Section: Research Paper

Retrospective Study of short term outcomes of Ventral Abdominal Wall Hernia Patients Operate by Extended Total Extraperitonial Mesh Repair

[1]Dr. Saurabh Prakash, [2]Dr. R.G Naniwadekar, [3]Dr. Harshwardhan D Haldipur

[1,3]Resident, [2]Professor, Department of General Surgery, Krishna Vishwa Vidyapeeth, Karad, Maharashtra, India

Corresponding author: Dr. Saurabh Prakash, Resident, Department of General Surgery, Krishna Vishwa Vidyapeeth, Karad, Maharashtra, India
Email: zombietheknightrider@gmail.com

ABSTRACT

Aim: The purpose of this study is to evaluate the results of patients who had extended total extraperitonial mesh repair for hernias in the ventral abdominal wall.

Materials and methods: After obtaining the participants' informed agreement, the researchers enrolled a total of two hundred patients in the trial, split them randomly into two groups of one hundred patients each, and compared the immediate results of eTEP and IPOM Plus procedures. Included in the Eligibility Criteria are: Adult patients who presented with primary ventral or incisional hernial defects, a midline defect of size that was equal to or less than 7 centimetres, elective hernia repair, considered eligible for hernia repair through a minimally-invasive approach, able to tolerate GA, and able to give consent for participation in the study. The diagnosis was arrived at with the assistance of a comprehensive medical history, a clinical examination, and information obtained from the appropriate authorities on past surgical treatments.

Results: Co-morbidities were discovered in both the e-TEP RS and the IPOM patient populations. In e-TEP RS, hypertension was found in 40 (40%) of the patients, and in IPOM, it was found in 42 (42%) of the cases. This was followed by stroke, which was found in 21 (21%) and 22 (22%), hypothyroidism, which was found in 5 (5%), and diabetes, which was found in 25 (25%) and 21 (21%) of the cases. The total percentage was 70% for primary hernias, and there was no significant difference between any of the groups. According to the EHS categorization, the majority of the hernias were of the M3 and M4 types. As compared to the e-TEP RS group, there was no statistically significant difference in the mean defect size of the IPOM Plus group, which was 4 cm (4.11 cm). Tables 1 and 2 provide the patient's basic demographic information as well as their clinical state. Incidence of Surgical site infection was 5 (5%) in e-TEP RS is and 7(7%) in IPOM, seroma in e-TEP RS is 17 (17%) and in IPOM 5(5%), Postoperative ileus in e-TEP RS is 12(12%) and in IPOM 32(32%),

Mesh infection in e-TEP RS 3(3%) and in IPOM 3 (3%), Recurrence in e-TEP RS is 3 (3%) and no recurrence observed in IPOM group.

Conclusion: the e-TEP RS repair had shown encouraging results and was gaining widespread acceptance. It results in less presence of co-morbidities and less complications when compared to IPOM repair, which results in less overall cost of treatment procedure, faster return to normal daily activity, lower rate of postoperative complications, and low rate of recurrence as compared to IPOM ventral hernia repair.

Keywords: Extended total extraperitonial, mesh repair, hernias , ventral abdominal wall

