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Laparoscopic Repair of Primary and Secondary Epigastric Hernias. Technical Considerations of the IntraPeritoneal On Lay Mesh + Defect Closure (IPOM-Plus Technique)

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Abstract

Introduction: We present our experiences with the laparoscopic repair of primary and secondary (incisional) epigastric hernias that occur in the vicinity of bony structures.

Material and Methods: In our institute, we retrospectively reviewed 51 patients with primary and secondary epigastric hernias from 2002 to 2016. The European Hernia Society guidelines were used for classifying these hernias. Laparoscopic dissection of the falciform ligament, intracorporeal suturing of the defect and intraperitoneal composite mesh onlay placement was performed in all patients.

Results: There were 32 males and 19 females with a mean age of 40 years and a mean BMI of 29.5kg/m^2. There were multiple defects in eight patients (15.68%). The mean hernial defect size was 5.75 cm^2 (range 3–8.5 cm^2). The surface of the used mesh was ranging from 225-400 cm^2 (mean 312.5 cm^2). Mean follow-up was nine months. Morbidity rate was 11.7% and the recurrence rate was 1.9%.

Discussion: Upper abdominal hernias are difficult to manage laparoscopically because of the complexity of dissection and their anatomic proximity to the falciform ligament, xiphoid and costal margins. Multiple defects and associated hernias can also be easily identified and laparoscopically repaired simultaneously with the placement of a large mesh. The mesh borders can be adequately fixed beyond the bony confines via the laparoscopic approach, which would otherwise be impossible in the open technique. Laparoscopic repair of these hernias is safe and effective and provides all the benefits of minimally invasive surgery.

Key words: *Epigastric hernias; traumatic hernia; laparoscopic repair; defect closure; composite mesh*

Introduction

The asynchronous development of structural and metabolic disorders of aponeuroses abdominis is the major factor in the formation of hernias of the linea alba [1]. These primary hernias that occur cephalad to the umbilicus in the upper midline along the linea alba are called fatty hernias of the linea alba (or epigastric hernias). Secondary hernias can also occur in this area due to upper midline, sub-xiphoid, subcostal or transverse incisions, or abdominal trauma. Several open techniques to repair them have been reported in the literature [2,3]. There are also a few studies that compared the open versus laparoscopic approaches in epigastric hernia repairs [4,5]. As far as the laparoscopic approach is concerned, the key to a good repair of these defects lies in the understanding of the anatomic proximity of the falciform ligament, xiphoid process and both costal margins/ribs. Laparoscopic ventral hernia repair was first described by LeBlanc and Booth in 1993 and has since become popular worldwide [6]. We present our experience with the laparoscopic repair IPOM-Plus technique (Intraperitoneal Onlay Mesh + Defect closure) of hernias localized in upper abdomen.

Methods

In this study, we describe the laparoscopic repair of all epigastric hernias using the IPOM-Plus technique treated in our institute. Median (M1 and M5) and lateral defects (L1 and L4) according to EHS Guidelines were used to classify the types of epigastric hernias in this study [7] (Table 1).

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Table 1. *Ventral Hernia Classification (European Hernia Society Guidelines).*

MIDLINE	Subxiphoidal	M1
	Epigastric	M2
	Umbilical	M3
	Infraumbilical	M4
	Suprapubic	M5
LATERAL	Subcostal	L1
	Flank	L2
	Iliac	L3
	Lumbar	L4

The different types managed in our series are as follow:

1. Primary midline epigastric hernias (fatty hernia of linea alba): M1, M2
2. Upper midline incisional hernias (M2) and sub-xiphoid incisional hernias (M1)
3. Lateral defects (subcostal incisions): L1

We retrospectively studied 51 patients with epigastric hernias from 2002 to 2016. There were 27 patients with primary epigastric hernias and 22 patients with secondary (incisional) epigastric hernias. Out of these 51 patients, the hernia arose from upper midline incisions (M2 Type) in 28 patients, from subcostal incisions (L1 Type) in 18 patients, from sub-xiphoid incisions (M1 Type) in three patients. Two patients had recurrent epigastric hernias following an open repair without mesh. The patients with the sub-xiphoid hernias had coronary bypass grafts and their sternal incisions extended onto the sub-xiphoid area. In one patient with incisional epigastric hernia, the cause was a prior penetrating abdominal trauma.

