Anterior component separation versus posterior component separation with transversus abdominus release in abdominal wall reconstruction for incisional hernia

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Background
Abdominal wall reconstruction after huge incisional hernias considered one of challenges that face surgeons, component separations, either anterior component separation (ACS) or posterior component separation (PCS) with transversus abdominus release (TAR), are novel and less expensive solutions for this problem.
Aim
This prospective randomized trial compares the results of ACS procedure versus PCS with TAR in repair of incisional hernias.
Patients and methods
This study included 40 patients who underwent surgical repair for midline incisional hernias with defects larger than 5 cm in width between March 2016 and October 2017 at Ain Shams University Hospitals. Patients were randomly assigned to surgical procedures. Patients in group I (n=20) underwent ACS, and patients in group II (n=20) underwent PCS with TAR.
Results
In group I (ACS), wound morbidity significantly exceeded that in group II (PCS with TAR) such that 10 (50%) patients in group I developed surgical wound infection compared with four (20%) patients in group II. Regarding wound dehiscence, seven patients in group I had this sequel, whereas two patients in group II had wound dehiscence. Hernia recurrence occurred in seven (35%) patients in group I, but only one (5%) patient in group II developed this.
Conclusion
PCS with TAR provides equivalent myofascial advancement with significantly less wound morbidity and recurrence rate when compared with ACS.

Keywords:
anterior component separation, incisional hernia, posterior component separation

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Introduction

Ventral abdominal wall hernias present a growing challenge that complicates 11–23% of all abdominal laparotomies. The ability to perform a reliable, durable ventral hernia repair with low morbidity and recurrence rate has become a significant problem for today's general surgeon [1,2], as hernia repair failure rates range from 25 to 54% for primary suture repair, and up to 32% for open mesh repair [3–7].

In 1990, Ramirez *et al.* [8] first described the technique of anterior components separation (ACS) to aid in medial fascial advancement and definitive reconstruction. In their component separation, Ramirez *et al.* [8] described the release of the posterior rectus sheath followed by the creation of a large skin flap exposure and the release of the external oblique. Over time, additional methods of external oblique release have been developed including periumbilical perforator-sparing components separation and endoscopic components separation with the intention of reducing the skin flaps needed to perform this release and thereby preserving the blood supply and minimizing wound morbidity [9–12].

Another novel technique is the retromuscular (Rives-Stoppa) hernia repair, which was first described in the early 1970s and uses the space between the posterior rectus fascia and the rectus muscle, extending ∼6–8 cm on either side of the midline [13–17]. Although durable, the Rives-Stoppa technique is limited by the lateral border of the posterior rectus sheath, and thus usually is inadequate for larger abdominal wall defects. As a result, several modifications on this technique have been developed. Such innovative approaches involve the use of the preperitoneal space or development of an intramuscular plane using a posterior component separation (PCS) technique [18,19].

Another modification of PCS technique, which using transversus abdominis muscle release (TAR) allows significant posterior rectus fascia advancement with preservation of the neurovascular supply, provides a large space for mesh sublay and avoids subcutaneous tissue undermining [20]. Moreover, TAR technique decreases skin flaps and is usually performed during traditional anterior component release.

Many authors considered these modifications to solve the major drawbacks of the traditional ACS technique such as extensive skin flaps, difficulties with suprapubic and/or subxyphoid defects, and the absence of a reliable space for prosthetic reinforcement, resulting in up to 30% recurrence and 26–42% wound infection rates [21,22].

Moreover, myofascial advancement during component release was considered as the most physiological reconstruction of large abdominal wall defects as it is based on mobilization and medial advancement of the abdominal wall musculature and accompanying fascia to obliterate the hernia defect using autologous tissue [23].

Patients and methods

This prospective study included 40 patients who underwent surgical repair of midline incisional hernias with defects larger than 5 cm in width. Patients with defects width less than 5 cm were excluded from the study. The study was conducted between March 2016 and October 2017 at Ain Shams University Hospitals. The study was approved by ethics committee of Ain Shams University and was conducted between March 2016 and October 2017 at Ain Shams University Hospitals.