Introduction

A ventral hernia is a kind of abdominal wall hernia that may develop at any point along the midline of the abdominal wall (vertical). [1] It is a weakening in the muscles that make up the abdominal wall that causes a protuberance of tissues via a vent in the cavity that contains them. This weakness causes a hernia. It may either be natural (primary) or it can be learned (secondary) (secondary). Epigastric hernia, also known as stomach area hernia, is a type of ventral hernia that can occur anywhere from just below the xiphisternum to the umbilicus or belly button. Umbilical hernia, also known as belly button hernia, is a type of ventral hernia that happens in the belly button area. An incisional hernia can develop at any site where there was a previous surgical scar. [1] Around one-third of individuals who have any major abdominal surgery have a risk of developing an incisional hernia at any location of their scar, which may take place at any point in time following abdominal surgery. This condition can manifest itself at any point in time. The weakening or thinning of the scar tissue results in the formation of a lump in the abdomen. This bump is caused by a piece of tissue, a portion of an organ, or the organ as a whole pressing up against the abdominal wall. Depending on where it is located on the abdomen wall, it is common in people of both sexes. Hernias that develop on the abdominal wall are brought on by morbid obesity, the accompanying comorbidities, wound site infections, immunosuppression, and prostatism in a substantial number of cases. In light of the fact that more than 20 million cases of hernia are diagnosed each year around the globe, researchers concluded that hernia repair is one of the most frequently performed surgical operations. [2, 3] In spite of ongoing debate about the most effective method, ventral hernia repair using minimally invasive (laparoscopic) surgery has become more common over the course of the last two decades. Due to the direct contact of intraperitoneal viscera and implanted mesh, laparoscopic surgery for anterior wall hernias can result in serious complications. These complications include obstruction of the small bowel caused by adhesions, infection of the mesh, erosion of the mesh, and enterocutaneous fistula. [3, 6] According to research that is now outdated, the open retro-muscular mesh hernioplasty (Rives-Stoppa) provides higher advantages than other treatments when it comes to issues that are connected to the mesh. [2] In 2012, Jorge Daes presented the enhanced view completely extraperitoneal (e-TEP RS) repair for inguinal hernia. Thereafter, Belyansky et al. recommended this method for the treatment of ventral hernia. [3, 4]. The e-TEP RS is the technique that is performed where the retro-rectus space, in addition to the preperitoneal space, and the spaces of Retzius and Bogros, at the level of the groyne. It has given surgeons

the chance to investigate the prospect of making use of the retro-rectus area in order to treat ventral hernias, which was previously impossible. eTEP, also known as endoscopic Rives and Stoppa, is the name of the method that is now spreading like wildfire among limited access surgeons (eRS). The findings of studies conducted up to this point have been promising, although conclusive research is still missing. Intraperitoneal Onlay Mesh, more often known as IPOM, is an innovative method of hernia repair in which a mesh is inserted into the abdominal cavity and then put from the interior over the aperture of the hernial sac after the hernial defect has been sutured. In this research, we are contrasting the short-term results of the e-TEP RS method with those of the IPOM Plus treatment for ventral hernial repair. Our goal is to highlight the benefits, drawbacks, and practicality of the e-TEP RS procedure.

Materials and methods

After obtaining the participants' informed agreement, the researchers enrolled a total of two hundred patients in the trial, split them randomly into two groups of one hundred patients each, and compared the immediate results of eTEP and IPOM Plus procedures. Included in the Eligibility Criteria are: Adult patients who presented with primary ventral or incisional hernial defects, a midline defect of size that was equal to or less than 7 centimetres, elective hernia repair, considered eligible for hernia repair through a minimally-invasive approach, able to tolerate GA, and able to give consent for participation in the study. Defects measuring more than 7 centimetres in length, Hernia defects, which are often thought to call for an open approach, Prior to the insertion of the mesh in the retro-rectus space, Patients with a body mass index (BMI) of more than 35 and those who have emergency cases, recurrent ventral hernias, hernias that are accompanied by skin infections and enterocutaneous fistula, patients who are not medically fit for GA, and patients with hernias that have skin infections all require GA. Patients who were unable to interpret a written permission form and sign it were not allowed to participate in this research. After ensuring that they satisfied all of the requirements for participation in the study, a written informed consent was obtained from them about their agreement to take part in the research, and they were told of the procedure that would be performed on them. The diagnosis was arrived at with the assistance of a comprehensive medical history, a clinical examination, and information obtained from the appropriate authorities on past surgical treatments. Ultrasonography of the abdomen, also known as USG, was performed preoperatively on all of the patients in order to determine the extent of the hernia defect (width). The following baseline demographic variables were gathered and analysed: age, gender, body mass index; location and size of primary or incisional hernia; and comorbidities. We took note of and compared a number of intra-surgical criteria, including operating time, the quantity of blood loss, and any complications encountered throughout the procedure. Laparoscopic surgeons with extensive training were responsible for all of the surgeries. After surgery, many post-operative complications were analysed and compared. They included seroma, surgical site infections (SSI), post-operative pain, the need of parenteral analgesia, and total hospital stay. Throughout the post-operative period, pain was rated using a visual analogue scale that ranged from 0 (no pain) to 10 (worst possible pain), with 0 representing no pain and 10 representing the worst possible pain. The

Visual Analog Scale was used to determine the patient's level of pain 12 and 24 hours following surgery. Tramadol was administered intravenously in all instances as a post-operative analgesic at a dosage of 50 milligrammes twice day; any extra doses that were administered were documented. Furthermore tracked and studied were recurrences of the condition as well as the readmission rate. After surgery, each individual patient was monitored for a period of six months. Every patient who had hernia surgery at our facility was given an antibiotic prophylaxis and a fresh shower in accordance with our hospital's protocol. Before operating on some patients, prophylactic treatment for deep vein thrombosis (DVT) was administered. During general anaesthesia, a Foley catheter was inserted into each patient, and it was typically withdrawn on the first postoperative day (POD-1).

