Ventral hernias meshplasty: does mesh-implantation site affect the outcome?

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Background
Although meshplasty has been established as the gold standard for ventral hernia repair, there is debate on the mesh-placement site. This study tried to compare onlay mesh placement with sublay meshplasty in terms of outcome.
Patients and methods
This is a prospective cross-armed study including 65 patients suffering from ventral hernias who were electively admitted to Sohag University Hospital between October 2013 and November 2014. Patients were randomly allocated to two groups: group A included 32 patients who underwent onlay meshplasty and group B included 33 patients who underwent sublay meshplasty. Patients were evaluated with respect to the outcome of both techniques and statistically analyzed after 2 years of follow-up.
Results
Regarding the operative and postoperative outcomes, the operative time was longer in group B, which was highly significant ($P \leq 0.001$). Postoperative wound pain was less in group B, which was significant ($P=0.018$). Regarding early postoperative complications, postoperative superficial infection ($P=0.050$) and hematoma formation ($P=0.033$) were significantly less in group B. Seroma formation was also significantly less in group B ($P=0.050$). The mean duration of postoperative hospital stay was shorter in group B and this was highly significant ($P<0.001$). During follow-up, recurrence was seen in group A, which was statistically significant ($P=0.015$).
Conclusion
Sublay meshplasty, when feasible, is superior to onlay mesh placement for open ventral hernia repair.

Keywords:
abdominal wall hernia, mesh repair, onlay, sublay

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Introduction

Ventral hernias occur through defects in the midline or in the lateral abdominal wall, including epigastric, umbilical, paraumbilical, incisional, and rare Spigelian hernias [1]. They should be repaired unless the patient's general condition contraindicates surgery or when complications are rare [2]. The use of a prosthetic mesh has become the gold standard treatment for all hernias as it has minimal or no tension and has lower recurrence rate as well as rapid recovery with minimal pain [1]. However, many studies show an increased risk for wound complications with mesh implantation, including infections, seromas, and mesh erosions [3].

There is debate regarding the best site for mesh placement – whether onlay (anterior to the aponeurosis and the defect), sublay/retrorectus, or inlay [4,5]. To choose the best site for mesh implantation, a number of conditions should be considered: mesh–tissue integration will decrease long-term recurrence [6]; wound complications increase the risk for recurrence [7]; the ideal mesh placement should have tissue coverage to minimize exposure to superficial infections as well as to the intraperitoneal bowel; finally, technical ease and risks for postoperative complications will encourage the surgeon's choice of technique [5].

Aim of the work

Onlay and sublay meshplasties are the two most frequently adopted techniques in open ventral hernia repair. Our aim was to compare the outcome of each to identify the best site for mesh implantation in open ventral hernia repair.

Patients and methods

This was a prospective uncontrolled randomized study comparing onlay with sublay meshplasty for

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open ventral hernia repair at the General Surgery Department, Sohag University Hospital, from October 2013 to November 2014. Patients were admitted electively through the outpatient clinic. Institutional Ethical Committee approval was taken before commencement of the study. Written and informed consent was taken from all patients after explaining the details of the operative procedures.

The included patients were divided randomly by the closed envelop method into two groups: group A (onlay meshplasty) and group B (sublay meshplasty).

The study included all patients with ventral hernias between 30 and 70 years of age without sex discrimination with a defect size of 4–15 cm. We excluded patients with chronic obstructive pulmonary disease, patients with abdominal malignancy and cirrhosis with end-stage liver disease, patients with previous loss of the abdominal wall and large scarred area of the abdominal skin, those with hernia size larger than 15 cm, patients with more than one hernia, patients with prior meshplasty, pregnant women or women planning future pregnancies, and those with active skin infection.