Patients were randomly assigned to surgical procedures. After their approval to participate in the study, patients are divided into two groups: group I (n=20) underwent ACS procedure, and group II (n=20) underwent PCS with TAR.

Patients were diagnosed clinically by clinical examination, and Pelvi abdominal CT scan (PA) computed tomography scan was done to ensure diagnosis and to exclude other abnormalities.

Wound morbidity was defined as superficial or deep surgical site infection, seroma, wound dehiscence, or development of a chronic draining sinus. Our primary outcome measure was the achievement of complete fascial closure, with our secondary outcome measures being wound morbidity and hernia recurrence.

Operative techniques

Anterior component separation

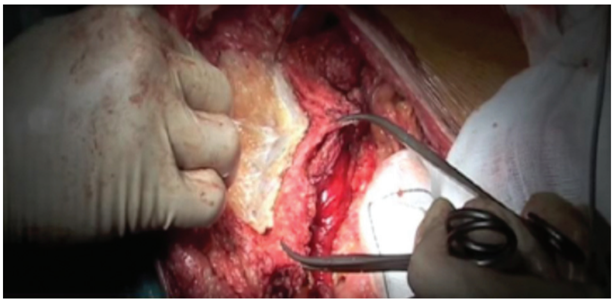
Our method for ACS was similar to what was described by Ramirez *et al.* in 1990 [8].

In summary, after a generous midline laparotomy, all visceral adhesions to the anterior abdominal wall were lysed. A skin flap was created exposing the external oblique muscle where cautery was used to dissect out the subcutaneous space which is released 2 cm lateral to the linea semilunaris (Fig. 1).

Cautery was also then used to cut the external oblique aponeurosis lateral to the rectus sheath. This incision was extended as needed from the fascia just overlying the ribs, down to the level of the anterior superior iliac spine (Fig. 2).

Release of the external oblique fascia was then repeated on the opposite side. Posterior rectus sheath release was performed by incising the sheath 2.5 cm lateral to the linea alba. Then the fascia was closed in the midline.

Figure 1



Elevation of skin flaps.

Figure 2

Incision of the external oblique aponeurosis lateral to linea semilunaris.

The mesh was placed lateral to the cut edge of the external oblique (Fig. 3). The mesh was secured using 2-0 nonabsorbable sutures.

The subcutaneous tissues were thoroughly irrigated. In most cases, one or two subcutaneous drains were placed over the fascia depending on the extent of subcutaneous dissection. The subcutaneous tissues were then closed with an interrupted absorbable, suture and the skin was closed using an absorbable subcuticular stitch or staples.

Posterior component separation with transversus abdominus release

It begins with a midline laparotomy incision, and all adhesions to the posterior abdominal wall have to be taken down, taking care to avoid injury to the posterior rectus sheath and peritoneum wherever possible. Freeing the posterior layer from the viscera permits the layer to move independently and without tension. If necessary, adhesiolysis is continued along the bowel. The bowel is protected by placing a surgical towel between it and the posterior layers.

To begin the reconstruction, the posterior rectus sheath is incised ~0.5 cm from its medial border, taking care to preserve the fascia at the medial border of the rectus that will become the linea alba (Fig. 4).

A retrorectus dissection is carried out, freeing the entire posterior rectus sheath from the rectus muscle. This plane is continued from medial to lateral, using a combination of blunt dissection and electrocautery. As the dissection nears the linea semilunaris, the intercostal neurovascular bundles are identified and preserved as they enter the poster lateral aspect of the rectus muscle (Figs 5 and 6).

The transverses abdominus is released to extend the dissection. Approximately 0.5 cm medial to the linea semilunaris, the posterior rectus sheath is incised, and the transversus abdominis muscle fibers are divided with electrocautery (Fig. 7).

This is typically started above the level of the umbilicus, where the transversus abdominis fibers are thicker and extend more medial, and then continued superiorly and inferiorly. By releasing the transversus while still medial to the linea semilunaris, the thoracolumbar nerves are preserved and rectus innervation is maintained.

