Comparative study between anterior component separation and transversus abodominis muscle release in reconstruction of abdominal wall defect

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Background
Ventral hernia repair is one of the most common operations performed today, yet when complex and huge, it presents a true challenge for the surgical team.
Patients and methods
Based on our prospective randomized study, a few preliminary conclusions can be drawn. There was no significant difference in most outcomes between patients who underwent repair with the Transversus abdominis muscle release (TAR) technique or with perforator-preserving component separation when using the same type of polyprolene mesh and in the same retro-muscular position.
Results
The mean hospital stay was slightly higher when performing the TAR technique (5.2 days), while it was 4.3 days after the perforator-preserving approach. There is a nearly equal incidence of postoperative wound complications and also no statistically significant difference in the rate of recurrence between the two methods, and the rate of wound complications and recurrence is significantly lower than the classic, commonly used method of anterior component separation.
Conclusion
After this comparative study, both the TAR and anterior component separation (perforator preserving) techniques are effective and reliable methods in experienced hands, and if there is no special indication for one of them, the choice between both should depend on surgeon preference and experience.

Keywords:
abdominal wall defect, anterior component separation, transversus abodominis muscle

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Introduction

Eleven% to 23% of all abdominal laparotomies are complicated by ventral abdominal wall hernias, which provide a difficult and increasing challenge [1].

Reconstructive procedures have become more well-known as a result of advancements in hernia surgery. A functioning abdominal wall should be restored with autologous tissue repair and mesh reinforcement in the majority if not all, hemorrhagic procedures [2].

The external oblique muscle and fascia are often released as part of anterior component separation methods. According to de Vries Reilingh *et al.* [3], the traditional method described by Ramirez can result in severe wound morbidity and the formation of extensive skin flaps in up to 63% of instances.

Although mesh implantation is typically restricted to the intraperitoneal underlay, less invasive alterations are known to minimize skin flaps and wound problems [4].

Classic Rives-Stoppa retrorectus restorations offer long-lasting results with little morbidity for moderate-sized defects [5].

The primary drawbacks of the traditional retrorectus repair, however, include restricted medial myofascial advancement and a lack of adequate sublay room for extensive visceral sac overlap in many hernias. Although ways to bypass the restrictions of the rectus sheath by applying pre-peritoneal or intramuscular repairs have been published, both are fraught with problems of restricted myofascial medialization and/or neurovascular bundle injury [6].

Although it does not require endoscopic tools, an open perforator that preserves anterior component separation enables medial myofascial advancement

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and preserves pulsatile blood flow to the anterior abdominal wall while still providing a small area for the implantation of retromuscular mesh [7].

Novitsky has recently devised another unique technique of posterior component separation using transversus abdominis muscle release to overcome the shortcomings of conventional retromuscular repairs [8].

This modification permits wide lateral dissection, significant posterior rectus fascia advancement, preservation of the rectus abdominis muscle's neurovascular supply, and a significant amount of space for mesh sublay, but it permits less medial anterior sheath advancement than anterior component separation [8].

The abdominal wall components can be medialized using these approaches, which is particularly essential because lip cutaneous flaps do not need to be raised. Here, we outline the technical aspects, assess the results, and contrast the transversus abdominis release approach and open perforator-preserving anterior component separation in a group of patients who had massive midline incisional hernia repairs.

Aim

This study compares the transversus abdominis release approach with open perforator preservation anterior component separation to prospectively assess postoperative morbidity and recurrence rate for large midline incisional hernias. The Ain Shams University Hospitals will host this study.

Patients and methods

Patients

This is a randomized prospective study that will be conducted at Ain-Shams University Hospitals on 60 patients diagnosed as having midline incisional hernia with a defect equal to or more than 10 cm in width and operated upon between December 2021 and December 2022 with a minimal follow-up of 12 months postoperatively.

Inclusion criteria

Clinically diagnosed large hernia (mostly incisional)

(1) Age 20–70 years old.
(2) Primary or recurrent hernia for the first time and without previous mesh.
(3) Defect surface area between 100 and 600 cm^2.
(4) Midline hernia.
(5) Clean operative field.