We began the dissection for the e-TEP RS procedure either in the upper or lower retro-rectus area, depending on the location of the hernial defect.[5] We prefer to dissect the right lower retro-rectus space first for abnormalities that are either supra-umbilical or epigastric. This is done by beginning the procedure below the umbilicus via the infra-umbilical port. In order to begin repairing abnormalities in the paraumbilical, umbilical, infra-umbilical, and suprapubic regions, we started by dissecting the retrorectus area in the left upper quadrant, which is located just below the costal borders and approximately 2.5 cm laterally to the midline. After the skin incision, a 10-mm optical trocar and a 0° telescope were used in order to conduct the dissection all the way up until the posterior rectus sheath came into view. Using telescopic dissection and a positive pressure created by the carbon dioxide insulation with the pressure set at 15 mmHg, the retrorectus space was dissected. After performing an acceptable amount of dissection, a port with a diameter of 10 millimetres was positioned roughly 5 centimetres below the camera port, just medial to the linea semi-lunaris. Moreover, a port with a diameter of 5 millimetres was positioned more inferiorly. Following this, an incision was made on the medial aspect of the posterior rectus sheath approximately 5 to 7 millimetres below the linea alba, and a crossing over was performed in the preperitoneal space below the linea alba but above the falciform ligament in order to visualise the right posterior rectus sheath. After making an incision approximately 5 to 7 mm below the linea alba in the right posterior rectus sheath, dissection was performed in the right retro-rectus region, and a port measuring 5 mm was positioned just below the costal border. The retrorectus gap was dissected cranially and caudally up to five centimetres depending on the extent of the defect and its location. On both sides, a lateral cut was made across space all the way up to the semilunar line. After the completion of the retro-rectus space creation on both sides, we attempted to reduce the sac. In the event that it was not possible due to dense adhesions between the contents and the sac or irreducibility, we opened the peritoneum proximal to the sac, entered the peritoneal cavity, and performed adhesiolysis, reducing the contents. We then closed the peritoneum along with the posterior rectus sheath bilaterally using absorbable barbed suture (V-Loc) 2-0 in a continuous fashion. After finishing the retro-rectus dissection, we used non-absorbable barbed suture (V-Loc) no.1 to seal the hernia defect while keeping the carbon dioxide insulating pressure at around 10 mmHg. A medium-weight, macroporous polypropylene mesh of size 15 by 15 centimetres or 20 by 15 centimetres was designed and inserted in the

retro-rectus area with a minimum of 5 centimetres of overlap surrounding the defect. No attachment was used. In order to ensure that the mesh was positioned correctly, the inflated gas was progressively deflated while being observed.

In the other group, a technique known as the traditional laparoscopic IPOM Plus was performed. After creating pneumoperitoneum at a pressure of 14 mm Hg using a veress needle, three ports were then inserted into the patient. One measuring 10 millimetres in the epigastric area, about 5 centimetres below the xiphoid, and two measuring 5 millimetres each in the left and right midclavicular regions, approximately 3–5 centimetres below the borders of the costal cartilages. Ports were put laterally while retaining triangulation in the case of an epigastric or supra-umbilical hernia. The contents of the hernia were decreased, and, if necessary, the urinary bladder and falciform ligament were set down in order to appropriately position the mesh. Intra-corporally, using loop nylon suture material No. 1 (Ethilon), and with the pneumoperitoneum at a low pressure, the defect was closed (10 mmHg). Using nylon suture material No.2-0 (Ethilon), four transfascial and intracorporeal sutures were used to fix a composite mesh of size 15x15 or 20x15 to the abdominal wall. There was at least a 5 cm overlap around the defect in all directions. The mesh was composed of polyester mesh along with a second layer of the anti-adhesive absorbable barrier of collagen. Under direct observation, the omentum was spread out across the intestine, and the pneumoperitoneum was deflated. In order to do statistical analysis, the Statistical Package for the Social Sciences, version 25.0, was used. In order to do a quantitative comparison between the two groups, the Mann–Whitney test was used. This was done since the data sets were not regularly distributed. To compare the qualitative variables, a Chi-Square test and a Fisher's exact test were carried out. If the p-value was less than 0.05, statistical significance was regarded to have been achieved.

