Access this article online

Quick Response Code:

Website:
www.herniasurgeryjournal.org

DOI:
10.4103/ijawhs.ijawhs_15_24

Novel laparoscopic "lateral three-port technique" of extended totally extra peritoneal approach for ventral hernias: Short-term results and technical aspects of 100 consecutive cases from a single center

K. Ganesh Shenoy, Marina Thomas, Ramesh B S, Amol Siddalingappa Jeur, Nawab Jan

Abstract

OBJECTIVES: The purpose of this study was to develop a simplified technical modification with an attempt to standardize the extended totally view extraperitoneal–Rives Stoppa (ETEP-RS) procedure. In this article, we present the technical aspects to perform this procedure by using novel lateral three ports and the short-term results of our experience in this subset of patients.

MATERIALS AND METHODS: A retrospective analysis of 100 consecutive patients who underwent laparoscopic ETEP-RS using the lateral three-port technique between January 2022 and July 2023 was done. In this technique, three lateral ports were placed for both midline and lateral ventral hernias (VH), with no need to shift camera, working ports, and monitor positions throughout the procedure. It can be coupled with repair of associated right inguinal hernia, divarication of recti (DR), and transversus abdominis release (TAR).

RESULTS: Of 100 consecutive patients who underwent ETEP approach for VH by using our lateral three-port technique, 84 patients underwent ETEP-RS and 16 patients underwent ETEP-TAR. Out of these 100 patients, 4 patients underwent ETEP for associated right inguinal hernia. The mean operating time was 119.9 min with a range from 45 min to 185 min. The mean defect width was 7.24 cm. We used 20 cm × 15 cm medium weight polypropylene mesh for most of our patients. There were no recurrences in the follow-up period. One patient required laparoscopic re-exploration for posterior rectus sheath rupture.

CONCLUSION: The laparoscopic novel lateral three-port ETEP-RS technique is safe, feasible, cost-effective, and reproducible. This can be combined with right-sided TAR, right inguinal hernias, and repair of DR. It can be standardized; however, larger studies and longer follow-up are needed to have an evidence-based answer.

Keywords:

ETEP-RS for ventral and inguinal hernias, ETEP-RS, ETEP-TAR, lateral port ETEP-RS, TAR, three-port ETEP-RS

Key Messages

ETEP-RS by using our novel lateral three-port technique is safe and reproducible and can decrease the learning curve for beginners as the port placements are standard irrespective of the size, site, and type of hernia.

Department of Minimal Access, Gastrointestinal and Bariatric Surgery, Fortis Hospital, Cunningham Road, Bengaluru, India

Address for correspondence: Dr. K. Ganesh Shenoy, Department of Minimal Access, GI and Bariatric Surgery, Fortis Hospital, #14, Cunningham Road, Vasanth Nagar, Bengaluru 560052, Karnataka, India.
E-mail: drshenoyganesh@gmail.com

Submitted : 10-Mar-2024
Revised : 10-May-2024
Accepted : 22-Apr-2024
Published : 30-Aug-2024

How to cite this article: Shenoy KG, Thomas M, B S R, Jeur A S, Jan N. Novel laparoscopic "lateral 3 port technique" of extended totally extra peritoneal approach for ventral hernias: Short-term results and technical aspects of 100 consecutive cases from a single center. Int J Abdom Wall Hernia Surg 0;0:0.

Introduction

Daes pioneered the technique of extended totally view extraperitoneal (ETEP) repair for inguinal hernias (IH),[1] which was later extended to ventral hernias (VH) by Belyansky *et al.*[2] Ever since there was acceptance of extended totally extra peritoneal–Rives Stoppa (ETEP-RS) for VH due to its advantages, there were variations in techniques with regard to patient positioning; position and number of monitors; site and number of ports based on the location, type, and size of the hernia; previous abdominal surgeries; surgeons comfort level; and available resources. It was observed that there was a need to shift the camera port (CP) and working ports (WP) and change from 10-mm to 5-mm telescope, 0- to 30-degree telescope, and vice versa, during the procedure. This resulted in increased learning curve for the beginners who wanted to adapt the ETEP-RS technique for VH.

The aim of this study was to develop a simplified technical modification with an attempt to standardize the ETEP-RS procedure. In this technique, three lateral ports were used for both midline and lateral VH, with no need to shift CP, WP, and monitor positions throughout the procedure. Only one monitor and one 30-degree 10-mm telescope sufficed. It can be coupled with associated right IH repair, repair of divarication of recti (DR), and transversus abdominis release (TAR) for large VH. In this article, we present the technical aspects to perform this procedure and the short-term results of our experience in this subset of 100 patients.

Materials and Methods

This is a retrospective study from a prospective database of 100 consecutive patients who underwent laparoscopic ETEP approach for VH by using our novel lateral three-port technique between January 2022 and July 2023 at a single center. This study is in compliance with the ethical standards of the institutional or regional human experimentation committee and the 1975 Declaration of Helsinki (2013 revision). Historical patient records were analyzed. Informed consent was obtained. We followed the European Hernia Society (EHS) classification for VH.[3]

Inclusion criteria

1. Primary hernia, incisional hernia (INH), and recurrent hernia (RH): midline and lateral (M2-M5, L1–L4) [Figure 1A and B]
2. Defect size 4–14 cm
3. Associated right IH
4. Associated DR
5. Fit for general anesthesia (GA)

Exclusion criteria

1. Subxiphoid hernia (M1)
2. Defect size <4 cm
3. Loss of domain
4. Cases requiring bilateral TAR
5. Associated left and bilateral IH
6. Not fit for GA

All patients underwent computed tomography scan of the abdomen [Figure 1C and D]. In our study, DR was defined as a distance of 2 cm or greater between the medial border of the two rectus muscles with patient in relaxed position, and as midline bulge seen during head and leg raising tests.[4] Patients with INH and RH with irreducible bowel loops as contents were admitted a day prior for bowel preparation. The others were admitted on the morning of surgery. Patients with diabetes mellitus, hypertension, ischemic heart disease, chronic obstructive pulmonary disease (COPD), and smokers were evaluated preoperatively and optimized. Possibility of conversion to open was explained.