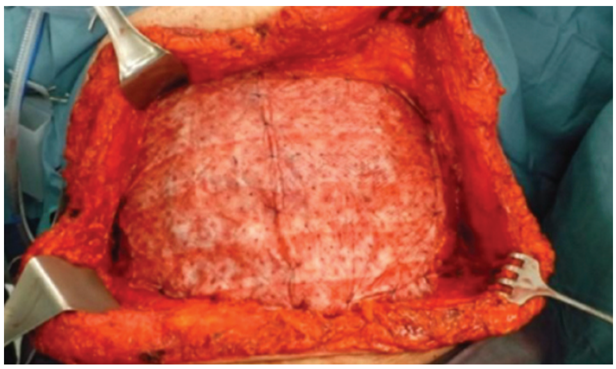
Once divided, the transversus can be retracted anteriorly and the large, avascular, retromuscular plane can be developed bluntly. The transversus abdominis muscle belly is bluntly pushed upward whereas the posterior layer of transversalis fascia and peritoneum is pushed downward (Fig. 8).

This wide plane extends to the psoas muscle laterally, under the costal margin to the central tendon of the diaphragm superolaterally (fascia diaphragmatica), below the inguinal ligament inferolaterally, and to the neck of the bladder inferiorly (Fig. 9).

Next, the posterior layer, consisting of the transversalis fascia, posterior rectus sheath, and peritoneum, is closed as a single layer with a running 2-0 polyglycolic acid suture (Fig. 10). In cases where the posterior layer cannot be reapproximated in the midline, an interposition patch of omental fat or hernia sac is used. Any fenestrations in the posterior layer are closed primarily with Vicryl suture to prevent bowel from contacting mesh or internally herniating between the posterior layer and mesh (which can result in an acute intraparietal hernia and bowel obstruction).

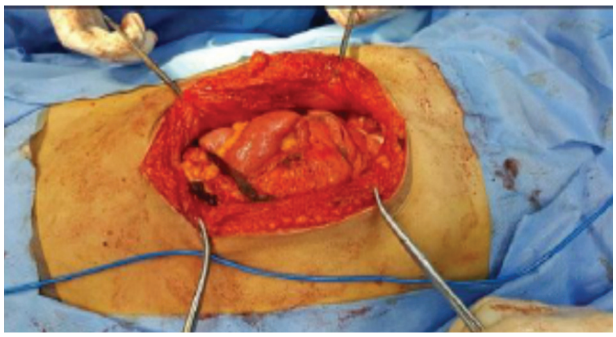
The mesh is placed in the avascular plane between the posterior layer and the transversus abdominis laterally or rectus abdominis medially (Fig. 11). Because the mesh is superficial to the posterior layer, it is protected

Figure 3



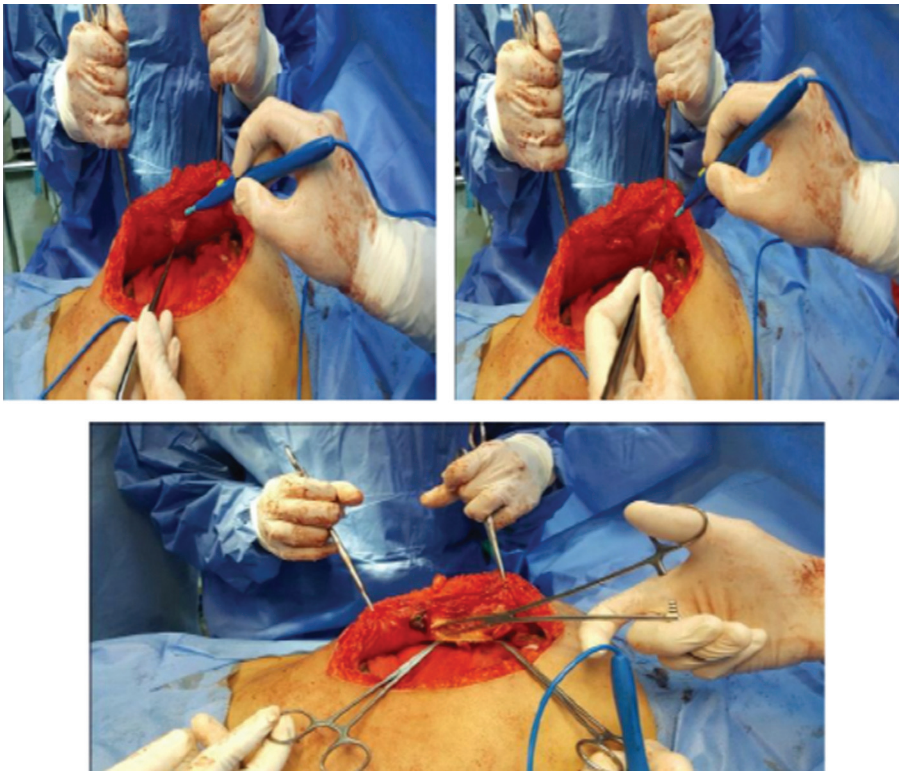
Mesh was placed lateral to the cut edge of the external oblique.

