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Comparison of Onlay vs Sublay Mesh Repair of Anterior Abdominal Wall Hernias; A Randomize Control Trial

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ABSTRACT

Background: Various surgical technique has been developed for anterior abdominal wall mesh placement, including onlay, inlay, sublay, preperitoneal, and intraperitoneal positions. Many advantages and disadvantages are linked to these surgical procedures.
Objectives: To compare onlay and sublay mesh repair techniques for anterior abdominal wall hernias in relation to the mean operative time, post-operative wound infections and seroma formation.
Materials and Method: The study was a randomized control trials, conducted at BKMC Swabi. The study includes 78 patients that were randomly allocated into two groups i.e. 39 patients in Group A (Onlay technique) and 39 in group B (Sublay Technique). Written informed consent was obtained from all participants. Upon enrollment, demographic information was recorded, and detail clinical examinations were conducted.
Results: Group A had a mean age of 43.05 years (SD = 5.385), a mean BMI of 26.46 (SD = 1.144), and an average operation time of 142.18 minutes (SD = 14.017) (p=0.037). In contrast, Group B had a mean age of 42.85 years (SD = 5.284), a mean BMI of 26.18 (SD = 0.885), and a significantly shorter average operation time of 105.77 minutes (SD = 1.307). Age distribution was similar between groups, with around 80% over 40 years old. Gender distribution was slightly more male in Group B (53.8%) compared to Group A (48.7%). ASA class distribution was identical across both groups. Postoperative wound infection rates were higher in Group B (35.9%) compared to Group A (23.1%) (P=0.214). Seroma formation was more common in Group A (46.2%) compared to Group B (35.9%) (P= 0.357).
Conclusion: Sublay repair better in terms of reduced operative time, decreased seroma formation compared to Onlay repair but higher incidence of postoperative wound infections in sublay's procedure should kept under the consideration and proper pre, per-op and post-op wound infections protocols should be followed.
Keywords: Mesh repair, Mean Operative-time, Onlay Technique, Post-operative wound infections, Sublay Technique and Seroma formation.

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INTRODUCTION

The literature review highlights numerous studies that have investigated hernia mechanisms and repair methods, emphasizing the management of hernia defects as part of generalized abdominal wall disorders. After repair, patient assessments reveal various predisposing factors responsible for herniation, including primary or secondary ventral hernia. These factors commonly include obesity, anemia, wound infection, inadequate local fascial and muscular layers due to prior tissue loss, muscle denervation, vascular insufficiency due to prior irradiation, sepsis, chronic pulmonary disease, malnutrition, corticosteroid dependency, and/or current malignant processes.[1]

Anterior abdominal wall hernias are characterized by fascial defects in the anterior abdominal wall, allowing intermittent or continuous protrusion of abdominal tissue or organs. Ventral hernia repair stands as one of the most frequently performed procedures globally, with an estimated incidence ranging from 15% to 20%.[2] The various types of anterior abdominal wall hernias include epigastric, hypogastric, umbilical, para-umbilical, and incisional hernias. Among these, incisional and para-umbilical hernias collectively represent 85% of all ventral abdominal hernias.[3] Abdominal wall hernias are among the most prevalent surgical problems and has significantly impact on healthcare economy and social security budget. The mesh reinforcement of the abdominal wall was an important advancement to increase the success of the repairs and reduce its long-term recurrence.[4]

The complexity of treating Abdominal Wall hernias is well-known, with a high risk of complications. Traditionally, local suture repair or relocation methods were used. However, modern approaches involve various mesh-based techniques, which are now commonly employed in minimally invasive procedures.[5] The use of polypropylene mesh for repair has emerged as the gold standard method for addressing all types of abdominal wall hernias.[6] Since the introduction of polypropylene mesh repair in 1962, various techniques have been developed for mesh placement, including onlay, inlay, sublay, preperitoneal, and intraperitoneal positions. The optimal position for mesh placement remains a subject of controversy and vigorous debate among surgeons.[7]

Rives introduced the sublay or retro muscular repair for ventral hernias in 1973 while Onlay method was introduced by Chevrel in 1979.[8] Many advantages and disadvantages are linked to both surgical procedures.

