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Evaluation of The Transversus Abdominis Release Method In Large Ventral Hernias and Its Effect On Postoperative Abdominal Pressure

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ABSTRACT

The aim of this study is to evaluate the effectiveness of the posterior separation technique performed by releasing the transversus abdominis in large ventral hernias (LVH) and its effect on postoperative intra-abdominal pressure (IAP).

LVH patients who treated with transversus abdominis release (TAR) technique in our hospital between March 2021 and June 2022 were evaluated. The patients' age, sex, body mass index (BMI), presence of comorbidities, hernia size, IAP, postoperative complications, presence of recurrence were evaluated. IAP (day 1-3) values were compared statistically.

In total, 35 patients were operated. 25.7% (9/35) of patients had previously known comorbid diseases. The cause of hernia was previous laparotomy in 21 patients (21/35; 60%), and primary ventral hernia in 14 patients (14/35; 40%). 14 patients (14/35; 40%) had a history of recurrence after hernia repair with on-lay technique. Postoperative day 1 IAP was measured as median 13.2 mmHg IQR:2.2, on day 2 median IAP was 9.5 mmHg IQR:3.6 and on day 3 median IAP was 8.6 mmHg IQR:3.5. IAP values decreased statistically significantly for three days (1st day-3rd day: p=0,001; 2nd day-3rd day: p=0,001; 1st day-3rd day: p=0,001). Wound infection was seen in one patient and hematoma was seen in one patient (2/35; 11.4%). Total follow-up was median 12 months, IQR:9. No recurrence was observed in any patient.

TAR technique provides good outcomes with no recurrence and low complication rates in LVH patients. This technique allows to safely closure of large defects without increasing intra-abdominal pressure.

Keywords: Intra-abdominal pressure, Large ventral hernia, Posterior component seperation, Transversus abdominis release

Introduction

Large ventral hernia (LVH) repair is one of the important problems of reconstructive surgery. It can affect up to 50% of patients undergoing laparotomy (1–6). Various complications and frequent recurrences are encountered after hernia repair. Although various surgical techniques have been described so far, satisfactory results have not been obtained, especially in large diameter defects.

A retromuscular hernia repair technique (Rives stoppa), which provides up to 6-8 cm of space on both sides of the midline, has been described (7–9). The limitation of this technique to the lateral edge of the posterior rectus sheath makes it ineffective in large ventral hernias (10).

In the anterior component separation (ACS) described by Ramirez et al., after incision the fascia of the external oblique muscle, medial rectus muscle is facilitated to move medially. Therefore, this technique is suitable for closure of large-diameter defects (11). However, over time, some disadvantages of this technique began to emerge. Skin necrosis and wound complications may occur after the use of large subcutaneous flaps (12). In the post-operative long term, "frog-belly appearance" occurs due to cambering on the lateral side of the abdomen and causes cosmetic problems.

Novitsky et al. [13] described the posterior component separation (PCS) technique by releasing the transversus abdominis muscle. This modification allows significant advancement of the posterior rectus fascia and wide lateral dissection. In this technique, neurovascular structures are protected and thus subcutaneous fat tissue is not weakened. Allows for a large area for sublay mesh with wide dissection. One of the advantages of the TAR technique is that it releases the transversus abdominis muscle, eliminating abdominal tension and keeping the intra-abdominal pressure at normal levels. Thus, it

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allows reconstruction even in very large ventral hernias without causing abdominal compartment syndrome.

The aim of this study is to evaluate the effectiveness of the TAR technique in LVH and its effect on postoperative abdominal tension with postoperative IAP measurements.

Material and Method

This study was approved by the ethics committee of our institution. Patients with LVHs who were operated with the TAR technique between March 2021 and June 2022 were included in the study. Cases with LVH over 18 years of age were included in the study. Those with an American society of anesthesiologists (ASA) score of 3 and above and patients under the age of 18 were excluded from the study.

Patients' age, sex, body mass index (BMI), presence of comorbidities, previous laparotomy and hernia repair, hernia sizes, IAP values, postoperative complications and recurrence were recorded retrospectively. The area of the hernia sac was measured intraoperatively.

IAP Measurement: IAP values were measured indirectly from the bladder on the 1st to 3rd postoperative days (14). While the patient was in the supine position, 50 cc of saline was injected into the bladder through the foley catheter, and one end was inserted into a urine bag with a severed top. Based on the symphysis pubis level, the fluid level was measured with a ruler in cm H2O units. The measured values were then converted to mm Hg. IAP ≥ 12 mm Hg was considered as intra-abdominal hypertension (15).