Figure 4



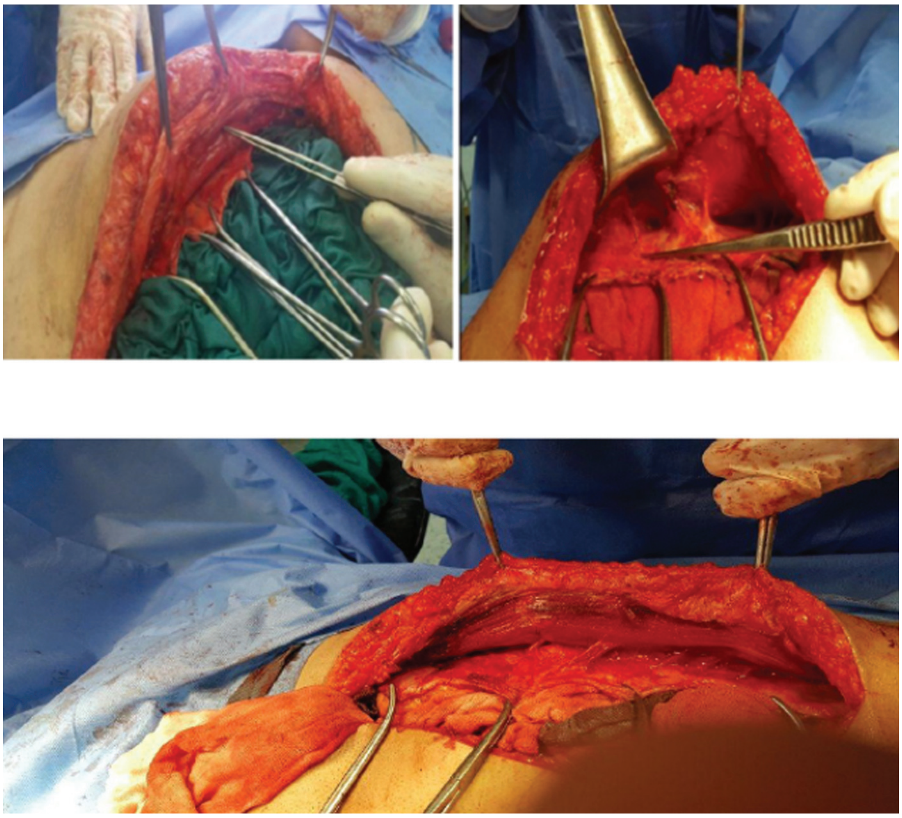
Incision of posterior rectus sheath 0.5 cm from its medial border.

Figure 5



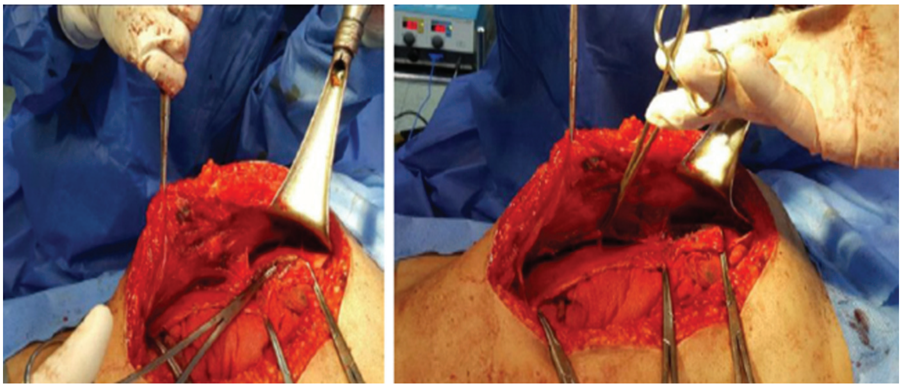
Retrorectus dissection from medial to lateral, and the intercostal neurovascular bundles are identified and preserved as they enter the poster lateral aspect of the rectus muscle.

