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Long-term outcomes and quality of life assessment after posterior component separation with transversus abdominis muscle release (TAR)

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Abstract

Background Although transversus abdominis release (TAR) to treat large incisional hernias has shown favorable postoperative outcomes, devastating complications may occur when it is used in suboptimal conditions. We aimed to evaluate postoperative outcomes and long-term follow-up after TAR for large incisional hernias.

Methods A consecutive series of patients undergoing TAR for complex incisional hernias between 2014 and 2019 with a minimum of 6 month follow-up was included. Demographics, operative and postoperative variables were analyzed. Postoperative imaging (CT-scan) was also evaluated to detect occult recurrences. The HerQLes survey for quality of life (QoL) assessment was performed preoperatively and 6 months after the surgery.

Results A total of 50 TAR repairs were performed. Mean age was 65 (35–83) years, BMI was 28.5 ± 3.4 kg/m^2, and 8 (16%) patients had diabetes. Mean Tanaka index was 14.2 ± 8.5. Mean defect area was 420 (100–720) cm^2, average defect width was 19 ± 6.2 cm, and mesh area was 900 (500–1050) cm^2; 78% were clean procedures, and in 60% a panniculectomy was associated. Operative time was 252 (162–438) minutes, and hospital stay was 4.5 (2–16) days. Thirty-day morbidity was 24% (12 patients), and 16% (8 patients) had surgical site infections. Overall recurrence rate was 4% (2 patients) after 28.2 ± 20.1 months of follow-up. QoL showed a significant improvement after surgery ($p = 0.001$).

Conclusions The TAR technique is an effective treatment modality for large incisional hernias, showing an acceptable postoperative morbidity, a significant improvement in QoL, and low recurrence rates at long-term follow-up.

Keywords TAR · Transversus abdominis release · Incisional hernia · Quality of life

After a laparotomy, almost 25% of the patients may develop an incisional hernia. [1]. Treatment of these patients is challenging and complex abdominal wall reconstructions are usually required, especially in those patients with a history of multiple operations and large hernias with loss of domain [2–5].

The concept of relaxing incisions with muscle mobilization in order to allow the closure of large defects, while avoiding abdominal compartment syndrome was first described in 1966 by Albanese [6]. Ramirez [7] in the early 1990s described the anterior component separation technique, which consisted of the section of the external oblique muscle with adequate tissue mobilization. However, as large skin flaps were required, this procedure was associated with high morbidity [8, 9]. In 2012, Novitsky et al. [10] described the posterior component separation with transversus abdominis muscle release (TAR) technique. In this operation, a large retromuscular space for mesh placement along with an extended myofascial flaps mobilization allows closing the middle line without tension [11, 12]. Advantages such as sublay mesh positioning and lack of skin flaps resulted in lower morbidity and adequate durability of the repair [13, 14]. However, complex abdominal wall reconstructions are not exempted from complications with negative impact on patient's QoL such as deep surgical site

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infection, mesh fractures, and injuries to the linea semilunaris [15].

We aimed to evaluate postoperative outcomes and long-term follow-up after TAR for incisional hernia repair.

Materials and methods

After approval by the Institutional Review Board of our Institution, medical records of a prospectively maintained database were revised. All consecutive patients who underwent abdominal wall repairs with TAR technique between 2014 and 2019 and with a minimum follow-up of 6 months were included.

Preoperative evaluation includes physical exam, laboratory, chest X-ray, computerized spirometry, and cardiologic and anesthesiologic evaluation. A computed tomography (CT) scan with Tanaka´s index calculation (hernia sac volume/abdominal cavity volume ratio) was performed in all patients [16]. Preoperative optimization [17] was as follows: all patients with a body mass index (BMI) $\geq$ 30 kg/m^2 were evaluated by the Nutrition department and encouraged to achieve a BMI under 30 kg/m^2 or lose 15% of the excess weight before the operation. Additionally, all patients received a liquid diet a week before the procedure. Patients with active smoking were encouraged to stop the habit for at least 4 weeks before the procedure. Patients with diabetes were evaluated by the endocrinology department and requested to achieve an adequate glycemic control (HbA1C < 7%). Despite decision making was in the intraoperative, the selection criteria for the TAR technique were patients with midline defect $\geq$ 10 cm in width or patients with smaller defects in whom the midline could not be closed with a standard Rives–Stoppa's technique.