Exclusion criteria

(1) Hernia with a defect less than 100 cm^2 or more than 600 cm^2.
(2) Recurrent hernia for more than time.
(3) Recurrent hernia after previous component separation or mesh repair.
(4) Nonmidline hernia.
(5) Loss of domain.
(6) Patient with the present stoma (increased risk of contamination).

One surgical team working under the direction of a consultant surgeon will provide care for all of the study participants. Odd numbers will be included in group A, and even numbers will be included in group B based on the patient's presentation of a serial number to the medical team. 30 patients in the first group (A) will have their transversus abdominis released and retromuscular polyprolene mesh inserted. 30 patients will be part of the second group (B), who will have open anterior component separation with perforator preservation and retromuscular implantation of polyprolene mesh.

Methods

All patients will be subjected to the following: Preoperative assessment:

Clinical history

Personal history, including age, weight, occupation, and special habits of medical importance, particularly smoking,

History of the present illness, number of previous laparotomies and previous hernia repair, and a review of other body systems, especially chest complaints, bowel problems like constipation, and urinary problems, especially prostatism.

Past history of medical diseases, specially diabetes, drug allergies, previous blood transfusions, and previous operations

Clinical examination

Local examination of the hernia defect size, contents, and reducibility.

Investigations

Were requested for all patients, including a complete blood picture, coagulation profile, liver and kidney

function tests, fasting blood sugar, chest radiography, and pelvi-abdominal U/S. Special investigations were requested for patients with specific complaints, as were pulmonary function tests for patients with manifestations of chronic obstructive airway disease and ECG for patients over the age of 40. Abdominal pelvic computed tomography scan with contrast for patients with a history of abdominal malignancies.

Intraoperative technique for group A:

The posterior rectus sheath is incised between 0.5 and 1 cm from its edge following a thorough adhesiolysis performed through a wide midline laparotomy. Normally, this is carried out at the umbilicus level.

The junction between the posterior and anterior rectus sheaths is then visualized when the retromuscular plane is formed toward the linear semilunaris.

The thoracoabdominal nerve branches that enter the lateral margin of the posterior rectus sheath and perforate the rectus muscle are visible, and well preserved.

Starting in the upper third of the abdomen, about 0.5 cm medial to the linear semilunaris, the posterior rectus sheath is incised to expose the underlying transversus abdominis muscle. The muscle is then divided along its entire medial edge using electrocautery.

This step is initiated in the upper third of the abdomen, where the medial fibers of the transversus abdominis muscle are easiest to identify and separate from the underlying fascia.

This step allows entrance to the space between the transversalis fascia and the divided transversus abdominis muscle.

This space is contiguous with the retroperitoneum and can be extended laterally to the psoas muscle, if necessary, extended superiorly cephalad to the costal margins and dorsal to the sternum by sweeping the peritoneum/transversalis fascia off the diaphragm, developing the retroxyphoid space, and extended inferiorly to the space of Retzius (anterior to the urinary bladder) to expose the pubis symphysis and both Cooper ligaments.

This dissection produces a considerable medial advancement of the posterior rectus sheaths as well as the development of a sizable retromuscular gap beyond the linear semilunaris.

The posterior rectus sheaths are reapproximated in the midline, and any openings in this layer are sealed after a comparable release has been carried out on both sides. In the retromuscular space, a synthetic non-absorbable mesh is positioned as a sublay and fastened with full-thickness transabdominal sutures. In addition, interrupted sutures hold the inferior border of the mesh to the Cooper ligaments on each side. On top of the mesh are closed suction drains. The linear alba ventral is then restored to the mesh by reapproximating the anterior rectus sheaths in the midline.

Intraoperative technique for group B:

Dissection of the sac from the skin and subcutaneous tissue using a midline incision Skin and subcutaneous flap rising to a point 4 to 5 cm laterally to the linear alba Creating the retromuscular space by cutting the posterior rectus sheath immediately lateral to the linear alba A 6 cm transverse skin incision is made on each side, 2 cm lateral to the linear semilunaris, and is dissected all the way down to the external oblique aponeurosis.

Rising of the subcutaneous flap superiorly till above the costal margin and inferiorly nearly to the inguinal canal.