Figure 6



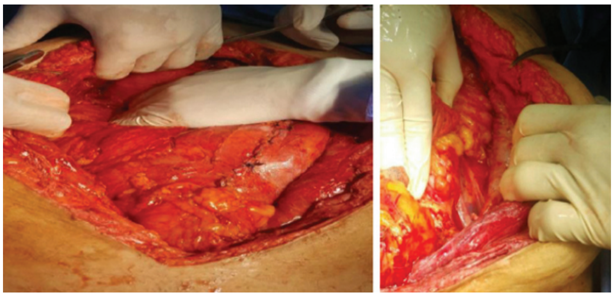
Retrorectus dissection from medial to lateral, and the intercostal neurovascular bundles are identified and preserved as they enter the poster lateral aspect of the rectus muscle.

Figure 7



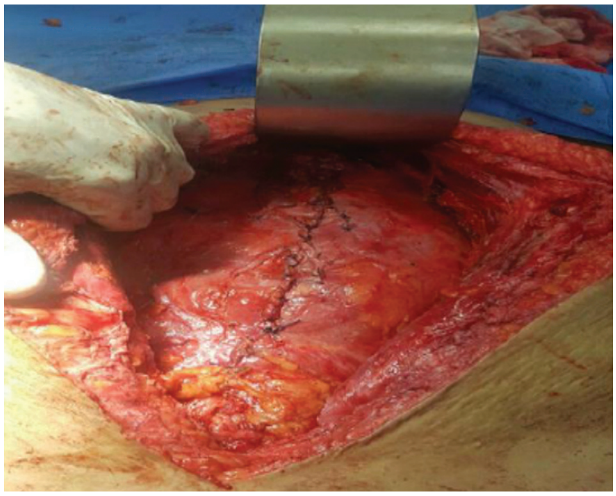
Division of transversus abdominis muscle fibers.

Figure 8



Transversus muscle is pushed upward while the posterior layer of transversalis fascia and peritoneum is pushed downward and the space is reaching psoas muscle laterally.

Figure 9



Extension of the plane under the costal margin to the central tendon of the diaphragm superolaterally.

from contact with the viscera, and permanent mesh is a safe option. At our institution, a medium size (30 cm^2) polypropylene mesh is favored. Polypropylene mesh has burst strength double that of the native abdominal wall tissue, yet retains better flexibility because of a less intense inflammatory reaction. Its open weave permits rapid tissue integration with the layers of vascularized abdominal wall, which may help resist infection.