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The Onlay mesh repair technique offers several advantages: it is technically simpler, requires less operative time, and can be applied to larger defects. However, it is associated with an increased risk of wound complications and mesh infection. On the other hand, Sublay repair presents advantages such as reduced mesh infection, early mesh adhesion to the posterior rectus sheath, and fewer wound complications. however, it demands greater technical skill, meticulous dissection to prevent damage to the rectus muscles, and careful preservation of their blood and nerve supply.[9]

The aim of the study is to compare onlay and sublay mesh repair techniques for anterior abdominal wall hernias in relation to the mean operative time, post-operative wound infections and seroma formation. There is a lack of sufficient data within the Pakistani population concerning the comparison between onlay and sublay mesh repair techniques for anterior abdominal wall hernias. The optimal positioning for inserting the material has not been definitively determined. Previous literature has provided contradictory findings regarding the frequency of postoperative complications associated with the two methods[10]. This study aims to provide local evidence regarding the superior mesh repair technique for patients with anterior abdominal wall hernias.

MATERIALS AND METHODS

The study was randomized control trials, conducted at Department of Surgery Bacha Khan Medical Complex/ Gajju Khan Medical College Swabi from February 12th 2023 to August 12th 2023 (Six months Duration), including cases that met the specified inclusion criteria. Sample Size was calculated using open epi.com software by keeping two side confidence level 95%, power of test 80%, test value of population mean 124.5 and anticipated population mean of 155.1 (mean operative time)[10] Data was collected using randomized Sampling technique and were randomly allocated into two group using randomized numbering in open epi.com software. All patients including male and female who give us written inform consent, having age between 16 to 70, presented with uncomplicated abdominal hernias and come under ASA Grade one to three (American society of Anesthesia) were included in the study. And all those patient having complicated Abdominal hernia (Strangulation, obstruction and irreducible hernia), Diabetics mellitus, ASA grade 4 and 5, patients having renal failure, bleeding disorders, recurrent abdominal hernias, patients previously operated for abdominal hernias and all those patients who did not give us written informed consent were excluded from the study. Strictly exclusion criteria were followed in order to control cofounder and bias in the study. Ethical Board review certificate was obtained from Ethical board of Bacha Khan Medical Complex/ Gajju Khan Medical College Swabi (Reference# 4404/Ethical/GKMCS).

For the purpose of present study anterior abdominal wall hernia is define as “Abnormal protrusion of viscus or a part of it through a defect in the anterior abdominal wall was termed as anterior abdominal wall hernia.[13]” Uncomplicated (reducible, non-tender, non-obstructed) epigastric, paraumblical and incisional hernias were included in the study. Patients presenting with a reducible swelling in the anterior abdominal wall with a positive expansile cough impulse was labelled as cases of anterior abdominal wall hernias.[11] The American Society of Anesthesiologists (ASA) physical status classification system came about to offer perioperative clinicians a simple categorization of a patient's physiological status to help predict operative risk. Operative time is defined as the time from the start of incision till the application of last stitch calculated in minutes. Patients developing post-operative fever, incision site redness and tenderness, wound discharge and wound abscess were labelled as having wound infection.[12] All the patients were followed on 1st, 7th, 14th and 28th postoperative days for wound infection and Seroma is the accumulation of fluids under the skin are the most common complication of anterior hernia repair.[13] This fluid is composed of blood plasma that has seeped out of ruptured small blood vessels and inflammatory fluid produced by the injured and dying cells. All the patients were followed on 7th, 14th and 28th postoperative days for seroma formation.

Following approval, the hospital's ethical review committee, a total of 78 patients diagnosed with anterior abdominal wall hernia were enrolled in the study. These patients presented to the surgical OPD and were admitted to the Department of Surgery Bacha Khan Medical Complex/ Gajju Khan Medical College Swabi. Written informed consent was obtained from all participants (see "Annexure A"). Upon enrollment, demographic details were recorded, and clinical examinations were conducted by consultant General surgeon in ward. Routine laboratory investigations including base line investigations including complete blood profile, Viral screening, covid PCR, liver function tests, kidney function tests were carried out, and fitness for general anesthesia was confirmed. All patients were randomly divided into two Groups using random numbering in open epi.com software I.e. Group A and Group B (Consort Chart Fig 01), each consisting of 39 patients. In Group A, mesh repair of anterior abdominal wall hernia was performed using the onlay technique, with the mesh placed above the rectus sheath. The defect was closed primarily using prolene 1/0 suture before mesh placement. The mesh extended 3-4 cm beyond the defect edges. In Group B, mesh repair was conducted using the sublay technique, with the mesh placed under the defect in the retro muscular layer of the abdominal wall, posterior to the rectus muscles and anterior to the posterior rectus sheath. Similar to Group A, the mesh extended 3-4 cm beyond the defect edges. All surgeries were performed under general anesthesia, with prophylactic antibiotic (injection Augmentin 1.2 grams intravenous) administered at the