Results

There were a total of 200 patients included in this trial. Of those patients, 100 were given the e-TEP RS procedure, while the other 100 were given the IPOM Plus procedure. Patients in either group did not vary from one another in terms of age, gender, body mass index, the kind of hernia they had (primary or incisional), the location of the hernia, or the co-morbidities they suffered from. In terms of age group Below the age of 25, 11 (11% of participants) were involved in e-TEP and 9 (9%) were involved in IPOM plus. This was followed by 27 (27%) and 29 (29%) participants who were in the age group 25-35. Finally, 41 (41% of participants) and 48 (48%) participants were in the age group that showed the highest participation in both techniques. There were 62 male participants who were treated with e-TEP RS and 56 male participants who were treated with IPOM plus therapy. The number of female individuals who got treatment was 38 (38%) and 44 (44%) respectively. The mean body mass index (BMI) for the IPOM Plus group was 29.01 kg/m2, whereas the mean BMI for the e- TEP RS group was 31.58 kg/m2. Co-morbidities were discovered in both the e-TEP RS and the IPOM patient populations. In e-TEP RS, hypertension was found in 40 (40%) of the patients, and in IPOM, it was found in 42 (42%) of the cases. This was followed by stroke, which was found in 21 (21%) and 22 (22%), hypothyroidism, which was found in 5 (5%), and diabetes, which was found in 25 (25%) and 21 (21%) of the cases. The total percentage was 70% for primary

hernias, and there was no significant difference between any of the groups. According to the EHS categorization, the majority of the hernias were of the M3 and M4 types. As compared to the e-TEP RS group, there was no statistically significant difference in the mean defect size of the IPOM Plus group, which was 4 cm (4.11 cm). Tables 1 and 2 provide the patient's basic demographic information as well as their clinical state.

Table 1: Demographic characteristics of the study population

Demographic characteristics		e-TEP RS	(%)	IPOM	(%)
Age	Below 25	11	11	9	9
	25-35	27	27	29	29
	35-45	41	41	48	48
	Above 45	21	21	14	14
Gender	Male	62	62	56	56
	Female	38	38	44	44
BMI (mean ± SD)		29.01 ± 2.69		31.58 ± 2.33	

Table 2: The clinical history of the study population

Clinical history		e-TEP RS	IPOM
Presence of co-morbidities	High blood pressure	40	42
	Stroke	21	22
	Hypothyroidism	5	4
	Diabetes	25	21
Mean Defect size of lesion (cms)		4.11 ± 0.74	4.35 ± 0.63
Hernia location as per EHS classification	M1	0	0
	M2	2	5
	M3	60	55
	M4	38	40
	M5	0	0

As compared to the e-TEP RS group, the IPOM Plus group had an operational time that was much reduced, with a mean of 83.18 minutes as opposed to 116.74 minutes. There were no difficulties during the operation for any of the patients, and none of the patients required a drain to be inserted. Participants in the e-TEP RS group reported considerably reduced discomfort at both 12 and 24 hours after the operation, in comparison to those in the IPOM Plus group. Patients in the IPOM Plus group required a considerably higher amount of parenteral analgesia after their operations than patients in the control group. Table 3 provides a comprehensive breakdown of the pain score as well as the analgesics that will be necessary

after the treatment. After surgery, the average number of days spent in the hospital for patients in the e-TEP RS group was 2.44, which was substantially smaller than the number of days needed for patients in the IPOM Plus group.