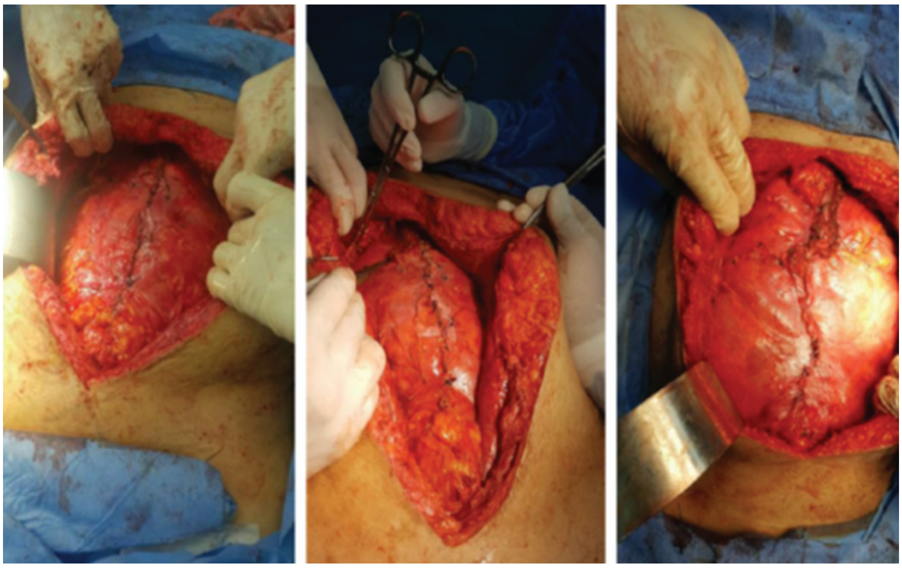
Dividing the transversus fibers, the hoop tension around the abdomen is released and the abdominal cavity is increased. The intra-abdominal pressure is also lowered by drawing the abdominal wall upward. Moreover, the force vector of the TA directly opposing the medialization of the fascia is abolished. The result is a fascial advancement of 8–12 cm on each side which allows restoration of the linea alba without tension with improved abdominal core muscle function. In addition there is no extensive skin flaps, and preservation of a significant portion of the abdominal wall blood supply improves healing and decrease wound morbidity [24].

The mesh is secured in a diamond configuration with eight transfascial sutures, typically, slow-absorbing 0 monofilament absorbable sutures (PDS) are used. Sutures are placed at the xiphoid process, just above the pubis, bilaterally below the costal margin in the midclavicular line, superior to bilateral anterior superior iliac spines in the anterior axillary line, and bilaterally in the posterior axillary line between the posterior superior iliac spine and the 11th rib (Fig. 12).

After placing the initial midline sutures, the medial edge of the anterior rectus sheath is grasped with a Kocher clamp and pulled to the midline during placement of the lateral sutures, and this physiologically tensions the mesh to shield stress from the anterior abdominal wall repair and prevent mesh laxity and folding that could lead to seromas.

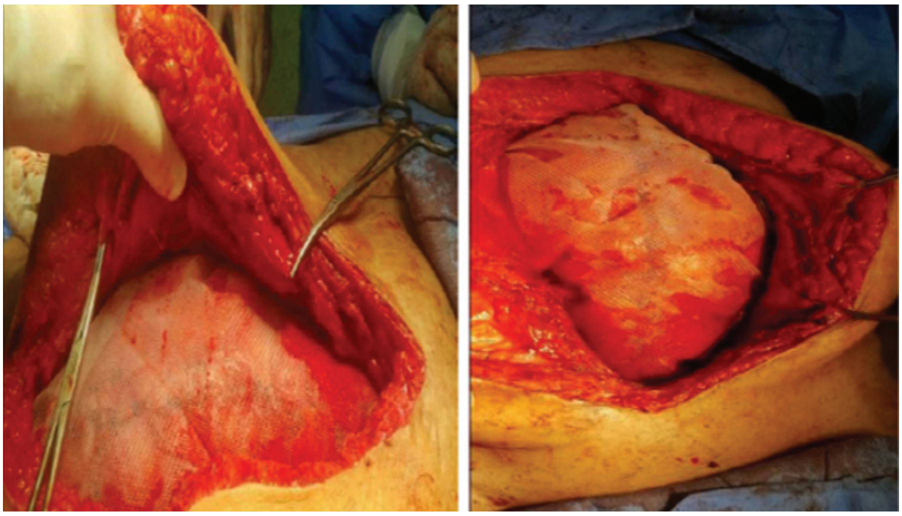
Loading tension on the mesh also provides medialization of the rectus muscles, which later aids in midline reapproximation.

Figure 10



Closure of the transversalis fascia, posterior rectus sheath, and peritoneum.

Figure 11



Polypropylene mesh is placed in the sublay fashion.

Figure 12

Fixation of the mesh with transfascial sutures and closure of anterior rectus sheath.

Drains are routinely left above the mesh. The anterior rectus sheath is then closed in the midline to reconstruct the linea alba. Because innervation to the rectus is kept intact, closure of its anterior sheath reconstructs a functional abdominal wall.