Preoperative workup included a thorough history of previous surgeries. Physical examination using provocative maneuvers were done to accentuate the hernia bulge and to delineate the lower limit of the defect. Routine blood test and urinanalysis test were performed in all patients, as was anesthetic assessment. Ultrasonogram (USG) was performed in all cases, which was helpful in determining the exact size of the hernia, its contents, and relation to the costal margins.

Procedure (IPOM-Plus Technique)

All the surgeries were performed by three specialist laparoscopic surgeons at our institute. All patients received 3 doses of intravenous antibiotics (ceftriaxone 1 gm) one hour before surgery and two, 12-hourly doses thereafter. The patients were placed supine, in a semi-lithotomy position, both arms outstretched, with a 20-degree right tilt. The operating camera surgeon and scrub nurse stood to the left of the patient. The monitor was placed on the patient's right side. Pneumoperitoneum was achieved via a Veress needle introduced in the umbilicus. We used three trocars for the procedure; one 10mm for the 30-degree angled laparoscope, and two 5mm trocars for the right and left working hands. All three trocars were placed along the left anterior axillary line (Figure 1). The procedure in all patients was commenced with a sharp adhesiolysis, avoiding injury to any hollow viscus. After the herniated contents were completely reduced (Figure 2), the falciform ligament was mobilized using a monopolar hook (Figure 3). Inferiorly, the median umbilical ligament was mobilised to facilitate mesh fixation. Both axes of the defect were measured with a tape and marked outside, on the anterior abdominal wall. The

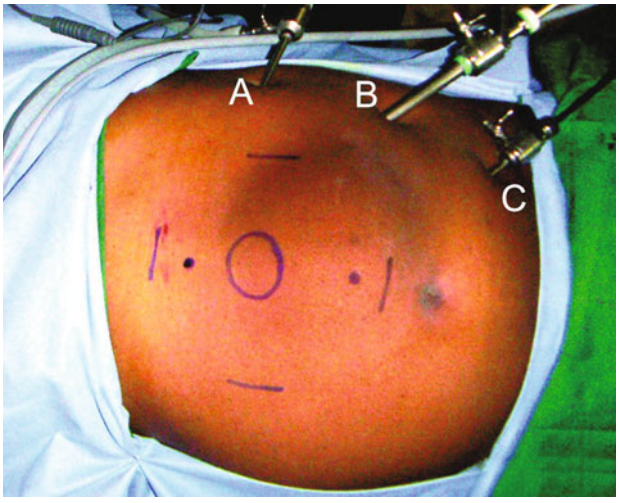

Figure 1. External view of the epigastric swelling and hernia defect (black circle); port position. A. Right working hand. B. Telescope. C. Left working hand.

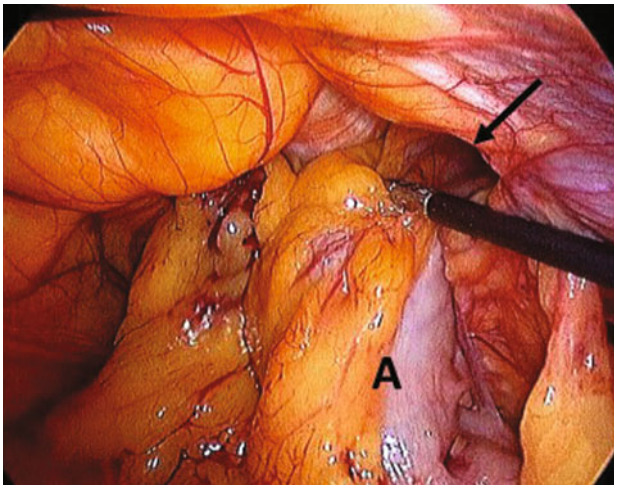

Figure 2. Reducing the hernial contents (A - transverse colon) from the defect (Arrow).