Preoperative Assessment: After taking detailed anamnesis and physical examination from the patients admitted to the clinic, complete blood count and wide metabolic panel were taken routinely. Those with previous comorbid diseases were consulted to the relevant branches. Compression stockings were put on the patients before the operation. A single dose of enoxaparin sodium 4000 IU was administered subcutaneously before the operation for anticoagulation. Prophylactically, 1 g of cefazolin was administered IV 6 hours before the operation.

Postoperative Assessment: Enoxaparin sodium 4000 IU was administered subcutaneously to each patient once a day for 3 days after the operation for anticoagulation. Prophylactically, 1 g of cefazolin was administered 3×2 IV during the operation and throughout the day after the operation. All patients used corsets for 3 months after the operation. The drain was removed when the hemorrhagic discharge fell below 30 cc in the drainage follow-up. The patients were discharged 5-7 days after the operation. Postoperative controls were performed with physical examinations at 1 month, 3 months, and 6 months. Contrast-enhanced abdominal CT was performed in patients with suspected recurrence. Pre- and postoperative images of a patient with ventral hernia are shown in figure 1.

TAR Technique: The patient is placed in the supine position and the operation area is sterilized. Under general anesthesia, scar tissue is extensively removed up to intact tissues. After opening a wide laparotomy in the midline of the abdomen, the hernia sac is reached. The hernial sac is opened and all abdominal adhesions are separated from each other. The posterior rectus sheath is incised approximately 1 cm from the muscle margin. The retromuscular space is extended to the linea semilunaris. Perforators are visualized and preserved. Starting from the upper third of the abdomen, the transversus abdominis muscle is cut to expose the transverse fascia. A dissection is made up to the posterior axillary line by entering between the transverse muscle and the transverse fascia. Superiorly, the sub-xiphoid area is dissected, and the fatty triangle is passed, from here it is advanced to the central tendon of the diaphragm. The dissection is extended inferiorly to the retropubic space and Cooper's ligaments. The posterior rectus sheaths are brought closer to the midline with monofilament sutures. To place the mesh, the area of the defect is measured. This measurement is made by measuring the lengths at least 5 cm above the xiphoid, up to Cooper below, and at least to the posterior axillary line on the sides. The mesh is fixed to both Cooper ligaments inferiorly and to the xiphoid superiorly with a single suture. Two drains are placed on top of the mesh. Finally, the anterior rectus sheath is closed with a monofilament suture in the midline with a small bite technique to reconstruct the linea alba. The operation is terminated by closing the skin and subcutaneous tissue. The images of the operation steps are shown in figure 2.

Statistical Analysis: Descriptive statistics were calculated for all variables. The mean ± standard deviation (SD) was calculated for the normally distributed variables, and the median value (minimum-maximum) was calculated for the non-normally distributed variables. Chi-square test was used for categorical variables. The number of people to participate in the study was determined

A B

Fig. 1. 70-year-old male patient. PCS was performed with TAR technique due to incisional ventral hernia. Preoperative (a) and postoperative (b) images are shown

by power analysis. Wilcoxon rank test was used to compare dependent samples that did not fit the normal distribution. In the test in which the three groups were compared, bonferroni correction was made and the significance value was determined as p=0.0167. Statistical analysis of the data was performed in the statistical package program IBM SPSS 22.0 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.).

Results

A total of 35 patients (4 male, 31 female; mean age 50.8±1.9; age range 28-78 years) were included in the study. The mean BMI was 30.2±0.7 kg/m2 (range: 22.9- 39.5). 25.7% (9/35) of patients had previously known comorbid diseases, which were hypertension (5/35; 14.3%), type 2 diabetes mellitus (3/35; 8.6%), coronary heart disease (2/35; 5.7%) and pulmonary disease (4/35; 11.4%)] (Table 1).

6 patients (6/35; 17.1%) had active smoking history. 14 patients (14/35; 40%) had a history of recurrence after hernia repair with the on-lay technique. There was a history of hernia repair once in 10 patients, twice in one patient, three times in two patients, and 11 times in one patient [median:1 IQR:1.25]. Hernia defect was measured intraoperatively, with a median of 283.3 cm2 IQR:60. No major intraoperative complications or mortality occurred in any of the patients (Table 1).

Postoperative day 1 IAP was measured as median 13.2 mmHg IQR:2.2, on day 2 median IAP was 9.5 mmHg IQR:3.6 and on day 3 median IAP was 8.6 mmHg IQR:3.5 (Table 2). By comparing the median values with the wilcoxon rank test, it was observed that the IAP values decreased statistically for three days (1st day-3rd day: p=0.001; 2nd day-3rd day: p=0.001; 1st day-3rd day: p=0,001) (Figure 3).

