ETEP TECHNIQUE FOR INGUINAL AND VENTRAL HERNIAS: APPROACH BEING SIMPLIFIED

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ABSTRACT Background: Enhanced view extraperitoneal (eTEP) approach foringuinal and ventral hernias repair is becoming the preferred technique. Initially, the technique was described by Jorge Daes for inguinal hernia repair, and later Igor Belyansky applied this technique for ventral and incisional hernia repair. Since it does not penetrate the peritoneal cavity, the major advantage of this approach is in reducing the risk of intestinal and vascular injuries as well as herniation at the trocar sites. Furthermore, this eTEP approach provides scope for flexible port placement and wide coverage by the prosthetic mesh inthe retromuscular space with hardly any transfascial fixation. Here we bring forward the technical benefits and avoidable hurdles that might render this the most sought approach. **Patients and Methods:** 72 patients with a mean age of 44 yrs underwent eTEPrepair between July 2018 and June 2022. The data was analysed for standardising the surgical steps of the eTEP approach, operative time taken, technical advantages of this approach and hurdles encountered **Results:** All 72 patients underwent laparoscopic repair successfully. There were six conversions to alternate laparoscopic hernia repair techniques. The operative time improved with the subsequent surgeries though initially, it was prolonged. **Conclusion:** Our clinical experience with the eTEP approach has been convincing.With improved technical steps, adjunct hybrid manoeuvres & hurdles overcome, eTEP is becoming a favourable approach for laparoscopic inguinal and ventral hernias repair in our practice. We believe this technique makes a striking presence among all the types of surgical approaches for laparoscopic hernia repair.

KEYWORDS eTEP, Laparoscopic inguinal hernia repair, Laparoscopic ventral hernia repair

Introduction

Inguinal & ventral hernias can be repaired laparoscopically by four broadly described techniques: Extraperitoneal (TEP) repair, Extended view extraperitoneal (eTEP) repair, Transabdominal preperitoneal (TAPP) repair and Intra-peritoneal onlay mesh (IPOM) repair [1]. The extraperitoneal (TEP) technique has constraints such as limited space for dissection & mesh placement, restricted port placement, possible intolerance of pneumoperitoneum, and difficulty in teaching & learning the technique, leading to the low implementation of the technique outside the circle of experts [2].

IPOM/Laparoscopic ventral hernia repair (LVHR) has rare complications such as adhesive bowel obstruction, mesh erosion & enterocutaneous fistula [3,4]. The transabdominal preperitoneal(TAPP) approach for inguinal, ventral & incisional hernia [5] has difficulty elevating & closing thin peritoneal flaps, making it challenging to reproduce; and so is Laparoscopic Trans-Abdominal Retromuscular (TARM) repair for ventral hernia described by Ashwin Masurkar [6]. The enhanced/ extended-view extraperitoneal (eTEP) approachis the latest laparoscopic technique for repairing inguinal & ventral hernia.

eTEP technique has been standardized since its first publication in Surgical Endoscopy. First, Jorge Daes described the eTEP technique for laparoscopic inguinal hernia repair in 2012 [7]. And then six years later, Igor Belyansky applied thistechnique for laparoscopic retromuscular hernia repair of ventral and inci-

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sional hernias, published in Surgical Endoscopy again [8]. The rationale behind the eTEP approach is that the preperitoneal space can be entered virtually from anywhere in the anterior abdominal wall[1].

Patients and Methods

Our study, between July 2018 and June 2022, consisted of 72 patients who underwent laparoscopic eTEP hernia repair. All patients underwent pre- operative work-up for surgical fitness and confirmation diagnosis. In addition, the data wasanalysed for standardising the surgical steps of the eTEP approach, operative time taken, and technical advantages of this approach, including a few hybrid manoeuvres and hurdles encountered, which were overcome in subsequent cases.

Inclusion criteria

All patients diagnosed with an inguinal, paraumbilical hernia and epigastric herniaParaumblical hernia/ epigastric hernia defect of fewer than 10 cms.