Operative techniques

In group A (onlay) herniotomy was performed in the usual way and the defect was closed with nonabsorbable suture. Then after an onlay mesh was fixed to the aponeurosis in the subcutaneous prefascial space using nonabsorbable suture without tension covering a distance of 5 cm in all directions from the suture line, with multiple interrupted stitches after fixing the four edges of the mesh, and then closure over one or two suction drains.

In group B (sublay) after herniotomy a retrorectus space was created for mesh placement. Thereafter the posterior rectus sheath and peritoneum were closed. A prolene mesh tailored to the size of this space was placed. Two drains were placed: one above the mesh and the other above the anterior sheath after its closure in the subcutaneous tissue (Fig. 1). Drains were removed when drainage was less than 20 ml in 24 h. The period of drainage ranged from 3 to 8 days.

Postoperative care

All patients received ceftriaxone for 3–5 days and later on oral quinolones (ciprofloxacin/levofloxacin) until removal of the drains for a further 3–9 days. Patients stayed in hospital following their surgery until they were ambulatory and had regained their bladder and bowel functions.

Follow-up visits were arranged on the seventh, 15th, and 30th day after discharge, and then every 3 months for 2 years.

Statistical study

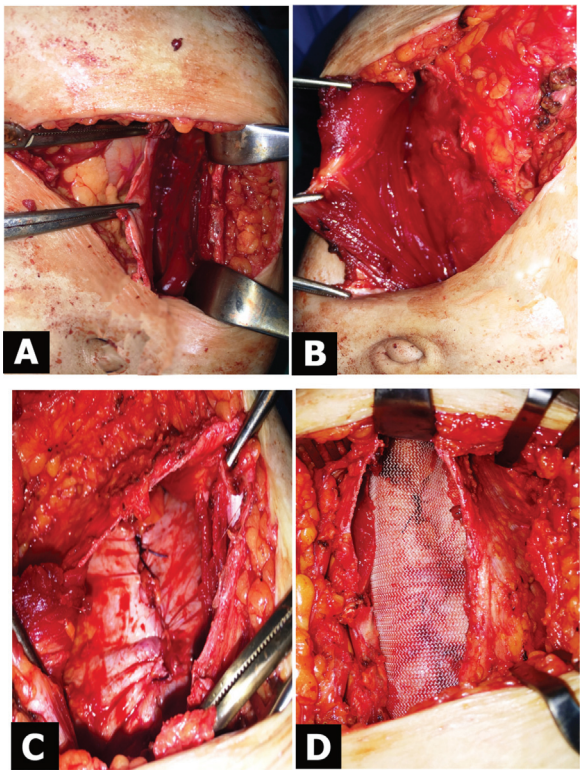
Parameters to be analyzed

Epidemiological data analyzed included age and sex, clinical features, smoking history, presence of diabetes mellitus, BMI, and glucocorticoid use. The primary outcome measure was the recurrence rate after at least 1 year of follow-up. The secondary outcomes included operative time (min), length of hospital stay (days), patient satisfaction, wound complications such as acute and chronic infections (sinus and mesh infection), seroma or hematoma formations, enterocutaneous fistula, and wound pain.

Statistical analysis

Statistical analysis was performed using SPSS (IBM-SPSS version 22 program for Windows (SPSS Inc, Chicago, IL)). Qualitative data were expressed as number and percentages, and quantitative data were

Figure 1



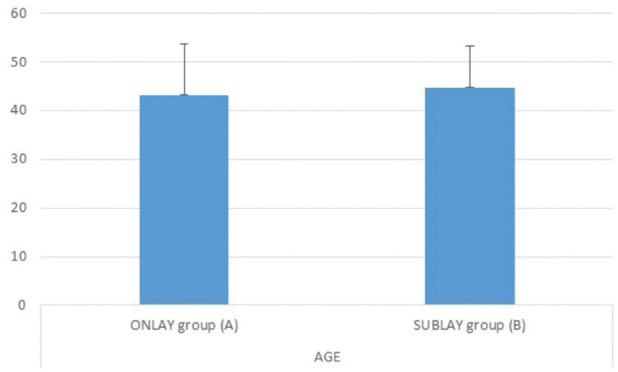
Sublay meshplasty technique: (a) and (b) Retrorectus dissection. (c) Closure of the posterior rectus sheath. (d) Placement of the mesh in retromuscular or preperitoneal position.