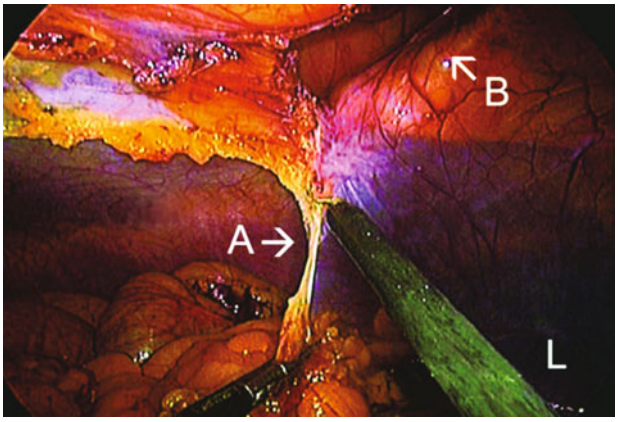

Figure 3. Falciform ligament being divided (A), large defect is seen (B), L – liver.

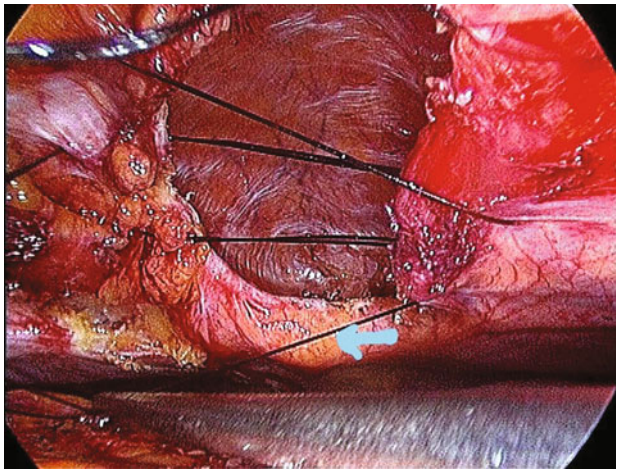

Figure 4. Intracorporeal suturing to close the defect; xiphoid process is visible at the proximal end of the defect (Arrow).

superior edge of the defect was closely associated with both costal margins in most cases. In patients with wide hernia defects (W2 and W3 Types) causing loss of domain, a 1.0 polypropylene suture was introduced into the peritoneal cavity directly through a 2-mm stab on the abdominal wall and the defect was closed with intracorporeal continuous sutures (Figure 4). Once the edges were marked, the insufflation was reduced, and the prosthesis was measured and trimmed to be 5 cm wider than the defect. The composite mesh (with the 3 pretied sutures) was introduced blindly into the peritoneal cavity via the 10mm trocar after removing the telescope. The mesh was deployed to cover the defect with an overlap of 5 cm on all sides. The pretied sutures of the mesh were brought individually through the fascia at each of the skin puncture sites and tied so that the knots were in the subcutaneous tissue. Further mesh fixation was achieved with intracorporeal polypropylene sutures using 1.0 polypropylene suture every 4 cm circumferentially around the mesh. Care was taken not to include any part of the costal cartilage in the sutures that fixed the superior border of the mesh. This prevents herniation of bowel loops between the mesh and abdominal wall. Should be emphasized the need of avoiding suturing or using tackers in vicinity of the intercostal nerves to prevent postoperative pain.