Opening of the external oblique aponeurosis longitudinally from the costal margin to the anterior superior iliac spine at the level of 1–2 cm lateral to the linear semilunaris, then dissecting the plane between the oblique muscles.

Closure of posterior rectus sheath at midline with insertion of the mesh in the retromuscular plane with fixation of the mesh ventrally.

Restoration of linear alba above the mesh Insertion of a closed suction drain at the retromuscular plane and at each of the transverse wounds and subcutaneous drain if needed Closure of subcutaneous and skin layers.

(1) Patients will be assessed and compared as regards.
(2) Operative time.
(3) Hospital stay.
(4) Postoperative complications:
    (a) Recurrence detected either clinically or by abdominal pelvic computed tomography.
    (b) Wound infection.
    (c) wound dehiscence.

Table 1 Patient demographics

	TAR group No.=30	Perforator group No.=30	Test value	*P* value	Significance
Age					
Mean±SD	45.97±12.28	46.83±11.20	0.286•	0.776	NS
Range	26–68	22–64			
Sex					
Female	14 (46.7%)	19 (63.3%)	1.684*	0.194	NS
Male	16 (53.3%)	11 (36.7%)			
DM					
No	24 (80.0%)	23 (76.7%)	0.098*	0.754	NS
Yes	6 (20.0%)	7 (23.3%)			
Smoking					
No	27 (90.0%)	25 (83.3%)	0.577*	0.448	NS
Yes	3 (10.0%)	5 (16.7%)			

P value greater than 0.05: Non significant (NS); *P* value less than 0.05: Significant (S); *P* value less than 0.01: highly significant (HS). *:χ^2Chi-square test. •: Independent *t*-test.

(d) Postoperative pain: clinically relevant.
(e) Postoperative seroma or hematoma.
(f) Postoperative ileus.
(g) Need for reoperation.

Outcomes were evaluated at the hospital at 2 weeks, 30 days, 6 months, and 1 year.

Statistical analysis

Data were gathered, edited, coded, and entered into IBM SPSS version 23 of the Statistical Package for Social Science. When the distribution of the quantitative data was determined to be parametric, the mean, standard deviations, and ranges were reported. Qualitative variables were also shown as percentages and numbers. As a result, the *P* value was deemed significant: *P* greater than 0.05 denotes nonsignificance, *P* 0.05 denotes significance, and *P* 0.01 denotes highly significant.

Results

This study was conducted on 60 adult patients presenting with large midline incisional hernias. They were divided into two equal groups of 30 patients each. The first group (A) includes thirty patients and was operated upon by transversus abdominis release posterior component separation, while the second group (B) includes thirty patients and was operated upon by a perforator sparing anterior component separation technique. (Table 1).

The mean operative time (in minutes) in Transversus abdominis muscle release (TAR) group A is 268.5 min (4 hr 28 min) with SD ± 47.4 while in perforator group B, it was 228.3 min (3 hrs 48 min)±68.8 showing a significant difference (*P* value = 0.011) between both groups as the mean time is shorter in the perforator group by about 40 min. (Table 2).

48 h after surgery, the postoperative pain was measured using the visual analogue score (VAS) score; the mean VAS scores for TAR group A were 6.77, 1.70, and 5.47, 1.85, respectively. With a *P* value of 0.06, highly significant statistical analysis between the two groups was discovered. (Table 3).

The wound complications (Surgical Site Occurrence (SSO)) in both groups show no statistically significant differences, with equal total numbers of patients suffering from wound complications. Eight patients in each group suffered from wound complications, which were as follows: Two patients in each group develop seroma and need frequent evacuation; two patients in the perforator group develop hematoma, which is managed by close follow-up; while in the TAR group, four patients develop hematoma, one of whom needs to be reoperated and presented after 6 months with a recurrent hernia, which was a small defect at the epigastric region above the edge of the inserted mesh. Two patients in the TAR group were complicated by

Table 2 Operative time in both groups

Operative time	TAR group No.=30	Perforator group No.=30	Test value	*P* value	Significance
Mean±SD	268.50±47.47	228.33±68.85	−2.631•	0.011	S
Range	170–360	130–385			

P value greater than 0.05: Nonsignificant (NS); *P* value less than 0.05: Significant (S); *P* value less than 0.01: highly significant (HS). •: Independent *t*-test.

