mesh-related complications like infection, extrusion, and fistula [Figure 5]. The average length of hospital stay in the onlay group was 3.10 ± 1.02 days, and retro-rectus group was 4.85 ± 1.31 days (*P* value < 0.001). Patients in the onlay group have a significantly shorter hospital stay compared to those in the retro-rectus group suggesting that the onlay surgical approach was associated with faster recovery and fewer complications compared to the retro-rectus approach. The onlay technique required a significantly longer mesh drain duration, averaging around 5.1 ± 2.47 days, compared to the retro-rectus technique, which had a shorter average duration at approximately 2.85 ± 0.75 days (*P* value < 0.001) [Figure 6 and Table 5]. Most of the studies did not provide information regarding drain placement which has an association with seroma formation. Our study provides information on the number of days the drain was kept which is helpful in fewer incidences of hematoma and seroma. While subcutaneous drains were placed in fatty patients undergoing retro-rectus repair, their duration was not significant due to the limited extent of dissection and the lack of mesh contact with the drain.

Table 4: Occurrence of complications between the onlay and retro-rectus groups

	Number (%)		*P* value
	Onlay *N* = 20 (100)	Retro-rectus *N* = 20 (100)	
Surgical site infection	1 (5%)	0 (0%)	1
Skin necrosis	3 (15%)	1 (5%)	1
Hematoma	0 (0%)	0 (0%)	N/A
Seroma	4 (20%)	0 (0%)	0.106
Recurrence	0 (0%)	0 (0%)	N/A

Table 5: Various outcomes with both the groups

		Mean ± SD		*P* value
		Onlay	Retro-rectus	
Duration of surgery (min)		70.25 ± 8.66	97.25 ± 10.69	<0.001
Length of hospital stay (days)		3.10 ± 1.02	4.85 ± 1.31	<0.001
Mesh drain duration (days)		5.1 ± 2.47	2.85 ± 0.75	<0.001
Postoperative pain – visual analog scale score	Day 1	2.75 ± 0.64	4.65 ± 0.67	<0.001
	Day 2	1.85 ± 0.49	3.15 ± 0.59	
	Day 3	1.05 ± 0.22	1.90 ± 0.45	