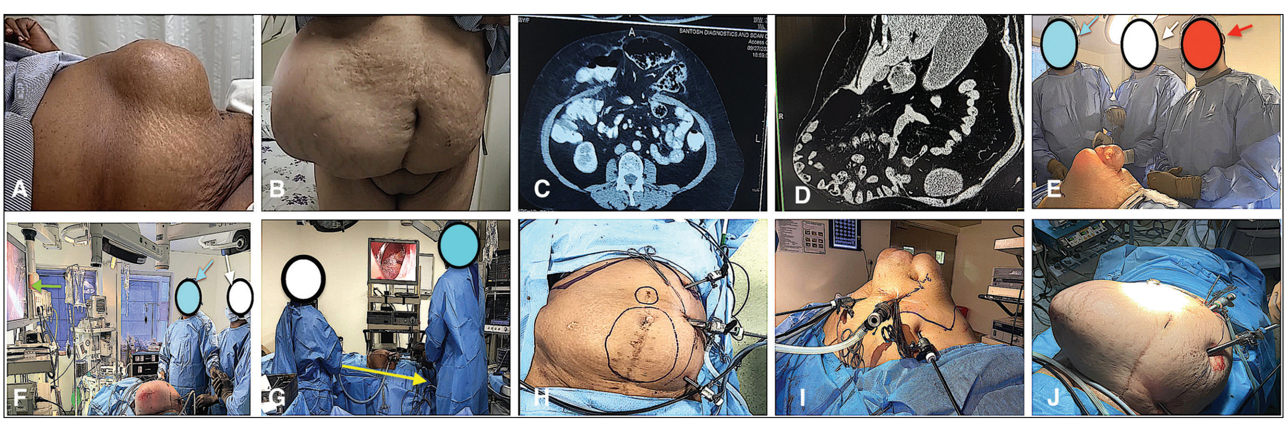

Figure 1: A: M3-4 incisional hernia. B: L2-3-4 incisional hernia. C: CT scan showing bowel loops as content. D: CT scan of L2-3-4 hernia with bowel loops as contents with 14 cm defect. E: Position of surgical team (blue arrow: operating surgeon, white arrow: camera surgeon, red arrow: scrub nurse). F: Position of surgical team and monitor (blue arrow: operating surgeon, white arrow: camera surgeon, green arrow: monitor). G: 20-degree head low position while creating RR space caudally using a telescope (yellow arrow: head low). H: Port placements for M2-5 hernia. I: Port placements for M2-3-4 hernia. J: Port placements for L2-3-4 (standard one 10 mm CP and two 5mm WP)

Operative technique

Patient, monitor position, and port placements

Under GA, the patient was placed in supine position with both arms tucked by the side. Nasogastric tube and foley catheter were inserted. The monitor was placed at the right side of the patient, with the operating surgeon, the camera surgeon, and the scrub nurse on the left side of the patient. In case of lateral hernias, the operating table was set at 20 degree right side up. The positions of the monitor, patient, operating and camera surgeons and ports were unchanged throughout the procedure [Figure 1E and F].

The left linea semilunaris (LS) was marked by palpation of lateral border of the rectus muscle (about 7 cm from the midline).[5] A 1.5-cm incision was made 3 cm above the umbilicus and just medial to the marked LS. A 10-mm blunt trocar was inserted between the rectus muscle and the posterior rectus sheath (PRS). The gas insufflator was connected with the pressure of 14 mm Hg and flow rate of 20 L/min. Retro-rectus (RR) space was created using a 30-degree telescope [Figure 1G]. Two 5-mm WP were placed 8 cm below the CP and at the highest point just below the left costal margin. The same technique and port placements were used for M2-M5 and lateral hernias [Figure 1H–J].

Midline crossover

We performed superior crossover first in all our cases. After clearing all fibro-fatty tissue in the RR space, the PRS and its insertion to linea alba (LA) were defined. The PRS was incised 5 mm from its insertion to LA from the subxiphoid region with monopolar diathermy [Figure 2A and B]. Crossover was performed only after incising the PRS up to the hernial defect in cases of M2-M3 hernias. In M4-M5 and lateral hernias, crossover was performed only after incising the left PRS till the umbilicus. The pre-peritoneal fat and fat pad of falciform ligament (FL) were swept downward, and white criss-cross fibers of LA were identified [Figure 2C]. This was continued till the hernial defect or at the level of the umbilicus. The sweeping down of the FL opened the space and helped to identify the insertion of the right PRS to the LA by the "mash mellow sign"[6] [Figure 2D]. The right PRS was then incised 5 mm from its insertion to LA to expose the right rectus muscle [Figure 2E]. The incision on the right PRS was parallel to LA till the defect. The dissection of the right RR space was continued beyond the hernial defect. The lateral dissection was performed till the right LS. The neurovascular (NV) bundles were defined—"lamppost sign" and preserved[6] [Figure 2F].

Entry into peritoneal cavity

The hernial sac and the defect were defined—"volcano sign"[6] [Figure 2G]. The sac was opened judicially, contents reduced with external pressure by the assistant [Figure 2H]. Bowel adhesions were released using cold scissors. Once contents were reduced, the PRS incision was extended and both the PRS were joined below the inferior margin of the defect [Figure 2I]. Dissection of RR space was performed about 10 cm beyond the inferior border of the defect in cases of M2-M3 hernias [Figure 2J]. In cases of M4-M5 hernias, lateral hernias, and associated right IH, the space of Retzius (SR) and the space of Bogros (SB) were also defined.

Posterior closure

The ability to perform tension-free PRS approximation was assessed after reducing the pressure to 6 mm Hg [Figure 3A]. The PRS was closed in a continuous manner using 2-0 Maxon or 2-0 barbed suture in the direction of least tension. We have closed the PRS defect transversely, longitudinally, and obliquely. We realized that a transverse or oblique closure of PRS along the lines of least tension resulted in tension-free approximation [Figure 3B]. All the buttonhole peritoneal rents during dissection were meticulously closed using 2-0 Maxon. The PRS was approximated from subxiphoid region in all cases, except the initial 13 cases. We believed that closing PRS from

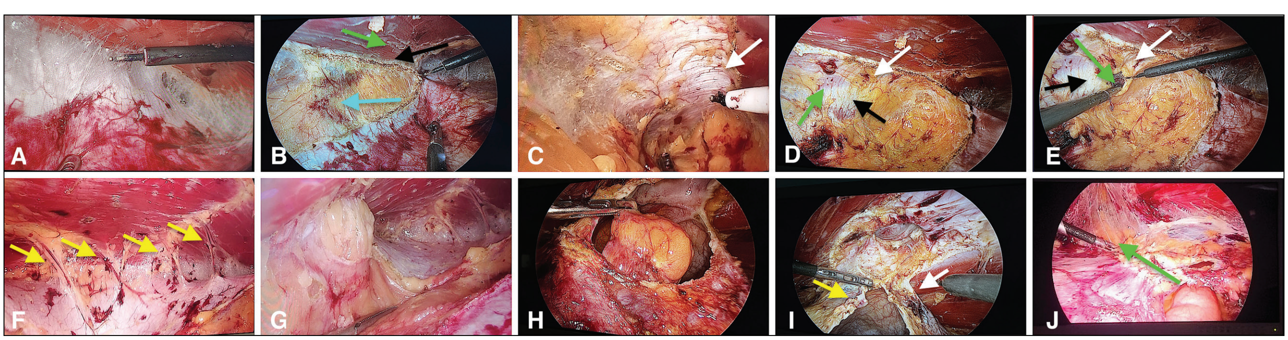

Figure 2: A: Left RR space cleared of all fibrofatty tissue. B: Left PRS divided 5 mm from LA till the hernial defect (black arrows: cut PRS, blue arrow: preperitoneal fat, green arrow: rectus muscle). C: Falciparum ligament pushed down to visualize criss-cross fibers of LA (white arrow: LA). D: Mash-mellow sign (white arrow: LA, black arrow: PRS, green arrow: rectus muscle seen through translucent PRS). E: Right PRS incised 5 mm from its junction with LA to see right rectus muscle (white arrow: LA, black arrow: PRS, green arrow: rectus muscle). F: Lamppost sign (yellow arrows: NV bundles). G: Volcano sign. H: Contents reduced. I: Both PRS joined below the lower margin of the defect (white arrow: right PRS, yellow arrow: left PRS). J: Dissection 10 cm beyond the defect in M2-3 hernias (green arrow: the lower border of PRS to dissected area)

