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Feasibility of Posterior Component Separation with Transversus Abdominis Release in Complex Ventral Hernias : Outcomes and Experience at a Single Centre

Harnam Singh Rekhi, Arshdeep Singh Rekhi, Malkiat Singh, Sudesh Partap Singh, Inderpreet Singh, Rajat Gupta, Mohit Parikh, Gurjot Singh

Department of General Surgery, Govt. Medical College, Patiala.

Corresponding Author : Dr. Gurjot Singh
Email : gurjot.ak@gmail.com
M.: 9402424539

Abstract

Introduction : Complex ventral hernias are a challenging entity which require some form of myofascial separation to achieve a tension free repair and adequate mesh placement. Posterior component separation with transversus abdominis release (TAR) has come up as an exciting tool in achieving the same albeit preserving the neurovascular arcade and recording lesser wound morbidity. In this study, we present our experience with this technique whilst operating on patients with complex ventral hernias.

Methodology : 20 patients requiring TAR (based upon the pre-operative imaging fulfilling the required criteria of defect width or size or the intra-operative need) were included in the study extending from January 2021 to April 2023. All the patients were operated at a single centre by the same surgical team.

Results : Majority of the patients were females (12; 60%) with a mean age of 56.4 years, a mean BMI of 28.8kg/m2 and a median ASA score of 2. Three of these patients had loss of domain. Fifteen (75%) patients had a history of previous surgery (incisional hernia). The mean defect width and total defect area were 10.8 + 2.16 cm and 193 + 20.45 (110-450) cm2, respectively. The mean surgical time was 207 minutes with an average of 7.8cm of medialisation of linea alba achieved. The mean visual analog scale (VAS) pain score on the first postoperative day was 4.2 and the median hospital length of stay (LOS) was 5 days. There were only four (20%) cases of minor wound related complications which were managed conservatively with no major complication/ re-surgery recorded. During the follow-up period (mean of 21.6 months), only one (5%) recurrence was recorded.

Conclusion : TAR offers an excellent option in managing complex and large ventral hernias with fairly less complications and wound morbidity adding to the armamentarium of the hernia surgeon.

Keywords : TAR, ventral hernia, component separation

Introduction :

Hernia is classically defined as abnormal protrusion of an organ through the wall that contains it. Ventral hernias comprise a group of hernias occurring in the anterior abdominal wall. Hernia surgery has fascinated surgeons worldwide and the proof could be seen in the numerous surgical techniques in vogue for management of these hernias. However, at the crux of these techniques lies the basic underlying goal of a tension free mesh hernioplasty. Complex ventral hernias are a challenging entity ascribed, though not exclusively, to hernias with a defect width > 10 cm, with loss of domain (LOD) > 20% or hernias present over a bony prominence, with underlying history of burst abdomen or having multiple hernial defects amongst others. The complexity of a hernia directly influences the outcome, complications as well as the risk of recurrence. Management of these complex ventral hernias have undergone a paradigm of shift with the

advent of myofascial component separation techniques for medialisation of the linea alba as well as creating a large anatomical space for mesh reinforcement. The first attempt at component separation is credited to Ramirez (1990) who described the Anterior Component Separation (ACS) by raising wide skin flaps bilaterally and then incising the external oblique aponeurosis (releasing incisions) at lateral ends to achieve medialisation of defect edges for closure.[1] Despite fairly good midline myofascial advancement, higher rate of local wound complications (infections, seroma, etc) as well as recurrence was seen.[1-3] Notwithstanding further modifications such as the endoscopic ACS and perforator sparing techniques, the rates of wound morbidity remained high.[4,5] The focus then shifted to utilising the retrorectus space, which was fully illustrated by Rives-Stoppa in their 'retrorectus repair'. The latter uses a 6-8 cm space between the bilateral recti and their posterior sheath to place a sublay mesh and gained widespread acceptance. [6,7]. However, the area for mesh coverage is restricted bilaterally by the linea semilunaris. Further, a large defect precludes medialisation of linea alba and midline defect closure. In view of the same, transversus abdominis release (TAR), a modification of the Rives-Stoppa procedure, was described by Novitsky et al. in 2012.[8] In the TAR technique, the fibers of the transversus abdominis muscle, which emerges behind the internal oblique aponeurosis are divided to enter a vast potential pre-peritoneal space and merge the same with the retrorectus space to secure a wide mesh. This technique, labelled as the Posterior Component Separation (PCS) with TAR has subsequently been found to have lower recurrence rates and fewer severe wound infections compared to other previously described techniques and has thus gained popularity in the surgical parleys especially in the management of complex hernias.[9]As of date, The 2023 European Hernia Society guidelines suggests a PCS with TAR in the following conditions:[10]