Wound infection was observed in one patient in the postoperative follow-up. In addition, one patient had a hematoma located behind the rectus muscle, which presented with pain in the right suprapubic region. The hematoma was drained under ultrasound guidance. Complications were seen in 2 patients (2/35; 11.4%) in total.

The clinical follow-ups of the patients were performed with physical examination at the 1st, 3rd and 6th months. Total follow-up was median 12 months, IQR:9. In addition to physical examination, 15 patients underwent abdominal CT at 6 months. No recurrence was observed in any patient.

Discussion

Large ventral hernia is a problem with increasing frequency. One of the reasons for this is obesity, which is becoming increasingly common in society. Another reason is the increased survival rate after major abdominal operations thanks to

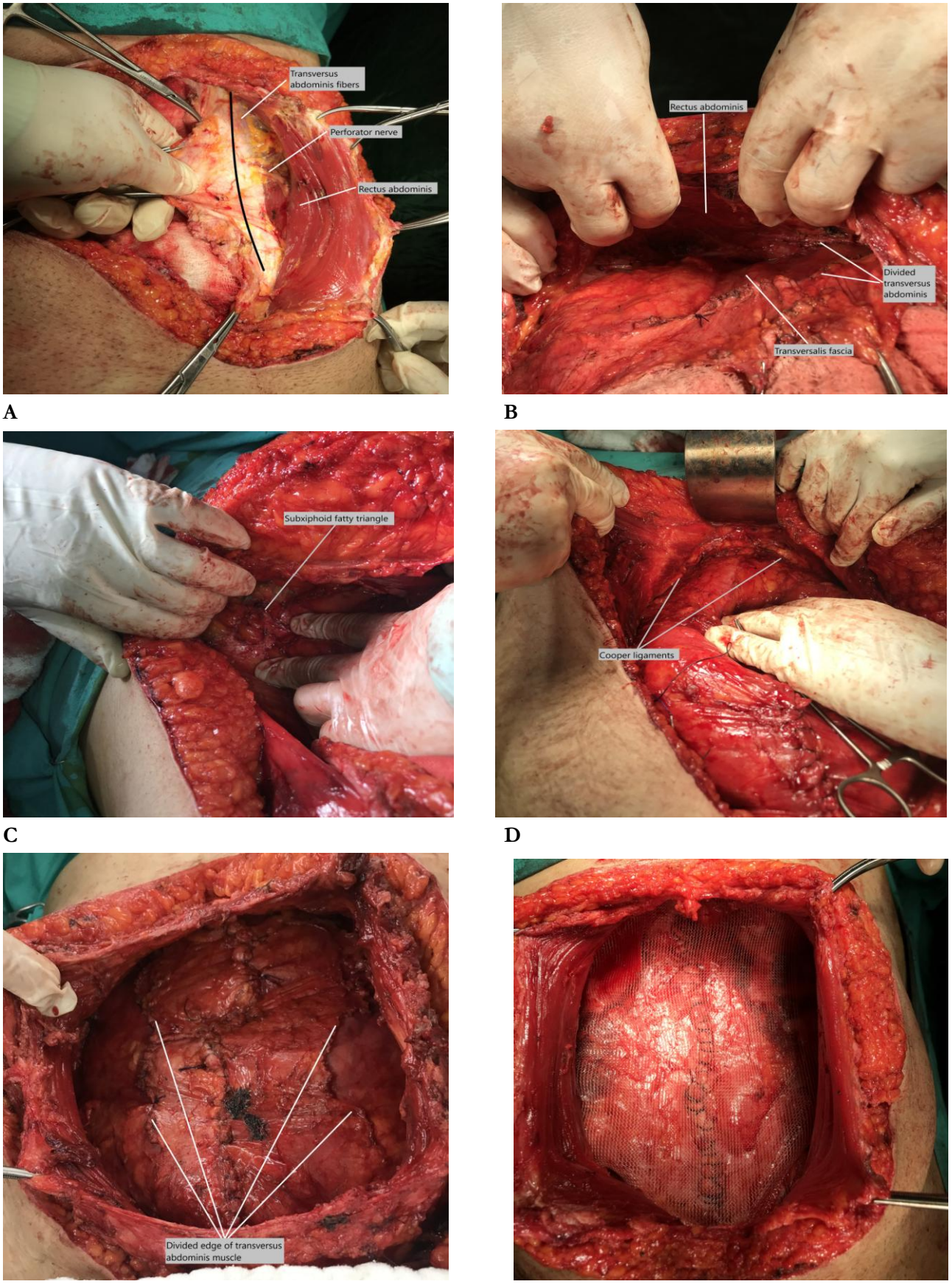

Fig. 2. Exposing the transversus abdominis muscle by dissection of the posterior rectus sheath (a). Exposure of the transversalis fascia with the transversus abdominis muscle division (black line represents linea semilunaris) (b).

