



Endoscopic enhanced-view totally extraperitoneal retromuscular approach for ventral hernia repair

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Abstract

Background Primary or incisional ventral hernia repair is one of the most common surgical procedures, addressed to general surgeons. The enhanced view-totally extraperitoneal technique (eTEP) was first described by Deas for inguinal hernias, but lately it has been applied to ventral hernias by Belyansky et al. So far, results are promising and data about the procedure are rising.

Methods Retrospective comparative analysis of 27 recruited eTEP procedures and 27 IPOM operations for the period between April 2017 and June 2018 at the department of Endoscopic surgery of Military Medical Academy, Sofia. Baseline characteristics, operative records and perioperative data are provided and compared for both groups.

Results Fifty-four patients were included. There were no differences between age, sex, BMI, primary or incisional hernias, co-morbidity, active smoking, EHS-classification and immunosuppression through the patients in different groups. Mean defect area—eTEP is 71 cm² with no statistical difference, compared to IPOM—76 cm². Operative time in eTEP is significantly longer with mean time of 186 min and 90 min in IPOM patients. Mean length of stay did not differ between the groups, with 2.9 days after eTEP and 3.4 after IPOM. Median pain score from the intraoperative (the day of surgery) to the seventh postoperative day is lower in the eTEP group. No surgical site infections and/or mesh infections were present. There was one readmission in the IPOM group with ASBO, and it was managed conservatively. There were no reinterventions and perioperative mortality in the sample.

Conclusion We found out that the eTEP/eRS approach is feasible and safe. Our study shows comparable results of eTEP/eRS to the IPOM procedure with reduced video analogue scale pain score to the 7th postoperative day and increased operative time. The study contributes to the upcoming evidence in the field of new minimally invasive techniques for ventral hernia repair.

Keywords Ventral hernia · eTEP · Retromuscular · Rives–Stoppa

Primary or incisional ventral hernia repair is one of the most common surgical procedures in general surgical practice. Incisional ventral hernia incidence is up to 28% after surgery through incision sites, and the optimal treatment for ventral hernias is still on the table for debate [1]. Durable repair with low morbidity and recurrence is the goal

of surgery [2]. So far we know that the sublay position of the mesh is characterized with lower rates of surgical site infections and recurrences in open ventral hernia repairs [3]. The open approach is burdened with high rate of surgical site infections and a slower recovery process [4]. For many years since the introduction of laparoscopic ventral hernia repair (LVHR) by LeBlanc and Booth, laparoscopic or minimally invasive approach was associated with intraabdominal position of the prosthetic mesh (IPOM). Current evidence suggests that laparoscopic procedures are associated with shorter length of stay, earlier return to work, reduced wound complications, including surgical site infections, and comparable recurrence rates, compared to open ventral hernia repair (OVHR) [5, 6]. One of the biggest disadvantages of the laparoscopic approach is the higher incidence of bowel

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injuries and the possibility for delayed complications with intraperitoneal mesh placement. Despite the great progress in the industry and mesh technology, intraperitoneal foreign body implantation brings a substantial risk of adhesive small bowel obstruction (ASBO) and bowel erosion [7]. According to the data, IPOM does not have any advantages in acute or chronic pain and quality of life (QOL) over OVHR [8]. Recently adopted well-known retromuscular techniques for mesh positioning in ventral hernias, using endoscopic approach, have been available and are becoming extremely popular among the surgical community [9]. The enhanced view-totally extraperitoneal technique (eTEP) was first described by Daes for inguinal hernias but lately has been applied well in ventral hernias [10]. The technique was called eTEP or endoscopic Rives & Stoppa (eRS). However, the procedure is technically challenging, time-consuming and demanding with several potential advantages in favor of the patient, such as avoiding intraperitoneal foreign body, sublay mesh position, faster recovery and restoration of the abdominal wall anatomy and physiology [11]. So far, the results are promising and the data about the procedure are rising every day. The aim of this study is to compare eTEP ventral hernia repair to IPOM procedures and to bring some data about advantages and disadvantages as feasibility and safety of endoscopic retromuscular technique.