Table 3 Comparison between both groups as regards postoperative pain using the visual analog scale

Pain score	TAR group No.=30	Perforator group No.=30	Test value•	*P*-value	Significance
Mean±SD	6.77±1.70	5.47±1.85	−2.836	0.006	HS
Range	3–9	3–9			

P value greater than 0.05: Nonsignificant (NS); *P* value less than 0.05: Significant (S); *P* value less than 0.01: highly significant (HS). •: Independent *t*-test.

Table 4 Postoperative wound complications

	TAR group No. (%)	Perforator group No. (%)	Test value*	*P* value	Significance
SSO					
No	22 (73.3%)	22 (73.3%)	0.000	1.000	NS
Yes	8 (26.7%)	8 (26.7%)			
Infection					
Yes	2 (6.7%)	4 (13.3%)	0.741	0.389	NS
Dehiscence					
Yes	1 (3.3%)	2 (6.7%)	0.351	0.554	NS
Seroma					
Yes	2 (6.7%)	2 (6.7%)	0.000	1.000	NS
Hematoma					
Yes	4 (13.3%)	2 (6.7%)	0.741	0.389	NS

P value greater than0.05: Nonsignificant (NS); *P* value less than 0.05: Significant (S); *P* value less than 0.01: highly significant (HS). *:χ^2Chi-square test.

wound infection, and one of them developed significant wound dehiscence, which was managed by vacuum dressing. Four patients in the perforator group developed wound infections; two of them were in the form of turbidity and positive cultures seen in the inserted drain and managed only with antibiotics. Another two patients developed wound dehiscence, which was also managed by vacuum dressing. (Table 4).

Only one patient in the whole study was reoperated for evacuation of a hematoma after the TAR technique. (Table 5).

Postoperative ileus was higher in the TAR group, which may be attributed to more adhesiolysis needed in this group, but it was statistically nonsignificant (*P* value 0.542). (Table 6).

The mean postoperative hospital stay was 5.2 days versus 4.3 days in the TAR group and perforator group, respectively. This difference was not significant (P =0.245). (Table 7).

One patient (3.3%) in the TAR group readmitted after initial discharge by hematoma, which was reoperated upon. In the perforator group two (6.7%) patients were readmitted by wound infection and dehiscence and were managed conservatively. (Table 8).

A total of 3 (5%) recurrent cases in both groups were in the TAR group, and the other two were in the perforator-preserving groups. (Table 9).

Table 5 Re-operation

Re operation	TAR group No. (%)	Perforator group No. (%)	Test value*	*P*-value	Significance
No	29 (96.7%)	30 (100.0%)	1.017	0.313	NS
Yes	1 (3.3%)	0			

P value greater than 0.05: Nonsignificant (NS); *P* value less than 0.05: Significant (S); *P* value less than 0.01: highly significant (HS). *:χ^2Chi-square test.

Table 6 Postoperative ileus

Ileus	TAR group No. (%)	Perforator group No. (%)	Test value*	*P*-value	Significance
No	22 (73.3%)	24 (80.0%)	0.373	0.542	NS
Yes	8 (26.7%)	6 (20.0%)			

P value greater than 0.05: Nonsignificant (NS); *P* value less than 0.05: Significant (S); *P* value less than 0.01: highly significant (HS). *:Chi-square test.

Table 7 Hospital stay

Hospital stay	TAR group No.=30	Perforator group No.=30	Test value	*P* value	Significance
Mean±SD	5.2±3.04	4.33±2.67	–1.172•	0.245	NS
Range	3–16	2–13			

P value greater than 0.05: Nonsignificant (NS); *P* value less than 0.05: Significant (S); *P* value less than 0.01: highly significant (HS). *:χ^2Chi-square test.

Table 8 Readmission

Readmission	TAR group No. (%)	Perforator group No. (%)	Test value*	*P* value	Significance
No	29 (96.7%)	28 (93.3%)	0.351	0.554	NS
Yes	1 (3.3%)	2 (6.7%)			

P value greater than 0.05: Nonsignificant (NS); *P* value less than 0.05: Significant (S); *P* value less than 0.01: highly significant (HS). *:χ^2Chi-square test.