expressed as mean and SD. For comparison of percentages in qualitative variables, a χ^2-test was used for parametric (normally distributed) data and Fisher's exact test was used for nonparametric (non-normally distributed) data. For comparison of means in quantitative variables, a Student *t*-test was used. For all of these tests, the *P* value was considered significant if less than 0.05 and highly significant if less than 0.001.

Results

This study included 65 patients suffering from various types of ventral hernias who underwent meshplasty during the first year of the study, after exclusion of 12 patients who were lost to follow-up. Patients were classified into two groups: group A (onlay) included 32 patients and group B (sublay) included 33 patients. Patient demographics are listed in Table 1 and Fig. 2.

Figure 2



Age of the study groups.

Table 1 Demographic criteria and clinical presentation

	Total [*n* (%)]	Group A (onlay mesh) (*n*=32) [*n* (%)]	Group B (sublay mesh) (*n*=33) [*n* (%)]	χ^2-Test/Fisher test	*P* value
Age					
3rd decade	4 (6.2)	3 (9.4)	1 (3.0)	6.519[b]	0.164
4th decade	20 (30.8)	9 (28)	11 (33.3)		
5th decade	27 (41.5)	15 (46.9)	12 (36.4)		
6th decade	12 (18.5)	3 (9.4)	9 (27.3)		
7th decade	2 (3)	2 (6.3)	0 (0.0)		
Mean age	–	43.16	44.76	0.667[b]	0.506
SD	–	10.62	8.58		
SEM	–	1.88	1.49		
Sex					
Male	26 (40)	12 (37.5)	14 (42.4)	0.164[a]	0.685 (NS)
Female	39 (60)	20 (62.5)	19 (56.6)		
Diabetes mellitus	10 (15)	8 (25)	2 (6)	4.057[b]	0.044 (S)
Smoking history					
Current smoker	18 (28)	12 (37.5)	6 (17)	4.018[b]	0.038 (S)
Nonsmoker	47 (72)	20 (62.5)	29 (83)		
Glucocorticoid use	2 (3)	2 (6.3)	0	2.128[b]	0.145 (NS)
BMI>30	10 (15)	3 (9.4)	1(3.0)	6.519[b]	0.164
Clinical presentation					
Abdominal swelling					
Reducible	55 (85)	24 (75)	31 (94)	4.447[b]	0.034 (S)
Irreducible	10 (15)	8 (25)	2 (6)	4.057[b]	0.044 (S)
Dragging pain	23 (35.4)	18 (56.3)	5 (15)	12.002[a]	<0.001 (HS)
Cough impulse					
Positive	55 (85)	24 (75)	31 (94)	4.447[b]	0.034 (S)
Weak	10 (15)	8 (25)	2 (6)	4.057[b]	0.044 (S)
Abdominal intertrigo	2 (3)	2 (6.3)	0	2.128[b]	0.145 (NS)
Type of ventral hernia					
Incisional	33 (51)	16 (50)	17 (52)	0.015[a]	0.903 (NS)
Spontaneous	32 (49)	16 (50)	16 (48)	0.015[a]	0.903 (NS)
PU		12 (37.5)	12 (36)	0.000[b]	1.000 (NS)
Epigastric		4 (12.5)	4 (12)	0.000[b]	1.000 (NS)
Size of the defect (cm)					
From 5–10 cm	28 (43)	18 (56)	10 (30)	4.461[a]	0.035 (S)
>10 cm	37 (57)	14 (44)	23 (70)	4.461[a]	0.035 (S)

Fisher's exact test was performed for some statistical data instead of the χ^2-test because of non-normality of distribution. PU, paraumbilical hernia. [a]The values were calculated using the χ^2-test. [b]The values were calculated using the Fisher test.