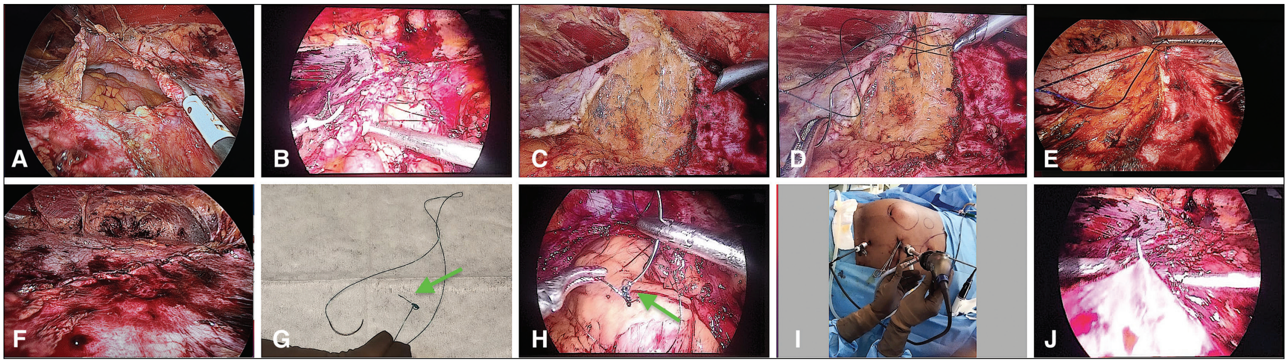

Figure 3: A: PRS defect and its assessment for closure. B: Transverse closure with 2-0 Maxon. C: FL hallow. D: Closure of PRS above FL with 2-0 Maxon. E: Closure of PRS above FL with barbed suture. F: Completed PRS closure to form a flat surface, indigenously prepared Maxon knot (green arrow: knot). H: Needle passed through eye of Maxon knot (green arrow: knot). I: Position of the telescope while suturing close to CP. J: View closer to CP

subxiphoid without tension creates a flat surface for the mesh instead of a hollow created when FL was pushed down, which may help to improve the abdominal contour and prevent postoperative bulges [Figure 3C–F].

Ergonomics and tips for PRS closure

Approximation with Maxon was economical compared with the barbed suture. We have created an indigenous pretied knot with a loop extracorporeally using Maxon, which avoided initial intracorporeal knotting like in V-lock suture [Figure 3G and H]. This pretied knot technique helps in centers where barbed/V-lock sutures are not available. Further continuous suturing was easier as few continuous bites could be taken on PRS with Maxon before it is pulled. Transverse closure of the PRS defect was easier compared with longitudinal closure with these ports. Suturing the PRS closer to the CP was a difficult task due to the ergonomics but was achievable with practice [Figure 3I and J].

While approximating the PRS above the FL from subxiphoid, the patient was placed in 20-degree head-up position. Since the initial part of suturing was close to the right hypochondriac port, the use of barbed suture (Trubarb, Healthium Medtech Limited, India) made suturing easy [Figure 3E]. With experience, Maxon was used for this approximation [Figure 3E]. A long Maryland/grasper was handy while suturing near the subxiphoid region, especially in tall and obese patients. This approximation was carried out caudally till the closed PRS defect. Reduction of pressure to 6 mmHg helped to achieve tension-free closure.

Peritoneal sac preservation technique (PSPT)

In cases of large VH with redundant sac, after reduction of contents, the herniated sac (peritoneum) into the defect was separated from the subcutaneous tissue using sharp dissection taking care not to breach the skin. Separated sac was maintained in continuity with the divided PRS and helped tension-free closure of PRS-peritoneum complex and avoided TAR [Figure 4A–C].

Techniques followed to avoid TAR

In cases of difficulty in tension-free approximation of PRS, we used the following methods to increase the peritoneal purchase before deciding to perform right TAR:

1. Dissection of SR and SB [Figure 4D]
2. Adhesiolysis under the PRS-peritoneal complex beyond the PRS defect margin [Figure 4E]
3. Division of round ligament close to the peritoneum in females [Figure 4F]
4. PSPT
5. Preservation of the peritoneal bridge between the PRS [Figure 4G]
6. Reduction of pressure to 6 mmHg

Limited down to up TAR[7]

After defining SB, dissection was carried out laterally and cranially below the arcuate line to create pre-peritoneal space. This prevents the inadvertent peritoneal rent while dividing the PRS. The junction of right PRS and the LS was defined. Then, the PRS was divided from the arcuate line, about 5 mm from LS while preserving the NV bundles. This sequence of creation of pre-peritoneal space, identifying the seam of PRS with LS, NV bundles, and division of PRS from down to up direction was continued until good purchase of peritoneum-PRS complex was achieved [Figure 4H–J].

Right-sided complete TAR[8,9]

For large midline VH where the posterior approximation was under tension despite the above-mentioned maneuvers, right-sided TAR was performed. The TAR was started near the right costal margin. The posterior lamina of the internal oblique was divided 1 cm medial to LS, and the transversus abdominis (TA) muscle was divided [Figure 5A–C]. Pretransversalis plane was dissected laterally by blunt dissection [Figure 5D]. With this, we could achieve good mobilization of the posterior layer [Figure 5E]. In patients with right subcostal hernias, right sided TAR was performed and diaphragmatic fibers, its junction with TA muscle at the 12th rib was

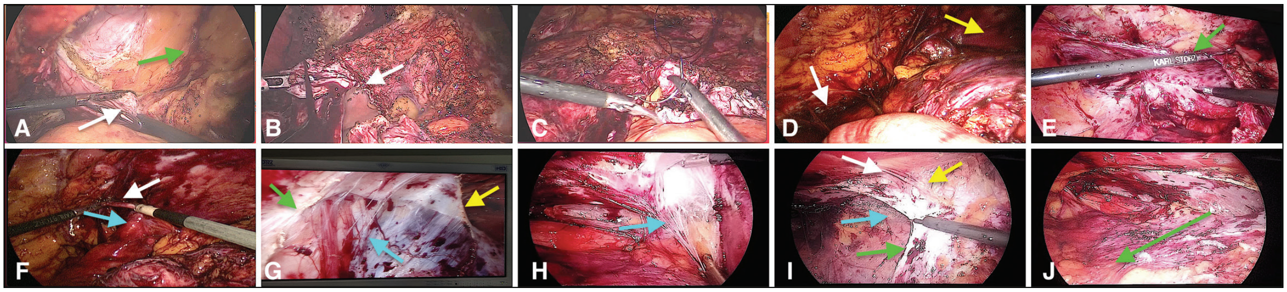

Figure 4: A: Sac dissected from subcutaneous tissue (white arrows: sac, green arrow: subcutaneous tissue). B: Preserved sac for posterior closure (white arrow preserved sac). C: Posterior closure with preserved sac. D: Space of Retzius and Bogros were dissected to get maximum peritoneal purchase (white arrow: space of Retzius, yellow arrow: space of Bogros). E: Additional adhesiolysis under the PRS-peritoneal complex performed well beyond the PRS defect margin (green arrow: PRS). F: Round ligament divided close to the peritoneum (blue arrow: peritoneum, white arrow: RL). G: Preservation of the peritoneal bridge between the 2 PRS and the hernial sac (yellow arrow: right PRS, green arrow: left PRS, blue arrow: peritoneal bridge between two PRS). H: Creation of pre-peritoneal space (blue arrow: pre-peritoneal space). I: Down to up TAR (green arrow: PRS, blue arrow: pre-peritoneal space, white arrow: LS, yellow arrow: NV bundles). J: Extra purchase of peritoneum for posterior closure (green arrow: medialization achieved)