Age: 20 to 60 years

Exclusion criteria

- All patients diagnosed with recurrent hernia
- All ventral hernia with defects of more than 10 cms
- Ventral hernias with loss of domain and dystrophic or ulcerated skin
- Incisional hernias of any size
- Patients unfit for general anaesthesia
- Paediatric hernias

Key technical steps

After induction of general anaesthesia, all umbilical/ ventral hernias, bilateral inguinal hernias and large inguinoscrotal hernias had Foley's catheterisation.

Patient positioning

The patient is in a supine position with arms tucked by the side. The Operation tablewith provision for table break to provide extension at hips and neck, especiallyfor umbilical/ ventral hernias and moreover in overweight/ obese patients, in fact a very important step in planning eTEP. Appropriate patient/ table positioning lead to a huge paradigm shift in our perception of eTEP approach [Figure 1a].

Inguinal hernia

1. **Entry into Retrorectus space by High camera port placement:** The crucial step of entering preperitoneal space is a 10-12 mm incision over the upper lateral quadrant of the abdomen, around 5 cms cephalad and 4 cm lateral to the umbilicus for the camera port [Figure 1b]. The incision is extended through the skin, subcutaneous tissue and anterior rectus sheath. Here the rectus abdominis muscle fibres are split. Next, the posterior rectus sheath and then rectro-rectus space is entered by manual/ digital dissection. Further dissection can be either with balloon trocar and visiport, as described by V. G. Radu [9] or blunt dissection with the camera itself. This high camera port placement can be eased by locating linea semilunaris under ultrasound guidance pre-operatively [10] or by asking patients to cough or perform valsalva manouvre prior to induction of general anaesthesia; which would taut the rectus abdominis muscle, thus hintingthe lateral border of rectus abdominis muscle/ location of linea semilunaris.

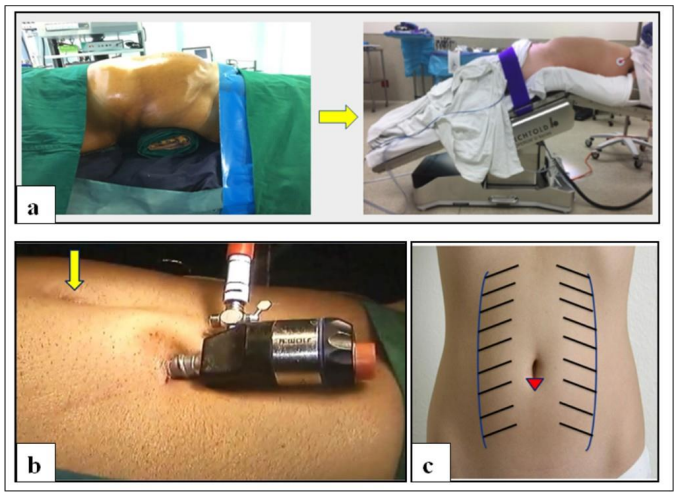

Figure 1 (a) Difference in patient positioning on the operating table, without and with table break; (b) High camera port location(Arrow locating the umbilicus); (c) Camera port location in classical TEP (Red) Semilunar lines (Vertical blue) Possible camera port and other ports locations (oblique black lines area) in eTEP

2. **Flexible port distribution:** As described by Jorge Daes initially, two additional ports are placed in unilateral inguinal hernia. One at the umbilicus and second port high in the lower abdominal quadrant opposite the hernia. Port placements can be flexible anywhere in the area of potential extraperitoneal space [Figure 1c] to achieve triangulation and a comfortable dissection. The advantage of this set-up is that clash of operating surgeon and the camera assistant can be avoided by standing in opposite sides, unlike in TEP or TAPP.