Regarding clinical presentation, all patients had a common presentation: an abdominal swelling, which was reducible in 84.6% of cases (44% in group A and 56% in group B) and irreducible in 15.4% of cases (80% in group A and 20% in group B). This was followed by dragging pain at the site of swelling in 35.4% of cases (78% in group A and 22% in group B). On examination the swelling was found to have positive cough impulse in 84.6% of cases (44% in group A and 56% in group B) and diminished in 15.4% (80% in group A and 20% in group B). Lastly there was abdominal intertrigo in relation to the swelling in 6% of patients in group A.

The most common type of ventral hernias dealt with was incisional hernia (51%), followed by spontaneous hernia (49%); this difference was nonsignificant (P=0.897). All incisional hernias were through midline scar and the majority through lower midline or lower part of full midline scar. Nature of previous surgery included cesarean section, hysterectomy, and laparotomy for appendix or gut perforation. Spontaneous hernias were distributed as paraumbilical hernia (75%; 50% in group A and 50% in group B) and epigastric hernia (25%; 50% in group A and 50% in group B). This difference was nonsignificant (P=0.993).

Regarding the defect size, 43% had a defect size measuring 4–10 cm, distributed as 64% in group A and 36% in group B, whereas the remaining 57% had defect size greater than 10 cm, distributed as 37.8% in group A and 62.2% in group B. Accordingly group B had more patients with a defect size greater than 10 cm and this was statistically significant (P=0.035) (Table 1).

Regarding the operative and postoperative outcomes, the operative time was longer in the sublay group; this difference was highly significant ($P \leq 0.001$) (Fig. 3). With respect to postoperative wound pain 27% of the sublay group had no wound pain, in comparison with 3% in the onlay group; this was reflected as a higher need for analgesics (NSAIDs and narcotics) among onlay group patients. This difference was significant (χ^2=7.277 and P=0.018).

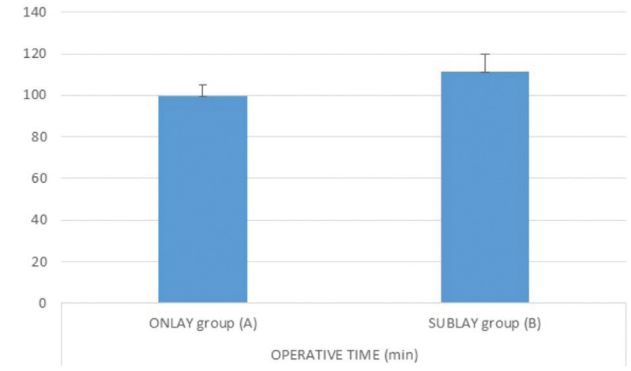
Regarding early postoperative complications, postoperative superficial infection was significantly lower in the sublay group (3%) compared with the onlay group (22%) (χ^2=5.908 and P=0.050).

Hematoma formation was seen only in 3% of patients in the sublay group compared with 19% in the onlay group; this was a significant difference (χ^2=4.569 and P=0.033). It responded well to conservative management; just needed delayed drainage.

Postoperative seroma formation was seen in 3% of patients in the sublay group compared with 22% in the onlay group and it responded well to conservative measures. This difference was statistically significant (χ^2=5.346 and P=0.050). Postoperative sinus formation with chronic seroma formation occurred in 3% of patients of the onlay group and in none in the sublay group; the difference was nonsignificant (χ^2=1.047 and P=1).