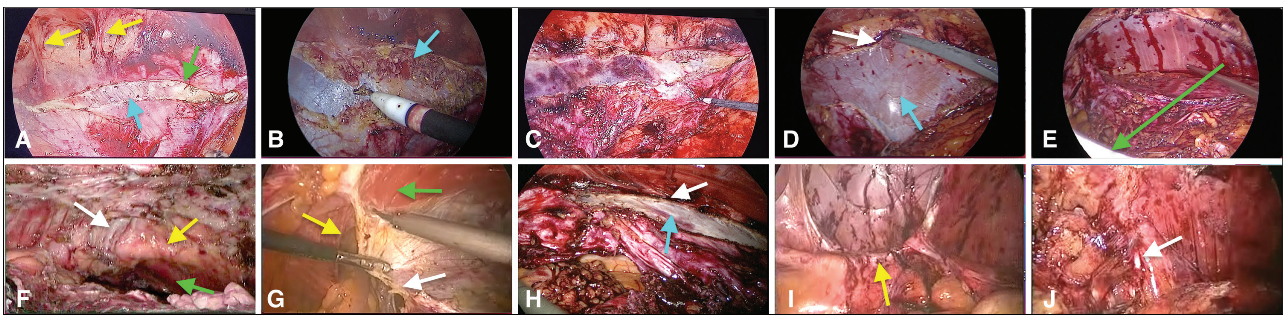

Figure 5: A: Posterior lamina of internal oblique divided (green arrow: cut edge of posterior lamina of IO, blue arrow: transversus abdominus (TA), yellow arrow: NV bundles). B: Fleshy muscular fibers of TA divided (blue arrow: TA muscle). C: Completed right-sided TAR. D: Pretransversalis plane creation using gauze piece (white arrow: gauze piece, blue arrow: pretransversalis plane). E: Medialization obtained with right-sided complete TAR (green arrow: medialization achieved). F: Junction of TA and diaphragmatic muscles in subcostal hernia (white arrow: TA muscle, green arrow: diaphragmatic muscle, yellow arrow: yellow watershed transition zone is the junction of TA and diaphragmatic muscles). G: Right PRS divided up to the lateral hernial defect (white arrow: PRS, yellow arrow: hernial defect, green arrow: rectus muscle). H: Right-sided TAR performed (white arrow: divided TA muscle, blue arrow: pretransversalis plane). I: Lower margin of defect defined (yellow arrow: lower margin of defect). J: Adequate inferior space creation (white arrow: iliac crest)

defined. Subcostal and subdiaphragmatic space was created to ensure adequate mesh overlap [Figure 5F]. In cases of lateral VH, TAR was performed to get access into the pretransversalis plane for the creation of space beyond LS for adequate mesh overlap and for posterior approximation in large defects [Figure 5G–J].

LA reconstruction and anterior closure

In the initial 12 cases, LA was reconstructed only in cases of LA breach and DR. After we learnt that repairing only the hernia orifice was insufficient because the defect affects not only the hernia orifice but also the entire length of LA, the LA was reconstructed in all cases that followed with No. 0 barbed, V-lock, or 40-mm taper cut or polypropylene (PP) No. 1 suture. This was done by approximating the cut medial edges of the two PRS continuously from subxiphoid region up to the defect. Later, it was started caudally using a separate suture material to create a neo–LA [Figure 6A–F].

The hernial defect was closed with a 40-mm taper cut PP No. 1 suture or No. 0 barbed suture taking part of the sac in the bites, thus inverting the redundant skin and reduce the rate of seroma [Figure 6G and H].

Anterior fascial traction technique (AFTT) [Figure 6I–L]

Our experience with bilateral TAR (excluded from this study) made us realize that TAR helps in more posterior mobilization than anterior fascial advancement. In two cases of W3 VH after right-sided TAR and tension-free posterior closure, the anterior fascial closure was difficult. We used an innovative AFTT where in No. 1 polyamide (Ethilon, Johnson & Johnson) slings were passed on either side of the rectus muscles and were pulled medially on the abdominal wall by the assistant giving traction. This resulted in bringing the medial borders of rectus muscles closer to aid in tension-free closure.

Excision of redundant skin, sac, and reconstruction [Figure 7A–C]

In two cases of M3 hernia, with excess redundant umbilical skin where plication and inversion of the sac would result in cosmetic disfigurement, the excess skin was excised. This was done under laparoscopic guidance with

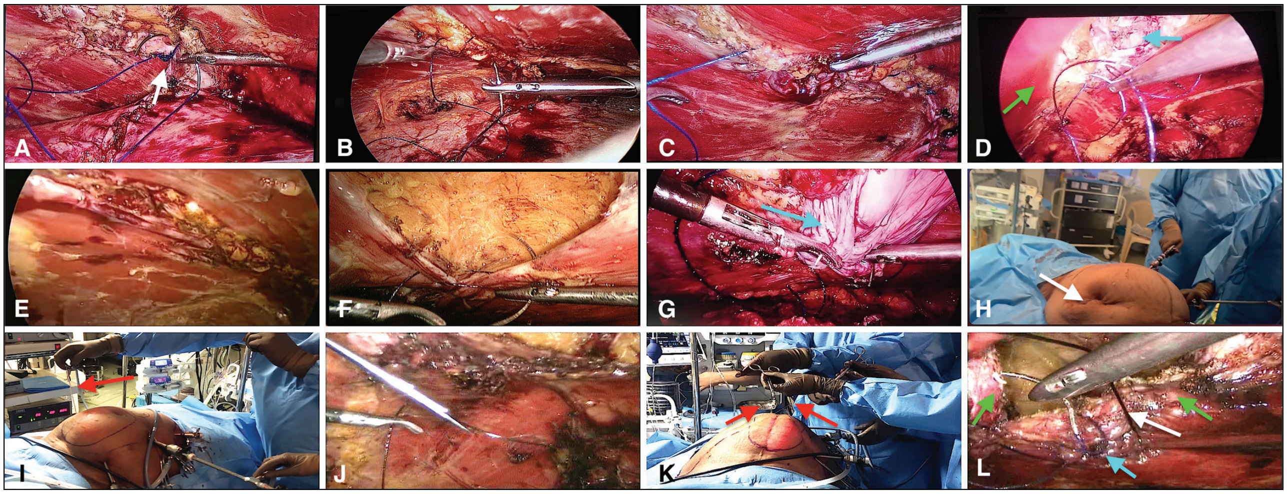

Figure 6: A: LA reconstruction using No. 1 polypropylene (note the indigenous pretied knot: white arrow). B: LA reconstruction using No. 0 V-lock. C: LA approximation using polypropylene. D: LA reconstruction from below upward (green arrow: left rectus muscle, blue arrow hernia defect). E: Completed LA reconstruction. F: Divarication of recti closure. G: Bites taken from sac in midline VH (blue arrow: sac). H: Overlying skin inverted (white arrow: inverted skin). I: Suture passer needle grasping No. 1 Ethilon passed through stab incision from one side of the defect exteriorly (red arrow: suture passer needle). J: No. 1 Ethilon grasped and retrieved outside. K: Ethilon slings grasped with mosquito forceps brought together medially outside giving traction (red arrow: Ethilon slings). L: Rectus approximation using barbed suture (green arrows: rectus muscle, blue arrow: barbed suture, white arrow: Ethilon sling)