Materials and methods

Local ethic committee and institutional review board approval was obtained to collect and review retrospective data of past medical records. We performed review of 27 patients underwent eTEP ventral hernia repair between April 2017 and June 2018 and 27 laparoscopic “IPOM” procedures in the department of Endoscopic surgery at Military Medical Academy Sofia-Bulgaria. The study is designed to compare the outcomes of the eTEP and IPOM techniques. Baseline characteristics, including primary or incisional hernia, sex, age, BMI, smoking habits and morbidity, were collected and compared. Every one of these 54 patients has been classified according to the EHS-classification. Defect size and area using preoperative CT for every patient were available for the study. Data from operative records were provided, including: operative time, intraoperative complications, blood loss. Perioperative complications, surgical site infections, seroma and hematoma formations were available for comparison. Video analogue pain scale (VAS) scores from 0 to 100 mm in rest and during physical activity were provided for first 7 days and on the 30th postoperative day after surgery for both groups. Readmission rates and length of stay were also included into the analyses.

Preoperative workup: emergency cases, history of prior ventral hernia repair, patients who are indicated for

abdominal wall reconstruction or lateral hernias are excluded from the study. Patients with loss of domain, skin infections, skin fistulas, active infection and BMI over 35 are also excluded from the analyses. Detailed medical history, physical examination, laboratory studies and abdominal computed tomography are mandatory for the study. According to the local preoperative checklist for ventral hernia repair every patient received cleaning shower with chlorhexidine-sponge, low weight fractionated heparin and antibiotic prophylaxis before the surgery. After general anesthesia and cleaning of the operative field, Foley catheter was routinely placed. Based on to the defect location, we began with dissection in the retrorectus space-superior or inferior. By the EHS classification in M1 and M2 defects, we prefer to achieve the retrorectus space first in lower right abdominal quadrant. In M3, M4 and M5 defects, we started with development of retrorectus space in upper left abdominal quadrant. Incision sites and trocar positioning are shown in Fig. 1.

After the skin incision, the subcutaneous tissue is dissected to the point of the anterior rectus sheath. After sharp incision of the fascia, the muscle is bluntly retracted and the posterior rectus sheath is reached. Finger dissection over retrorectus area is performed, and the first 12 mm trocar is placed. The second 5-mm trocar is placed near the semilunar line after sufficient dissection with the 30-degree scope and positive pressure from the pneumoperitoneum (Fig. 2).

Incision in the medial aspect of the posterior rectus fascia is made as soon as possible and crossing to the preperitoneal space under linea alba to the contralateral posterior rectus sheath is achieved (Fig. 3A, B). After incision of the contralateral posterior rectus sheath and an adequate dissection in the contralateral retrorectus space, the third 12-mm trocar is placed. Above-described dissection continues to the level of xiphoid process cranially and to the space of Retzius

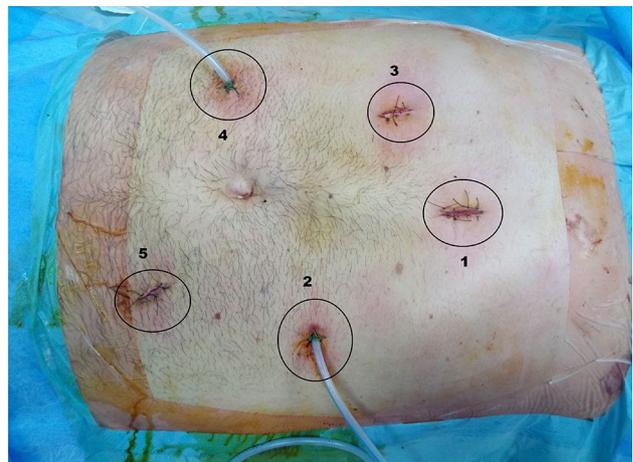


Fig. 1 Port position in eTEP/eRS

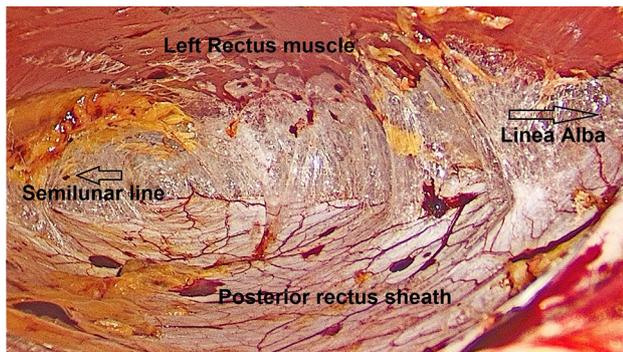


Fig. 2 Initial working space in left upper abdominal quadrant

caudally (Fig. 3C, D). Lateral dissection is done until the point of the semilunar line in both sides.