(a) if the fascial defect width > 8 cm
(b) or the area of the defect > 164 cm2
(c) or the Rectus-defect width ratio (RDR) < 1.34
(d) or the Component separation index (CSI) is > 0.146.

This article presents our experience with the use of PCS with TAR and its outcomes for management of complex ventral hernias at a single surgical centre.

Material and Methods

This study is a retrospective analysis of a prospective data set in the patients undergoing PCS with TAR technique for complex ventral hernia performed by a single surgical team at a tertiary care centre between January 2021 to March 2023.

The inclusion criteria were

(a) patients with defect or multiple cumulative defects ≥ 8 cm in width
(b) hernias with loss of domain (LOD)
(c) ventral hernias with CT imaging showing either an area > 164 cm2 or RDR < 1.34 or CSI > 0.146.
(d) those ventral hernias in whom the linea alba could not be medialised with a standard retrorectus technique.

The exclusion criteria were patients not requiring TAR for hernial repair or the ones not consenting to be a part of the study.

The study was commenced after obtaining the institutional ethical clearance and a thorough informed and written consent was taken from all the patients who were selected for the study. Routine laboratory tests and physical examinations were performed preoperatively on all patients. Preoperative computed tomography (CT) scan was used to measure the defect size, abdominal wall anatomy and hernia content of all patients. Tanaka's index was calculated in suspected LOD patients. RDR and CSI were duly calculated on the CT. RDR was calculated as the ratio of the sum of width of both the recti to the defect width while the CSI was calculated as the value of angle formed between the aorta and the two edges of the defect divided by 360. The hernia was assigned the EHS ventral hernia category. Demographic data was collected alongside the patient's BMI, comorbidities, and American Society of Anaesthesiology (ASA) score. Inoperative outcomes such as operative time, the type of TAR (one-sided or bilateral), the extent of myofascial medialisation achieved and additional procedures performed (if any) such as panniculectomy, partial omentectomy or inadvertent tissue injury (eg. Enterotomy) were duly

recorded. Post-operative outcomes were measured in form of post-operative pain on day one (using VAS scale), length of hospital stay (LOS) (in days) and incidence of post-operative minor (Clavien-Dindo grade 1 or 2) and major (grade 3-5) complications. Follow-up evaluation of all patients was done at one month, 6 months and a year (yearly thereafter) to rule out long term complications such as chronic pain, mesh infection, chronic seroma formation or hernia recurrence rates. The SPSS 22 software was used for statistical analysis of all data. Categorical variables are presented as n (%), and continuous variables are presented as mean ±SD.

Surgical Technique

The preoperative prophylaxis with Injection Ceftriaxone 1g is administered 30 minutes prior to the surgery. The patient position is supine with arms abducted. A nasogastric tube and a urinary catheter are placed after induction of general anaesthesia. Skin is prepared for asepsis and a midline laparotomy is fashioned (from virgin area in cases of incisional hernias). The hernia sac is preserved to the extent feasible as it may be needed to augment bridging the linea alba. Meticulous adhesiolysis is done and the underlying viscera prevented from any inadvertent injury. Then, the retrorectus plane is developed by incising the posterior rectus sheath, about 0.5-1cm from its medial border on one side. Retromuscular dissection is performed until the neurovascular bundles are seen at the linea semilunaris. At this point, the posterior lamina of the internal oblique aponeurosis is divided 0.5–1cm. medial to the linea semilunaris to expose the fibers of the transversus abdominis muscle (TAM). The TAM fibers are then divided cephalad to caudal and the cut distal fibres are swept up to develop a vast pre-peritoneal/ pre-fascia transversalis space. The whole procedure is repeated on the other side following which a large space (Rives-Stoppas and the pre-peritoneal space merged) extending from the xiphisternum to the space of Reitzus below and the posterior axillary lines laterally is created wherein a large prosthetic mesh can be placed. In cases of LOD hernias, a partial omentectomy may be performed to facilitate closure without risk of abdominal hypertension. The posterior layer is closed using a running slowly-absorbing sutures. Thereafter, a large mesh is placed in the space created above and secured at two or three points. Suction drain is kept over the mesh. The midline is then closed with a nonabsorbable continuous sutures. A panniculectomy may be performed if required.