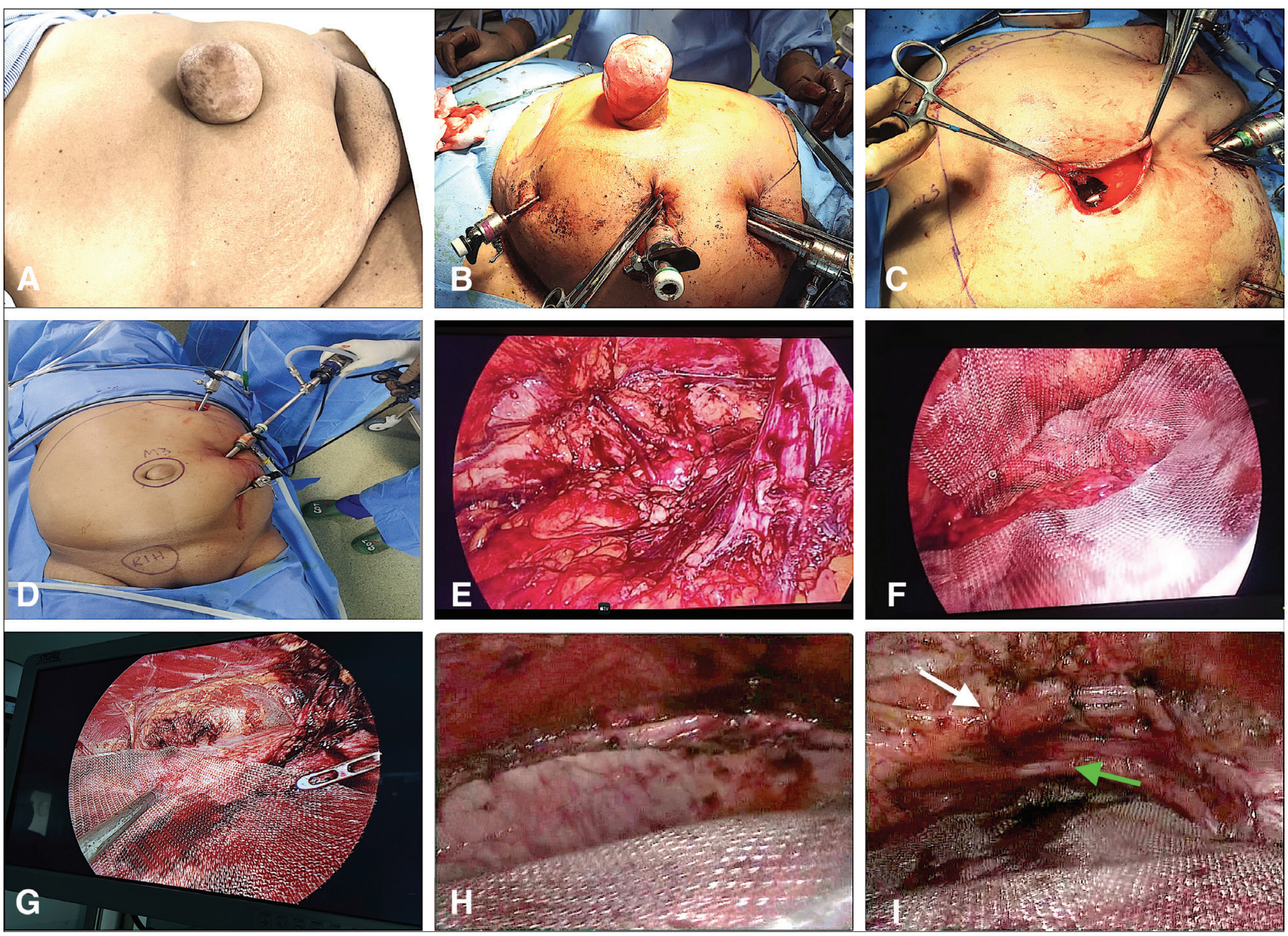

Figure 7: A: Large umbilical hernia with redundant skin. B: Excision of redundant umbilical skin and transillumination of the sac. C: Reconstruction of umbilicus after sac excision. D: Same lateral three ports with long instruments for associated right IH. E: Completely defined MPO of Fruchaud. F: Mesh placed and fixed with tack to coopers ligament. G: Medium weight PP mesh placement after ETEP-RS. H: Mesh covering beyond LS when right-sided TAR was performed. I: Mesh covering well beyond the defect in subcostal and subdiaphragmatic space (white arrow: costal margin, green arrow: diaphragm)

Table 1: Patient demographics

Total number of patients		100	Range
Mean age, years		54.9	38–79
Gender	Male	38	
	Female	62	–
Mean BMI, kg/m^2		28.5	21–40
Prior abdominal surgery		76	–
Comorbidities	Type II diabetes mellitus	42	–
	Hypertension	35	–
	Coronary artery disease	38	–
	Chronic obstructive pulmonary disease	12	–
	Hypothyroidism	2	–
Smoking		12	–

Table 2: Hernia subgroup classification

	n
Incisional	73
Primary	27
Recurrent	8
Following open onlay	5
Following laparoscopic IPOM plus repair	3
Associated right inguinal	4

IPOM = intraperitoneal onlay mesh

transillumination and the pneumoperitoneum helping to define the entire sac and its excision. The neoumbilicus was reconstructed using 3-0 Poliglecaprone (Monocryl, Ethicon).

Associated right IH [Figure 7D and E]

Associated right IH were dealt with using the same three lateral ports but with longer instruments.

Mesh placement

The dissected space was measured vertically and transversely keeping the pressure at 14 mm Hg. The size of mesh varied depending on the defect size, area dissected, and the patient's body habitus. In associated IH, additional 12 cm × 17 cm mesh was placed covering the myopectineal orifice of Fruchaud and fixed to the Cooper's ligament by titanium tack (ProTack, USA, Covidien) [Figure 7F]. In cases of ETEP-RS, approximately 20 cm × 15 cm medium weight macroporous PP mesh was used in most of the cases [Figure 7G]. In cases where right-sided TAR was performed for midline hernias, a 25 cm × 20 cm mesh was placed [Figure 7H]. In cases of lateral hernias that required TAR and the dissected space was more, a 30 cm × 22 cm mesh was placed [Figure 7I]. The mesh was not fixed.