Surgical technique

All the procedures were performed by the same surgeon (EES). The implemented surgical technique was the one described by Novitsky and Rosen, in 2012 [10]. Briefly, a midline laparotomy was performed with adhesiolysis, followed by posterior rectus sheath incision to access the retromuscular space. Here, dissection ended when the branches of the thoracoabdominal nerves were visualized. Then, the posterior rectus sheath was cut to expose the underlying transversus abdominis muscle which was incised to reach the complete disinsertion, allowing the entrance to preperitoneal space. After the release was completely performed, the posterior rectus sheath was closed with an absorbable running suture. If that was not possible, a synthetic absorbable mesh (polyglactin) was used to bridge the gap. Next, a flat piece of mesh was placed in a sublay fashion in the retromuscular space, achieving a complete reinforcement including a lateral overlap beyond TAR. When mesh fixation was decided, transfascial stitches with buried knots and suturing to Cooper ligaments were performed. Once the prosthesis was in place, the space was irrigated with an antibiotic solution for 5 min (Vancomycin 2 g and Gentamicin 80 mg, in 500 mL of warm saline water). Then, the anterior rectus sheath was closed in the midline with a running non-absorbable monofilament suture. No drains were placed routinely. In patients with redundant skin and fat tissue, a panniculectomy was performed. Mesh selection criteria were based on (1) the patient's BMI, (2) type of surgery, and (3) health care provider. There was a trend to use mid-weight macroporous polypropylene prosthesis in patients with BMI < 30 and contaminated procedures. A bio-synthetic mesh was used in dirty procedures or patients colonized with multiple-resistant bacteria (one case).

Early mobilization was encouraged postoperatively, and discharge was performed after adequate oral intake and pain control with oral analgesics. Follow-up was planned at day postoperative day 10, 30, 6 months, and 1 year and then annually.

Variables and outcomes

Collected data included age, gender, BMI, American Society of Anesthesiologists (ASA) classification, and CT-scan diagnosis with Tanaka index calculation. Operative variables such as defect size, mesh size, type of mesh, surgery classification, associated panniculectomy, and operative time were also registered. Length of hospital stay (LOS), 30-day morbidity, postoperative CT-scan, and recurrence rates were also considered for analysis. Potential risk factors for SSIs such as concomitant panniculectomy, obesity, contaminated surgery, SSO-risk (Ventral Hernia Working Group grading system) [18], and previous recurrences were also analyzed.

In addition, all but two patients (deaths not related to hernia surgery) were contacted by phone and responded the ventral hernia repair-telephone survey (VHR-TS). This is a previously validated tool to assess recurrence in TAR repairs which consists of four questions [13], and a positive response of any of the questions is considered a recurrence until proven otherwise. Quality of life (QoL) assessment was also evaluated through the HerQLes questionnaire [19]. This is also a validated 12-question survey focused on abdominal wall functionality, and it was implemented preoperatively at 6 months after the surgery. Calculations were performed following the updated HerQLes score [20], so that a 0 value is the worst possible response, and a value of 100 indicates the best possible response. Higher summary scores represent a better QoL.

The results were expressed in median. The work has been reported in line with the STROCSS criteria [21].

Statistical analysis

Statistical analysis was performed with IBMSPSS v.24 (IBM, Armonk, New York, USA). The Student's *t*-test was used to compare continuous variables, whereas the χ^2 and Fisher test were used for categorical variables. For QoL evaluation, the paired sample *t*-test was used. A $p < 0.05$ was considered statistically significant.

Results

During the study period, a total of 50 patients underwent posterior component separation technique with transversus abdominis muscle release (PCS-TAR). Thirty patients were men (60%), and the mean age was 65 (35–83) years. BMI was 28.5 ± 3.4 kg/m^2. Twelve (24%) patients had a recurrence of a previous incisional hernia repair. Preoperative CT-scan revealed a Tanaka's index of 14.2 ± 8.5. The ASA classification was II in 30 patients (60%). Preoperative optimization results are reflected in Table 1.