Table 9 Recurrence

Recurrence	TAR group No. (%)	Perforator group No. (%)	Test value*	*P* value	Significance
No	29 (96.7%)	28 (93.3%)	0.351	0.554	NS
Yes	1 (3.3%)	2 (6.7%)			

P value greater than 0.05: Nonsignificant (NS); *P* value less than 0.05: Significant (S); *P* value less than 0.01: highly significant (HS). *:Chi-square test.

Discussion

Numerous techniques continue to yield satisfactory outcomes for incisional hernia repairs. The original anatomy and physiology are nearly restored through facial component separation.

The weak point of the classic fascial component separation technique, large flaps impairing skin vascularity and increasing wound morbidity, is not found in both techniques in this study. And there is no available randomized controlled study comparing both techniques.

In both techniques, we use the same type of synthetic polyprolene mesh in the same retromuscular position. However, in TAR, the mesh is significantly larger. We try to compare both techniques in the same disease and within a clean operative field to guide the surgeons in the management of this relatively challenging abdominal wall reconstruction, as the choice of the appropriate component separation method is still difficult.

Sixty patients with large midline incisional hernias who underwent elective surgery in the years 2021 and 2022 were included in the study. The patients were split into two groups:

Thirty patients who had transverses abdominis muscle release with retromuscular polyprolene mesh implantation make up the first group (A).

The second group (B) consists of 30 patients who underwent open anterior component separation with perforator preservation along with the retromuscular implantation of polypropylene mesh.

Odd numbers were included in group A, and even numbers were included in group B when allocating patients to either group based on the serial numbers of patients presented to the treating team. All of the study participants were included in the analysis because none of them were excluded, withdrew, or passed away during the experiment.

Patients in both groups were similar with respect to age; their ages ranged from 20 to 70 years, with the mean age in both groups around 46 years. There is no big difference in the male-to-female ratio between the two groups, with more male patients in the group underwent perforator-preserving ACS and nearly the same number of males and females in the group underwent TAR operation.

In American studies for TAR by Novitsky *et al.* [9] the mean age was 58 years, and in Krpata *et al.* [10], the mean age was 54.7 years, so the age group in our study is younger. Additionally, the cohort in the Ghali *et al.* [11] study on perforator preservation was younger, with a mean age of 63.4 years.

As regard DM, there is no significant difference between the two groups in our study, as well as between our study and Novitsky *et al.* [9] for TAR and Ghali *et al.* [11] for the perforator-preserving group. The percentage of diabetics ranges between 20 and 23% in all groups.

The patient demographics between the two groups in our study show no statistically significant difference.

The TAR group's mean operation time was (268± 47) minutes, which is extremely close to Novitsky *et al.*'s [9] mean operation time of 251 min and Krpata *et al.* [10] mean operation time of 228 min used in their prospective trial.

When comparing early postoperative wound problems, such as seroma, hematoma, wound infection, and wound dehiscence, the mean operating time in our research is considerably shorter in the perforator-preserving ACS approach by roughly 40 min. While there is no discernible difference between the two techniques in our study, prior comparative studies compared one of these two techniques to the traditional open anterior component separation, which has the significant drawback of significant wound morbidity.

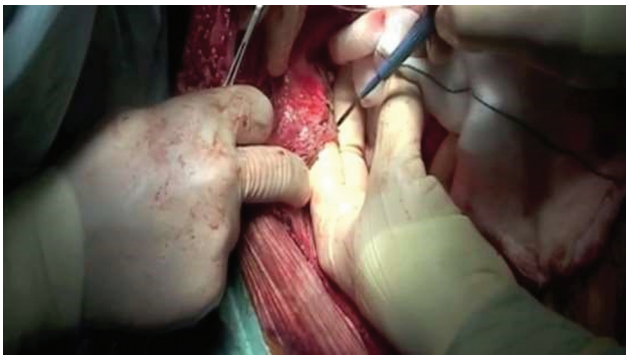
In our study, seroma was equal between the two groups; hematoma was slightly higher in the TAR technique, while wound infection and dehiscence were slightly higher in the perforator-preserving technique.