Postoperative care

The patients were started liquids orally 6 h following surgery and soft diet on post-operative day (POD) 1. In patients where bowel loops were adherent to abdominal wall and extensive adhesiolysis was performed during the procedure, they were kept nil by mouth overnight. Liquids were started orally on POD 1 for this sub group of patients. All patients were discharged on POD 1 or 2 with adequate size abdominal corset, except one patient who got discharged on POD 5. Pressure bandage was maintained for POD 7. The patients were followed up at 7 days, 1 month, 3 months, 6 months, 1 year, and 2 years following surgery.

Clinical trial registry

This work is a retrospective analytical study. No clinical trials were involved.

Results

This was a retrospective study from a prospective database of 100 consecutive patients who underwent laparoscopic ETEP approach for VH and associated right IH by using the novel lateral three-port technique from January 2022 to July 2023. The surgery was performed at a single center by a single surgical team. Historical patient records were analyzed.

Patient characteristics

Patient demographics and comorbidity details are provided in Table 1.

Hernia characteristics

Of the 100 patients, 73 had INH and 27 primary VH. Of the 73 patients with INH, 8 patients were RH of whom 5 were following previous open onlay mesh repair and 3 following laparoscopic intraperitoneal onlay mesh (IPOM) plus repair. Four patients had associated right IH [Table 2]. We followed EHS classification for both primary and INH [Tables 3–5].

Perioperative characteristics [Tables 6 and 7]

No concomitant nonhernia surgery was performed in any patient. None of the 27 patients with primary VH required TAR. Among 73 patients with INH, right-sided TAR was performed in 16 patients [Table 6]. In the initial 12 cases, LA was reconstructed only in 5 cases: 3 cases of DR and 2 cases linea breach. Later, LA was reconstructed in all the 88 consecutive cases, and thus, complete LA reconstruction was performed in 93 patients. Complete PRS closure from above the FL was performed in 87 patients. The mean operating time for ETEP-RS was 92.3 min (155 min

Table 3: Primary ventral hernias as per EHS classification

	Total cases *N* = 27	Small < 2 cm	Medium > 2–4 cm	Large > 4 cm	Associated right inguinal hernia	Associated divarication
Umbilical	23	Excluded	19	4	2	20
Epigastric	4	Excluded	3	1	0	2

Table 4: Incisional hernias as per EHS classification

	Total cases *N* = 73	W1 < 4 cm	W2 > 4–10 cm *N* = 61	W3 > 10 cm *N* = 12	Recurrent *N* = 8	Associated right inguinal hernia N = 2
M1	Excluded	Excluded				
M2	3	–	3	0		
M3	55	–	45	10	6	2
M4	3	–	3	0	1	
M5	8	–	7	1		
L1	1	–	1			
L2	1	–	1			
L3	2	–	1	1	1	
L4	0	–	0	0		

Table 5: Details of recurrent incisional hernias

Previous VH surgery	Midline	Lateral	W2	W3	ETEP-RS	ETEP/ right TAR
IPOM plus repair	3	0	3	0	0	3
Open onlay mesh repair	4	1	3	1	4	1

IPOM = intraperitoneal onlay mesh

Table 6: Details of cases requiring right-sided TAR (*N* = 16)

	W2	W3
Midline incisional	0	9
Midline recurrent	3	0
Lateral incisional	3	0
Lateral recurrent	0	1

when combined with right-sided TAR and 112.4 min when combined with right IH repair). With an increase in experience, the operative time had reduced [Table 7].

Complications [Table 8]

Breach of LA was the most common intraoperative complication [Figure 8A]. Seroma was seen in four patients and treated conservatively. One patient who was a known case of COPD had violent cough postoperatively and developed acute intestinal obstruction on POD 2. CT abdomen showed part of the bowel herniating into the PRS defect, suggesting PRS rupture. On laparoscopic re-exploration, the bowel loop was reduced, and IPOM repair using composite mesh (Parietex composite mesh, Covidien, France) was performed [Figure 8B–E].

Discussion

From its inception, various modifications in the technique with regard to the number and position of ports and monitors, RR space creation, change of telescope from 5 mm to 10 mm and from 0-degree to 30-degree telescope, and shift of CP and WP were noticed. These variations were based on location, size and type of the hernia, previous surgical scars, presence or absence of previous mesh, available resources, need for component separation, and personal preferences. This can be challenging and time-consuming while dealing with large VH by using ETEP approach. With our novel technique, we have tried to circumvent these shortcomings. With this technique, we could manage large primary, incisional midline, lateral, and recurrent VH from M2-M5, L1-L4 with defect size 4–14 cm (W2-W3), associated right IH and DR.

In the study by Baig and Priya,[10] involving 21 cases, the monitor for M3,4,5 hernias was placed at the foot end and the camera was initially placed in the left subcostal port until both RR spaces were dissected. Thereafter, the camera was shifted to the right upper port for further dissection and suturing the defect. Two monitors were used. In the study by Mitura *et al.*,[11] involving 34 patients, first port was below the umbilicus for M2 hernias, while for M3, M4 it was in the epigastrium. After midline crossover, another 10-mm port was placed for the camera in the right RR space. Although these are tailored approaches, we felt techniques involving shift of CP and WP may increase the learning curve for beginners with respect to port placements based on the location of hernia. This also may need the requirement of two monitors and two telescopes of 5 mm and 10 mm with increased initial investment.

In our study by using this lateral three-port technique, we have managed both midline and lateral VH with a width of 4–14 cm. Balachandran *et al.*[12] in their series of three cases with VH ranging from 4.8 to 7.2 cm performed PSPT

Table 7: Perioperative characteristics

Type of procedure	
ETEP-RS	84
ETEP-RS –right-sided TAR	16
ETEP-RS + ETEP right inguinal	4
Mean operating time (min)	
ETEP-RS	92.3 min (range: 40—110 min)
ETEP-RS – right-sided TAR	155.0 min (range: 100–180 min)
ETEP-RS + ETEP right inguinal	112.4 min (range: 70–120 min)
Mean defect width	7.24 cm (range: 4–14 cm)
Mean defect area	40.7 cm^2
Mean mesh area	360.16 cm^2 (range: 300–660 cm^2)
Previous mesh	
Open onlay	5
IPOM plus repair	3
Posterior reconstruction (PRS defect closure)	*N* = 100
No. 2-0 Maxon	87
No. 2-0 barbed suture	13
Closure of PRS above falciparum ligament	*N* = 87
No. 2-0 barbed suture	77
No. 2-0 Maxon	10
Defect closure	*N* = 100
No. 1 polypropylene	19
No. 0 barbed suture/V-lock	81
Linea alba reconstruction	N = 93
No. 1 polypropylene	10
No. 0 barbed suture/V-lock	83
Peritoneal sac preservation technique (PSPT)	5
Anterior fascial traction technique (AFTT)	2
Division of round ligament	9
Limited down to up TAR	3
Right-sided complete TAR	16
Excision of redundant umbilical skin	2
Vacuum drain placement	2
Mean length of postoperative stays (days)	1.3 days (range: 1–5 days)

IPOM = intraperitoneal onlay mesh

Table 8: Complications

Intraoperative	**N**
Entry into peritoneal cavity during initial trocar	1
IEV injury	2
Linea alba breach	4
Linea semilunaris injury	1
Serosal injury to bowel	2
Enterotomy	0
Postoperative	
Subacute intestinal obstruction	1
Posterior rectus sheath rupture	1
Seroma	4
Chronic pain	3
SSI	0
DVT	0
Respiratory complication	0
30-day readmission	0
Recurrence	0
Death	0

to avoid TAR. In our series of five cases of PSPT, two cases were W3 defects in which we could preserve the sac to achieve good posterior closure without the need for TAR. Additionally, in 10 cases with W3 defect (largest 14 cm), a right-sided TAR was performed using these three lateral ports to get tension-free PRS approximation. In our study even W3 hernias which were dealt by open approach in other studies were managed by Laparoscopic ETEP-TAR using our novel three port technique. There was no conversion or need for hybrid procedure in our series.