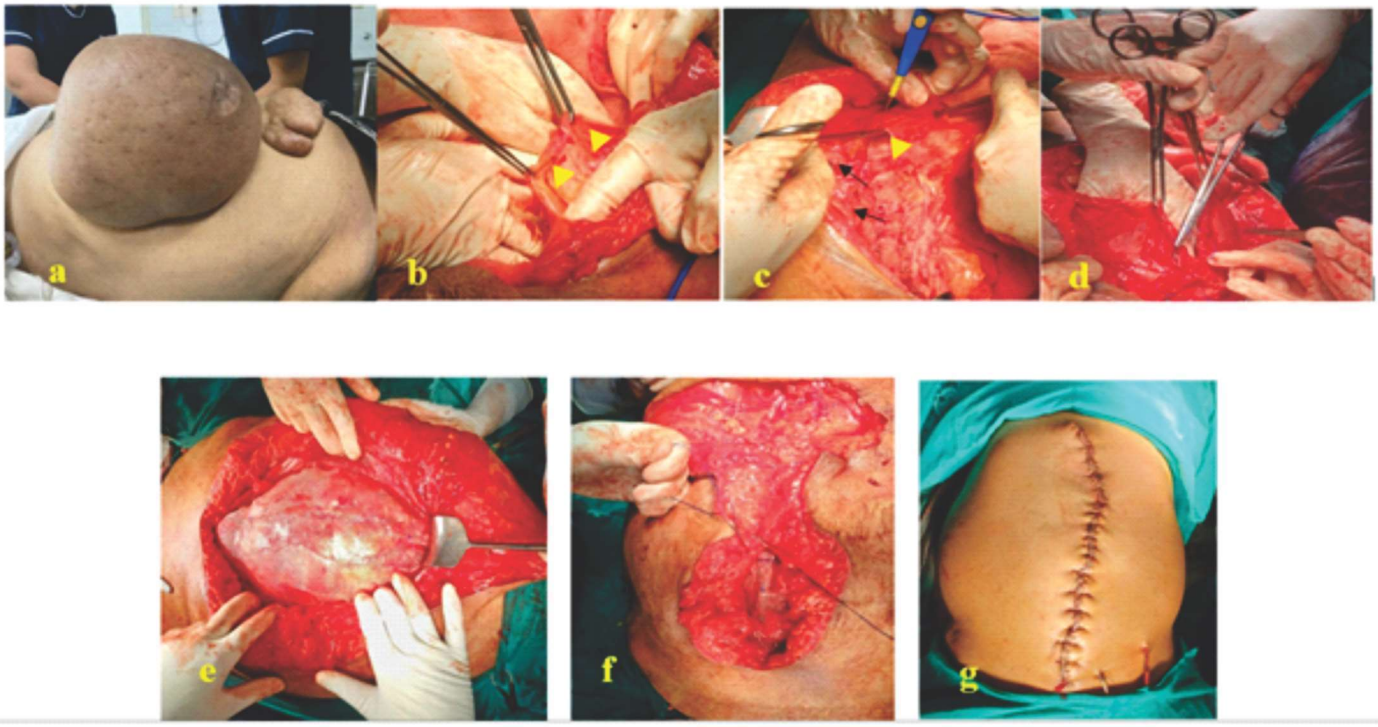


Figure -1 : Surgical steps TAR (a) One of the cases with pre-operative presentation (b) Entering the retro-rectus space by incising the posterior rectus sheath (yellow arrowheads) (c) Release of the Transversus Abdominis muscle (yellow arrowhead) about 0.5-1cm medial to the neurovascular bundle in retrorectus space at linea semilunaris (black arrows) (d) Myofascial medialisation with posterior midline closure facilitated by TAR (e) Placement of a large mesh in the retrorectus-retroperitoneal space created (f) Anterior fascial closure over the mesh (g) final outcome with panniculectomy