Results

Analysis of the data was done using SPSS (statistical program for the social sciences) version 23 (SPSS Inc., Chicago, Illinois, USA) as follows:

(1) Quantitative variables will be described using mean and SD and compared using Student's *t*-test.

(2) Qualitative variables will be described using frequency and percentages and compared using χ^2 for parametric variables and using Mann–Whitney *U*-test for nonparametric variables.
(3) Significance level will be set to 0.05.

In total, 40 patients were identified as having undergone component separation procedures during the study period, where 20 (50%) patients had an ACS and 20 (50%) patients had a PCS with TAR. The mean age for ACS group was 44 years, with range of 28–65 years, whereas that for PCS with TAR was 46 years, with range of 33–63 years, with no significant statistical differences (*P*=0.48). The mean defect widths were 10.6 and 11.1 cm, respectively. Patient's demographics were listed in Table 1. The mean operative time for ACS was 215.45, with range of 122–280 min, and for PCS with TAR was 217.1, with range of 170–290 min, with no significant statistical difference (*P*=0.9). Synthetic prolene mesh was used in 100% of the patients.

The mean estimated blood loss was 527 ml, ranging from 200–800 ml; there were no intraoperative blood transfusions.

Wound seroma, infection, and dehiscence were identified in 21, 14, and nine patients, respectively, where more wound complications were denoted in ACS group, as 10 (50%) patients had wound infections and seven (35%) patients had wound dehiscence, than in PCS with TAR group, with four (20%) and two (10%) patients, respectively, with a significant difference (*P*=0.04). Most of wound infections in both groups responded to antibiotics therapy alone, whereas in six (30%) patients, severe up to necrotizing wound infections were seen, as these patients were diabetics, requiring surgical wound debridement and frequent wound dressing. In addition, these necrotizing wound infections occurred more in ACS group.

Seven (35%) hernia recurrences were identified in ACS after follow-up of 1 year. In contrast to PCS with TAR, only one (5%) case of hernia recurrence was found with statistically significant (*P*=0.03), as shown in Table 2.

Discussion

The goal of any herniorrhaphy is first of all the restoration of a functional abdominal wall by recreating the linea alba reinforced with a large prosthetic mesh overlap and with minimal early and late wound morbidity.

De Vries Reilingh *et al.* [6] performed their study on 43 patients with large midline incisional hernia,

Table 1 Patient demographics and operative characteristics

Demographic data	Group I (*n*=20) [*n* (%)]	Group II (*n*=20) [*n* (%)]	*P* value
Sex			
Male	10 (50.0)	11 (55.0)	0.500
Female	10 (50.0)	9 (45.0)	
DM	5 (25.0)	4 (20.0)	0.500
COPD	4 (20.0)	4 (20.0)	0.653
BPH	2 (10.0)	0 (0.0)	0.244
Smoking	9 (45.0)	12 (60.0)	0.624
Previous hernia repair	13 (65.0)	9 (45.0)	0.170
Removal of previous mesh	10 (50.0)	8 (40.0)	0.376
Age [mean±SD (range)] (years)	44.55±11.6 (28–65)	46.85±8.83 (33–63)	0.486
Defect width [mean±SD (range)] (cm)	10.6±3.33 (6–17)	11.1±3.385 (6–17)	0.640
BMI [mean±SD (range)] (kg/m^2)	35.2±4.92 (27–45)	35.55±3.73 (29–43)	0.801
Operative time [mean±SD (range)] (min)	215.45±42.8 (122–280)	217.1±41.04 (170–290)	0.902
Blood loss [mean±SD (range)] (ml)	510±164.3 (300–750)	545±184.88 (200–800)	0.531