Aliseda *et al.*,[13] in their meta-analysis of ETEP-RS of 13 studies involving 918 patients, noted seroma in 5%, with the reoperation and readmission rate of 1%. The mean operative time was 148.89 min, and the length of hospital stay was 1.77 days. In our study with a follow-up period of 6 months–2 years, the seroma rate was 4%, which was comparable with other studies.[14] The reoperation rate was 1%. The mean operating time was 119.9 min, and the length of hospital stay was 1.3 days. In a study by Satterwhite *et al.*,[15] involving 106 cases, the incidence of small bowel obstruction after complex abdominal wall hernia repairs was 1.9%. We had one case (1%) of PRS rupture that was managed by IPOM repair.

We had eight cases of RH, among which three were following previous IPOM plus repair. Although one may feel previous IPOM repair may not interfere with ETEP approach as ETEP is a virgin plane, previously placed composite mesh, transfascial sutures and tacks do pose a challenge [Figure 8F]. Despite the claim that composite meshes are nonadherent, there are many studies where adhesions after IPOM have been noted[16] [Figure 8G]. The challenges encountered in managing these hernias were difficult RR space creation due to the adhesion of the PRS to the rectus muscle due to previous mesh fixation using tacks and transfascial sutures, increased fibrosis in the RR space, dense small bowel adhesions to the mesh, and the presence of titanium tacks over the rectus muscle. There is increased chance of enterotomy during adhesiolysis. LA breach is common during crossover, adhesiolysis, and dissection as the composite mesh will also be covering the LA and fixed with transfascial sutures/tacks. The PRS was divided along with the underlying mesh. TAR was required as the PRS-peritoneum complex was fibrosed [Figure 8H–J] preventing tension-free approximation and due to sacrifice of part of PRS on bowel loops during adhesiolysis.

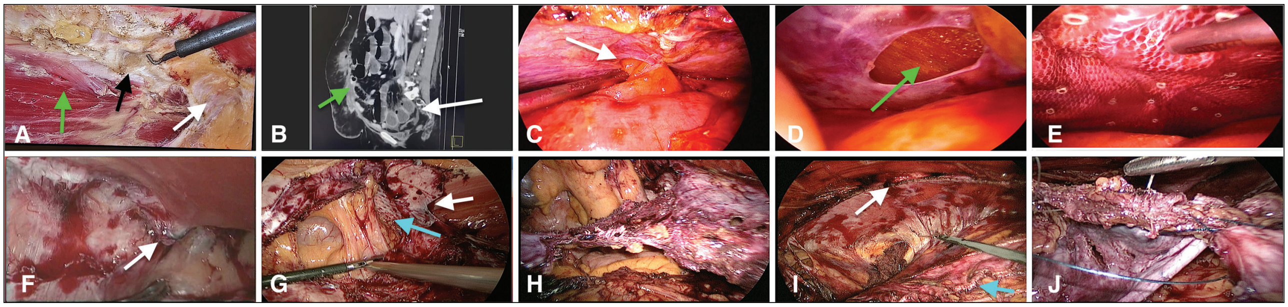

Figure 8: A: LA injury during crossover (black arrow: LA injury, white arrow: LA, green arrow: rectus muscle). B: CT scan showing PRS rupture with herniating bowel loop causing subacute intestinal obstruction (white arrow: dilated bowel loops, green arrow: herniating wall of small bowel loop). C: Herniating bowel loop (white arrow: herniating bowel loop through peritoneal rent). D: Polypropylene mesh seen through the defect (green arrow: mesh). E: 20 × 15 cm composite mesh placed and fixed with tacks. F: Previous metallic tack in retro-rectus space (white arrow: tacks). G: Mesh adherent to PRS (blue arrow: mesh, white arrow: PRS). H: Thickened and fibrosed PRS. I: Right-sided complete TAR (white arrow: cut edges of TA, blue arrow: PRS-mesh complex). J: Posterior closure using the PRS-mesh complex

We approximated the PRS from the subxiphoid region downward in all cases, except the initial 13 cases. We were of the belief that closing PRS from subxiphoid without tension creates a flat surface for the mesh and may help to improve the abdominal contour and prevent postoperative bulges. However, in a recent study by Daes *et al.* using the Eclipse 9 tool,[17] it was proved that factors other than PRS closure such as lack of physical activity and neuromuscular bundle damage in the upper abdomen leading to rectus atrophy play a role in the postoperative abdominal contour and bulges.

The limitations of ETEP-RS are steep learning curve, requirement for superior laparoscopic skills, difficult crossover in large defects, and prolonged operative time.[18] Robotic ETEP-RS may have some added advantages compared with laparoscopy, especially when suturing the midline in larger hernias and while performing TAR as it aids in dissection and improves ergonomics, dexterity, and freedom of movement. Belyansky *et al.*[19] described the first series of 37 patients with complex hernia defects with the robotic ETEP with promising results using lateral docking. Morrell *et al.*,[20] in their series of 22 patients with VH treated with robotic-assisted surgery with a three-port lateral docking setup, the average size of the largest defect dimension was 5.1 cm, the average prosthesis coverage area was 433.5 cm^2, and the average operative time on the console was 170.7 min. We performed the same using the laparoscopic approach as we did not have access to robotic platform. In our series of 100 cases, the average size of the defect was 7.24 cm, the average mesh coverage area was 360.16 cm^2, and the mean operative time was 119.9 min.

There are certain limitations in our study. This was a retrospective study from a prospective database. It is not a comparative study between different endoscopic techniques used for VH repairs. We could not replicate this technique in M1 hernias and could not be implemented in associated left or bilateral IH or cases requiring left-sided TAR also as it requires an additional 5-mm port on the right side and shift of monitor. PRS closure from the subxiphoid downward, DR repair, and LA reconstruction with the three lateral ports might be a difficult task for beginners without advanced suturing skills. Although we did not have recurrences in 100 cases, the follow-up period is short (6 months–2 years).

Conclusions

Laparoscopic lateral three-port ETEP-RS technique is safe, feasible, cost-effective, and reproducible for both midline and lateral VH. This novel technique can be combined with right-sided TAR, right IH, and repair of DR. This technique can be standardized; however, larger studies and longer follow-up are needed to have an evidence-based answer.