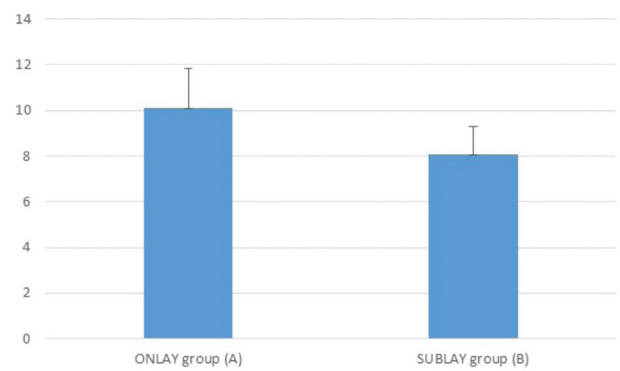
Although wound dehiscence was not seen in any of the patients in the sublay group compared with 6% of patients in the onlay group, the difference was nonsignificant (χ^2=2.128 and P=0.459). Although mesh infection was not seen in any of the patients in the sublay group compared with 6% of the onlay group, the difference was nonsignificant (χ^2=2.128 and P=0.459). Meanwhile, enterocutaneous fistula occurred in 3% of patients in the sublay group and in none in the onlay group; the difference was nonsignificant (χ^2=0.985 and P=1). The reason for this nonsignificance may be the limited number of these complications.

Figure 3



Operative time in groups.

Figure 4



Postoperative stay.

The mean duration of postoperative hospital stay was 10.994±1.766 days in the onlay group and 8.061±1.223 days in the sublay group; this difference was highly significant ($P<0.001$) (Fig. 4).

During follow-up, although more patients in the sublay group were satisfied compared with the onlay group, this was nonsignificant ($\chi^2=2.424$ and $P=0.238$). Neuralgia was not seen in any of the patients in group B compared with 6% of patients in group A; this difference was nonsignificant ($\chi^2=2.128$ and $P=0.459$). The reason for this nonsignificance may be the limited number of patients with neuralgia. Recurrence was seen in 12.5% of group A patients and in none of the group B patients. This was statistically significant ($\chi^2=4.395$ and $P=0.015$) (Table 2).

Discussion

Open ventral hernia repair with a mesh has improved long-term outcomes [3], although there is debate on the best site for mesh placement [5].

In our study, the incidence of ventral hernia was highest (72%) in the fourth and fifth decades of life, with a female to male ratio of 1.5 : 1. This difference was nonsignificant ($P=0.69$). The difference in age group and higher female incidence was due to the higher number of lower midline incisions among women for obstetric and gynecological surgeries, which result in incisional hernia, which was the most common type of ventral hernia (51%) dealt with; all incisional hernias were through the lower midline or lower part of the full midline scar. This is in line with other literature [8].

Sublay meshplasty is technically more difficult than onlay meshplasty, thus making the operative time longer in the sublay group. This difference was highly significant ($P\leq0.001$). However, sublay meshplasty is limited in patients with damaged posterior rectus sheath or damaged rectus abdominis muscle, which will render this space difficult to create, limited in size, or nonexistent, in addition to the risks of damaging the blood supply, muscle, or lateral penetrating nerves. Furthermore, the semilunar lines limit the lateral extent of the sublay repair and potentially limit the amount of mesh overlap. Also this technique is not applicable for offmidline incisions [5].

Many studies showed an increased risk for wound complications with meshplasty, including infections, seromas, and mesh erosions, which are influenced by the mesh site [9]. Of the common postoperative complications encountered in our study was transient seroma formation in 22% of the onlay meshplasty patients; this difference was statistically significant ($\chi^2=5.346$ and $P=0.050$). The previously reported rates of seroma occurrence with different types of mesh