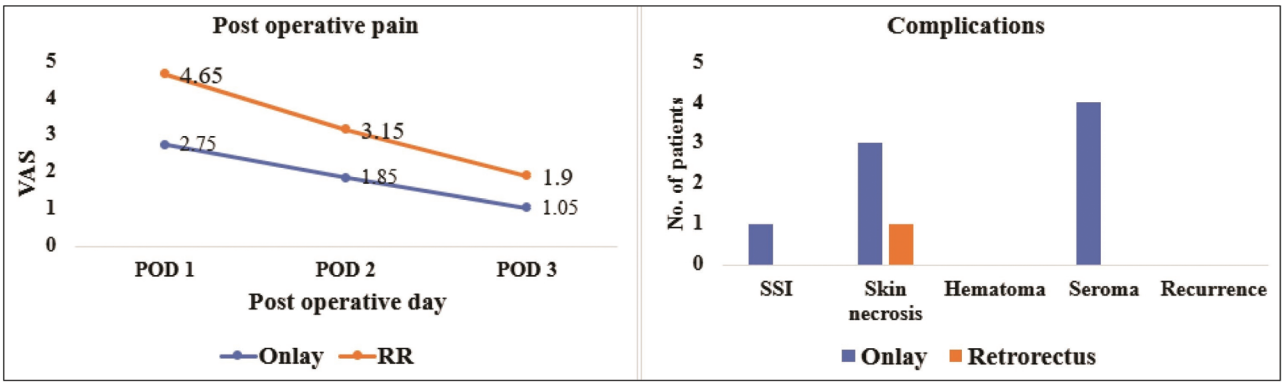

Figure 5: Postoperative visual analog scale, complications

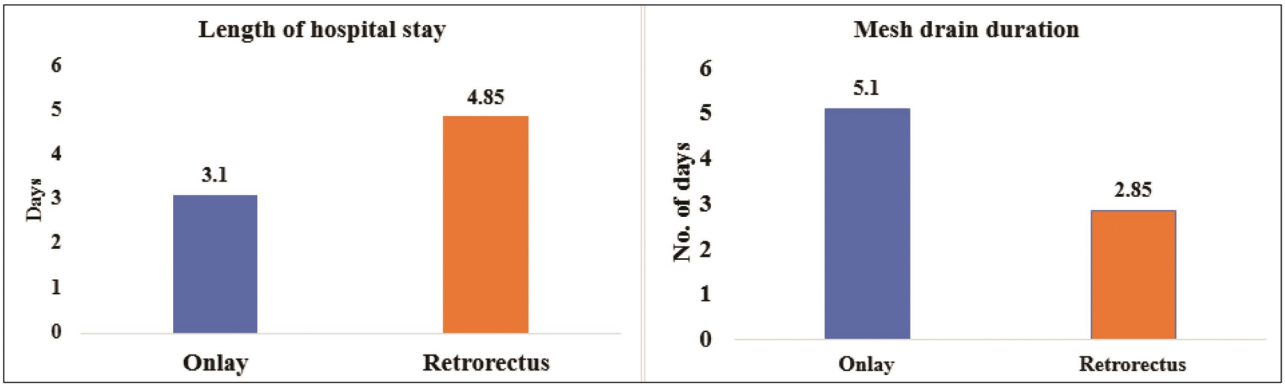

Figure 6: Length of hospital stay and mesh drain duration

Discussion

Ventral hernia repair is a widely performed surgical procedure, with most ventral hernias resulting from previous abdominal surgery. The main causes include decreased macromolecules necessary for wound healing and relative ischemia. Due to symptoms and complications such as pain, discomfort, obstruction, incarceration, and strangulation, repair is deemed necessary in all cases. In our study, gynecological surgery accounted for the majority of the previous surgical history, making it a significant contributor to incisional hernia development. This may be due to technical factors, closure techniques, and wound-related SSI. Surprisingly, all the patients with recurrent hernias had undergone a previous onlay meshplasty. The reason for this could be inadequate mesh overlap over the defect and improper fixation, both of which compromise the durability of repair. Also, one animal study showed mesh shrinked more in onlay compared to sublay placement.[13] A meta-analysis by Timmermans *et al*.[14] did not confirm superiority of sublay over onlay but seven out of eight studies included in this meta-analysis reported more recurrences with onlay repair. Various approaches have been developed for repair, depending on mesh placement. In this study, we compare two well-known techniques: onlay and retro-rectus. The onlay technique is technically easier to perform and less time-consuming consistent with three studies which included operative time and associated with less postoperative pain and shorter hospital stays.[15,16] It involves extensive dissection of the subcutaneous plane down to the anterior rectus sheath, and sometimes, large subcutaneous flaps are raised for larger defects.[17,18] However, this can increase the risk of skin necrosis, SSI, longer drain duration, and seroma formation due to potential dead space. SSI incidence was more in the onlay group contrary to Timmermans *et al*.[14] Majority of the studies showed no differences in seroma formation but Venclauskas *et al*.[15] observed more seroma in the onlay group.[19] Additionally, the mesh in the onlay technique is more exposed, increasing the probability of mesh infection due to its superficial placement. We did not observe any mesh-related complications, which can be attributed to maintaining strict sterility and proper fixation with suture bites through the fascia.

In contrast, the retro-rectus technique involves placing the mesh in a compact space where intra-abdominal pressure fixes the mesh between the rectus muscle and the PRS, leaving no potential space after closing the anterior rectus sheath. The retro-rectus group had more patients with relatively higher BMI compared to the onlay group. The retro-rectus space is more vascular due to the muscle above and the superior and inferior epigastric arteries. This increased vascularity leads to better tissue incorporation and enhanced mesh fibrosis, but it also increases the risk of bleeding and hematoma formation, which can be managed with meticulous hemostasis. In most cases, the hematoma is a radiological hematoma, confined to retro-rectus space, and not clinically appreciable. We did not do any investigation for clinically not appreciable hematomas or seromas.[20] The retro-rectus technique was associated with more postoperative pain and longer hospital stays despite the use of epidural analgesia, primarily due to the laparotomy needed for repair. Despite these challenges, the retro-rectus technique offers a more secure plane for mesh placement, with relatively lower chances of mesh infection and recurrence. Retro-rectus repair is technically challenging and requires a thorough understanding of anterior abdominal wall anatomy. Both techniques should be chosen based on the demands of the clinical situation, considering patient and surgeon factors.

Limitations

Further research and long-term follow-up studies are warranted to validate our findings and guide clinical decision-making in ventral hernia repair. This is a single institute study. In future, this study can be conducted in a multi-institutional and prospective manner.

Conclusion

Our comparative study between retro-rectus and onlay mesh repair outcomes for ventral hernia in a tertiary care center sheds light on the efficacy and complexities associated with both techniques. While retro-rectus repair demonstrated favorable outcomes in terms of more tensile strength, SSIs, duration of drain placement, and seroma formation, onlay repair showcased advantages in terms of shorter operative time, short learning curve, less postoperative pain, and reduced hospital stay. We did not face any recurrence in both groups, but a larger study group and longer follow-up are required. Nonetheless, the onlay repair recurrent hernia cases in our study cannot be ignored. However, it is essential to recognize that each approach has its own set of benefits and drawbacks. Retro-rectus repair requires a deeper understanding of anterior abdominal wall anatomy and poses technical challenges, yet it offers more secure mesh placement with potentially lower complications. On the other hand, onlay repair is technically simpler and quicker to perform, making it an attractive option for surgeons, particularly those who are less experienced. Ultimately, the choice between retro-rectus and onlay repair should be tailored to individual patient factors, including age, BMI, co-morbidities, and location of the defect, previous surgery, and the surgeon's expertise.

Author contributions

All authors contributed to the conception and design of the study. Material preparation, data collection, and analysis were carried out by Rashmiranjan Sahoo and Ketan Gupta. The first draft of the manuscript was written by Ketan Gupta. Statistical analysis was performed by Aakriti S Ganesh. Patient follow-up was managed by Nalini Naik and Abhinav Voona. All authors reviewed and provided feedback on previous versions of the manuscript. All authors read and approved the final manuscript.

Ethical policy and institutional review board statement

The study was conducted in accordance with the ethical standards of the (IMS & SUM Hospital, SOA Deemed to be University) and with the 1964 Helsinki Declaration and its later amendments. As this was a retrospective study involving de-identified data, it was exempt from requiring Institutional Review Board approval.

Declaration of patient consent

The eligible patients were informed about the procedure's details, and written consent was obtained.

Data availability

The data are not publicly available to protect patient identity. However, these data may be made available upon reasonable request to the corresponding author.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Acknowledgments

Not applicable.

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