3. **eTEP space creation:** The Linea semicircularis/ Arcuate line/ semicircular line of Douglas (Douglas's line) is the line demarcating the lower limit of posterior rectus sheath. The Douglas's line is divided blindly with scissors, as described by Jorge Daes. Thisenhances the visibility but runs the risk of pneumoperitoneum. In our experience, this accidental pneumoperitoneum was much easier to manage and proceed with eTEP, unlike in TEP; this was attributed to the splinting effect of a tougher posterior rectus sheath compared to flimsy peritoneum which obstructed vision in TEP. We also managed accidental pneumoperitoneum with a fan retracter [Figure 2a] introduced to maintain space since there was scope for additional ports and, of course, the additional step of introducing a verees needle at Palmar's space into the intra-peritoneum. At times, introducing 5mm visiport at the palmar's space to let out pneumoperitoneum by partially opening the valve was of great help. The left retrorectus space dissection is continued caudally till pubic bone is identified, the first landmark in creating eTEP space for inguinal hernia. Next, space for deploying mesh is created with blunt and sharp dissection. Limits of dissection are umbilicus superiorly, linea semilunaris and anterior superior iliac spine laterally, retro- pubic space inferiorly and linea alba medially in unilateral hernias. Crossing midline

caudal to Douglas's line in bilateral hernias is relatively easier since the posterior rectus sheath and linea alba is a deficit.

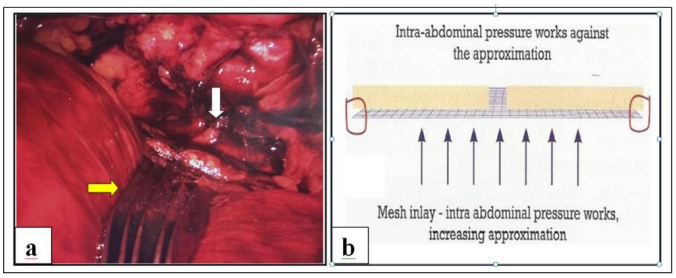

Figure 2 (a) Fan retractor (Yellow) to maintain eTEP space (White-Pubic symphysis); (b) Pascal's law for mesh repair

4. **Ports placement for inguinal hernia:** Following the creation of retrorectus space, the rest of the ports are placed under vision.Then, ports arrangement for the right inguinal hernia [Figure 3a] and left inguinal hernia [Figure 3b] are demonstrated.

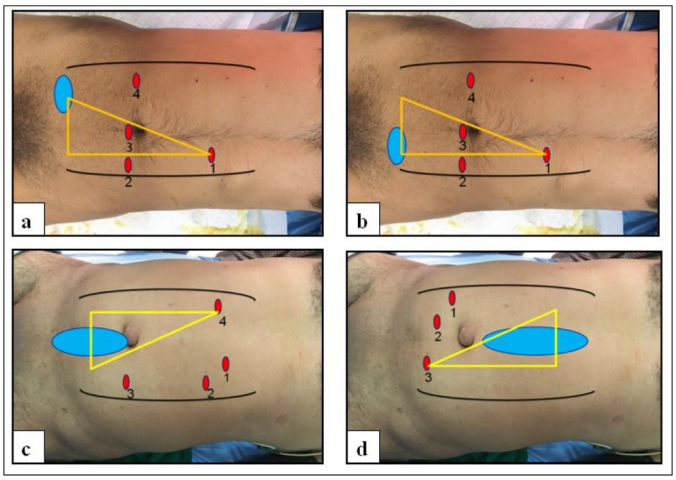

Figure 3 Semilunar lines (Black); (a) For Right Inguinal Hernia, sequence of ports placement (Red-1, 2, 3 & 4) area of hernia dissection (Blue) visual approach by camera port (Yellow); (b) For Left Inguinal Hernia, sequence of ports placement (Red-1, 2, 3 & 4) area of hernia dissection (Blue) visual approach by camera port (Yellow): Fig. 4: Semilunar lines (Black); (c) For Umbilical and Lower Midline Ventral Hernias, sequence of ports placement (Red-1, 2, 3 & 4) area of hernia dissection (Blue) visual approach by camera port (Yellow) (d) For Upper Midline Ventral Hernias, sequence of ports placement (Red-1, 2 & 3) area of hernia dissection (Blue) visual approach by camera port (Yellow)

