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ORIGINAL ARTICLE

Comparative Outcomes of On-lay Mesh and Sub-lay Mesh Techniques in Ventral Hernia Repair: A Prospective Study of 140 Patients

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ABSTRACT

Objective: The purpose of this study is to compare the outcomes of the on-lay mesh technique and the sub-lay mesh technique for ventral hernia repair.

Study Design: Prospective/Comparative Study

Place & Duration: Department of General Surgery, Akhtar Saeed Medical College, Lahore from June 2022 to May 2023.

Methods: A total of 140 individuals of both sexes, aged 18 to 75 years, undergoing ventral hernia repair were included in the study. After obtaining the patient's consent, demographic data, including age and gender, were recorded. The patients were randomly divided into two groups: Group I and Group II. Participants in Group I underwent repair using the on-lay mesh technique, while Group II received the sub-lay mesh approach. Postoperative outcomes, including pain levels, wound infections, seroma formation, and hospital stay duration, were compared between the two groups. Data analysis was performed using SPSS 24.

Results: In Group I, the mean age was 47.12 ± 5.38 years, while in Group II, it was 48.7 ± 11.66 years. Of the total patients, 81 (57.8%) were females, and 59 (42.2%) were males. Postoperative pain was significantly higher in Group I (mean 5.1 ± 3.18) compared to Group II (mean 2.9 ± 4.16). Wound infection occurred in 24 (17.1%) patients in Group I and 14 (10%) patients in Group II ($p < 0.005$). Seroma formation was noted in 16 (11.4%) patients in Group I and 8 (5.7%) patients in Group II ($p < 0.005$). The average hospitalization duration was significantly longer for patients in Group I (6.0 ± 1.36 days) compared to those in Group II (3.2 ± 0.44 days, $p < 0.05$).

Conclusion: The sub-lay mesh technique for ventral hernia repair proved to be not only effective but also safer, with a lower incidence of complications, reduced postoperative pain, and a shorter hospital stay compared to the on-lay mesh technique.

Keywords: On-lay Mesh Technique, Ventral Hernia Repair, Outcomes, Sub-lay Mesh Technique

INTRODUCTION

A ventral abdominal wall incisional hernia is defined as a defect in the musculoskeletal layers of the abdominal wall, usually located near a previous surgical scar. It is one of the most common types of hernias encountered in surgical practice. Incisional hernias are the most frequent form of ventral abdominal wall hernias, and their repair represents one of the most common surgical procedures performed globally. In the United States alone, over 250,000 ventral hernia repairs are performed annually[1]. The incidence of incisional hernias reported in the literature varies, ranging from 2-11% to 10-20%[2,3]. The recurrence, morbidity, and high costs associated with incisional hernia repair present significant challenges for general surgeons[4].

The use of prosthetic mesh during open surgery has become a standard approach, with techniques such as the onlay and sublay methods being widely adopted. Previous studies have failed to demonstrate a clear superiority of one technique over the other[5]. However, it is believed that the placement of the graft in the sublay position may reduce the formation of seromas, a common postoperative complication[6]. In contrast, onlay mesh repair, while associated with a higher risk of complications, is thought to result in fewer hernia recurrences[7]. Both techniques are widely utilized, but the long-term outcomes of graft placement in different layers of the abdominal wall remain incompletely understood[8,9].

Historically, hernias were first documented by Arnauls de Villeneuve in 1285 A.D., with the first successful repair recorded in 1805[10]. Since the development of anesthesia, asepsis, and antisepsis in the 11th century, abdominal surgeries have become more common, leading to a rise in the incidence of incisional hernias. Modern-day ventral hernias represent one of the most common issues addressed by surgeons, with the repair of ventral hernias accounting for 15-18% of all surgical procedures[11]. Additionally, the incidence of incisional hernias in laparoscopic surgery patients has been reported to be between 3-13%, with prevalence rates rising up to 23%[12].

Given the challenges surrounding incisional hernia repair, the current study aims to compare the outcomes of the on-lay and sub-lay mesh techniques and evaluate their respective advantages and risks.

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MATERIALS AND METHODS

This prospective study was conducted at the Department of General Surgery, Akhtar Saeed Medical College, Lahore from June 2022 to May 2023. The study aimed to compare the outcomes of the on-lay and sub-lay mesh techniques for ventral hernia repair. A total of 140 patients, aged between 18 and 75 years, of both sexes, who required ventral hernia repair, were included in the study.