Extending the dissection to the subxiphoid region superiorly and to the retzius space inferiorly (c,d). Closure of the posterior rectus sheath (e). Placement of synthetic mesh in the prepared area behind the rectus muscle (f).

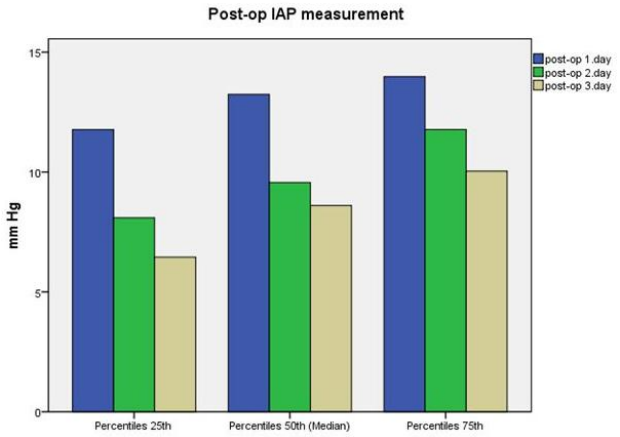

Fig. 3. IAP measurement of patients belong to post-operative 1,2 and 3 days are shown on the graphic

the improved intensive care conditions and the ventral hernia seen in these patients (16).

LVH is a condition that causes aesthetic problems, leads to constipation due to decreased intestinal motility and reduces quality of life due to pain complaints. In some patients, it presents with life-threatening incarceration or strangulation. LVHs are primarily caused by the weakening of the anterior abdominal wall muscles in women who have multiparity. It develops secondarily after major abdominal surgery.

Complex ventral hernia patients often have multiple comorbidities, often have multiple previous abdominal operations, and have risky hernia types. These reasons lead to an increase in adverse surgical outcomes and hernia recurrence (17).

The recurrence rates of the Rives-stoppa technique have been reported between 5-7% [18–20] and the recurrence rates of PCS techniques are reported between 3.1-7.3% (21–24). In this study, we did not detect any recurrence in patients with LVH who were operated with the TAR technique during an average follow-up period of 1 year. These results show that the TAR technique is at least as effective as other PCS techniques.

In the ACS described by Ramirez et al (11)., after incising the fascia of the external oblique muscle, medial rectus muscle is facilitated to move medially, which allows for the repair of larger defects. The ACS has some disadvantages. First, when wide subcutaneous dissection is performed, wound complications occur in the skin and subcutaneous tissues whose nutrition is impaired

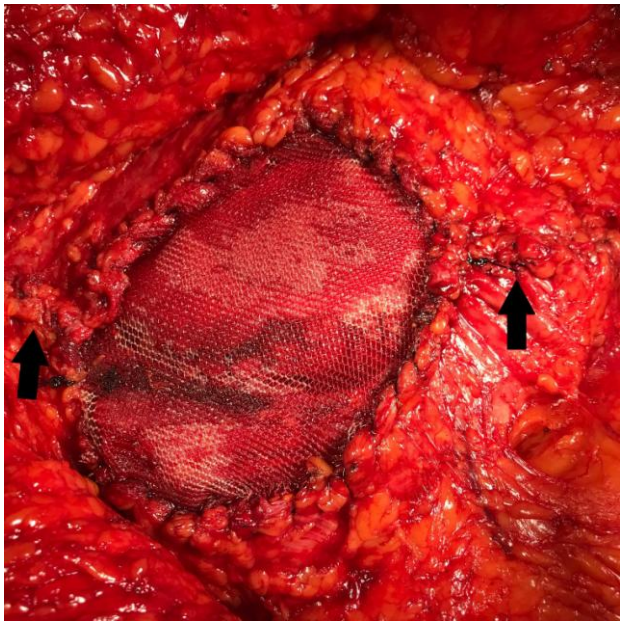

Fig. 4. While medializing the rectus muscles, the proximal and distal ends (arrows) were closed, but tension occurred when closing the middle segment. Therefore, mesh was used as a bridge to close the midline

as a result of damage to the perforating vessels. Recurrence rates of 9-18% have been reported in the ACS technique with mesh, and up to 52% in the ACS performed without mesh. Although the recurrence rate is low in the ACS technique with mesh, the possibility of wound infection is increased (25).