Postoperative Care : DVT prophylaxis was followed for the hospital stay. Early mobilization and initiation of enteral feeds was promoted. Suction drains were removed when the output became clear and dropped to less than 50 mL per day. The patients were discharged once on full oral feeds and with reasonable pain control.

Results

Twenty patients underwent PCS with the TAR technique between January 2021 and April 2023. The minimum follow-up was for 12 months (mean of 21.6 months). Majority of the patients were females (n=12; 60%). The patients had a mean age of 56.4 + 7.34 years, a mean BMI of 28.8 + 3.01 kg/m2, and a median ASA score of 2.0. Fifteen (75%) patients presented with post laparotomy incisional hernia with a history of burst abdomen. The patient demographic profile is summarized in Table 1.

Parameter		**Value**
Mean age (years)		56.4 $\pm$ 7.34
Male : Female		8 : 12 (40:60%)
Mean BMI (kg/m^2)		28.8 $\pm$ 3.01
Median ASA score		2
Incisional hernia cases (post laparotomy)		15 (75%)
Comorbidity	Hypertension	12 (60%)
	Diabetes	10 (50%)
	COPD	6 (30%)
	Others	3 (15%)

Table -1 : Patient demographic profile

The extent and the type of hernia was characterised using preoperative CT scan and the EHS category given accordingly. Three patients had LOD which was established using the Tanaka's index (> 0.25). Additionally, CT was used to calculate width of the defect and the defect area which had mean values of 10.8 + 2.16 cm and 193 + 20.45 cm2 (range 110-450 cm2). Lastly, the CT was used to calculate RDR and CSI which had mean values of 1.04 + 0.14 and 0.192+ 0.19 respectively. Thereafter, the patients underwent TAR surgery with 18 (90%) undergoing bilateral TAR whilst the remaining two underwent unilateral TAR with Rives-Stoppa procedure. Important peri-operative outcomes are elicited in Table – 2. Posterior midline myofascial closure was achieved in all the cases and no intra-operative adverse outcomes (visceral/ bowel injury) were observed though three patients had bowel seromuscular tears during adhesiolysis which were appropriately repaired.

CT Findings	
Most common hernia (EHS)	M3 (n =13; 65%)
Mean defect width (cm)	10.8 $\pm$ 2.16 cm
Mean Defect size (cm^2)	193 $\pm$ 20.45 cm^2
Mean RDR	1.04 $\pm$ 0.14
Mean CSI	0.192 $\pm$ 0.19
Patients with LOD	3 (15%)
Intra-operative findings	
Bilateral vs unilateral TAR	18 vs 2
Mean operative time (mins)	207 $\pm$ 23.42 mins
Mean medialisation of myofascia achieved (cm)	7.8 $\pm$ 1.06 cm
Partial omentectomy	4 (20%)
Most common mesh size used	30 x 30 cm
Vertical panniculectomy	6 (30%)

Table – 2 : Peri-operative parameters (Pre surgery CT findings and intra operative record)

Post operative outcomes

The mean VAS pain score on the first postoperative day was 4.2 and the median hospital LOS was 5 days. Four patients (20%) developed

minor post-operative complications (Clavien Dindo Grade 1 or 2) with two having clinical seroma and one each having a hematoma and superficial SSI which responded well to antibiotics. None of the patients had deep SSI or major post operative complication (Clavien Dindo grade 3-5). No mortality was recorded. Majority (n = 15; 75%) were followed up for two years. On long term follow up, two patients (10%) complained of chronic pain whilst one patient had hernia recurrence (5%) at two years due to central mesh failure. Salient post-operative outcomes are illustrated in Table- 3