time of induction. Redivac suction drain was placed post-operatively in all patients. Patients were discharged on the first post-operative day after drain removal and were followed up in the OPD on the 7th, 14th, and 28th post-operative days. The operation time (in minutes) for each procedure was recorded, measured from the time of incision until the application of the last stitch. Patients were monitored for wound infection and seroma formation as per the operational definitions outlined. Data for each patient were recorded on a pre-designed patient's proforma (see Annexure 'B'). All operations were performed by the same surgical team, and data collection was personally conducted by the author. Follow-up was ensured by maintaining contact with the patients.

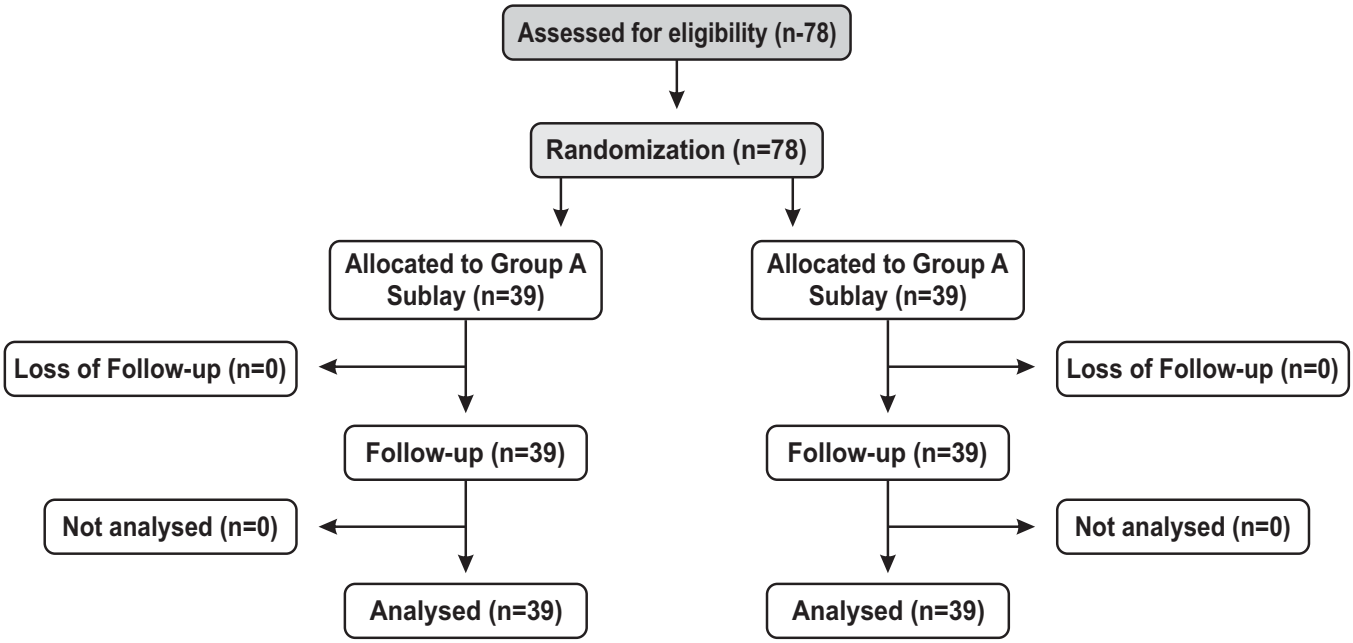


Figure 01. Consort Flow Chart

Data Analysis

Data was analyzed using SPSS version 26.0. Mean and standard deviation was calculated for quantitative variables like age, BMI, and operation time. For categorical variables like gender, ASA class, post-operative wound infection and seroma formation frequency and percentages would be presented. Comparison of post-operative wound infection and seroma formation was done using Chi-square test. Comparison of operation time was done using independent sample T-test. P value of ≤0.05 was taken as significant. Effect modifiers like age, ASA class, BMI and gender was controlled by stratification. Post-stratification Chi-square/ T-test was applied taking p value of ≤0.05 as significant.