Table 2 Operative and postoperative outcomes

	Group A (onlay mesh) ($n=32$)	Group B (sublay mesh) ($n=33$)	*t*-Test[a]/Fisher test[b]	*P* value
Operative time (min)	99.53±5.29	111.36±8.41	6.764[a]	<0.001 (HS)
SEM	0.94	1.46		
Wound pain				
No postoperative analgesia	1	9		
NSAIDs ($n=44$)	23	21	7.277[b]	0.018 (S)
Narcotics ($n=11$)	8	3		
Postoperative superficial infection	7	1	5.346[b]	0.050 (S)
Hematoma formation ($n=7$)	6	1	4.569[b]	0.033 (S)
Postoperative seroma formation	7	1	5.346[b]	0.050 (S)
Postoperative sinus formation	1	0	1.047[b]	1 (NS)
Wound dehiscence	2	0	2.128[b]	0.459 (NS)
Postoperative mesh infection	2	0	2.128[b]	0.459 (NS)
Enterocutaneous fistula	0	1	0.985[b]	1 (NS)
Postoperative hospital stay				
Mean±SD	10.094±1.776	8.061±1.223	5.380[a]	<0.001 (HS)
SEM	0.312	0.213		
Patient satisfaction				
Satisfied ($n=57$)	26	31	2.424[b]	0.238 (NS)
Nonsatisfied ($n=8$)	6	2		
Neuralgia	2	0	2.128[b]	0.459 (NS)
Recurrence	4	0	4.395[b]	0.015 (S)

Fisher's exact test was performed instead of the χ^2-test because of non-normality of distribution. HS, highly significant; S, significant. [a]The values were calculated using the *t*-test. [b]The values were calculated using the Fisher-test.

range from 4 to 8% with polypropylene grafts [10]. The reasons for this are not known; however, implantation of a foreign body increases the risk for seroma formation and infection [11]. Moreover, direct contact between mesh and subcutaneous fat contributes to seroma formation and purulent complications that result in hernia recurrence [12]. In our study postoperative superficial infection occurred in 22% of onlay meshplasty patients and was significantly lower in the sublay group (χ^2=5.908 and P=0.050). Also postoperative sinus formation with chronic seroma formation occurred in 3% of patients in the onlay group; the difference was nonsignificant (χ^2=1.047 and P=1). This can be explained by insufficient biocompatibility of the used mesh [13].

Add to this, hematoma formation was seen in 19% of patients in the onlay group, and was significantly less in the sublay group (χ^2=4.569 and P=0.033), and although wound dehiscence was not an annoying complication it occurred only in two patients of the onlay group with a nonsignificant difference (χ^2=2.128 and P=0.459). This can be because of the extensive undermining of subcutaneous tissue while placing the onlay mesh leading to disruption of skin perforators and impairment of healing [14].

Enterocutaneous fistula occurred in only one patient of the sublay group, with a nonsignificant difference (χ^2=0.985 and P=1). This may be due to the deep placement of the mesh leading to erosion into the bowel and fistula formation [15].

There is a higher rate of postoperative wound pain with the use of nonabsorable suture material due to permanent mechanical tissue irritation [16]. Add to this the lateral attachment of the mesh to the anterior rectus sheath leading to reduced flexibility of the abdominal wall [17]. This is reflected in the incidence of postoperative wound pain, which showed a significant difference (χ^2=7.277 and P=0.018), being less in sublay meshplasty.

The mean duration of postoperative hospital stay, which is an indicator of postoperative outcome, was quite longer in the onlay meshplasty group, and this difference was highly significant between the two groups (P<0.001). This is in line with other studies [18].

During follow-up onlay meshplasty group had higher recurrence (12.5%), which was statistically significant (χ^2=4.395 and P=0.113). These results are in line with the results of other studies [19,20]. This is due to the anatomical position of the mesh. Intra-abdominal pressure leads to lateral detachment of the mesh in onlay meshplasty, resulting in its higher recurrence rates, while it keeps the mesh in place in case of sublay meshplasty (Pascal's principle) [21].

On the basis of our results we believe that sublay meshplasty when feasible is superior to onlay meshplasty because of the lower recurrence rates and lower complication rates.

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Conflicts of interest
There are no conflicts of interest.

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