The mean defect area was 420 (r = 100–720) cm^2; the average defect width was 19.6 ± 6.2, and mesh area was 900 (r = 500–1050) cm^2. Most of the procedures were clean (78%), and 11 (22%) were performed in combination with a contaminated procedure, mainly colorectal operations. The used prosthesis and their location are summarized in Table 2. Sublay mesh reinforcement was used in 46 patients (92%), and a heavy-weight polypropylene mesh was the most common prosthesis utilized (84%). In 4 patients, a synthetic absorbable mesh (polyglactin) was used to bridge the posterior sheath gap. In 30 (60%) patients, a panniculectomy was done due to the redundant skin and fat tissue after abdominal wall closure. The average operative time was 252 (162–438) min. The average length of hospital stay was 4.5 days (2–16 days). Intraoperative variables are summarized in Table 2.

Table 1 Demographic and perioperative variables

Demographics and preoperative variables	$n = 50$
Age (years)	65 (35–83)
Gender	
Male	30 (60%)
Female	20 (40%)
BMI (kg/m^2)	28.5 ± 3.4
Preoperative BMI < 30 kg/m^2 (%)	38 (76)
Preoperative BMI > 30 kg/m^2 (%)	12 (24)
Weight loss average (kg)	6.3 ± 2.2
Optimized, BMI < 30 kg/m^2	4 (33)
Optimized, reduction > 15% of weight excess	9 (75)
Diabetes (%)	8 (16)
Glycemic control (HbA1C < 7%)	7 (87)
Active smoking (%)	6 (12)
Stop smoking (%)	4 (67)
ASA (%)	
I	–
II	30 (60)
III	20 (40)
IV	–
Tanaka's index	14.2 ± 8.5

Table 2 Intraoperative variables

Intraoperative variables	$n = 50$
Off-midline defect (%)	7 (14%)
Defect size (cm^2)	420 (100–720)
Width's defect size	19.2 ± 6.2
Mesh size (cm^2)	900 (500–1050)
Wound classification	
Clean	39 (78%)
Contaminated	11 (22%)
Mesh	
Polypropylene (%)	42 (84%)
Physiomesh (%)	3 (6%)
Gore-BioA (%)	3 (6%)
Proceed (%)	1 (2%)
Polyester (%)	1 (2%)
Associated panniculectomy	30 (60%)
Operative time (min)	252 (162–438)

Thirty-day morbidity was 24% (12 patients); 8 surgical site infections (SSIs) (2 deep, 6 superficial) that were successfully treated with wound opening and antibiotic therapy, and 3 surgical site occurrences (SSO), all of them seromas. One (2%) patient underwent an enterectomy and mesh removal due to small bowel obstruction with gangrene on postoperative day 5. The abdominal wall was closed with sutures and an intraperitoneal absorbable mesh (polyglactin), and a recurrence was detected 9 months after surgery. Concomitant panniculectomy, obesity, contaminated field, and previous recurrence did not show a significant increment in SSIs ($p = 1$; $p = 0.7$; $p = 0.68$; $p = 1$, respectively).

Postoperative CT-scan was obtained in 35 (70%) patients (average of 14 months after surgery). All but two patients answered the VHR-TS survey, and there were no positive responses. Overall clinical and imaging recurrence rate was 4% (2 patients), after 28.2 ± 20.1 months of follow-up. Timing to recurrence was at 9 months in the abovementioned patient who developed a midline hernia, and the second patient developed a parastomal recurrence after re-do Bricker's procedure (separate ureteroenteric anastomosis after radical cystectomy) at 11 months postoperative of the incisional hernia repair, both of them had a grade 3 incisional hernia (VHWG classification). Thirty-eight patients

(76%) completed the HerQLes quality of life questionnaire pre- and postoperatively. The cohort mean preoperative survey score was 50.9 ± 22.9, which showed a statistically significant improvement at 6 months' postoperative evaluation, with an increment to 91.8 ± 18, ($p < 0.001$) (Fig. 1). Postoperative variables are summarized in Table 3.