When the hernial defect is reached, we try to push down the hernial sac and its contents back into the abdominal cavity, without opening the peritoneum, but if that is not possible, entrance into the hernial sac, adhesiolysis and suture of the created hole is performed. At this point, three spaces (two retrorectus and preperitoneal) are united into the one. If we started with cranial crossover, trocars in lower abdominal quadrants may be needed for the upper dissection and if we started with caudal crossover, trocars in upper abdominal quadrants may be needed for the dissection around the Retzius space. When complete retrorectus dissection is achieved,

we suture the linea alba, the defect and also the posterior rectus sheaths one to another, using PDS 0 Stratafix suturing material (Fig. 4 A, B).

After internal measurement of the created space, well-sized wide polypropylene medium weight macroporus mesh is positioned in the sublay fashion to cover the whole retrorectus space without any fixation. The procedure is finished with 2 Blake suction drains on J–Vac containers. Pneumoperitoneum is released under vision ensuring proper mesh position sandwiched between the muscle and posterior rectus sheath.

The well-known IPOM procedure without defect closure has been performed in the control group. After establishment of 14 mmHg pneumoperitoneum with Veress needle or Hasson approach, usually four trocars are placed—three medial in the left side (if possible) and one in the right side, for contralateral mesh fixation. Hernia contents were reduced using blunt and sharp dissection; the falciform ligament was dissected for sufficient mesh coverage. PTFE mesh is secured to the abdominal wall using double crown technique without transfascial sutures on a low pneumoperitoneum (8–10 mmHg) with at least 5 cm coverage of the defect in every direction. For statistical analyses, we used the statistical software IBM SPSS Statistics v19.0 matched pair analysis for non-homogeneous groups was made and continuous bivariate analysis was performed with Student's *t* test. Continuous nonparametric data were compared with