Table 3: Perioperative details

Variable	e-TEP RS	IPOM Plus	*p* value
Mean operative time (min)	116.74 ± 8.36	83.18 ± 5.63	S
Blood loss over 50 ml	0	0	NS
Mean VAS Score at			
12 h after surgery	4.58 ± 0.15	8.01 ± 0.66	S
24 h after surgery	3.11 ± 0.25	6.25 ± 0.84	S
POD 7	0.41 ± 0.01	1.71 ± 0.23	S
Mean postoperative parenteral analgesia required (equivalent to morphine in mg)	13.63 ± 3.87	32.58 ± 6.47	S
Mean length of stay after surgery (days)	2.44 ± 0.44	2.87 ± 0.55	S

Incidence of Surgical site infection was 5 (5%) in e-TEP RS is and 7(7%) in IPOM, seroma in e-TEP RS is 17 (17%) and in IPOM 5(5%), Postoperative ileus in e-TEP RS is 12(12%) and in IPOM 32(32%), Mesh infection in e-TEP RS 3(3%) and in IPOM 3 (3%), Recurrence in e-TEP RS is 3 (3%) and no recurrence observed in IPOM group. Table 4 provides information on the postoperative complications that were encountered. In this research, all of the patients were treated with conservative management, with the exception of two patients who had post-eTEP RS who were treated with ultrasound-guided aspiration. There were no readmissions in the IPOM Plus group, but during the first six months of the follow-up period, two patients in the e-TEP RS group were hospitalised with a recurrence and were handled with IPOM Plus. The posterior rectus sheath dehiscence was the root of the problem that kept coming back.

Table 4: Postoperative complications

Complications	e-TEP RS	(%)	IPOM	(%)
Surgical site infection	5	5	7	7
Seroma	17	17	5	5
Postoperative ileus	12	12	32	32
Mesh Infection	3	3	3	3
Recurrence	3	3	0	0

Discussion

Repairing a ventral hernia is possible in a number of ways these days, ranging from the open approach, which might include a range of mesh locations, to various less invasive surgical procedures. The majority of these strategies were established in the preceding ten years. [7]

Nevertheless, owing to the many different approaches and degrees of mesh placement, the decision-making process during ventral hernia surgery may be exceedingly challenging. Numerous distinct methods using a variety of mesh placements are included in the aforementioned list. [8] The management of giant ventral hernias was difficult for two reasons: first, the wide variety of clinical presentations and numerous therapeutic options; and second, the high mortality rate associated with large ventral hernia repair, which could be higher than the rates observed for neoplastic pathologies. Both of these factors contributed to the difficulty. [9] The primary focus of this research was to examine the similarities and differences between two different treatment methods, namely e-TEP RS and IPOM. The retromuscular e-TEP RS approach not only has the benefits of placing the mesh in a sublay location, but it also has all of the benefits that come with the treatment being as minimally invasive as possible. In addition, if there were no foreign things in the abdominal cavity during the surgery, there would be less difficulties as a consequence of it. [10] Many randomised control trials and meta-analyses were carried out for the purpose of this research. The results showed that the benefits of the IPOM technique could be obtained without sacrificing the recurrence rates. [11] According to the findings of a research, IPOM is linked to an increased risk of bowel damage, acute small intestine obstruction, bowel erosion, and greater morbidity in redo surgery, with the risk of visceral injury increasing to a maximum of 21%. [18]

e-TEP RS has the advantage of being a minimally invasive treatment, and since the mesh is placed in the sublay/retrorectus position, it avoids the intra-abdominal problems that are associated with mesh placement. An additional benefit of the e-TEP RS is that, in cases of large ventral hernia, the posterior component separation technique, which takes the form of releasing the transversus abdominis muscle, can be combined with the anterior component separation technique in cases where closure is difficult or impossible. It is believed that mesh in the sublay position offers superior quality of postoperative connective tissue formation, less recurrence, and less cost when compared to composite mesh with an anti-adhesion barrier that is used for the intraperitoneal position [13]. This is in accordance with the evidence that is currently available. The data that are now available are insufficient, since just one retrospective comparison research of both methods, carried out by Penchev et al., has been published up to this point. [12] They performed a retrospective study on a total of 54 patients, with 27 individuals assigned to each group. The researchers found that the mean defect area for eTEP and IPOM were 71.4 and 76 cm2, respectively. As compared to IPOM, the mean operation duration for e-TEP RS was 186 minutes, while it was only 90 minutes for IPOM. The median visual analogue pain score after surgery was considerably lower in the group that received e-TEP RS. In this study, the incidence of Surgical site infection was 5 (5%) in e-TEP RS is and 7(7%) in IPOM, the incidence of seroma was 17 (17%) in e-TEP RS and 5(5%) in IPOM, the incidence of postoperative ileus was 12(12%) in e-TEP RS and 32(32%) in IPOM, the incidence of mesh infection was 3(3%) in e-TEP RS and 3 (3%). Table 4 provides information on the postoperative complications that were encountered. In this research, all of the patients were treated with conservative management, with the