In comparison to previous studies that involved the TAR technique, our results are similar to those of the previous studies, as shown in the following chart: With the difference that some studies involve both clean and contaminated operative fields, some also use synthetic mesh while others use biologic mesh.

The early wound complications in the perforator-preserving group are comparable with those in other studies, taking into consideration that they use biologic mesh or even repair without mesh, as shown in the Clarke [12] study.

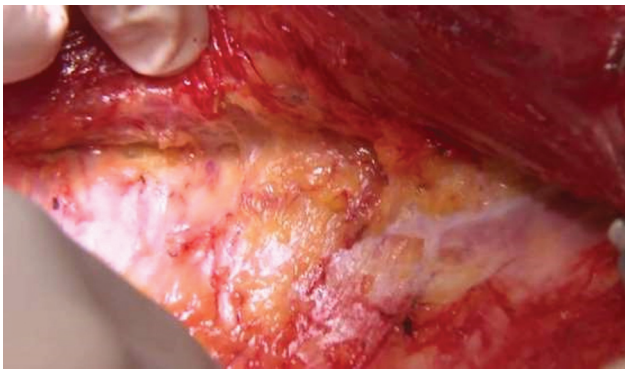
The incidence of surgical site occurrence in perforator-preserving ACS is shown in the following chart: Our

Figure 1



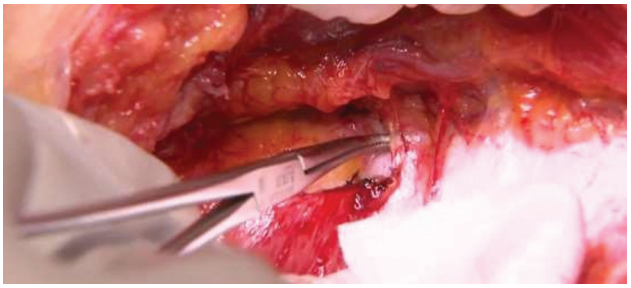
Opening the posterior rectus sheath.

Figure 2



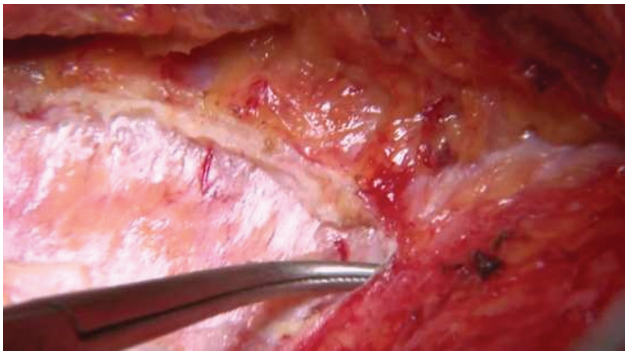
Retrorectus space with preserved neurovascular bundles.

Figure 3



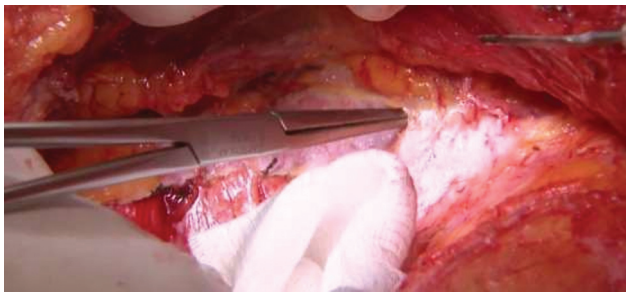
Division of transversus abdominis muscle (a).

Figure 4



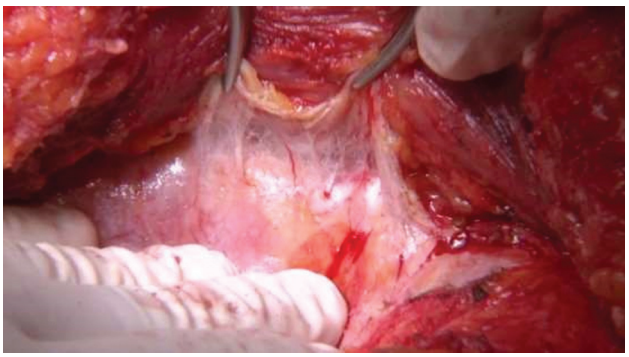
Division of transversus abdominis muscle (b).