Sample Size Calculation: The sample size was calculated using a standard formula for comparing two proportions. Assuming a 10% difference in the incidence of complications between the two groups, with a confidence level of 95% and a power of 80%, a total of 140 patients (70 in each group) was determined to be sufficient to achieve statistically significant results.

Inclusion Criteria:

- Adult patients aged 18 to 75 years.
- Patients undergoing elective ventral hernia repair.
- Both male and female patients.
- Patients who provided written informed consent to participate in the study.

Exclusion Criteria:

- Patients under the age of 18 years.
- Patients with liver cancer or any other malignancy.
- Patients with a history of severe allergic reactions to mesh implants.
- Patients who refused to participate or did not sign the informed consent form.

Data Collection Procedure: After obtaining written informed consent, demographic data, including age, gender, and medical history, were recorded for each patient. Patients were randomly assigned to one of two groups:

- **Group I (On-lay Mesh Technique):** 70 patients who underwent ventral hernia repair using the on-lay mesh technique.
- **Group II (Sub-lay Mesh Technique):** 70 patients who underwent the sub-lay mesh technique for ventral hernia repair.

Both procedures were performed under general anesthesia, and the surgery was carried out by experienced surgeons. Postoperative data, including pain levels (measured using a visual analog scale), wound infection rates, seroma formation, and length of hospital stay, were collected during the postoperative period (within 30 days).

Data Analysis: The collected data were analyzed using SPSS version 24. The categorical variables, such as gender, wound infection, and seroma formation, were compared between the two groups using the Chi-square test. The continuous variables, such as age and length of hospital stay, were compared using the independent t-test. A p-value of less than 0.05 was considered statistically significant. All results were presented with their corresponding 95% confidence intervals.

RESULTS

A total of 140 patients were included in the study, with 70 patients in each of the two groups: Group I (on-lay mesh technique) and Group II (sub-lay mesh technique). The demographic characteristics, postoperative complications, and hospital stay durations were compared between the two groups.

The mean age of the patients in Group I was 46.8 ± 9.4 years, and in Group II, it was 47.5 ± 10.1 years. The study population consisted of 84 (60%) females and 56 (40%) males. The age distribution between the two groups was comparable ($p > 0.05$), indicating no significant difference between the two groups in terms of age and gender distribution. (Table 1)

Postoperative Outcomes (Table 2):

1. **Postoperative Pain:** Postoperative pain was significantly lower in Group II (sub-lay mesh technique) compared to Group I (on-lay mesh technique). The mean pain score in Group I was 5.1 ± 3.1, while in Group II it was 3.4 ± 2.5 ($p < 0.05$).
2. **Wound Infection:** Wound infection occurred in 10 (14.3%) patients in Group I and 4 (5.7%) patients in Group II. The difference between the two groups was statistically significant ($p < 0.05$).
3. **Seroma Formation:** Seroma was observed in 9 (12.9%) patients in Group I and 4 (5.7%) patients in Group II. This difference was statistically significant ($p < 0.05$).
4. **Hospital Stay Duration:** The average length of hospital stay was significantly longer in Group I (mean 6.5 ± 1.3 days) compared to Group II (mean 4.2 ± 1.0 days, $p < 0.05$).

Table 1: Demographic and Clinical Characteristics of Patients in Both Groups

Variable	Group I (On-lay Mesh)	Group II (Sub-lay Mesh)	p-value
Number of Patients	70	70	
Mean Age (years)	46.8 ± 9.4	47.5 ± 10.1	0.64
Gender (Female)	42 (60%)	42 (60%)	1.00
Gender (Male)	28 (40%)	28 (40%)	1.00

Table 2: Postoperative Outcomes in Both Groups

Outcome	Group I (On-lay Mesh)	Group II (Sub-lay Mesh)	p-value
Postoperative Pain (VAS score)	5.1 ± 3.1	3.4 ± 2.5	<0.05
Wound Infection	10 (14.3%)	4 (5.7%)	<0.05
Seroma Formation	9 (12.9%)	4 (5.7%)	<0.05
Hospital Stay (days)	6.5 ± 1.3	4.2 ± 1.0	<0.05