Results

There was a total of 51 patients (32 males and 19 females), with a mean age of 40 years (range, 24-56) and a mean BMI of 29.5 kg/m^2 (range 26-33). It is noted that all patients were either overweight or obese. Transverse colon was the content of the hernial sac in five (9.8%) patients, omentum in 30 (58.8%) patients, and small bowel in 16 (31.37%) patients. There were multiple defects in eight (15.68%) patients. The mean hernial defect size was 5.75 cm (range, 3–8.5) and the average mesh size 312.5 cm^2 (range, 225–400). The prosthesis that was used for all the patients was the dual mesh from Parietex™. Mean operating time was 90 minutes (range 55–125 min), with no significant blood loss. Hospital stay averaged 1.5 days (range 1–2). Intravenous analgesics were administered only on the day of surgery, and thereafter oral analgesics were sufficient for pain relief. Complications were seen in six patients (overall morbidity 11.7%) and included seroma – 3 (5.8%); deep venous thrombosis – one (1.9%); chronic pain (> five weeks) – two (3.9%). Recurrence was seen in one (1.9%) patient. All three seromas spontaneously resolved within 12 weeks. All patients were scheduled for follow-up at seven days, one month, six months, 12 and 18 months (mean nine months). A mean follow -up time of 36 months was possible for 36 patients. The patient with the recurrence was detected at the 12-month follow-up. He was identified as having a large (W3) secondary epigastric hernia in the upper midline scar (M2 Type) before the first surgery. Thereafter, he successfully underwent an open mesh repair as he was unwilling for a re-laparoscopy.

Discussion

Primary midline epigastric hernias comprise 0.35 – 1.5% of all abdominal hernias [8]. In our institute, primary epigastric hernias were found in a percentage of 0.9% (51/5500) of all ventral hernias in the study period. Primary epigastric hernias can develop anywhere along the linea alba between the xiphoid process and the umbilicus. They rarely deviate away from this straight-lined area and commonly occur in patients with ages ranged from 20-50 years, more often in men than in women [9]. This fact is corroborated in our series, where men were almost twice as more affected than

women (32 versus 19). It is now believed that the majority of midline hernias result from a structural deficiency in the linea alba created by excessive mechanical forces. The following mechanisms are thought to be involved in the formation of primary epigastric hernias: The linea alba shows a triple-decussation of fibers along a single line at the midline in 70% of humans. Only 30% of humans have a single decussation arrangement. It is believed that these individuals with a single decussation are prone to develop midline hernias [10]. Also, epigastric hernias may form at the exit sites of the neurovascular bundles that pierce the fascia. These perforation spots are inherent weak areas, and it is reasonable to assume that increases in intra-abdominal pressure will cause an initiation of the herniation, which always contains pre-peritoneal fatty tissue in the beginning [11]. However, in large defects (W3), the hernia sac may contain epiploic appendages or viscera such as ileum, omentum, transverse colon, Meckel's diverticulum, liver, gall bladder and stomach [12-14].

Secondary (incisional) epigastric hernias occurring in this region, follow upper midline, transverse or sub-xiphoid incisions [15]. Most commonly, sub-xiphoid hernias occur following sternotomy for cardiothoracic surgery [16,17]. Transverse incisions are always superior to vertical ones over the abdominal wall. This is also reflected in our study, as 68% of the hernias occurred in upper midline incisions and 22% in transverse subcostal incisions. Penetrating abdominal trauma is another uncommon cause of secondary epigastric hernias. We had one such patient in our series that developed a hernia two years after trauma due to a road traffic accident. These are relatively difficult to treat because the skin scar and muscular damage are not easily controlled like in a planned laparotomy.