Table 3 Postoperative variables

Postoperative variables	$n = 50$
Hospital stay (days)	4.5 (2–16)
Overall 30-day morbidity	12 (24%)
Surgical site infections	8 (16%)
Seromas	3 (6%)
Mesh removal	1 (2%)
Postoperative CT-scan	35 (70%)
Recurrence	2 (4%)
Follow-up (months)	28.2 (7–79)

Discussion

In this study, we performed a retrospective evaluation of postoperative outcomes after TAR repairs for complex incisional hernias and we found: (1) an acceptable overall morbidity, (2) a low recurrence rate, and (3) a significant improvement of QoL in most patients.

Since its introduction in 2012 by Novitsky et al. [10], TAR technique has gained popularity as an effective technique for the treatment of complex ventral hernias. This technique has several advantages such as placing a large mesh in the sublay space and no need for extensive skin flaps, which resulted in low postoperative morbidity and recurrence rates [22–24]. On the other hand, performing this procedure in suboptimal conditions could develop adverse consequences. Thus, improvements in the surgical technique, correct selection of cases [15], and preoperative optimization of patients are essential to minimize postoperative complications [17]. A recent study [25] evaluated the influence of comorbidities (obesity, diabetes, and smoking) in postoperative results after incisional ventral hernia repair, and found that an increasing number of comorbidities resulted in a significant increment of 30-day wound morbidity rate. This study indeed highlights the need for an adequate preoperative patient's optimization. In our cohort, most patients achieved the goals of smoking cessation and glycemic control. Regarding obesity, 9 patients (75%) from 12 lost weight and reached our goals, but only 4 (33%) patients achieved a BMI < 30. In a previous report conducted by Rosen et al. [26], an average of 17 months was required to optimize obese patients, pointing out that this is a very challenging issue that requires a multidisciplinary approach for outcomes improvement. In our cohort, despite having high patient adherence to optimizing goals, we could not show any significant impact probably due to the relatively healthy population and small sample size. Overall, although patient' optimization is challenging, it should be one of the pillars in abdominal wall reconstruction. Obesity is probably the risk factor which has the greater influence on postoperative events, and thereby preoperative weight loss should be strongly encouraged.

In the largest published series with 428 TAR procedures, the authors found an overall wound event in 80 patients (18.7%) [13]. Similar results were observed in our series, with a 30-day morbidity rate of 24% (12 patients); all successfully treated with wound opening and antibiotics, and only 1 (2%) patient requiring reoperation with mesh removal. Interestingly, patients who had a contaminated surgery or underwent concomitant panniculectomies

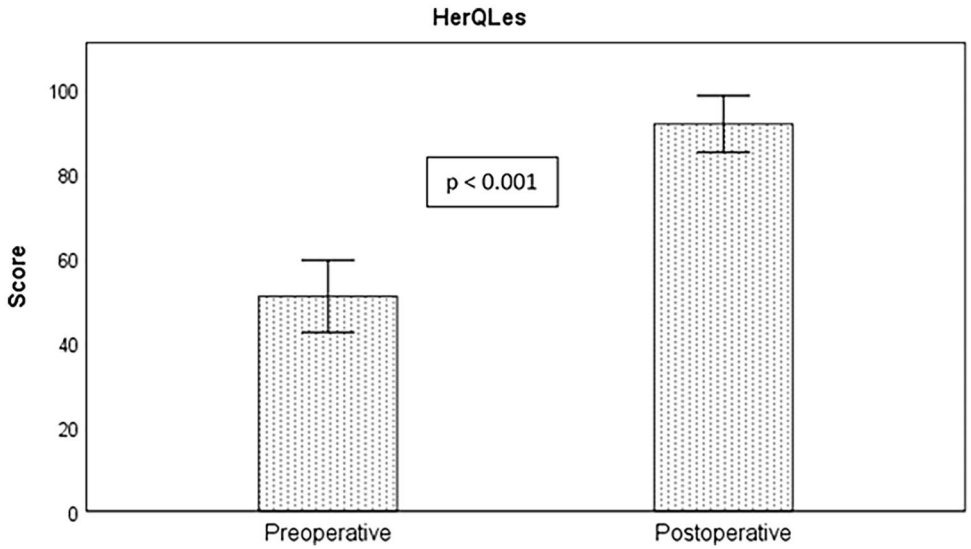

Fig. 1 QoL assessment, preoperative, and postoperative results. Bars show median scores obtained before and after TAR repairs (with its respective standard deviations), with higher results as better outcomes. QoL improved significantly 6 months after surgery, $p < 0.001$