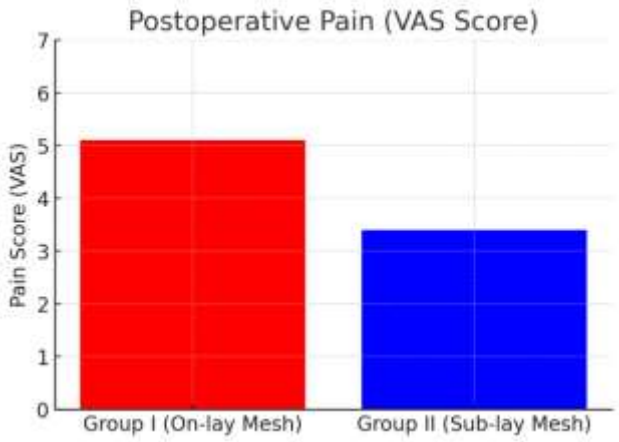

Figure 1: Comparison of Postoperative Pain Between the Two Groups

Figure 1 illustrates the comparison of postoperative pain levels, measured using the Visual Analog Scale (VAS), between the two groups. Group I (on-lay mesh) showed a higher average pain score compared to Group II (sub-lay mesh), with a statistically significant difference ($p < 0.05$).

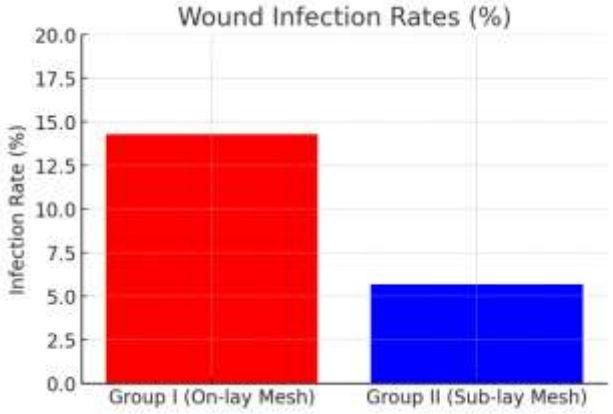

Figure 2: Wound Infection Rates in Both Groups

Figure 2 compares the wound infection rates between the two groups. The infection rate was significantly higher in Group I (14.3%) compared to Group II (5.7%), with a p-value of <0.05.

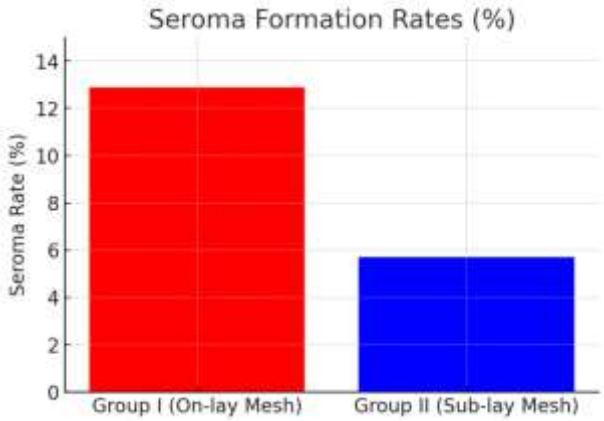

Figure 3: Seroma Formation in Both Groups

Figure 3 depicts the seroma formation rates between the two groups. Group I had a higher percentage of seroma formation (12.9%) compared to Group II (5.7%), which was statistically significant ($p < 0.05$).

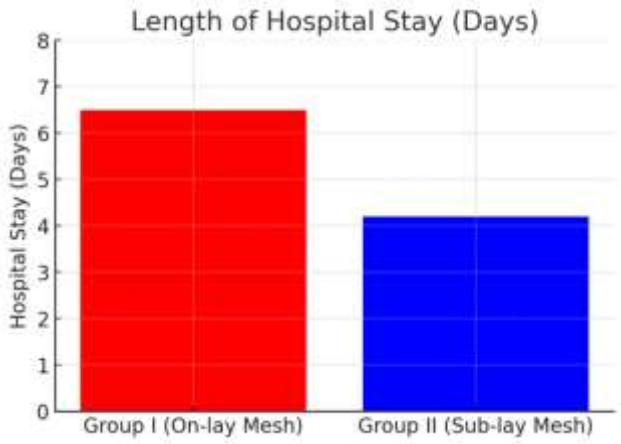

Figure 4: Length of Hospital Stay in Both Groups

Figure 4 compares the average length of hospital stay between the two groups. Group I (on-lay mesh technique) had a significantly longer hospital stay (6.5 days) compared to Group II (sub-lay mesh technique), with a p-value of <0.05.