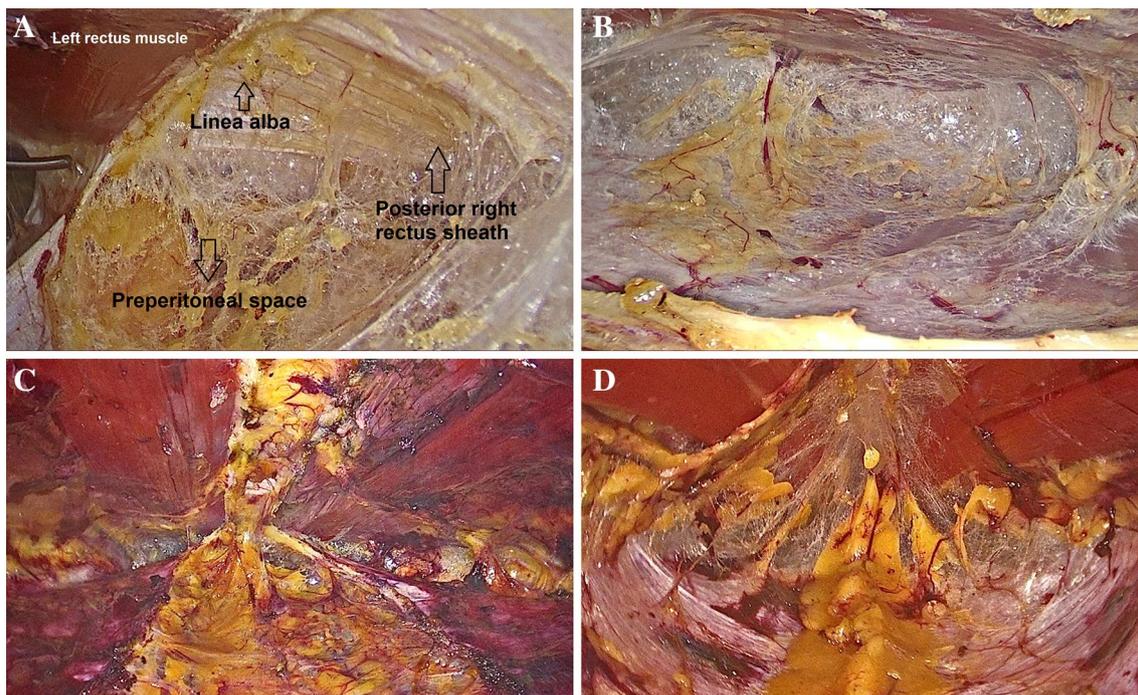
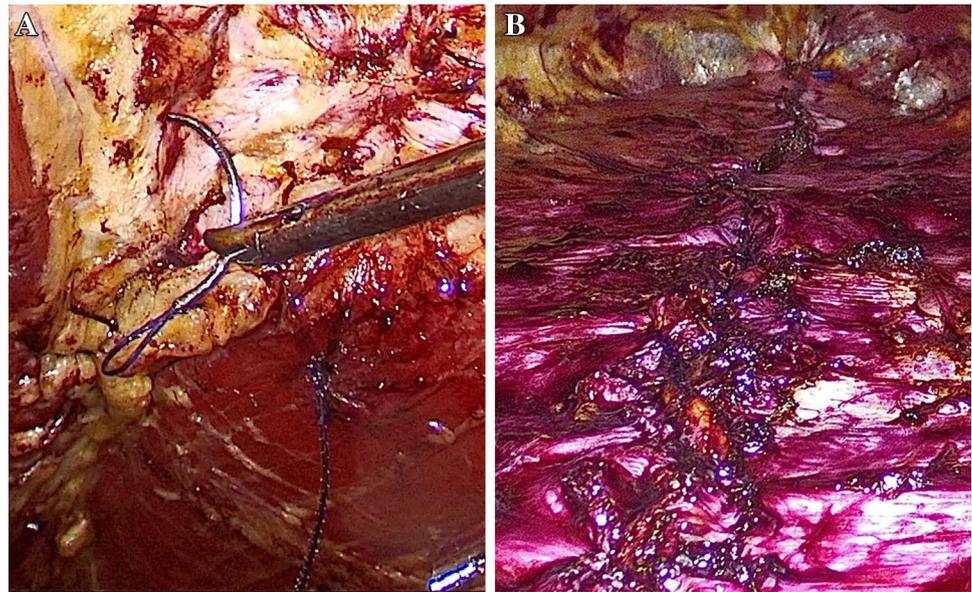


Fig. 3 Main steps of the procedure. **A** Upper crossover from left to the right retromuscular plane. Left rectus muscle, posterior right rectus sheath and preperitoneal space under linea alba is shown with arrows.

B Right retromuscular plane after crossover. **C** Cranial dissection to the level of xiphoid. **D** Caudal dissection to the level of Retzius space

Fig. 4 Suturing part. **A** Suture of linea alba and the defect. **B** Posterior rectus sheath suture



the Chi-squared test or Fisher's exact for small sample sizes. P values <0.05 were considered significant.

Results

Fifty-four patients are included into the analysis—27 (15 males/12 females) eTEP retromuscular ventral hernia repairs and 27 (16 males/11 females) laparoscopic IPOMs. There are no differences in age, sex, BMI, primary or incisional hernias, co-morbidity, active smoking, EHS-classification and immunosuppression throughout the patients between the groups. Patients underwent eTEP are slightly older, compared to IPOM. Mean BMI in the eTEP group is 25.1 and 27.1 in IPOM group. There were 14 primary and 40 incisional hernias, with no significant prevalence of the incisional hernias in the IPOM group. Active smoking is more common in the eTEP group with six patients. One patient with immunosuppression due to active Crohn's disease underwent eTEP. Detailed EHS classification in groups and basic demographics are shown in Table 1.