did not show an increment in morbidity rates, suggesting that TAR could be safely performed in these challenging scenarios in well selected patients.

Obtaining an adequate durability of the repair is one of the main goals in hernia surgery, and it has been observed that most recurrences after TAR develop within the first postoperative year [13]. In addition, a high variability in recurrence was reported ranging from 4 to 21% [13, 27]. At a median follow-up of 28.2 ± 20.1 months, we observed two recurrences (4%). This low recurrence rate could be associated with the use of permanent meshes utilized in all but 3 of our patients [13, 27]. Similar results have been reported [13, 28, 29] advocating that TAR technique offers an adequate durability of the repair. Although follow-up with CT-scans might detect occult recurrences, this practice is not well standardized and might not be appropriate in asymptomatic patients. In a recent prospective study conducted by the French Society of Surgery [30], the authors found similar recurrence rates of 17.7% and 18.1% with CT-scan and CT-scan plus physical exam, respectively, at 1 year follow-up after ventral hernia repairs. We obtained postoperative CT-scans in 70% of the patients (35/50) with a median of 14 months after TAR, and none recurrence was detected. Based on these results, a solely clinical follow-up after ventral hernia repairs seems rationale, reserving CT-scan for those cases with inconclusive physical examination.

Another important issue when performing any component separation technique is the potential deleterious effect on core abdominal wall and spine stability. However, this topic has been investigated in TAR repairs showing muscle hypertrophy after linea alba restoration [31]. In addition, an improvement in functional evaluations with dynamometry was observed at 6 month postoperative of TAR repairs which correlates with an improvement in patients' QoL [32]. In order to evaluate postoperative outcomes from the patients' standpoint, we used the HerQLes survey preoperatively at 6 months after the TAR repair. Seventy-six percent of patients (38/50) completed the questionnaires, and a statistically significant improvement in patient's QoL after TAR repairs was observed. Similarly, Krpata and colleagues reported a significant improvement in QoL after ventral hernia repair in 88 patients evaluated with the HerQLes survey before the surgery and 2 weeks, 4 weeks, and 6 months after the procedure (<0.01) [19]. In the same way, Haskins at et. using the HerQLes survey, showed an improvement in most of the patient's QoL, who underwent TAR technique for incisional hernias, 6 months after the surgery [33]**.** The importance of patients' related outcomes was highlighted in a recent study in which the authors showed an improvement in QoL despite of having undesired postoperative clinical outcomes [34]. Therefore, these data could be relevant for preoperative surgical planning and patients' counseling.

The main limitation of this study is its retrospective nature. In addition, the small sample size of a single-center cohort also limits the results. Despite these limitations, we were able to evaluate morbidity, recurrence and QoL after TAR procedure and showed the whole performance of the technique when repairing complex abdominal wall defects.

Conclusion

Component separation technique with TAR represents an effective treatment modality for complex incisional hernias. This procedure showed low morbidity, a significant improvement in QoL, and low recurrence rates at long-term follow-up.

Author contributions EES writing-original draft preparation, visualization, supervision, project administration. MEP data curation, visualization, investigation, formal analysis. CBH investigation, resources. MAC investigation, resources. FS writing-original draft preparation, visualization, supervision. FL conceptualization, methodology, writing- original draft preparation.

Declarations

Disclosures Emmanuel Ezequiel Sadava, Maria Elena Peña, Camila Bras Harriott, Maria Agustina Casas, Francisco Schlottmann and Francisco Laxague have no conflicts of interest or financial ties to disclose.

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