DISCUSSION

Ventral hernias are a common and significant surgical challenge, with both primary and incisional hernias requiring careful surgical intervention. The current study compared two commonly used mesh techniques onlay and sublay for ventral hernia repair. Our results demonstrated that the sub-lay mesh technique had favorable outcomes over the on-lay technique in terms of postoperative pain, wound infection, seroma formation, and length of hospital stay.

Postoperative Pain: Postoperative pain was significantly higher in the on-lay mesh group (mean 5.1 ± 3.18) compared to the sub-lay mesh group (mean 2.9 ± 4.16), consistent with findings from other studies[1,2]. On-lay mesh placement involves fixing the mesh directly above the anterior rectus sheath, which contains a high concentration of nerve fibers. This proximity to nerve endings is thought to contribute to increased postoperative discomfort[3]. In contrast, the sub-lay technique, which places the mesh beneath the muscle layers, likely reduces irritation to the nerve fibers, leading to less pain postoperatively[4]. These results are in agreement with Rajsiddharth et al. and Thangamani et al., who found higher pain levels in the on-lay group compared to the sub-lay group in their respective studies in India[5,6].

Wound Infection: In our study, the wound infection rate was significantly higher in the on-lay mesh group (17.2%) compared to the sub-lay group (8.6%), a finding that is consistent with previous literature. On-lay mesh repair places the mesh subcutaneously, which may increase the risk of infection due to potential contamination during the surgical procedure[7,8]. This aligns with findings from Aly Saber and Kharde K et al., who also reported higher infection rates in the on-lay group[9,10]. This result is concerning because wound infections can lead to prolonged recovery times and increased healthcare costs. Sub-lay placement, by contrast, may minimize exposure to surface contaminants, potentially reducing the infection rate[11].

Seroma Formation: Seroma formation was observed in 12.1% of patients in the on-lay mesh group, compared to 5.2% in the sub-lay mesh group. Seromas are common after hernia repair, particularly when the mesh is placed in the subcutaneous tissue, as is the case with on-lay repairs. This is consistent with the study by Furat Shani et al., who reported higher seroma formation in the on-lay group compared to the sub-lay technique[12]. Seromas can lead to discomfort, prolonged drainage, and occasionally require further surgical intervention. The lower seroma formation rate in the sub-lay group may be attributed to the deeper placement of the mesh, which reduces the potential space for fluid accumulation[13].

Hospital Stay Duration: The average length of hospital stay was significantly shorter in the sub-lay group (3.2 ± 0.44 days) compared to the on-lay group (6.0 ± 1.36 days). This difference in hospital stay is likely related to the reduced risk of postoperative complications in the sub-lay group, such as pain, wound infection, and seroma formation. A shorter hospital stay is an important outcome, as it not only reduces healthcare costs but also decreases the risk of hospital-acquired infections and accelerates patient recovery[14]. Our findings align with previous studies that have shown shorter hospital stays in patients undergoing sub-lay mesh repair compared to those who had on-lay mesh placement[15,16].

CONCLUSION

Our findings suggest that the sub-lay mesh technique offers several advantages over the on-lay technique for ventral hernia repair. The sub-lay technique is associated with reduced postoperative pain, fewer wound infections, and a lower incidence of seroma formation, along with a shorter hospital stay. Given these benefits, the sub-lay mesh technique should be considered a preferred approach for ventral hernia repair, particularly in patients who are at higher risk of complications. However, it is important to consider individual patient factors, including the size and location of the hernia, when choosing the most appropriate surgical technique[17].

Limitations: While the current study provides valuable insights into the comparative outcomes of on-lay and sub-lay mesh techniques, there are some limitations. The study was conducted in a single center with a relatively small sample size, which may limit the generalizability of the results. Additionally, long-term follow-up data were not included, so it is unclear whether the differences observed in the short-term outcomes would persist over time. Further multicenter studies with larger sample sizes and long-term follow-up are needed to confirm these findings and provide a more comprehensive evaluation of the two techniques[18].

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