The mean defect area in eTEP arm is 71 m², with no statistical difference compared to the IPOM—76 cm². Mean mesh coverage did not reach statistical significance, with 428 cm² in eTEP and 318 cm² in the IPOM patients. Operative time was significantly longer in eTEP, with mean 186 min and 90 min in IPOM patients. Only one patient had intraoperative complications leading to blood loss over 100 ml, without the need of hemotransfusion. Usually drains were removed on the second postoperative day in patients undergoing eTEP. One patient was readmitted after, due to adhesive small bowel obstruction on the 25-th postoperative day, which was managed conservatively. There were no

Table 1 Baseline characteristics

Variable	eTEP-27	IPOM-27
Age (Mean \pm SD ; years)	58.7 \pm 11.7	55.6 \pm 14.1
Sex male/female (i)	15/12	16/11
BMI (mean \pm SD)	25.1 \pm 3.9	27.1 \pm 3.2
Primary/incisional (N)	8/19	6/21
EHS classification (N)		
M1	1	2
M2	2	3
M3	21	17
M4	3	4
M5	0	1
W1	2	1
W2	24	25
W3	1	1
R	0	0
Co-morbidity (N)		
Diabetes	2	1
COPD	1	0
Cardio-vascular	4	6
Other	2	3
Active smoking (N)	6	5
Immunosuppression (N)	1	0

N absolute number, *SD* standard deviation, *BMI* body mass index, *EHS* European hernia society, *COPD* chronic obstructive pulmonary disease

readmissions in eTEP group. Mean length of stay did not differ between the groups with 2.9 days after eTEP and 3.4 after IPOM. One recurrence occurred in the IPOM group 8 months after procedure, with lateral mesh failure but the