One of the most important advantages of the TAR technique is that both the anterior and posterior components of the lateral abdominal wall and posterior rectus sheath can be advanced medially. In this technique, the hernia sac is preserved and a wide extraperitoneal retromuscular space is created. This plan provides an ideal area for synthetic mesh, preventing direct contact of the mesh with organs and preventing adhesion formation. Additionally, thanks to the developed retromuscular area, it allows the placed mesh to completely cover even the largest hernia defects.

One of the most important purposes of the TAR technique is to provide linea alba restoration. Although this is not possible in all patients, it is achieved in most cases despite the large hernia diameter (17). In our study, medialization of the anterior components was not possible during linea alba reconstruction in two patients. In these

Table 1: Patients Demographics

Age	50,8±1,9 (28-78)
Sex	
Male	4/35 (11.4)
Female	31/35 (88.6)
BMI	30,2±0,7 (22,9-39,5)
Prior comorbidities	
Hypertension	5/35 (14.3)
Diabetes Mellitus	3/35 (8.6)
Coronary Heart Disease	2/35 (5.7)
Pulmonary Disease	4/35 (11.4)
Smoking history	6/35 (17.1)
Number of previous hernia repair	14/35 (40)
Recurrence number	1 IQR:1.25 (1-11)
Previous abdominal surgery	21 (60)
Primer ventral hernia	14 (40)

BMI: Body Mass Index

Table 2: Pre- and Post-Operative Data of Patients

Hernia area (cm2)	283,3 IQR:60 (227-346)
IAP 1.Day	13,2 IQR:2,2 (8-14,7)
IAP 2.Day	9,5 IQR:3,6 (6,6-13,2)
IAP 3.Day	8,6 IQR:3,5 (5,7-10,7)
Complication	2/35 (5.7)
Follow up	12 IQR:12 (1-20)
Recurrence	0

IAP: Intra-abdominal pressure

Table 3: Literature Data of TAR in Large Ventral Hernias

	n (patient number)	Surgical site occurence	CNS infection	Recurrence	Follow up (months)
Winder et al.	37	2 (5)		1 (3)	21 (12-42)
Parent et al.	67	13 (19)	2 (3)	4 (6)	8 (6-13)
Novitsky et al.	428	80 (19)	39 (9)	13 (4)	32 (12-84)
Appleton et al.	12	1 (8)	2 (17)	2 (17)	24 (18-37)
Chatzimavroudis et al.	125	11 (8.8)	3 (2.4)	1 (0.8)	29.8 (12-60)
Present study	35	2 (5.7)	1 (2.9)	0 (0)	12 (1-20)

patients, we used mesh as a bridge to close the anterior component defect (Figure 4). Thus, the anterior component defect was closed without creating abdominal tension.

The function of the transversus abdominis muscle is to provide abdominal wall tension. In the TAR technique, the transversus abdominis muscle is released, thus keeping the IAP at normal levels. Therefore, the development of life-threatening complications such as abdominal compartment syndrome is prevented. In our study, the median value of IAP on day 1 was 13.4 mmHg in IAP measurements made in the post-operative period, which was consistent with mild intra-abdominal hypertension. However, with the early mobilization of the patients, a median of 9.5 mmHg on the 2nd day and a median of 8.6 mmHg on the 3rd day were measured, and we observed

that these pressures returned to normal levels and decreased significantly compared to the postoperative 1st day.

One of the advantages of the TAR technique is the creation of a well-vascularized area for the mesh, while preserving the perforating vascular structures. Thus, mesh integration becomes easier. In these patients, wound complications and infection are less common with the preservation of vascularization (17). In our study, hematoma was observed in one patient and surgical site infection was observed in one patient (2/35; 5.7%). In the literature, surgical site complications were reported between 5-19% (17,26–29), and we obtained similar results in our study.

This study had some limitations. One of them was the retrospective design of the study. Another was the low number of patients. The reason why we observed fewer complications compared to other studies in the literature may be due to the low number of patients.

In conclusion, in this study, we showed that the TAR technique provides closure of large ventral hernias with a low complication and recurrence rate. By preventing the increase in abdominal pressure, it allows the closure of large-diameter defects without causing abdominal compartment syndrome.

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