exception of two patients who had post-eTEP RS who were treated with ultrasound-guided aspiration. There were no readmissions in the IPOM Plus group, but during the first six months of the follow-up period, two patients in the e-TEP RS group were hospitalised with a recurrence and were handled with IPOM Plus. The posterior rectus sheath dehiscence was the root of the problem that kept coming back. When we compared the e-TEP RS group to the IPOM Plus group, we found that the VAS pain score and the length of hospital stay after surgery were much lower in the e-TEP RS group, although the operating time was significantly higher. In a multicentric retrospective assessment of a total of 79 patients, it was found by Belyensky et al. that 38 of the patients underwent e-TEP RS and 41 of the patients underwent e-TEP RS with TAR. The e-TEP RS solo group had a mean defect size (width) of 6.2 cm, whereas the e-TEP RS plus TAR group had a mean defect size (width) of 11.1 cm. The mean duration of stay was one day for e-TEP RS and 2.7 days for e-TEP RS with TAR in their research, and only one patient had recurrence after e-TEP RS [4]. Both the mean duration of stay and the rate of recurrence found in our analysis are similar to those found in the study by Belyensky et al. A retrospective study conducted by Baig et al. on 21 patients showed that 9 patients underwent e-TEP RS only while the remaining 12 patients required TAR along with e-TEP RS, 2 patients had surgical site occurrence and one patient had recurrence, the median pain score using VAS at the first postoperative day was 3, and the time to discharge after surgery was 3 days; these findings are comparable to the results of our study [14]. When the mesh is put so that it is sandwiched between the muscle and the posterior sheath when it is in the sublay position, it does not need any kind of fixation. As several studies found a direct correlation between aggressive mesh fixation and postoperative pain [15, 16], it is possible that the absence of mesh fixation in e-TEP RS with tackers or sutures is the cause of the reduced amount of postoperative pain experienced by patients.

Mesh that provides enough coverage should be utilised for the treatment of small ventral hernias, as new research and SAGES recommendations suggest [17]. This results in a lower risk of recurrence in these types of hernias. e-TEP RS has been shown to have a number of drawbacks, which have been discovered in at least one investigation. To begin, the e-TEP RS is not an appropriate treatment option for big and difficult ventral hernias, in particular those cases in which abdominal wall repair is required. In addition, the treatment might be particularly challenging for patients who have a number of different minor abnormalities. According to the evidence that is currently available, the limitations of e-TEP RS include a prolonged operative time, a prolonged learning curve, the requirement of advanced laparoscopic skills, and the difficulty in crossing over to the other side when dealing with a large defect that has already been incised [12].

Conclusion

According to the research that was referenced above, the e-TEP RS repair had shown encouraging results and was gaining widespread acceptance. It results in less presence of co-morbidities and less complications when compared to IPOM repair, which results in less overall cost of treatment procedure, faster return to normal daily activity, lower rate of postoperative complications, and low rate of recurrence as compared to IPOM ventral hernia

repair. It results in less presence of co-morbidities and less complications when compared to IPOM repair. As a result, the e-TEP RS repair is generally regarded as the method of choice for the repair of ventral hernias in the majority of research.

References

[1] Akkary E, Panait L, Roberts K, Duffy A, Bell R. Sutureless laparoscopic ventral hernia repair in obese patients. JSLS.2011; 15 (2): 154-159. doi: 10.4293/108680811X13022985131859

[2] Daes J. The enhanced view-totally extraperitoneal technique for repair of inguinal hernia. Surg Endosc.2012; 26 (4): 1187-9. doi: 10.1007/s00464- 011-1993-6.

[3] Robinson T, Clarke J, Schoen J, Walsh M (2005) Major meshrelated complications following hernia repair events reported to the food and drug administration. Surg Endosc 19: 1556–1560.