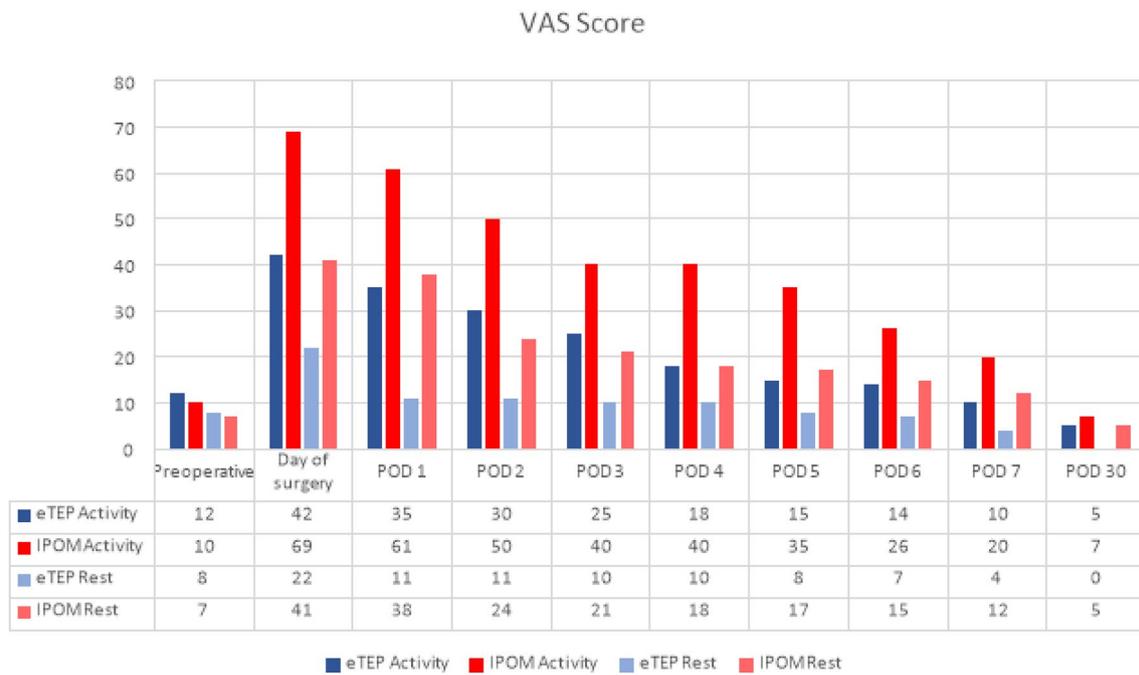


Fig. 5 Table and chart of video analogue pain score

Table 2 Operative and perioperative data

Variable	eTEP-27	IPOM-27	<i>P</i>
Defect area (mean ± SD ; cm ²)	71.4 ± 47.1	76 ± 53.2	NS
Mesh size (mean ± SD ; cm ²)	428.4 ± 220.6	318.2 ± 137.3	NS
Operative time (mean ± SD ; min)	186 ± 62	90 ± 31	S
Blood loss over 100 ml (<i>N</i>)	1	0	NS
Drain removal (mean ± SD ; POD)	2.25	No drain	–
LOS (mean ± SD ; POD)	2.9	3.4	NS
Readmission (<i>N</i>)	0	1	NS
Recurrences (<i>N</i>)	0	1	NS

N absolute number, *SD* standard deviation, *NS* non-significant, *S* significant ($P < 0.05$), *LOS* length of stay, *POD* postoperative day

patient refused further repair. Median video analogue pain score in rest and during physical activity from the day of surgery to the 7-th postoperative day is lower in the eTEP group. Disturbing pain more than 30 mm in eTEP group occurred from the intraoperative day to the second postoperative day when they were active. In both groups, the VAS score reached the point below the preoperative values during the 30-day follow-up. No conversions were performed on patients included in this study. The above-mentioned results are listed in Table 2 and Fig. 5.

The incidence of complications during the 30-day follow up is presented in Table 3. There are no significant differences between the groups. One patient developed a

Table 3 Complications

Variable (<i>N</i>)	eTEP-27	IPOM-27
Intraoperative complications	1	0
SSI	0	0
Seroma	4	3
Hematoma	0	0
Pneumonia	0	1
UTI	1	0
Cardio-vascular	0	0
Mesh infection	0	0

N absolute number, *SSI* surgical site infection, *UTI* urinary tract infection

urinary tract infection, and one-pulmonary infection. Both of them were managed by antibiotics. Four postoperative seromas—three of them without symptoms managed conservatively and one symptomatic—were treated by a single outpatient ultrasound-guided aspiration in the eTEP group. In the IPOM group, 3 patients had asymptomatic seromas, all managed conservatively. No surgical site infections and/or mesh infections are present. In the presented sample, there are no complications requiring surgical reintervention. There is no 30-day perioperative mortality.

Defect closure and linea alba suture were obtained in all eTEP cases, while posterior sheath closure was possible in 24 cases. In the other three cases, posterior rectus sheath

was not possible to be sutured, because of high tension and only peritoneum on the defect was closed.

Discussion

Nowadays, hernia surgeons are faced with so many different options to repair ventral hernia—from open ones with different mesh positions to various minimally invasive techniques. Most of them were developed in the last decade, and sufficient evidence is lacking [12]. Variety of techniques and levels of mesh positioning make decision-making process in ventral hernia surgery difficult. Several different techniques with different mesh locations are available such as subcutaneous onlay approach (SCOLA), endoscopic mini/less open sublay operation (EMILOS), robotic transabdominal preperitoneal ventral hernia repair (rTAPP), retromuscular approach eTEP/eRS and IPOM procedure [13–15]. The retromuscular eTEP/eRS approach combines the advantages of the sublay position of the mesh and all benefits from the minimal invasiveness of the procedure. Avoiding foreign bodies in the abdominal cavity would lead to less related complications [16]. OVHR are proven to be inferior to minimally invasive approach with high incidence of SSI. Several randomized control trails and meta-analyses have shown advantages of IPOM procedure without compromising the recurrence rates [17]. However, IPOM is associated with increased risk of bowel injury, ASBO, bowel erosion and increased morbidity in redo surgery with the risk of visceral injury going up to 21% [18]. Maybe eTEP can overcome them by avoiding foreign bodies in the abdominal cavity with proper sublay mesh position. The current data are lacking with only one multicenter report from Belyansky et al. They report 79 cases—41 of them needed transversus abdominis muscle release (TAR) with mean defect area of 132 cm². Median length of stay was less than 2 days, without readmissions and only three postoperative complications—two of them seroma and one dehiscence at port site without SSI. The recurrence rate in this study is 1.3% [19]. Our data provide comparable results with an average 2.9 LOS and 18.5% complication rate, without recurrences and readmissions. The retromuscular approach provides a possibility for proper position of wide-sized meshes, sandwiched between the posterior fascia and muscle fibers, without any fixation. In contrast to most minimally invasive procedures, IPOM does not necessarily reduce pain or improve the quality of life [20]. Maybe lack of fixation in eTEP procedure can be a reason for reduced postoperative pain. Further quality of life and pain studies between different minimally invasive procedures need to be conducted in order to bring more evidence. The relationship between aggressive double crown fixation and/or transfascial sutures and postoperative pain is presented in some studies [21]. Most of the studies show significant rate of acute