Figure 5



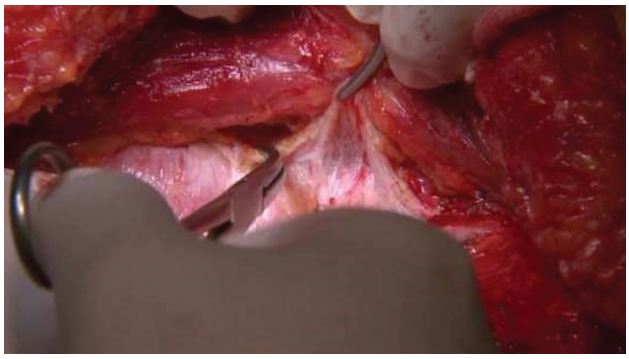
Division of transversus abdominis muscle (c).

Figure 7



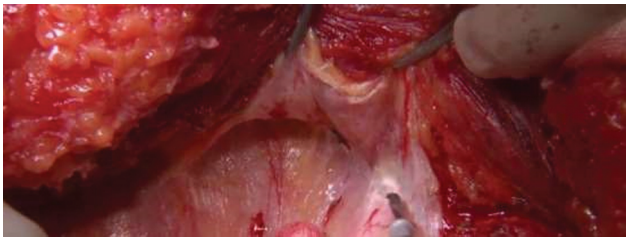
Exposure of fascia transversalis after raising cut edge of transversus abdominis muscle.

Figure 6



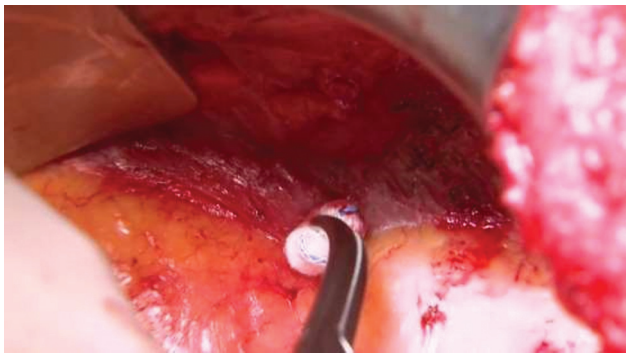
Entry to the retromuscular space dorsal to transversus abdominis.

Figure 8



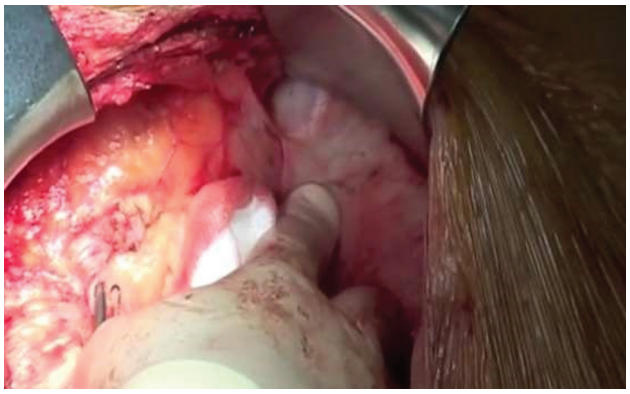
Dissection of retromuscular space by electro-cautery.

Figure 9



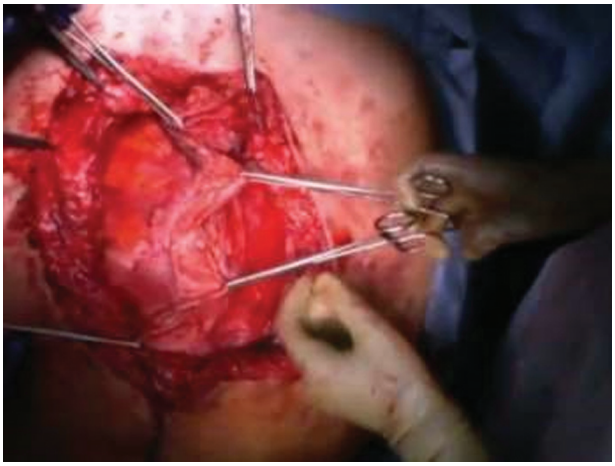
Dissection of retromuscular space by blunt dissection.