5. **Hernia repair:** In the extraperitoneal space, the initial important landmark pubic tubercle is reached & Cooper's ligament is exposed, epigastric vessels are identified, and Bogros space is developed. In direct hernia, transversalis fascia is separated from hernia content. The hernia sac is retracted medially in an indirect hernia while cord structuresare dissected laterally. In large inguinoscrotal hernias, sac can be opened, contents reduced, sac ligated proximally with a catgut loop and divided distally, followed by lay opening of the distal sac for parietalisation to avoid seromas and pseudohydroceles. This manoeuvre can often be achieved with the help of external pressure on the scrotum of the inguinoscrotal hernia. Redundant sacs can be hitched to the pubic tubercle or abdominal wall above the ileopubic tract with absorbable tacks following complete hernia reduction. We used 10 x 15 cms medium-weight macroporous polypropylene mesh, which was trimmed accordingly. Mesh is anchored with synthetic absorbable tacks to the pubic tubercle& coopers ligament inferior-medially. Tackers were avoided in the triangle of pain and the triangle of doom. Hence, mesh stays in position by Pascal's law asin Rives-Stoppa repair [11,12] [Figure 2b].

6. **Ports closure:** Anterior rectus sheath of 10mm ports is closed with 2-0 vicryl absorbable suture. A skin incision of all ports is closed.

Umbilical & ventral hernia

1. **Entry into Retrorectus space by High camera port placement:** Initial port placement and midline crossover depend on hernia defect location. Not to mention that the flexion of the operation theatre table and the patient position are of utmost importance. The first incision for camera port entry into retrorectus space for umbilical and lower midline ventral hernias was similar to the inguinal hernia approach [Figure 1b]. For the upper midline defect, the camera port entry was 2 cm below a horizontal line drawn through the umbilicus and just medialto linea semilunaris, as described by Igor Belyansky [8].

2. **Ports placement for umbilical & ventral hernia:** The rest of the ports are placed under vision following the creation of retrorectus space for umbilical/ lower midline hernias and Retzius space for upper midline hernias. Ports arrangement for umbilical/ lower midline defects [Figure 3c] and upper midline defects [Figure 3d] are as demonstrated in the figures, with the 'triangulation' of ports being incorporated.

3. **eTEP space creation and crossing the midline:** The Douglas's line is approached similarly as in the inguinal hernia while approaching lower midline defects; further dissection would be as in the bilateral inguinal hernia described earlier. In upper midline defects, dissection from Retzius space is continued cephalad to identify the released posterior rectus sheaths, and retro rectus space is connected on either side. The crossover of the midline can be challenging in the upper midline region. This is achieved by the incising medial aspect of the posterior rectus sheath, entering the preperitoneal space just superficial to the Falciform ligament. Then the medial aspect of the opposite posterior rectus sheath is identified and incised to enter the contralateral retrorectus space. The retrorectus dissection is then continued on either side to approach most distal attachments of the hernia sac. A laparoscopic posterior component separation in the form of Transverses Abdominis Release (TAR) described by Dr Novitsky et al. [13] can be added in cases with wide (>10 cm) posterior defect, predicted tension over the posterior layerwhile closing the defect, narrow retrorectus space (<5 cm) or when dealing a poorly compliant abdominal wall [Figure 4a] which did not require in our cases with respect to exclusion criteria of >10 cms defect.

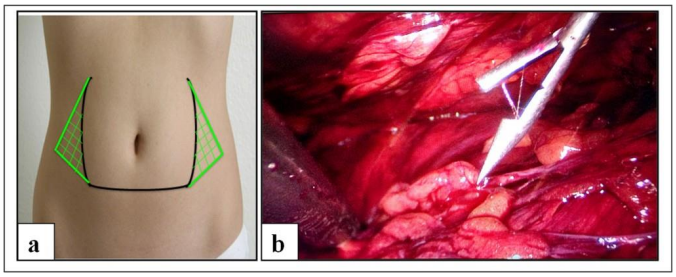

Figure 4 (a) eTEP access to preperitoneal space for TAR (Green) outside semilunar lines (Black); (b) Extra- corporeal cobbler needle assistance for closure of hernia defect in umbilical and ventral hernias

4. **Hernia repair:** Defects in the posterior rectus or peritoneum are closed with 2-0 absorbable sutures, and of anterior rectus is closed with 1-0 barbed non-absorbable sutures. A medium-weight macroporous polypropylene mesh was deployed after resizing it to the size of defect with 5 cms of overlap beyond the defect. Very little or hardly any mesh fixation is required, as Pascal's law described earlier works out[11,12]. Despite that, we have used a few synthetic absorbable tacks (Secure strap) in mostcases, although there has been a description of transfascial sutures & fibrin sealant glue.