Early outcomes		
Mean VAS (at day 1)		4.2
Mean Hospital LOS (days)		5.4 days
Minor complications	Seroma	2 (10%)
	Hematoma	1 (5%)
	Superficial SSI	1 (5%)
Major complications/ Mortality		-
Long term outcomes		
Chronic pain		2 (10%)
Recurrence		1 (5%)
Chronic seroma/Others		-

Table – 3 : Post operative outcomes

Discussion

The TAR technique incorporates a posterior myofascial release with the classical Rives-Stoppa retrorectus dissection thus providing enhanced medialisation of the linea alba, decreased tension on the closure as well as creating a large retromuscular and preperitoneal space with preservation of the neurovascular arcade allowing for placement of large mesh.[8,9,11] The PCS with TAR offers a promising surgical solution for complex ventral hernias with lesser wound morbidity, lower recurrence rates and thus improved patient outcomes in comparison to other techniques in vogue.[9] Krapta DM et al. (2012) compared ACS and PCS with TAR and reported a lower recurrence rate (14% versus 4%) and a lower wound complication rate (48.2% versus 25.5%) for TAR although recent studies with improvised ACS techniques such as perforator sparing ones have shown lower wound adverse outcomes.[2,4,5] Recent studies by Bilezikian JA (2021) and Gala J et al. (2023) comparing ACS and TAR have showed similar one-year recurrence rates and quality of life though the surgical site occurrences, especially the worse wound complications were observed in ACS.[11,12] Laparoscopic and robotic approaches have come up in TAR with robotic TAR (R-TAR) and hybrid robotic TAR (hrTAR) techniques having lesser hospital stay and systemic and local complications albeit with significantly longer operative hours.[13,14]

Operative times for the open TAR technique range from 188 minutes to 383 minutes in literature.[9,15-17] The mean operative time in the present study was 207 minutes, comparable to the abovementioned studies. TAR offers an excellent medialisation of the myofascia thus allowing for tension-free linea alba closure. A fascial closure was achieved in all the patients with an average medialisation of 7.8 + 1.06 cm. Most studies have reported fascial closure rates of 97-100%.[9,18] In case a midline closure is not possible, bridging of the fascial edges may be achieved by using the hernial sac (if available) or a heavyweight mesh. Partial omentectomy was performed in four patients, three of whom were preoperatively detected with LOD on CT imaging. Other commonly used techniques in LOD patients are the use of pre-operative Botulinum Toxin A injections and preoperative progressive pneumoperitoneum. In the literature, a routine panniculectomy in TAR procedures has been shown to increase the risk of wound morbidity though Sadava et al. performed panniculectomy on 60% of their patients and declared similar SSI rates.[19] Six patients (30%) needed vertical panniculectomy in our study. In contrast to the study mentioned above, all SSIs were seen in panniculectomy patients. The median hospital LOS was 5 (mean 5.2, 2-10) days which is comparable to those in other studies (4.0 to 9.0 days).[8,9,1912,14,16]

SSIs rate in TAR have been reported between 27 and 41% patients with deep mesh infection rate of 5% to 10%.[18] Despite the high SSI rate, most of these infections are benign requiring no more than extended antibiotic cover.[18,20] In the present study too, there were four cases (20%) of mild surgical site

adversity in form of seroma (two), hematoma or SSI (one each) which were successfully managed conservatively. We had no cases of deep lying wound or mesh infection. Recurrence is a robust marker for any hernia surgery and is the biggest challenge in complex hernia surgery irrespective of the technique. A meta-analysis reported recurrence rates of 5.7% (3%-8.5%) for the TAR procedure.[18] The recurrence rate of the present study was 5% (one case with central mesh failure), comparable to the aforementioned study. Furthermore, two patients had chronic pain which was managed conservatively.

Limitations

The biggest limitation is the small sample size at a single centre with a relatively limited follow up period to truly gauge the procedure's success rate at preventing recurrence and improving the patient's quality of life in the long run.

Conclusion

The TAR procedure offers excellent advantages of creating a tension free myofascial closure as well as providing an adequate space for mesh reinforcement and bilaminar tissue ingrowth with additional benefits of lesser wound complications and recurrence rates when compared to other techniques in managing complex ventral hernias.

Conflict of interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

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