Figure 10



Cranial part of the dissection at diaphragmatic muscle.

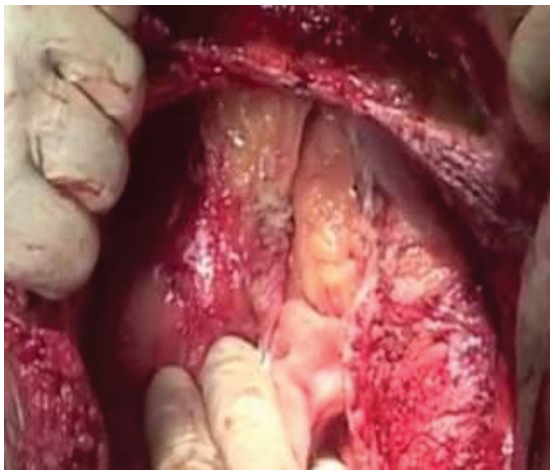
Figure 11



Approximation of post Sheath.

study results are similar to those of Butler *et al*. [13], Patel *et al*. [14], and Ghali *et al*. [11], who used mesh in their repairs, but higher than those of Saulis and Dumanian and Clarke [7], who did not insert mesh.

Figure 12



Posterior and anterior sheaths after release.

Figure 13

Transverse skin incision with its center just lateral to linear semilunaris.

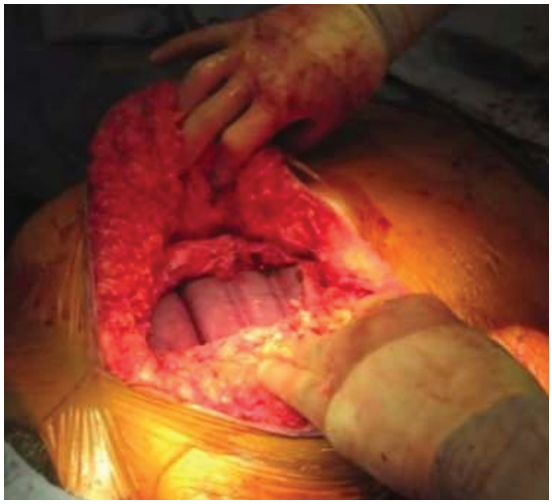
Figure 14

Incision till reaching external oblique.

Figure 15

Opening of external oblique aponeurosis.

Figure 16



Insertion of mesh at retro-rectus space after closure of posterior sheath.

The mean postoperative hospital stay was 5.2 days versus 4.3 days in the TAR group and perforator group, respectively. This period is comparable with the median length of hospitalization for patients included in the Novitsky *et al.* [9] study, which was 5.9 days, ranging from 2 to 34 days.

In our study, postoperative ileus and postoperative pain scores were lower in the perforator-preserving group. In the studies comparing the TAR, or perforator-preserving group, with the classic open ACS technique, there is always a higher incidence of recurrence in the classic technique, which may be attributed to a significantly higher incidence of wound complications, which is a major risk factor

Figure 17

Image at the end of the procedure.

for recurrence. In our study, among sixty patients, there are three cases that presented with recurrence during one year of follow-up; one of them was operated on by the TAR technique, and the other two were operated on by the perforator-preserving technique.

When comparing the recurrence rate after the TAR technique in previous studies, the rate was relatively high in Petro *et al.* [15] and Fayezizadeh *et al.* [16], but this may be attributed to the high rate of contaminated operative fields in those studies. While the rate of recurrence in Krpata *et al.* [10] and in Novitsky *et al.* [9] studies is nearly the same as in our study TAR group, as shown in the following chart.

Recurrence after perforator preservation technique was relatively high in Saulis and Dumanian and Clarke [7] studies, which may be attributed to nonmesh insertion (Figs 1–17).

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Conflicts of interest
There are no conflicts of interest.

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