[4] Belyansky I, Daes J, Radu VG, Balasubramanian R, Reza Zahiri H, Weltz AS et al (2018) Anovel approach using the enhancedview totally extraperitoneal (eTEP) technique for laparoscopic retromuscular hernia repair.Surg Endosc 32: 1525–1532

[5] Prakhar G, Parthasarathi R, Cumar B et al (2020) Extended view: totally extra peritoneal (e-TEP RS) approach for ventral and incisional hernia—early results from a single center. Surg Endosc. https: //doi. org/10.1007/s0046 4-020-07595-4

[6] Holihan J, Nguyen D, Nguyen M, Mo J, Kao L, Liang M (2016) Mesh location in open ventral hernia repair: a systematic review and network meta-analysis. World J Surg 40 (1): 89–99

[7] Vorst AL, Kaoutzanis C, Carbonell AM, Franz MG. Evolution and advances in laparoscopic ventral and incisional hernia repair. World J Gastrointest Surg.2015; 7 (11): 293-305. doi: 10.4240/wjgs. v7. i11.293.

[8] Bellido Luque J, Bellido Luque A, Valdivia J, Suarez Gráu JM, Gomez Menchero J, García Moreno J, et al. Totally endoscopic surgery on diastasis recti associated with midline hernias. The advantages of a minimally invasive approach. Prospective cohort study. Hernia.2015; 19 (3): 493-501. doi: 10.1007/s10029- 014-1300-2.

[9] Schwarz J, Reinpold W, Bittner R. Endoscopic mini/less open sublay technique (EMILOS)-a new technique for ventral hernia repair. Langenbecks Arch Surg.2017; 402 (1): 173-180. doi: 10.1007/s00423- 016-1522-0.

[10] Iqbal CW, Pham TH, Joseph A, Mai J, Thompson GB, Sarr MG. Long-term outcome of 254 complex incisional hernia repairs using the modified Rives- Stoppa technique. World J Surg.2007; 31 (12): 2398- 404. doi: 10.1007/s00268-007-9260-7.

[11] Forbes SS, Eskicioglu C, McLeod RS, Okrainec A. Meta-analysis of randomized controlled trials comparing open and laparoscopic ventral and incisional hernia repair with mesh. Br J Surg.2009; 96 (8): 851-8. doi: 10.1002/bjs.6668.

[12] Penchev, G. Kotashev, V. Mutafchiyski, Endoscopic enhanced-view totally extraperitoneal retromuscular approach for ventral hernia repair. Surg Endosc.2019; 33: 3749–3756 https: //doi. org/10.1007/s00464-019- 06669-2

[13] Binnebösel M, Klink CD, Otto J, Conze J, Jansen PL, Anurov M et al (2010) Impact of mesh positioning on foreign body reaction and collagenous ingrowth in a rabbit model of open incisional hernia repair. Hernia 14: 71–77

[14] Baig SJ, Priya P (2019) Extended totally extraperitoneal repair (eTEP) for ventral hernias: Short-term results from a single centre. J Minim Access Surg 15 (3): 198–203

[15] Brill JB, Turner PL (2011) Long-term outcomes with transfascial sutures versus tacks in laparoscopic ventral hernia repair: a review. Am Surg 77 (4): 458–465

[16] Nguyen S, Divino C, Buch K, Schnur FNP, Weber J, Katz KMD, Reiner L, Aldoroty M, Herron RD (2008) Postoperative pain after laparoscopic ventral hernia repair: a prospective comparison of sutures versus tacks. JSLS 12 (2): 113–116

[17] Earle D, Roth J, Saber A, Haggerty S, Bradley J, Fanelli R, PriceR RW, Stefanidis D (2016) SAGES guidelines for laparoscopic ventral hernia repair. Surg Endosc 30 (8): 3163–3183

[18] Jenkins ED, Yom V, Melman L, Brunt LM, Eagon JC, Frisella MM, Matthews BD. Prospective evaluation of adhesion characteristics to intraperitoneal mesh and adhesiolysis-related complications during laparoscopic re-exploration after prior ventral hernia repair. Surg Endosc.2010; 24 (12): 3002-7. doi: 10.1007/s00464- 010-1076-0.