Technical Considerations

Traditionally, laparoscopic ventral hernia repairs are performed with a minimum 5-cm overlap of mesh past the edge of the hernia defect and fixation with full-thickness transabdominal sutures or mechanical fixation devices [18]. LeBlanc has suggested the concept related to mesh size that "the bigger the better". Indeed his data has shown that the recurrence rate reduced as the mesh size increased [19]. This principle is true for primary and secondary epigastric hernias as well. In order to achieve this 5-cm overlap all around, these hernias will require dissection of and taking down the falciform ligament. Inferiorly, if the defect is just above the umbilicus, some part of the median umbilical ligament needs to be mobilized to allow for this 5-cm overlap. In our series, we performed this dissection on seven patients. All the margins of the mesh can be easily fixed except the superior border, which is limited by the costal margins. The advantage of laparoscopy in the repair of these upper abdominal hernias is that the mesh can easily be placed and fixed beyond the bony confines with either intracorporeal sutures or tacks. If this crucial step is ignored, there is a risk of the mesh to migrate away from the hernial defect, thereby causing recurrence. The size of the mesh was calculated by adding the size of the defect with a 5 cm overlap on all sides. Circumferential mesh fixation is usually achieved with full-thickness transabdominal sutures, intracorporeal sutures, combination of both, or helical tacks [20]. In our center, a combination of both full-thickness transabdominal sutures and intracorporeal sutures is always used for mesh fixation. Pain over the anterior abdominal wall due to these full-thickness sutures can occur in a proportion of patients [21]. Primary epigastric hernia is frequently associated with other types of hernia [22]. In our series, there were eight patients with associated inguinal hernias and two patients with umbilical hernias. These associated hernias were also repaired simultaneously – another advantage of laparoscopy.

Regarding management of the hernial defect, we close the medium and large defects (W2 and W3 Types) with intracorporeal sutures before prosthetic reinforcement, which is the standard practice in our center for all ventral hernia repairs [23]. This concept has been eloquently expressed by a Danish study that compared closure versus non-closure of hernia defect in patients undergoing laparoscopic epigastric and umbilical hernia repair [24]. They concluded that defect closure provides a better cosmetic result, possibly lower recurrence rates, improves abdominal wall function, may also decrease seroma formation and improve overall patient satisfaction. Recently, there have been many important studies published supporting that defect closure is indeed desirable [25,26]. This policy of defect closure may also contribute to our low recurrence rate in this series. In a recent study, Silecchia et al stated that sub-xiphoid and subcostal incisional hernia repairs have low morbidity but a 5 % recurrence rate [27]. Our overall morbidity rate was 11%, while our recurrence rate was 1.9%. We attribute the very low recurrence rate to improved techniques like closing the defect before mesh placement. Ponten et al in a series of 235 consecutive patients report a recurrence rate as high as 10%, following mesh repair of epigastric hernias, whereas Stabilini reported a 3.1% recurrence rate [28,29].

Approximately, 20% of epigastric hernias are multiple: for this reason, strengthening of the entire linea alba up to umbilicus is probably essential to prevent recurrence or the occurrence of a new defect [30]. This is the reason that the mesh must ideally cover the entire linea alba from the xiphoid to the umbilicus. It has been postulated that high recurrence rate with simple open closure techniques is a result of enlargement of missed multiple defects [31]. We consider that this is the advantage of laparoscopy over the open ap-

proach, where multiple defects can easily be visualised and managed accordingly. In our series, we had eight (15.6%) patients with multiple defects, which is consistent with the reported incidence of 20%. Laparoscopic management of incarcerated epigastric hernias have also been published [32]. There were no incarcerated hernias in our series.

In conclusion, dissection of the falciform ligament and sometimes the median umbilical ligament is the key for adequate mesh coverage. The close proximity of these defects to bony prominences like the xiphoid and costal margins presents a challenge for the surgeon. In case of multiple linea alba defects, laparoscopy is useful in the diagnosis and treatment. It is associated with less pain, better cosmetic result, lower incidence of mesh and wound complications, and possibly a lower recurrence rate.

Ethical Approval – Informed Consent: *The authors declare that the study has been approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. Also all patients gave their written informed consent prior to their inclusion to the study.*

Conflict of Interest: *The authors declare that they have no conflict of interest. The authors have full control of all primary data and they agree to allow the journal to review their data if requested.*

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