Table 2 Postoperative complications

	Group I (*n*=20) [*n* (%)]	Group II (*n*=20) [*n* (%)]	*P* value
Hernia recurrence	7 (35.0)	1 (5.0)	0.031
30-day readmission	6 (30.0)	1 (5.0)	0.046
Wound morbidity			
Seroma	14 (70.0)	7 (35.0)	0.042
Surgical wound infection	10 (50.0)	4 (20.0)	0.048
Wound dehiscence	7 (35.0)	2 (10.0)	0.046
Chronic sinus	2 (10.0)	0 (0.0)	0.244

where the mean width of the defect was 13±7 cm SD and mean BMI was 27 kg/m^2, and 30% have recurrent incisional hernia. In our study, which was conducted on 40 patients with midline incisional hernia, the mean defect width was 10.6 ±3 cm, BMI was 35±4, and 65% of patients have previous hernia repair. Patient demographics in the study of Krpata *et al.* [24] show significant difference regarding age, sex, and BMI between ACS and PCS groups, where *P* values were 0.03, less than 0.01, and less than 0.01, respectively. In contrast to our study, there were no significant differences regarding age, sex, and BMI, where the *P* values were 0.48, 0.5, and 0.8, respectively.

DiBello and Moore [25] used the ACS technique in 35 patients, and in none of the patients a release of the posterior rectal sheath was done, and in 15 patients midline closure was supported by an on-lay prosthesis. Postoperative wound complications were reported in 14%, and recurrence was found in 9% after a mean follow-up of 22 months. Girotto *et al.* [26] applied the original technique in 30 patients. Postoperative wound complications were reported in 27%, with recurrence rate of 6% after a mean follow-up of 21 months. Shestak *et al.* [27] applied the same technique as DiBello and Moore [25] in 22 patients. Postoperative wound complications were reported in 14%. Recurrence was found in 5% after a mean follow-up of 52 months. Postoperative complications were more frequent in the series of Lowe *et al.* [12], who reported on 30 patients. Reherniation was found in 10% of the patients after a mean follow-up of 12 months. In our study, 20 patients underwent ACS and were followed up for 1 year; surgical site infection was reported in 50% of cases, with 35% wound dehiscence, and necrotizing wound infections occurred in four cases and required surgical wound debridement with removal of parts of the mesh. Recurrence was reported in 35% of cases after 1-year follow-up.

Many institutions evaluating their outcomes after PCS technique with TAR have demonstrated promising results including decreased rates of wound infection. Early descriptions by Novitsky and Elliott [20] of the use of TAR starting with a case series of 42 patients undergoing TAR demonstrated a 7.1% wound infection rate and 4.7% recurrence rate with follow-up averaging 26 months. Moreover, another study conducted on 55 patients by Krpata *et al.* [24] demonstrated a 10% wound infection rate and 3.6% recurrence rate with mean follow-up 7 months. Our study on 20 cases that underwent PCS with TAR shows a 20% surgical wound infection and 10% wound dehiscence with no need of mesh removal during surgical debridement as the infection was away from the sublay mesh and 5% recurrence rate during a period of follow-up for 1 year.In our study, occurrence of surgical wound seroma was reported in 70% of ACS group, which is a predicted sequela in this technique owing to the excessive skin flaps, and in 35% of PCS with TAR group, which might be a sequela from the remaining subcutaneous hernia sac that may be left undisected.

If wound morbidity is the measure of short-term success after ventral hernia repair, then recurrence is the gold standard for the long-term outcome of a successful hernia repair. Recurrence rates after components separation have been reported to be 10–22%, with mean follow-up periods ranging from 9.5 months to 4.5 years [28,29]. In our study, we discovered that PCS with TAR was associated with lower recurrence rates than ACS with significant difference between the two groups (P=0.03); although follow-up duration was somewhat limited, we believe that the sublay approach was associated with lower risk of recurrences and surgical site infections compared with on-lay, inlay, and underlay [30,31].

We believe that the TAR technique in PCS has better outcome in our study than ACS for many reasons. First, the TAR technique allows a relatively tension-free repair using a large mesh with myofascial reconstruction dorsal and ventral to the mesh, restoring the native biomechanics of the abdominal wall [20]. Second, it avoids disruption of the nerves and blood supply to the rectus abdominis and anterolateral abdominal wall skin.

Conclusion

Abdominal wall reconstruction using PCS with TAR had an equivalent fascial closure to ACS in huge incisional hernias, but PCS with TAR was associated with a lower risk of wound morbidity which is believed to be related to the preservation of the abdominal wall blood supply by eliminating skin flaps needed for ACS, with lower recurrence rates.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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