RESULTS

This study was conducted on 78 patients (39 patients in each group) presented at the Department of General Surgery Bacha Khan Medical Complex/ Gajju Khan Medical College Swabi. Results of my study are as under: - In Group A (Onlay Technique), mean and SDs for age was 43.05+5.385. Mean and SDs for BMI was 26.46+1.144. Mean and SDs for Operation times was 142.18+14.017 (T test; p=0.037). In Group B (Sublay Technique), mean and SDs for age was 42.85+5.284. Mean and SDs for BMI was 26.18+0.885. Mean and SDs for operation time was 105.77+1.307. In Group A (Onlay Technique), 07 (17.9%) patients were below 40 years of age while 32 (82.1%) patients were above 40 years of age. In Group B (Sublay Technique), 08 (20.5%) patients were recorded below 40 years of age and 31 (79.5%) patients were recorded above 40 years of age. In Group A (Onlay Technique), 19 (48.7%) patients were male and 20 (51.3%) patients were female. In Group B (Sublay Technique), 21 (53.8%) patients were male and 18 (46.2%) patients were female. In Group A (Onlay Technique), 14 (35.9%) patients had ASA Class I, 16 (41.0%) patients had ASA Class II and 9 (23.1%) patients had ASA Class III. In Group B (Sublay Technique), 14 (35.9%) patients had ASA Class I, 16 (41.0%) patients had ASA Class II and 9 (23.1%) patients had ASA Class III. In Group A (Onlay Technique), 09 (23.1%) patients had post op wound infection. In Group B (Sublay Technique), 14 (35.9%) patients had post op wound infection. In Group A (Onlay Technique), 18 (46.2%) patients had seroma formation while in Group B (Sublay Technique), 14 (35.9%) patients had seroma formation.

Table 01. Different parameter tabulated form Presentation

Parameter	Group # 1 (Onlay Technique)		Group # 2 (Sublay Technique)		
Age (n=78)	Mean	43.05 Year	Mean	42.85 years	
	SD	05.38 Year	SD	05.28 Years	
Age Group Distribution (n=78)	< 40 years	17.90 % (n=07)	< 40 years>	20.50 % (n=08)	
	>40 years	82.10 % (n=32)	40 years	79.50 % (n=31)	
Body Mass Index (n=78)	Mean	26.46 Kg/m^2	Mean	26.18 Kg/m^2	
	SD	1.14 Kg/m^2	SD	0.88 Kg/m^2	
Mean Operation Time n=78 (p=0.037).	Mean	142.18 mints	Mean	105.77 mints	
	SD	14.01 mints	SD	13.07 mints	
Gender Distribution (n=78)	Male	48.70 % (n=19)	Male	53.80 % (n=21)	
	Female	51.30 % (n=20)	Female	46.20 % (n=18)	
ASA Grade Distribution (n=78)	ASA-1	35.90 % (n=14)	ASA-1	35.90 % (n=14)	
	ASA-2	41.00 % (n=16)	ASA-2	41.00 % (n=16)	
	ASA-3	23.10 % (n=09)	ASA-3	23.10 % (n=09)	
Post op wound infections (n=78)		Percentage		Percentage	Level of significance
	Yes	23.10 % (n=09)	Yes	35.90 % (n=14)	P= 0.214
	No	76.90 % (n=30)	No	64.10 % (n=25)	
Seroma Formation (n=78)		Percentage		Percentage	Level of significance
	Yes	46.20 % (n=18)	Yes	35.90 % (n=14)	P= 0.357
	No	53.80 % (n=21)	No	64.10 % (n=25)	

DISCUSSION

Abdominal hernia repair without significant per and post-op complication remains is always challenging task for Surgeons, several advancements in surgical techniques make it possible to prevent complication in hernia repair, mesh repair are considerd as the gold standard technique for abdominal wall hernias repair.[14] The onlay and sublay techniques are the two most commonly methods used for placing mesh during ventral hernia repair and our study finding highlights significant advantages favoring the Sublay technique. Sublay repair better in terms of reduced operative time, lower incidence of postoperative wound infections, and decreased seroma formation compared to Onlay repair.