postoperative and chronic pain [22, 23]. So far it is not clear which one of the fixations methods is causing more pain and maybe lack of fixation method will cause less pain. The restoration of a functional abdominal wall is an important factor in OVHR. Failure to close, the fascia can result in higher rates of hernia recurrence [24]. The closure of the defect, linea alba and posterior rectus sheath can decrease the incidence of seroma formation, recurrence, eventration and pseudorecurrence and secures possibility for standard macro-porous mesh implantation [25–27]. Nguyen and Chen have shown an interesting technique for posterior closure during the EMILOS procedure, using the stapled technique [28]. Despite the above-mentioned advantages, a price has to be paid with the prolonged operative time and ergonomic problems for the surgical team. We report mean operative time of 186 min in eTEP group, which is significantly higher than the IPOM's [29]. A multicenter report of Belyansky et al. also reports an operative time of 218.9 min, including 41 cases with release of transversus abdominis [19]. A robotic platform can be a solution for the ergonomic problems during the procedure [30]. In the beginning of 2018, results from a large multicenter double blind study provide strong evidence for reduction of the recurrence rates in small primary umbilical hernias when mesh is used. As a result of this study, eTEP/eRS should not be considered as an overkill for a small hernia defect, which needs sufficient mesh coverage of at least 5 cm in each direction [31, 32].

There are several limitations of the eTEP procedure. In the first place, procedure is not suitable for large and complex ventral hernias where abdominal wall reconstruction is required. Also in patient with multiple small defects procedure can be extremely difficult. So far the method is quite new and longer-term follow-up and recurrences have not yet been assessed. According to the current evidence, there may be a bias because the results are from a high-volume hernia center performed by the top experts in the field. Proper designed prospective randomized trial is needed to bring some strong evidence in the field [33]. Compared with open techniques, trauma is considerably reduced. The eTEP operation is also ideal for obese patients. Compared to the IPOM technique where expensive meshes with an adhesion barrier have to be used, standard large pore meshes can be used in the retromuscular space without any fixation. This can reduce the risk of bowel adhesions, visceral lesions, nerve damage, and acute and chronic pain. The greatest disadvantages that we know so far in eTEP procedure are prolonged operative time even in the expert hands in large volume hernia center and technical difficulties during the operation. Also the learning curve for laparoscopic eTEP approach may be steep, requiring advanced laparoscopic skills. In addition, large defects with previous incisions should not be considered for eTEP as crossover may be troublesome and unsafe [11, 34, 35].

Retromuscular ventral hernia repair by minimally invasive approach is a reproducible and safe technique. Our study shows comparable results of eTEP/eRS and the IPOM procedure. The differences between the two procedures are the reduction in mean postoperative VAS score and the longer operative time both in favor of eTEP. The long-term benefits of the sublay mesh position need to be kept in mind, compared to the intraabdominal prosthesis. On the background of this lack of evidence, this study contributes to the rising data in the field of new minimally invasive techniques for ventral hernia repair. Drawbacks of the study include the small sample size and the minimal number for detection of specific complications. The follow-up period is insufficient for any conclusions about recurrence rates. The pain estimation is not sufficient to evaluate the quality of life after ventral hernia repair with mesh, due to the lack of mesh sensation and movement limitation evaluation so any conclusions about the quality of life are premature. Implementation of new techniques can lead to case selection or learning curve effect on the sample results. The design of the study is retrospective. Strong evidence and randomized control trial are needed to prove the potential benefits of the method.

Compliance with ethical standards

Disclosures Drs. Penchev, Kotashev and Mutafchieski have no conflicts of interest or financial ties to disclose.

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