Author contributions

KGS: Concepts, design, definition of intellectual content, literature search, clinical studies, data analysis, manuscript editing, manuscript review, guarantor;
MT: Literature search, clinical studies, data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript editing, manuscript review, guarantor;
RBS: Manuscript editing, manuscript review, guarantor;
ASJ: Data analysis, manuscript editing, manuscript review, guarantor;
NJ: Manuscript editing, manuscript review, guarantor.

Ethical policy and institutional review board statement

Not applicable.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Data availability statement

All data generated and/or analyzed during this study are included in this published article.

Financial support and sponsorship

Nil

Conflicts of interest

There are no conflicts of interest.

Acknowledgments

The authors thank Dr Vijay Borgoankar, Director and Head, Department of MAS and GI Surgery, Krupamayi Hospital, Aurangabad, Maharashtra, India, for his support and advice in writing this article.

Abbreviations

ETEP: extended totally view extraperitoneal
IH: inguinal hernias
VH: ventral hernias
ETEP-RS: extended totally extra peritoneal–Rives Stoppa
CP: camera port
WP: working ports
DR: divarication of recti
TAR: transversus abdominis release
EHS: European Hernia Society
INH: incisional hernia
RH: recurrent hernia
DM: diabetes mellitus
HTN: hypertension
IHD: ischemic heart disease
COPD: chronic obstructive pulmonary disease
GA: general anesthesia
LS: linea semilunaris
PRS: posterior rectus sheath
NV: neurovascular
RR: retro-rectus
LA: linea alba
FL: falciparum ligament
SR: space of Retzius
SB: space of Bogros
PSPT: peritoneal sac preservation technique
TA: transversus abdominis
PP: polypropylene
AFTT: anterior fascial traction technique

References

1. Daes J. The enhanced view-totally extraperitoneal technique for repair of inguinal hernia. Surg Endosc 2012;26:1187-9. doi:10.1007/s00464-011-1993-6.
2. Belyansky I, Daes J, Radu VG, Balasubramanian R, Reza Zahiri H, Weltz AS, *et al*. A novel approach using the enhanced-view totally extraperitoneal (eTEP) technique for laparoscopic retromuscular hernia repair. Surg Endosc 2017;32:1525-32. doi:10.1007/s00464-017-5840-2.
3. Muysoms FE, Miserez M, Berrevoet F, Campanelli G, Champault GG, Chelala E, *et al*. Classification of primary and incisional abdominal wall hernias. Hernia 2009;13:407-14. doi:10.1007/s10029-009-0518-x.
4. Hernández-Granados P, Henriksen NA, Berrevoet F, Cuccurullo D, López-Cano M, Nienhuijs S, *et al*. European Hernia Society guidelines on management of rectus diastasis. Br J Surg 2021;108:1189-91. doi:10.1093/bjs/znab128.
5. Mahadar R, Arora E. Trocar insertion in enhanced-view totally extra-peritoneal (eTEP) repair of inguinal hernias. J Minim Access Surg 2021;17:580-3. doi:10.4103/jmas.JMAS_312_20.
6. Ramana B, Arora E, Belyansky I. Signs and landmarks in eTEP Rives-Stoppa repair of ventral hernias. Hernia 2021;25:545-50. doi:10.1007/s10029-020-02216-4.
7. Robin-Lersundi A, Blazquez Hernando L, López-Monclús J, Cruz Cidoncha A, San Miguel Méndez C, Cubedo E, *et al*. How we do it: Down to up posterior components separation. Langenbecks Arch Surg 2018;403:539-46. doi:10.1007/s00423-018-1655-4.
8. Novitsky YW, Elliott HL, Orenstein SB, Rosen MJ. Transversus abdominis muscle release: A novel approach to posterior component separation during complex abdominal wall reconstruction. Am J Surg 2012;204:709-16. doi:10.1016/j.amjsurg.2012.02.008.
9. Radu VG, Lica M. The endoscopic retromuscular repair of ventral hernia: The eTEP technique and early results. Hernia 2019;23:945-55. doi:10.1007/s10029-019-01931-x.
10. Baig SJ, Priya P. Extended totally extraperitoneal repair (eTEP) for ventral hernias: Short-term results from a single centre. J Minim Access Surg 2019;15:198-203. doi:10.4103/jmas.JMAS_29_18.
11. Mitura K, Romańczuk M, Kisielewski K, Mitura B. eTEP-RS for incisional hernias in a non-robotic center. Is laparoscopy enough to perform a durable MIS repair of the abdominal wall defect? Surg Endosc 2023;37:1392-400. doi:10.1007/s00464-022-09365-w.
12. Balachandran P, Tirunelveli SS, Swathika VC. Hernia sac preservation for prevention of transversus abdominis release in laparoscopic extended-totally extra peritoneal repair of ventral hernia: A minimalistic solution for a formidable challenge. J Abdom Wall Surg 2022;1:10634.
13. Aliseda D, Sanchez-Justicia C, Zozaya G, Lujan J, Almeida A, Blanco N, *et al*. Short-term outcomes of minimally invasive retromuscular ventral hernia repair using an enhanced view totally extraperitoneal (eTEP) approach: Systematic review and meta-analysis. Hernia 2022;26:1511-20. doi:10.1007/s10029-021-02557-8.
14. Mishra A, Jabbal HS, Nar AS, Mangla R. Analysis of "enhanced-view totally extra-peritoneal" (eTEP) approach for ventral hernia: Early results. J Minim Access Surg 2023;19:361-70. doi:10.4103/jmas.jmas_129_22.
15. Satterwhite TS, Miri S, Chung C, Spain D, Lorenz HP, Lee GK. Outcomes of complex abdominal herniorrhaphy: Experience with 106 cases. Ann Plast Surg 2012;68:382-8. doi:10.1097/SAP.0b013e31823b68b1.
16. Turcu F, Arnăutu O, Copaescu C. Adhesiolysis-related challenges for laparoscopic procedures after ventral hernia repair with intraperitoneal mesh. Chirurgia (Bucur) 2019;114:39-47. doi:10.21614/chirurgia.114.1.39.
17. Daes J, Luque E, Hanssen A, Rocha J. eTEP Rives-Stoppa impact on abdominal contour: A retrospective observational and clinical quality improvement study using Ellipse 9 tool. Surg Endosc 2024;38:2197-2204. doi: 10.1007/s00464-024-10767-1.
18. Penchev D, Kotashev G, Mutafchiyski V. Endoscopic enhanced-view totally extraperitoneal retromuscular approach for ventral hernia repair. Surg Endosc 2019;33:3749-56.
19. Belyansky I, Reza Zahiri H, Sanford Z, Weltz AS, Park A. Early operative outcomes of endoscopic (eTEP access) robotic-assisted retromuscular abdominal wall hernia repair. Hernia 2018;22:837-47. doi: 10.1007/s10029-018-1795-z.
20. Morrell ALG, Morrell A, Morrell-Junior AC, Mendes JMF, Morrell AG Standardization and ten essential steps in the lateral robotic extended totally extraperitoneal (eTEP) repair of ventral hernias. Rev Col Bras Cir 2020; 47:e20202622. doi: 10.1590/0100-6991e-20202622.