The mean age in our study findings in both group were around 43 years which correlate with study conducted by zahoor et.all in khairpur Pakistan which in both group the mean age of patients was around 45 years.[15]

The mean operation time vary between the two procedures. This study had find out that the mean operative time of onlay's procedure is longer than the mean operative time of sublay mesh-repair. Majority of existing literature contrast with our study finding. Some literature search shows no significant different between the mean operation of both procedure[16]. Moreover, other literatures show the mean operative time of onlay's procedure is shorter than the mean operative time of sublay mesh-repair.[17,18] The reason for shorter mean operative time is that, that onlays procedure involve placing mesh directly on the defect without extensive dissecting and creating space for mesh repair. In contrast to this, in our study the sublay procedure, which typically has a longer operative time, was performed more quickly than the onlay procedure.[19] Not all but some literature are parallel to out findings like the some study,[19] find out that sublays technique has shorter mean operative time as compare to onlay technique. Moreover, other literature studies concluded reduce mean operative time of sublays procedure over onlay procedure with comparable outcome.[20] The variability of mean operative time between two procedures could be due to surgical team expertise, type of anesthesia used during the procedure, type of patients etc etc.[21] Our surgical teams have extensive experience with the sublay technique, as they regularly performed it before the study, potentially leading to greater efficiency.

Moreover, in our Study in Group A (Onlay Technique), 09 (23.1%) patients had post op wound infection and 46.20% had seroma formation while in Group B (Sublay Technique), 14 (35.9%) patients had post op wound infection and 35.90% patients had seroma formation. The findings correlated with a study by Demetrashvili et al in Georgia[10] reported Frequency of

wound infection was 6.4% in onlay group versus 2.6% in sublay group while frequency of seroma formation was 41.0% in onlay group versus 16.9% in sublay group respectively. A similar study by Saeed et al. from Karachi,[22] found that the mean operation time was 104 minutes in the onlay group compared to a mean operative time of 83.5 minutes in the sublay group. Additionally, the frequency of wound infection was 5% in the onlay group versus 10% in the sublay group. Similarly, the frequency of seroma formation was 7.5% in the onlay group compared to 0% in the sublay group, respectively. Additional literature also supports Sublay repair over Onlay in terms of reducing wound infections and seroma formation. For example, a study conducted by Khawaja FG et. all[23] at CMH hospital Rawalpindi Concluded that "Post-surgical complications were frequently observed among patients within the initial two weeks following surgery. Moreover, individuals undergoing Onlay mesh repair exhibited a higher susceptibility to seroma formation, post-operative pain, and surgical site infection compared to those undergoing Sublay repair". Moreover, in a study conducted by Leithy et. al,[24] a wound infection frequency of up to 40% and seroma formation among 40% of patients were reported in Onlay repair, compared to 6% wound infection and seroma formation in the Sublay method. Additionally, other study[25] found that in the Onlay repair group, wound infection was reported by 4% and seroma formation by 24%, while in the Sublay repair group, wound infection was reported by 4% and seroma formation by 2%.

Our study's strength lies in its randomized controlled trial design and implementation in a tertiary care hospital, which enhances reliability, but it faces limitations such as potential surgeon bias and limited generalizability. Future research should focus on larger multicenter trials, long-term outcomes, and cost-effectiveness to further validate these findings and address the study's limitations.

CONCLUSION

In conclusion, the comparison between Sublay mesh repair and Onlay mesh repair for anterior abdominal wall hernias highlight significant advantages favoring the Sublay technique. Sublay repair better in terms of reduced operative time and decreased seroma formation compared to Onlay repair. Moreover, onlay repair had better outcomes in term of postoperative wound infections (although there is no statistical significance in seroma, mean operation time and post op wound infections in both procedures. These findings suggest that Sublay mesh repair emerges as a preferred surgical approach for addressing anterior abdominal wall hernias, offering both clinical effectiveness and improved patient outcomes but higher incidence of post-op wound infections in sublay's procedure should kept under the consideration and proper pre, per-op and post-op wound infections protocols should be followed.

Ethical consideration

This study was approved by Institutional Review Board of Bacha Khan Medical Complex / Gajju Khan Medical College (4404/Ethical/GKMCS), Swabi, Pakistan.

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Conflict of Interest

Authors declared no conflict of interest.

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DATA SHARING STATEMENT: The data that support the findings of this study are available on request from the corresponding author. The data is not publicly available due to privacy or ethical restrictions.

AUTHORS' CONTRIBUTION

The following authors fulfill authorship criteria as per ICMJE guidelines;

Khan AA, Basit SA: Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.

Shah MA: Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.

Shuja MI: Analysis and interpretation of data, drafting the manuscript, final approval, agreed to be accountable for all the work.

Zia F: Analysis and interpretation of data, critical revision, final approval, agreed to be accountable for all the work.

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