5. **Ports closure:** Similar to as described earlier for inguinal hernias

Results

Seventy-two cases were operated between July 2018 to June 2022. 42 were male & 30female. 44 patients had inguinal hernias, of which 14 were bilateral inguinal hernia, 22 patients had paraumblical hernia and 6 were epigastric hernias.

The patient's ages ranged between 28 & 60 yrs. All 72 patients underwent laparoscopic hernia repairs successfully. Two inguinal hernias were converted to TAPP due to accidental pneumoperitoneum, compromising the working space. Two paraumbilical hernias were converted to TARM due to the wide divarication of rectii. Two paraumbilical hernias were converted to IPOM due tounsuccessful entry into preperitoneal space. Duration of surgery was approx 80 mins in a unilateral inguinal hernia, 110 mins in a bilateral inguinal hernia and in a paraumbilical or epigastric hernia around 150 to 180 mins. Foley's catheter was removed on postoperative day 1. Most of our patients went home by post-op day 2.

Discussion

Technical benefits

This study's onus lies in elaborating on technical benefits and hurdles to overcome. The salient features of eTEP technique are rapid & facile creation of theextraperitoneal domain, large operative space, flexible port set-up & improved tolerance of pneumoperitoneum[1,7] attributed to the splinting effect of the posterior rectus sheath. eTEP approach is favourable in learning & mastering the procedure by novel surgeons & for challenging hernia cases such as large inguinoscrotal, sliding or incarcerated inguinal hernias, obese or post-bariatric patients, previous pelvic surgeries, a short distance between umbilicus & pubic tubercle[1,7]. We observed that the operative time duration of eTEP improved with the subsequent surgeries, more so in inguinal hernias than umbilical/ ventral hernias, though initially, it was prolonged. Mesh's cost-effectiveness is higher in eTEP ventral hernia repair compared to IPOM. The advantage of eTEP over IPOM/ TAPP repair for ventral hernia is that it does not involve entry into the abdominal cavity, thus reducing the risk of intestinal & vascular injuries and herniation at trocar sites, mesh and tacker-related issues of IPOM [3,4]. eTEP follows Pascal's principle of hydrostatic pressure for Hernia-Mesh repair as in Rives-Stoppa repair[11,12] [Figure 2b]; there is the scope of renovative space augmentation steps like the use of fan retractor [Figure 2a], extracorporeal cobbler needle aided closure of hernia defect in umbilical and ventral hernias [Figure 4b], opening hernia sac and direct visualization in large inguinoscrotal hernias and of course flexible ports placement [Figure 1c]. An intuition for converting to alternate laparoscopic approaches of inguinal & ventral hernias such as TAPPand TARM is the safety harness in case the eTEP plane of dissection not achieved or dissection does not progress further over some time.

Hurdles

The hurdles encountered can be easily overcome. However, we faced some, and some derived from previous publications. To mention: Wide divarication of rectii with loss of domain, narrow rectus abdominis muscles compromising the inter-rectus sheath space rendering difficult eTEP entry and space creation, large ventral hernias which took more time when compared to IPOM, poor positioning of the patient, which emphasizes the importance of table break for umbilical & ventral hernias.

Conclusion

Our initial experience with the eTEP technique in 72 patients has been convincing. This is a small group observation & there is scope for larger group observation.eTEP technique is striking among all surgical approaches for laparoscopic hernia repair. There are many scopes to improve on technical steps with leverage to incorporate hybrid steps and enough opportunity to overcome hurdles. eTEP approach gives a wide area to negotiate around and conclude the procedure, thus taking out the shortcomings of TEP/ TAPP in inguinal hernias & IPOM/ TARM in umbilical/ ventral hernias. Hence , eTEP is becoming a favourable approach for laparoscopic inguinal and ventral hernias repair in our practice.

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